

Department of Energy

FY 2020 Congressional Budget Request



Electricity
Cybersecurity, Energy Security, and Emergency Response
Naval Petroleum and Oil Shale Reserves
Strategic Petroleum Reserve
Northeast Home Heating Oil Reserve
Southeastern Power Administration
Southwestern Power Administration
Western Area Power Administration
Bonneville Power Administration
Fossil Energy Research and Development

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Volume 3 Part 1
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FUNDING BY APPROPRIATION

Department of Energy Budget by Appropriation	(SK)				
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted	
				\$	%
Energy and Water Development, and Related Agencies					
Energy Programs					
Energy Efficiency and Renewable Energy	2,321,778	2,379,000	343,000	-2,036,000	-85.6%
Electricity Delivery and Energy Reliability	261,329	0	0	0	N/A
Electricity	0	156,000	182,500	+26,500	+17.0%
Cybersecurity, Energy Security, and Emergency Response	0	120,000	156,500	+36,500	+30.4%
Nuclear Energy	1,205,056	1,326,090	824,000	-502,090	-37.9%
Fossil Energy Programs					
Fossil Energy Research and Development	726,817	740,000	562,000	-178,000	-24.1%
Naval Petroleum and Oil Shale Reserves	4,900	10,000	14,000	+4,000	+40.0%
Strategic Petroleum Reserve	260,716	235,000	174,000	-61,000	-26.0%
Strategic Petroleum Account	8,400	10,000	27,000	+17,000	+170.0%
Northeast Home Heating Oil Reserve	6,500	10,000	0	-10,000	-100.0%
Total, Fossil Energy Programs	1,007,333	1,005,000	777,000	-228,000	-22.7%
Uranium Enrichment Decontamination and Decommissioning (D&D) Fund	840,000	841,129	715,112	-126,017	-15.0%
Energy Information Administration	125,000	125,000	118,000	-7,000	-5.6%
Non-Defense Environmental Cleanup	298,400	310,000	247,480	-62,520	-20.2%
Science	6,259,903	6,585,000	5,545,972	-1,039,028	-15.8%
Advanced Research Projects Agency - Energy	353,314	366,000	-287,000	-653,000	-178.4%
Nuclear Waste Disposal (26M in DNWF 050)	0	0	90,000	+90,000	N/A
Departmental Administration	189,652	165,858	117,545	-48,313	-29.1%
Indian Energy Policy and Programs	0	18,000	8,000	-10,000	-55.6%
Inspector General	49,000	51,330	54,215	+2,885	+5.6%
International Affairs	0	0	36,100	+36,100	N/A
Title 17 - Innovative Technology Loan Guarantee Program	30,892	13,000	-160,659	-173,659	-1,335.8%
Advanced Technology Vehicles Manufacturing Loan Program	5,000	5,000	0	-5,000	-100.0%
Tribal Energy Loan Guarantee Program	1,000	1,000	-8,500	-9,500	-950.0%
Total, Energy Programs	12,947,657	13,467,407	8,759,265	-4,708,142	-35.0%
Atomic Energy Defense Activities					
National Nuclear Security Administration					
Federal Salaries and Expenses	407,595	410,000	434,699	+24,699	+6.0%
Weapons Activities	10,642,138	11,100,000	12,408,603	+1,308,603	+11.8%
Defense Nuclear Nonproliferation	1,999,219	1,930,000	1,993,302	+63,302	+3.3%
Naval Reactors	1,620,000	1,788,618	1,648,396	-140,222	-7.8%
Total, National Nuclear Security Administration	14,668,952	15,228,618	16,485,000	+1,256,382	+8.3%
Environmental and Other Defense Activities					
Defense Environmental Cleanup	5,988,048	6,024,000	5,506,501	-517,499	-8.6%
Other Defense Activities	840,000	860,292	1,035,339	+175,047	+20.3%
Defense Nuclear Waste Disposal (90M in 270 Energy)	0	0	26,000	+26,000	N/A
Total, Environmental and Other Defense Activities	6,828,048	6,884,292	6,567,840	-316,452	-4.6%
Total, Atomic Energy Defense Activities	21,497,000	22,112,910	23,052,840	+939,930	+4.3%
Power Marketing Administrations					
Southeastern Power Administration	0	0	0	0	N/A
Southwestern Power Administration	11,400	10,400	10,400	0	N/A
Western Area Power Administration	93,372	89,372	89,196	-176	-0.2%
Falcon and Amistad Operating and Maintenance Fund	228	228	228	0	N/A
Colorado River Basins Power Marketing Fund	-23,000	-23,000	-21,400	+1,600	+7.0%
Total, Power Marketing Administrations	82,000	77,000	78,424	+1,424	+1.8%
Federal Energy Regulatory Commission (FERC)	0	0	0	0	N/A
Subtotal, Energy and Water Development, and Related Agencies	34,526,657	35,657,317	31,890,529	-3,766,788	-10.6%
Excess Fees and Recoveries, FERC	-9,000	-16,000	-16,000	0	N/A
Title XVII Loan Guarantee Program Section 1703 Negative Credit Subsidy Receipt	0	-107,000	-15,000	+92,000	+86.0%
Sale of Northeast Gas Reserve	0	0	-130,000	-130,000	N/A
Sale of Northeast Home Heating Oil Reserve	0	0	-27,000	-27,000	N/A
Total, Funding by Appropriation	34,517,657	35,534,317	31,702,529	-3,831,788	-10.8%

Electricity

Electricity

Electricity
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Electricity
Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for electricity [delivery] activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, [~~\$156,000,000~~] *\$182,500,000*, to remain available until expended: Provided, That of such amount, [~~\$17,000,000~~] *\$19,600,000* shall be available until September 30, [2020] *2021*, for program direction. (*Energy and Water Development and Related Agencies Appropriations Act, 2019*)

Public Law Authorizations

Public Law 95-91, "Department of Energy Organization Act", 1977

Public Law 109-58, "Energy Policy Act of 2005"

Public Law 110-140, "Energy Independence and Security Act, 2007"

Public Law 114-94, "Fixing America's Surface Transportation Act", 2015

**Electricity
(\$K)**

FY 2018 Enacted	FY 2018 Supplemental ^a	FY 2018 Enacted (Comparable) ^b	FY 2018 Supplemental (Comparable) ^{ab}	FY 2019 Enacted	FY 2020 Request
248,329	+13,000	149,000	+10,100	156,000	182,500

Overview

The Office of Electricity (OE) leads the Department’s efforts to strengthen, transform, and improve energy infrastructure so that consumers have access to secure and resilient sources of energy. OE provides solutions to market, institutional, and operational failures that go beyond any one utility’s ability to solve.^c To accomplish this critical mission, OE works with private industry and Federal, State, tribal, territorial, and regional governments on a variety of initiatives to modernize the electric grid.

Grid modernization is critical to achieving public policy objectives, sustaining economic growth, supporting environmental stewardship, and mitigating risks to secure the Nation. The goal for the future grid is to deliver reliable, affordable, and resilient electricity to consumers.

Within the next decade, proactive, coordinated, and innovative steps are needed to address four critical challenges:

- Increasing threats and risks to the security of energy infrastructure
- Changes in demand driven by population growth, adoption of more energy efficient technologies, dynamic economic conditions, and broader electrification
- Changes in the supply mix and location (centralized, distributed, and off-shore) of the Nation’s generation portfolio
- Increasing variability and uncertainty from both supply and demand, including integration of variable renewables, more active consumer participation, and accommodating new technologies and techniques

Due to the critical role the electric grid plays across Federal, State, tribal, territorial, and regional jurisdictions, OE programs work in an integrated manner in partnership with industry and other stakeholders, as well as other DOE offices, to enhance key characteristics of the U.S. electric transmission and distribution systems:

- Resilience—the ability to withstand and quickly recover from disruptions and maintain critical function
- Security—the ability to protect system assets and critical functions from unauthorized and undesirable actors
- Reliability—consistent and dependable delivery of high quality power
- Flexibility—the ability to accommodate changing supply and demand patterns and new technologies
- Affordability—more optimal deployment of assets to meet system needs and minimize costs
- Efficiency—low losses in electricity delivery and more optimal use of system assets

Timely action is needed to perform the research and development that facilitates industry in deploying a reliable electric power grid that supports the vitality of other critical sectors that depend on electricity, such as telecommunications, banking and finance, water, and public health and safety. A reliable and resilient power grid is critical to U.S. economic competitiveness and leadership.

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

^b The FY 2019 appropriation split the Electricity Delivery and Energy Reliability appropriation into two appropriations: Electricity Delivery and Cybersecurity, Energy Security, and Emergency Response (CESER). To allow an apples-to-apples comparison with FY 2019 and the FY 2020 request, the comparable amounts for FY 2018 exclude amounts for the Cybersecurity for Energy Delivery Systems and Infrastructure Security and Energy Restoration programs, and a portion of Program Direction funding, equivalent to what would have been in CESER had the current structure been in place in FY 2018.

^c Examples include wide-area visibility, identified from the 2003 Northeast blackout, and faster modeling and analysis, identified in the 2011 Southwest blackout.

Within the request, OE funds:

- Research and Development (R&D)—pursuing research for technologies to improve grid reliability, resilience, efficiency, flexibility, and functionality
- Modeling and Analytics—developing core analytic, assessment, and engineering capabilities that can evolve as the technology and policy needs mature to support decision making within the Department and for stakeholders; analyses explore complex interdependencies among energy infrastructure systems, such as between electricity and natural gas systems
- Institutional Support and Technical Assistance—building capacity in the industry and convening stakeholders to coordinate efforts to transform the electric grid; providing technical assistance to Federal, State, tribal, territorial, and regional entities to improve policies, utility incentives, State laws, and programs that facilitate the modernization of the electric infrastructure
- Coordination of Federal Transmission Permits—streamlining permits, special use authorizations, and other approvals required under Federal law to site electric transmission facilities

The investment proposed for FY 2020 continues to support OE’s mission of security and resilience through four key priorities:

- North American Energy Resiliency Model: Working with the national labs and relevant stakeholders, develop an integrated North American Energy Resiliency Model (NAERM) to conduct planning and contingency analysis to address vulnerabilities in the North American energy system
- Megawatt Scale Grid Storage: pursue megawatt-scale storage capable of supporting voltage and frequency regulation, ramping, and energy management for bulk and distribution power systems
- Revolutionize Sensing Technology Utilization: pursue integration of high-fidelity, low-cost sensing technology for predictive and correlation modeling for electricity and interdependencies with oil and natural gas (ONG) systems
- Transmission: pursue electricity-related policy issues by carrying out statutory and executive requirements, while also providing policy design and analysis expertise to Federal, State, tribal, territorial, and regional entities

NAERM will provide unique and ground-breaking national-scale energy planning and real-time situational awareness capabilities for rigorous and quantitative assessment, prediction, and improvement to ensure reliable and resilient energy delivery across multiple sectors, spanning multiple organizations and authorities, while considering a range of large-scale, emerging threats.^a DOE will lead this initiative in order to ensure a sustained and controlled analytic capability supporting its critical infrastructure protection responsibilities for energy sector under Presidential Policy Directive 21 (Critical Infrastructure Security and Resilience) and the FAST Act (Public Law 114–94).

The United States is increasingly experiencing threats, natural and man-made. The need to proactively plan and prepare for events that threaten this Nation’s well-being and security necessitates an ambitious span of scope. NAERM will enable prediction of threat impacts, evaluation and identification of effective mitigation strategies, and black-start planning, benefiting the United States by advancing energy and economic security. NAERM will be developed in phases to address long-term energy planning with offline data, energy planning and operational studies with real-time data streams, national-level situational awareness with real-time data streams for both infrastructure and threats, and then advanced analytic and decision support capabilities to anticipate threats and mitigate their impacts in real-time. By the end of the final phase, NAERM will be a first-of-its-kind capability providing an operational situational awareness tool capable of monitoring the power system, predicting potential threat consequences, and mitigating those consequences to provide capabilities to operate-through adverse events.

Major power system outages are often caused in part by a lack of adequate situational awareness of grid conditions. To address this problem, and to provide utilities with new tools and critical information to mitigate and respond to potential issues and threats, high-fidelity, fast acting sensor technologies will be developed and integrated into the electric power system. Along with advances in data analytics, these sensor technologies will enable greater speed, accuracy, and precision in determining the state of the power system. This will meet needs for managing grid assets and operations with their

^a Resilient systems (versus reliable) anticipate, withstand, and recover critical loss-of-supply resulting from low-probability, high-impact threats. Threats include, for example, natural disasters, coordinated cyber-physical attacks, and electromagnetic pulses due to nuclear detonation

increased complexity, as well as monitoring and managing interconnected and interdependent effects among the Nation's critical infrastructures—all under increasing levels of threat conditions.

Advanced Energy Storage Initiative (AESI): AESI is a coordinated effort across DOE to accelerate energy storage R&D as a key to increasing energy security, reliability, and resilience. Leveraging the full suite of DOE technologies, AESI will focus DOE's efforts to take a broad, more holistic view of energy storage as a set of capabilities that enables flexibility of both generation and load in the conversion of energy resources to useful energy services. Building on OE, Energy Efficiency and Renewable Energy, Fossil Energy R&D, and Nuclear Energy activities, the initiative will develop a coordinated strategy for aligning DOE R&D and establish aggressive, yet achievable goals for cost competitive energy storage services.

OE's Energy Storage program's request supports grid-related AESI objectives and other OE R&D efforts are also complementary to AESI goals.

Highlights and Major Changes in the FY 2020 Budget Request

Transmission Reliability and Resilience (\$70,500,000; +\$31,500,000) is focused on ensuring the reliability and resilience of the U.S. electric grid through early-stage and foundational R&D on measurement and control of the electricity system and risk assessment to address challenges across integrated energy systems. A critical aspect of the request is beginning the full development of a dynamic integrated NAERM to allow the United States to conduct planning and contingency analyses that address vulnerabilities in the North American energy system. Building on lessons learned from the FY 2018 Puerto Rico work of creating a near-real-time model and efforts seeded in FY 2019, the FY 2020 request supports assessment of cross-infrastructure interdependencies and contingencies in the North American energy system. A Sensors and Data Analytics activity is also proposed to be established to develop and integrate high-fidelity, fast-acting sensing technologies, and advanced data analytics, to revolutionize their use in electric transmission systems for improved diagnosis, prediction, and determination of action during normal and extreme-event conditions.

Resilient Distribution Systems (\$27,900,000; -\$12,100,000) focuses on the development of innovative technologies, tools, and techniques to modernize the distribution portion of the electric delivery system. The reduction from the FY 2019 appropriation is due to two activities that were fully funded in FY 2019: sensing intelligent machines and advanced low-cost distribution sensors.

Energy Storage (\$48,500,000; +\$2,500,000) is designed to develop new and advanced technologies that will ensure the stability, reliability, and resilience of electricity infrastructure. The request supports the development of advanced power electronic architectures and topologies to address stranded energy, improve battery failure diagnostics, and integrated highly accurate state-of-charge and state-of-health monitoring of energy storage systems. The request also supports design and construction planning for an OE Grid Storage Launchpad (GSL) project aimed at accelerating materials development, testing, and independent evaluation of battery materials and battery systems for grid applications.

Transformer Resilience and Advanced Components (\$9,000,000; +\$2,000,000) supports modernization, hardening, and resilience of the grid by addressing the unique challenges facing transformers and other critical grid components responsible for carrying and controlling electricity from where it is generated to where it is needed. The request builds on material research and design innovations for next-generation grid hardware, moving towards prototypes for technologies and concepts related to solid-state power substations and advance conductors.

Transmission Permitting and Technical Assistance (\$7,000,000; no change) promotes a secure and resilient electricity system through regulatory and policy solutions. TPTA evaluates existing laws, policies, and regulations to better understand the regulatory landscapes, and provides technical assistance to Federal, State, tribal, territorial, and regional entities in their efforts to address the changing dynamics and uncertainties in the energy environment. TPTA also implements a number of legal authorities and seeks to improve transmission infrastructure by facilitating better coordination between Federal agencies for transmission lines that require multiple Federal authorizations and by permitting transmission facilities crossing the U.S international border. In FY 2020, TPTA will provide grid resilience tools and analyses to support State and regional decision-makers and institutional support for resilience infrastructure investments.

FY 2018 Key Accomplishments

Grid-Scale Energy Storage Cost Reductions: A reduced cost of grid-scale (over 1 megawatt MW) energy storage technologies has been demonstrated at \$275 per kilowatt hour for a 4-hour system based on a new aqueous soluble organic electrolyte. Energy storage is emerging as an integral component to the grid modernization strategy to provide a diverse

range of services including energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization.

Puerto Rico Energy Resilience: As part of its commitment to support Puerto Rico for long-term resiliency improvement, DOE convened experts in December 2017 from the community of public and private energy stakeholders who had expressed interest in supporting the long-term recovery of Puerto Rico. In June 2018, OE released the *Energy Resilience Solutions for the Puerto Rico Grid* report, which contains resilience recommendations for the Government of Puerto Rico to consider for incorporation into its recovery plans. These recommendations address near-term actions and identify areas where further analysis is needed to make more technically-informed investment decisions.

Two R&D 100 Awards: Two technologies supported by OE's Advanced Grid R&D Division won 2017 R&D 100 Awards. The Microgrid Design Toolkit (MDT), developed by Sandia National Laboratories, is a free software product used to help designers create optimal microgrids. The Control System for Active Damping of Inter-Area Oscillations, also developed by Sandia National Laboratories, improves grid reliability by continuously damping inter-area oscillations, allowing greater power transfer. Both projects have major implications for improving the resilience and reliability of the Nation's power grid, from design to operation.

Helping utilities measure the cost and impact of power outages: In July 2018, OE released, through the Lawrence Berkeley National Laboratory (LBNL), an updated Estimating Power System Interruption Costs: A Guidebook for Electric Utilities and the Interruption Cost Estimate Calculator 2.0 (icecalculator.com). The guidebook sets forth standard procedures for measuring electric utility customer interruption costs using generally accepted surveying techniques. The calculator is an online tool designed for electric reliability planners at utilities, government organizations, and other entities interested in estimating interruption costs and the benefits associated with reliability improvements.

Improving the Permitting Process for Major Infrastructure Projects: OE led the Department's effort to implement the August 15, 2017 Executive Order (EO) 13807: Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects. The EO established "One Federal Decision" approach for use with major infrastructure projects. OE also led the Department's efforts to meet the statutory objectives of Title 41 of the Fixing America's Surface Transportation (FAST-41) Act. OE ensured that Permitting Timetables for covered projects are maintained and updated on the public Federal Permitting Dashboard, worked across relevant Program Offices to implement best practices, documented compliance with best practices for the Annual Report to Congress, and coordinated senior-level attendance at Council meetings. Both EO 13807 and FAST-41 are intended to improve the timeliness, predictability, and transparency of the Federal environmental review and authorization process for covered infrastructure projects.

Electricity
Funding by Congressional Control (\$K)

	FY 2018 Enacted	FY 2018 Supplemental	FY 2018 Enacted (Comparable)	FY 2018 Supplemental (Comparable)	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Transmission Reliability and Resilience	39,000	+5,987	39,000	+5,987	39,000	70,500	+31,500
Resilient Distribution Systems	38,000	+2,600	38,000	+2,600	40,000	27,900	-12,100
Cybersecurity for Energy Delivery Systems	75,829	0	0	0	0	0	0
Energy Storage	41,000	0	41,000	0	46,000	48,500	+2,500
Transformer Resilience and Advanced Components	7,000	0	7,000	0	7,000	9,000	+2,000
Transmission Permitting and Technical Assistance	7,000	+850	7,000	+850	7,000	7,000	0
Infrastructure Security and Energy Restoration	12,000	+2,900	0	0	0	0	0
Program Direction	28,500	+663	17,000	+663	17,000	19,600	+2,600
Total, Electricity	248,329	+13,000	149,000	+10,100	156,000	182,500	+26,500
Federal Full Time Equivalent Employees (FTEs)	75	+2	50	+2	52	62	+10
Additional FE FTEs at NETL supporting OE ^a	21	0	12	0	12	12	0
Total OE-funded FTEs	96	+2	62	+2	64	74	+10

SBIR/STTR:

- FY 2018 Enacted: SBIR/STTR: \$5,750
- FY 2018 Enacted (Comparable): SBIR/STTR: \$4,188
- FY 2019 Enacted: SBIR/STTR: \$4,218
- FY 2020 Request: SBIR/STTR: \$4,850

^a OE funds FTEs at FE's National Energy Technology Laboratory who are FE employees, but support OE activities. The FTEs are in FE's FTE totals and are not included in the OE FTE totals shown on the "Federal Full Time Equivalent Employees (FTEs)" line.

The tables below shows the funding allocation between the two offices under the FY 2018 enacted budget structure and the budget structure in the FY 2019 appropriation and FY 2020 request.

**FY 2018 Enacted Comparability Matrix
(\$K)**

Current Structure FY 2018 Structure	Electricity	Cybersecurity, Energy Security, and Emergency Response	Total
Transmission Reliability and Resilience	39,000	...	39,000
Resilient Distribution Systems	38,000	...	38,000
Cybersecurity for Energy Delivery Systems	...	75,829	75,829
Energy Storage	41,000	...	41,000
Transformer Resilience and Advanced Components	7,000	...	7,000
Transmission Permitting and Technical Assistance	7,000	...	7,000
Infrastructure Security and Energy Restoration	...	12,000	12,000
Program Direction	17,000	11,500	28,500
Total	149,000	99,329	248,329

**FY 2018 Supplemental Comparability Matrix
(\$K)**

Current Structure FY 2018 Structure	Electricity	Cybersecurity, Energy Security, and Emergency Response	Total
Transmission Reliability and Resilience	+5,987	...	+5,987
Resilient Distribution Systems	+2,600	...	+2,600
Transmission Permitting and Technical Assistance	+850	...	+850
Infrastructure Security and Energy Restoration	...	+2,900	+2,900
Program Direction	+663	...	+663
Total	+10,100	+2,900	+13,000

**FY 2019 Enacted Appropriation Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Electricity	Cybersecurity, Energy Security, and Emergency Response	Total
Transmission Reliability and Resilience	39,000	0	39,000
Resilient Distribution Systems	40,000	0	40,000
Cybersecurity for Energy Delivery Systems	0	89,500	89,500
Energy Storage	46,000	0	46,000
Transformer Resilience and Advanced Components	7,000	0	7,000
Transmission Permitting and Technical Assistance	7,000	0	7,000
Infrastructure Security and Energy Restoration	0	19,000	19,000
Program Direction	17,000	11,500	28,500
Total	156,000	120,000	276,000

**FY 2020 Request to Congress Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Electricity	Cybersecurity, Energy Security, and Emergency Response	Total
Transmission Reliability and Resilience	70,500	0	70,500
Resilient Distribution Systems	27,900	0	27,900
Cybersecurity for Energy Delivery Systems	0	75,000	75,000
Energy Storage	48,500	0	48,500
Transformer Resilience and Advanced Components	9,000	0	9,000
Transmission Permitting and Technical Assistance	7,000	0	7,000
Infrastructure Security and Energy Restoration	0	70,000	70,000
Program Direction	19,600	11,500	31,100
Total	182,500	156,500	339,000

Transmission Reliability and Resilience

Overview

The Transmission Reliability and Resilience (TRR) program provides the electric sector with the necessary tools and analyses to assess risks, inform decisions, and improve power system planning and performance including mitigating the risks of large-scale blackouts. The TRR program is focused on ensuring the reliability and resilience of the U.S. electric grid through early-stage and foundational research and development (R&D) concentrated on measurement and control of the electricity system, as well as model development and validation for assessing risks across integrated energy systems. TRR brings together energy stakeholders from government, industry, and academia to generate ideas and develop solutions to the Nation's energy infrastructure challenges.

The Federal Government's responsibilities for national defense, economic prosperity, and public health and safety across all States and territories demand a holistic perspective on energy infrastructure security that is separate from, but complementary to, those found at the individual company, State, tribal, and local levels. Understanding how the North American energy system as a whole would react to disruptions to one or more of its individual components is a vital part of the Nation's ability to protect the Nation's critical infrastructure and defense installations.

The development of an integrated North American Energy Resiliency Model (NAERM) will allow the United States to conduct planning and contingency analyses that address vulnerabilities in the North American energy system. Building on lessons learned from the FY 2018 Puerto Rico work of creating a near real time model and efforts seeded in FY 2019, the FY 2020 request begins the full development of a dynamic integrated NAERM to assess cross-infrastructure interdependencies and contingencies in the North American energy system in coordination with critical infrastructure Federal partners and stakeholders.

This capability will incorporate all relevant assets of the integrated bulk energy system and identify recommendations for infrastructure investments and improvements to be made by asset owners and operators that would improve resilience and mitigate risks associated with energy system interdependencies. The resulting model will also allow the exploration of sequences of events that create risk across critical infrastructure sectors and identification of key critical infrastructure interdependencies.

The NAERM will leverage previous national laboratory efforts to fully understand the resilience risks associated with operating the highly diversified, regionally isolated North American electric grid and associated fuel delivery systems. National laboratories including the Argonne, Idaho, Los Alamos, National Renewable Energy, Oak Ridge, Pacific Northwest, Lawrence Livermore, and Sandia National Laboratories, among others, have a long history of developing system-wide modeling and analysis tools. This national capability will provide:

- Tools to better assess all forms of electricity generation, gas, oil, and electricity transmission infrastructure at risk of being disrupted by all-hazards events;
- Contingency analysis models to determine the impacts that loss of assets can have on system-wide resilience and reliability;
- Tools to estimate impacts to and from interdependent infrastructure systems such as natural gas and electric generation; and
- Real-time situational awareness with automatic worst-case analysis to inform operational decision making.

The NAERM will improve analysis of the significant interdependencies that have evolved within the energy sector. The Federal Government will have the ability to better evaluate strategic opportunities for improving system performance through the deployment of certain types of infrastructure, for example, energy storage for frequency control. This and other features of the enhanced planning and analysis tool will inform national security investments and enhance decision making and the use of authorities to respond to grid security emergencies. Overall, the NAERM and associated tools will support several private and public efforts:

- Utilizing a systems perspective to compare and collectively plan for impacts across geographic and jurisdictional boundaries
- Systematically defining critical energy infrastructure criteria through a defensible and repeatable methodology at the State and local level
- Targeting collaboration on mitigations with energy infrastructure owners and operators to most effectively address national security concerns

Such a coordinated effort is essential for identifying the critical contingencies necessary for risk mitigation, establishing North American-wide consequences when multi-State disruptions occur, and most effectively managing the deployment of high-priority investments. The ability to analyze data and models, predict consequences, and prioritize infrastructure protection is a necessary prerequisite for enhancing the resilience of the North American energy sector.

Improving energy sector resilience requires an enhanced ability to deliver real-time information on the status of transmission system operations and infrastructure components. There is a growing need to improve monitoring and assessment to ensure that the Bulk Power Energy system remains reliable while improving the overall security and resilience. This is critical to improving the ability of owners and operators to rapidly identify and diagnose faults and failures and monitor the health of key system components to mitigate potential challenges, natural and man-made.

Thus, a new program, Sensors and Data Analytics, is proposed to be established in FY 2020; this program will develop and integrate high-fidelity, fast-acting sensing technologies, and advanced data analytics, to revolutionize their use in electric transmission systems for improved diagnosis, prediction, and determination of action during normal and extreme-event conditions. Advances in data analytics are needed to enable utilizing an increasing number of heterogeneous data sources to infer complex underlying dynamics, diagnose system behavior and abnormalities, and provide situational awareness for operators to make informed decisions. The outcome of Sensors and Data Analytics R&D will enable determining the state of the power system with greater speed, accuracy, and precision than ever before, as required to manage the increasing complexity of grid operations and assets and to monitor and manage the interconnected and interdependent effects among the nation's critical infrastructures, all under increasing levels of threat conditions.

To date, the energy sector has adopted a number of techniques for accessing timely and accurate information on the status of energy systems. However, existing data feeds often do not provide the accuracy, speed, or level of detail needed to fully evaluate system stability. The deployment of sensing technology across the energy system can greatly enhance the sector's ability to gather and analyze critical information needed to rapidly identify infrastructure vulnerabilities. The sector can then increase its ability to mitigate disruptions to key infrastructure, or it can identify alternative pathways for energy delivery.

The advanced sensors capability will foster the development and integration of high-fidelity, low-cost sensing technologies, as well as the advanced data analytics needed to revolutionize the diagnosis, prediction, and mitigation of system disruption during steady state and extreme-event conditions.

DOE will lead Federal efforts to adopt a common approach across its national laboratory complex to strengthen partnerships with the energy industry and to promote the development and deployment of next-generation interoperable energy system sensors. This capability will enable the Grid Modernization Laboratory Consortium (GMLC) to:

- Deploy cost-effective sensors directly at critical assets to improve monitoring;
- Evaluate opportunities to improve phasor measurement units;
- Develop data analytics for asset health monitoring and anomaly detection;
- Utilize sensors to enhance distribution system resilience; and
- Improve situational awareness and system evaluation through providing data feeds to DOE initiatives including the NAERM.

Through this national capability, the Department and its partners will have access to the information needed to make informed decisions about the operation and security of key energy system assets across transmission across energy systems. In addition, sensor data will be used to make energy systems resilient down to the component level. Increased resilience will be accomplished by allowing operators to effectively reconfigure systems to avoid disruptions prior to outages occurring. Taken together, these next-generation monitoring tools and analytics will vastly enhance the ability of the energy sector to improve resilience.

TRR's mission manifests itself in several key areas:

- Advancing early-stage and foundational research in electric grid measurements, models, mathematics, and computation
- Developing and validating early-stage proof-of-concept tools intended to enable the electricity system operators and planners to improve reliability, resilience, and security of the system
- Enhancing risk-based quantification to improve methods and models used to study power system resilience, recovery, and restoration
- Transforming protective relaying approaches; these approaches will include efforts to improve system resilience against modern threats while enhancing recovery operations following natural events

- Producing a model that allows understanding of risks across critical infrastructure sectors and identifying key energy infrastructure interdependencies

TRR directly engages energy stakeholders and decision makers to disseminate research results and promote innovation, and risk-informed energy system decisions. TRR activities also focus on advancing university-based power systems research, helping ensure an enduring strategic national capability for innovation in this essential area.

Highlights of the FY 2020 Budget Request

The request supports TRR's goals to:

- Develop methods for validating power system models using real-time data (such as synchrophasor measurements) to support reliable grid operations and improve electrical power infrastructure security and resilience;
- Develop the next generation of mathematical and statistical algorithms for improvement of the security, reliability, and resilience of the electric power system, including interdependencies and failure analysis;
- Develop integrated risk-based, measurement-model approaches to improve detection, mitigation, and recovery/restoration from weather events and man-made attacks to the electric power system, and to enable the operation of degraded or damaged electricity systems while sustaining critical functionality;
- Research protective relaying approaches to improve system resilience against modern threats while enhancing recovery operations following natural disasters;
- Develop and test algorithmic methods to manage uncertainty associated with data, modeling, and model validation in a dynamic, probabilistic, and stochastic environment targeted to improve resilience, reliability, and security of the electric power system;
- Integrate real-time data into NAERM to provide situational awareness; and
- Initiate R&D on sensors and data analytics for transmission systems.

The FY 2020 request will initiate new projects to address the needs for new sensors and advanced data analysis techniques to enable successful realization of incipient failure detection schemes along with associated condition-based maintenance programs ubiquitously throughout the grid. The resultant early detection schemes will provide utilities and other stakeholders with sufficient warning time and specificity regarding the failure mechanism to enable predictive and prescriptive actions to prevent potentially disruptive, costly, and even catastrophic failures before they occur, with the ultimate objective of ensuring that electricity delivery to the nation's critical facilities and services is uninterrupted under all circumstances.

The FY 2020 request will support R&D on sensors and data analytics for transmission systems in the following areas:

- Development of fast-acting current and voltage sensors for detection of electrical abnormalities for fault detection and dynamic system protection (from power surges, over and under frequency, over and under voltages, harmonics, etc.) and could include phasor measurement units (PMUs) and novel transducers in place of traditional electromechanical-based instrument transformers (voltage transformers [VT] and current transformers [CT]). Electro-optic effect based VTs, magneto-optical effect based CTs, and all-optical transducer technologies, as well as derivative sensors for voltage and current, will be considered for development to achieve rapid, high-bandwidth, and low-latency electrical parameter measurements.
- Transmission system asset monitoring and fault diagnosis. This technical area will build on electrical parameter measurements for signatures of low-probability, high consequence events to enable actions that prevent large-scale failures and minimize impacts for increasing grid resilience. Additional R&D thrusts include sensor technology platforms that could include multiple non-electrical parameters (for example, temperature, pressure, motion and vibration, inclination, proximity and tampering, and gas phase chemistry) for identification of faults and failures internal of the transmission system, optical- and wireless-sensing based devices that must be compatible with electrically energized components for asset monitoring, and remote monitoring using unmanned aerial vehicles instrumented with on-board sensing, imaging, or diagnostic or interrogation capabilities for wide area infrastructure monitoring.

The request continues TRR's focus on developing early-stage algorithms, methods, and proof of concept tools to improve the resilience, reliability, and security of electric grid.

FY 2018 Supplemental Appropriation

P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided \$13.0 million to the Office of Electricity and Office of Cybersecurity, Energy Security, and

Emergency Response for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985. \$6.0 million of that was allocated for TRR activities.

Modeling and analysis activities in support of the Federal effort regarding a more resilient electric grid in Puerto Rico: A cross-national laboratory effort developed and delivered a suite of electric sector models to the Puerto Rico Electric Power Authority (PREPA), including an understanding of critical interdependent infrastructures in the fuel supply and telecommunications sectors. The effort included certain analyses needed for DOE to make recommendations when requested by the Department of Housing and Urban Development (HUD) and the Federal Emergency Management Agency (FEMA) in the execution of their recovery responsibilities.

Centers^a

The request includes the planned final year of DOE support for the Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks (CURENT), which is jointly funded by the National Science Foundation (NSF) and the Department and based at the University of Tennessee, Knoxville. CURENT seeks to develop fundamental knowledge in monitoring and modeling methodologies, control theory and transmission network architectures, that supports a nationwide, resilient electric power grid that is fully monitored and dynamically controlled in real time for high reliability, high efficiency, and low cost, while educating a new generation of electric power and energy systems engineering leaders with a global perspective coming from diverse backgrounds. Additional activities may be considered depending on programmatic needs in related research areas and the Center's unique capabilities for effectively addressing them. CURENT's programmatic and technical goals are to develop new systems methodologies to take advantage of advancements in wide-area measurement and communication; flatten the control and information structure so it is less hierarchical and can replace, at all levels of the power grid, traditional inflexible operations strategies; draw on high performance computing capability to realize large-scale and faster-than-real-time simulation for predictive control (and fast response) to ensure secure and reliable operation; and investigate use of widely allocated high power electronic actuators coupled with transmission-level energy storage.

DOE will explore new opportunities for university based research centers related to electric power systems in coordination with National Science Foundation (NSF).

^a Per the guidance on inclusion of centers in budget justifications in H.Rpt. 113–135, the House report for the FY 2014 Energy and Water Development appropriations.

**Transmission Reliability and Resilience
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Transmission Reliability and Resilience	39,000	+5,987	39,000	70,500	+31,500

SBIR/STTR:

- FY 2018 Enacted: SBIR: \$1,230; STTR \$173
- FY 2019 Enacted: SBIR/STTR \$1,273
- FY 2020 Request: SBIR/STTR: \$2,320

**Transmission Reliability and Resilience
Explanation of Major Changes (\$K)**

	FY 2020 Request vs FY 2019 Enacted
• Efforts related to the development of NAERM including dynamic models and incorporation of real time data	+30,000
• Initiate R&D on sensors and data analytics for transmission systems	+8,500
• Reduced activities in R&D for synchrophasor specific tools	-7,000
Total, Transmission Reliability and Resilience	+31,500

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

Transmission Reliability and Resilience

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Transmission Reliability and Resilience \$39,000,000	\$70,500,000	+\$31,500,000
<ul style="list-style-type: none"> Continue technical support for NASPI to advance model validation using synchrophasor measurements, as well as to conduct information sharing and joint problem solving among utilities, vendors, universities, and the Government Continue support for the university-led CURENT Engineering Research Center, in coordination with NSF Continue efforts in architecture and data analytics for turning the data into actionable information Continue to develop the next generation of mathematical and statistical algorithms for improvement of the security, reliability, and resilience of the electric power system Develop new modeling-based capability for monitoring the long-term resilience of our grid and identifying opportunities to improve resilience and mitigate risks associated with the energy systems interdependencies 	<ul style="list-style-type: none"> Conduct research in protective relaying. These approaches will include efforts to improve system resilience against modern threats while enhancing recovery operations following natural disasters. Continue technical support for NASPI to conduct information sharing and joint problem solving among utilities, vendors, universities, and the Federal Government. Continue support for the university-led CURENT Engineering Research Center, in coordination with NSF Continue exploring the mathematical and computational research to manage uncertainty, associated with data, modeling, and model validation Continue co-funding with the National Science Foundation of development of the next generation of mathematical and statistical algorithms for improvement of the security, reliability, and resilience of the electric power system 	<ul style="list-style-type: none"> Reduced activities in R&D for synchrophasor-specific tools

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
	<p><i>North American Energy Resiliency Model</i></p> <ul style="list-style-type: none"> • Fully integrate dynamic critical infrastructure models for NAERM in coordination with critical infrastructure Federal partners • Initiate incorporation of real-time data into dynamic models for NAERM to provide situational awareness • Develop use cases for NAERM to study the impact of Electricity, Natural Gas, and Communication infrastructures on each other and develop plan to minimize the risk <p><i>Sensors and data analytics for transmission systems</i></p> <ul style="list-style-type: none"> • Define performance requirements for novel voltage and current transducers, including PMUs, for transmission system power flow and grid state monitoring • Define performance requirements for sensor technology platforms for transmission system asset monitoring and fault diagnosis • Award new R&D projects for sensors and data analytics for the transmission system 	<p><i>North American Energy Resiliency Model</i></p> <ul style="list-style-type: none"> • Efforts related to the development of NAERM including dynamic models and incorporation of real time data <p><i>Sensors and data analytics for transmission systems</i></p> <ul style="list-style-type: none"> • New R&D efforts on transmission sensors

Resilient Distribution Systems

Overview

Resilient, reliable, and affordable electricity is a cornerstone for a strong economy and provides foundational support for communities to grow and attract new businesses. Today's electric grid is undergoing dramatic changes. While this provides new benefits and new opportunities, it also presents significant operational challenges to maintaining the safe and reliable delivery of affordable power to consumers. For the most part, the existing electrical distribution system—the infrastructure that takes power from the transmission system and delivers it to individual businesses and homes—was designed and built using engineering principles established over 100 years ago. Today, however, that same distribution system is being relied upon to perform in ways it was neither intended nor designed to do. As States, tribes, municipalities, and local communities look for ways to increase resilience, integrate distributed energy resources, and provide consumers with more choices for managing their energy consumption, distribution system operations have become increasingly complex and in many cases are challenged to maintain safety and reliability. As the electricity distribution system continues to evolve and its complexity increases, these problems will continue to grow unless new technologies are developed that enable changes to the way the electric grid is operated. In order for utilities to maintain reliable and resilient operations, they need to have the tools and capabilities to perform dynamic protection and control across all distribution system assets.

The Resilient Distribution Systems (RDS) program focuses on addressing the challenges facing the electric power grid by developing the innovative technologies, tools, and techniques to enable industry to modernize the distribution portion of the electric delivery system. RDS pursues strategic investments in early-stage research and development of innovative technologies and practices that improve reliability, resilience, outage recovery, and operational efficiency, building upon previous and ongoing grid modernization efforts.

The technological convergence of the electricity infrastructure with information and communication systems presents an enormous opportunity to improve overall system resilience and reliability through the integration of vast amounts of information/data from historically disparate systems. Information and communication technology advances have initiated opportunities to leverage increased data volumes as never before possible to begin addressing many distribution grid operation technical challenges, including increased demand and supply variability, bi-directional power flow, data management and security, interoperability between new and legacy technologies and devices, and the increasing interdependencies between distribution and transmission operations.

The focus of Advanced Distribution Management Systems (ADMS) early-stage research is to explore an innovative, new approach to the management and control of utility distribution grids. ADMS will enable a new level of visibility and control across a utility's entire service territory. Microgrid research investments have shown success in addressing reliability, resilience, and efficiency, particularly at the community level, and will continue to be a focus within the RDS program. New approaches and technologies will also be investigated, including Dynamic Controls and Communications research and development (DC&C) to enhance the Nation's electric distribution grid to harness flexibility across all distribution assets to withstand and recover from disruptions caused by extreme weather events and man-made events, as well as for normal operations.

Results from the RDS research in ADMS, microgrids, and DC&C will enable industry to strengthen the resilience of electrical infrastructure against adverse effects of future extreme weather phenomena and other unforeseen natural and man-made occurrences.

Highlights of the FY 2020 Budget Request

The request includes a continued investment in the development of an open-source ADMS application platform, known as GridAPPS-D. The ADMS effort is developing a new distribution "operating system" that will lay the foundation for the private sector to develop new applications, products and services that expand utility capabilities. Existing Distribution Management Systems (DMS/ADMS) are closed, proprietary, vendor-specific products that are costly and difficult to implement. In addition, today's DMS/ADMS face the following technical challenges:

- Inadequate to manage the growing penetration of distributed energy resources (DERs) for reliable and resilient grid performance;
- Incapable of holistically coordinating and managing grid operations throughout the grid from transmission, to distribution, to local energy networks such as microgrids;

- Limited use of real-time data from sensing and measurement devices to determine the grid state for improved operational planning, protection, control, and optimization; and
- In general, difficult to integrate with legacy systems or new applications from different vendors.

GridAPPS-D enables standards-based development of advanced applications that utilize data-rich, data-driven approaches to improve distribution system reliability and resiliency under increasing penetration of DERs. This common software platform is aimed to be deployed on compliant systems of any vendors for developing and integrating future systems with reduced costs and enhanced functionalities for both planning and operations research and development. Following release of versions 1 and 2 of GridAPPS-D in FY 2018 and FY 2019, respectively, the FY 2020 development will expand the capability to support interactions with legacy systems and other commercial software, incorporate new features requested by the user community, conduct field trials of the platform for developing and hosting applications in a small number of utilities, and support developers of other platforms and products in becoming compliant with the GridAPPS-D application programming interface (API) and data models. The platform development will culminate with demonstration of ADMS resiliency functions—such as Fault Location Isolation and System Restoration (FLISR), switch order management, and dynamic feeder reconfiguration—at the ADMS test bed in FY 2020. The core capabilities of the DOE-developed ADMS platform will then be transitioned to industry to maintain and further develop the core in response to industry needs.

Microgrid and Resilience Tools R&D activities will continue national laboratory foundational R&D in several areas:

- Optimal Design & Operation (OD&O) tool for networked microgrids with control architectures to achieve optimized resilience, reliability, and economics. R&D to further enhance the OD&O tool capabilities will continue, with development of new models for protection coordination and dynamic stability and their integration into version 2 of the OD&O tool in FY 2020. Further a second networked microgrid test case will be designed in FY 2020 using version 2 of the OD&O tool.
- New control solutions—based on advanced control theory, topologies, and algorithms—for integrating control functions of microgrid and DMS products to enhance the resilience of distribution systems with high penetration of distributed energy resources (DER). The activity of integrating micro energy management systems (μEMS) with DMS will progress from laboratory-based simulations (completed in FY 2019) to field validation. Two use cases and associated test plans will be developed, based on real system architectures and performance metrics of two electric distribution utilities. Comprehensive testing will be conducted in field settings in FY 2020 to validate that the integrated μEMS/DMS system is capable of managing microgrids and DER to meet the performance metrics for grid reliability and resilience while providing optimal resource value to utilities and customers, under normal and extreme event conditions.
- Resilience strategy and tools to address vulnerabilities and hazards. A structured resilience framework process will continue to be followed to provide stakeholders (reliability coordinators, transmission and distribution companies, and interdependent sector entities) with a structured methodology to systematically assess, hypothesize, and implement grid resilience enhancements. Activities in FY 2020 will focus on R&D gap areas, identified by stakeholders, for enhancing existing tools and developing new prototype tools and technologies to advance operational capabilities and strengthen electric grid resilience. Prototypes of new and/or enhanced tools will be operationalized in actionable exercises in operating and planning environments in FY 2020. Further R&D to expand real-time electric/natural gas modeling capabilities will continue, with inclusion of real-time natural gas electronic data interchange (EDI) data in FY 2020.

DC&C R&D activities will support priorities on grid resiliency and dynamically sourced grid support services to help harden and evolve critical distribution grid infrastructure. Activities will be supported in the following areas in FY 2020:

- Dynamic Controls: These activities will develop the theoretical basis for methods and tools to evolve from centralized command and control to a more decentralized but coordinated system. Economic-control theory hybrid work, developed in previous years and continued in FY 2020 will be tested in simulation relative to traditional control methods.
- Blockchain concepts will be explored through public private partnerships in academia and industry for the purposes of secure peer to peer transactions, high integrity distributed data stores, and secure computing platforms in untrusted environments.
- Grid Communications: R&D activities to develop low latency, resilient communications networks capable of adapting to extreme events and disruptions. Efforts on adaptive spectrum research and co-simulation of power and communications to enhance communications bandwidth for utility applications will be completed. Foundational efforts on advanced resilient grid communication networks concepts will be initiated.

OE coordinates with the Office of Energy Efficiency and Renewable Energy and other relevant DOE programs through the Grid Modernization Initiative and regular programmatic outreach to ensure the programs support complementary R&D and avoid duplication. Work in this area will continue to leverage and integrate energy storage, power electronics, systems controls and first of a kind technologies that could meet the technical needs of microgrids that can support various types of communities ranging from rural to islanded grids.

Support of R&D activities through the Grid Modernization Laboratory Consortium (GMLC) will continue.

FY 2018 Supplemental Appropriation

P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided \$13.0 million to the Office of Electricity and Office of Cybersecurity, Energy Security, and Emergency Response for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985. \$2.6 million of that was allocated for RDS activities.

In June 2018, DOE completed and released a report (*Energy Resilience Solutions for the Puerto Rico Grid*) that contained recommendations for the Government of Puerto Rico to consider for incorporation into its recovery plans—including the plan that Congress required from the Federal Emergency Management Agency (FEMA) to support the Commonwealth in developing through Section 21210 of P.L. 115-123 (2018).^a The recommendations reflected principles of resilience, and were intended to inform investments that used Federal appropriations in the energy infrastructure in the Commonwealth of Puerto Rico.

Activities were also undertaken to evaluate the value of microgrids and energy storage in providing electricity resiliency to Puerto Rico. Efforts were focused on potential resilient power solutions for commercial sites; a microgrid plan was devised for industrial parks in Puerto Rico. Initial efforts were leveraged to support microgrid proposal requests by Puerto Rico for the most promising industrial sites; the labs provided technical assistance/support and sensitivity analysis for these sites. Finally, work included modeling, simulation, and examination of hardware and advanced technologies for end of line/remote communities to design reliable, resilient and cost-effective microgrids.

^a <https://www.energy.gov/oe/articles/office-electricity-releases-energy-resilience-solutions-puerto-rico-grid-report>

**Resilient Distribution Systems
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Resilient Distribution Systems	38,000	+2,600	40,000	27,900	-12,100

SBIR/STTR:

- FY 2018 Enacted: SBIR: \$1,128; STTR: \$159
- FY 2019 Enacted: SBIR/STTR: \$1,313
- FY 2020 Request: SBIR/STTR: \$905

**Resilient Distribution Systems
Explanation of Major Changes (\$K)**

- No new activities in advanced low cost distribution sensors
- No new activities in university-based research and development of sensing, intelligent machines in the Internet of Things

FY 2020 Request vs FY 2019 Enacted
-12,100

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

Resilient Distribution Systems

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Resilient Distribution Systems \$40,000,000	\$27,900,000	-\$12,100,000
<ul style="list-style-type: none"> • Complete preliminary design to prepare for the release of the full open source GridAPPS-D platform in accordance with approved transition plan • Utilize version 1 of the OD&O tool to create a networked microgrid system design for microgrids controlled by a single entity • Identify control objectives and control strategies for integrated DMS and microgrid control solutions • Research advanced communications methods and apply them to decentralized data-rich control systems; propose viable legacy migration approaches • Complete preliminary design of prototypes of new and/or enhanced tools for use in actionable exercises by stakeholders to advance operational capabilities and strengthen electric grid resilience • Develop a methodology to demonstrate the ability to obtain firm forward resource commitments for four grid services critical to resilience (load shed, reactive power, deferred load pickup, and frequency response) through transactive mechanisms in high DER and microgrid environments • Improve the ability to model and run simulations of distributed controls and distributed (local) markets that leverage locational time-varying values 	<ul style="list-style-type: none"> • Demonstrate ADMS resiliency functions (FLISR, switch order management, and dynamic feeder reconfiguration) at the ADMS test bed at National Renewable Energy Laboratory • Conduct field trials of the use of the GridAPPS-D platform for developing and hosting applications in two utilities • Execute the transition plan and release the GridAPPS-D core capabilities in terms of software and documentation to industry for stewardship and continued development • Develop models for protection coordination and dynamic stability for integration into version 2 of the OD&O tool • Validate the control solutions of the integrated μEMS/DMS system, via field testing in two utility use cases • Further development of distribution system designs responsive to high resilience architecture requirements, including laminar coordination which enables decentralized, resilient control. • Blockchain and related distributed technology application to grid challenges involving local resilience and reliability markets, high integrity distributed data, and secure trusted computing platforms. • Foundational research into “Serotinous Networks” capable of automatically re-establishing critical grid communications after extreme events 	<ul style="list-style-type: none"> • No additional activities for advanced low cost distribution sensors and university-based research and development of sensing, intelligent machines in the Internet of Things

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> Develop advanced simulations to evaluate stability of transactive control solutions in high DER scenarios, on time scales that are supported by existing technology 	<ul style="list-style-type: none"> R&D efforts to develop methods to prioritize distribution system information flows based on dynamic control needs. 	

Energy Storage

Overview

The Energy Storage program leads a national effort to ensure a more resilient and flexible U.S. power grid through increased deployment of bi-directional electrical energy storage. The electric power grid is the backbone of our modern economy and success of the grid has rested on two key principles: reasonably predictable load and a measure of control over generation. As the electric grid evolves to accommodate more distributed energy resources, new models and tools, such as energy storage, must be developed to effectively manage these changes. Energy storage is an enabling element for this transition as it is a bi-directional flexible resource capable of providing a suite of grid services while improving the inherent resiliency of the grid.

The U.S. electric grid's installed electricity generation summer capacity of just over 1 terawatt (TW) (1,000 GW) has roughly 23 GW of energy storage, of which 21 GW is provided by large pumped hydro energy storage plants. Historically, less than one percent of installed generation capacity is provided by modular, flexible energy storage assets (such as batteries and flywheels) that offer the greatest potential for large scale deployment and operational flexibility. To make energy storage ubiquitous throughout the grid infrastructure, further research is needed in reducing the cost of energy storage systems, along with significant improvements in the safety and long term reliability of utility-scale energy storage systems. In addition, further research is needed in developing analytic models that can facilitate greater understanding of technical and economic benefits energy storage can provide to utilities and grid operators.

The Energy Storage program is designed to develop new and advanced technologies that will ensure the stability, reliability, and resilience of electricity infrastructure. The FY 2020 R&D program focuses on:

- **Energy Storage Technology Development**—perform advanced research on the development of novel materials and system components to resolve key cost and performance challenges with respect to novel flow, lithium, sodium, zinc, and magnesium batteries, electrode materials, membranes, electrolytes, interconnects, and supporting power electronics and power conversion systems. These advanced battery and device technologies that will lead to significant improvements in the cost and performance of energy storage systems that enable wide spread deployment and support domestic manufacturing.
- **Safety and Reliability**—continue establishing a scientifically derived knowledge base that will improve the understanding and predictability of energy storage systems and components and support fostering greater confidence in the safety and reliability of energy storage systems. Improving the safety and reliability of energy storage technologies and their installation in close collaboration with fire departments, building managers, and other approval authorities.
- **Energy Storage Analytics**—develop open source analytic tools for small and large utility customers and regulatory agencies to facilitate planning and implementation of energy storage in transmission and distribution infrastructure. Support the development of open-source tools for optimal sizing, placement, and valuation of energy storage and develop performance protocols for rapid adaption of energy storage. Design and build advanced control systems to optimize fleets of diverse energy storage systems to supply existing and emerging grid services.

Highlights of the FY 2020 Budget Request

Grid energy storage is one of the key components for the development of a flexible and resilient electric grid infrastructure and the proposed OE research portfolio greatly advances further deployment of grid scale energy storage. The FY 2020 request supports continued materials research on the next generation of battery chemistries, development of new materials and new device technologies for efficient power conversion, development of optimal design and control architectures for energy storage integration into the grid infrastructure, and development of open source models and software tools for system level energy storage planning and evaluation.

The research program builds on a long history of successful research, development, and deployment (RD&D) by the OE Energy Storage program. The advanced materials focus in past programs developed high energy density electrolytes for flow batteries, advanced materials research in improving life and performance of sodium and zinc based batteries, polymeric and ceramic ionic conductors, membranes with fast ion kinetics and enhanced mechanical and chemical stability, and advanced materials and device topologies for power electronics and power conversion systems. This foundation enhances research depth and efficiency, achieving greater progress at lower cost. Future efforts will focus on the development of innovative redox flow chemistries, such as aqueous soluble organic electrolytes, and support the fundamental research to advance the development of batteries based on earth abundant materials such as sodium and zinc. The program will also emphasize the

synthesis and development of low-cost polymeric membranes as well as ceramic membranes to enable the development of safer, metal electrode batteries.

The program will continue to develop and improve new wide-bandgap materials for power electronics and advanced dielectric materials for high voltage capacitors, and to improve the reliability of power convertors. This award-winning research will propel energy storage with low-cost, high-performance inverter technologies. New R&D activities will be initiated for development of new topologies with optimal control and engineered safety using power electronics. The program will support the development of advanced power electronic architectures and topologies to address stranded energy, improve battery failure diagnostics, and integrated highly accurate state-of-charge and state-of-health monitoring of energy storage systems.

Safety and reliability of energy storage systems are critical for large scale deployment of storage technologies into grid infrastructure. The energy storage program is a broad connector for this collective-action problem. Every energy storage manufacturer knows they are judged not only on their safety and reliability but the safety and reliability of their competitors. Thus, it is in their collective interest to establish strong safety standards. Leading this effort means working closely with fire departments, building managers, and other approval authorities to understand the critical R&D needs of the end users, then conducting fundamental investigations into the broad range of mechanisms affecting the safety and reliability of energy storage systems, and last communicating and proliferating research products to standards development organizations such as the Institute of Electrical and Electronics Engineers (IEEE), National Fire Protection Association (NFPA), and UL. This closed-loop program design maximizes research impacts and establishes U.S. standards as the model for how to successfully integrate storage on the grid. Establishing a referenceable database of energy storage degradation and expected lifetimes will continue to be a priority in FY 2020 through an energy storage reliability testing capability at PNNL. This capability was developed in FY 2018 with the goal of developing a standardized method to determine the expected lifetime of storage technologies when operated under grid duty cycles. Collaboration with stakeholders across the country will provide critical use-case information for researcher to use to predict the lifetime of deployed systems based on lab-scale testing.

A serious barrier preventing the wider-scale adoption of energy storage, and the resulting benefits to grid flexibility, is the scarcity of technical information on the economic performance of energy storage technologies. The energy storage analytics focus has an established track record for providing analysis on performance of energy storage systems for a full range of grid application. The program will continue to support the development open source analytic tools to support large scale deployment of energy storage in the electric utility industry and ensure that the future electric grid has flexible and distributed resources to be reliable and resilient. The program will continue to support the development of robust user tools for storage planning, operation, and evaluation. This entails open source software development for optimal sizing and placement, optimal control and coordination, cyber-threat analysis/protection, and techno-economic assessment. These tools lower the barriers to entry for grid planners, behind-the-meter customers, and regulators to quickly understand how integrating storage into the grid can lower energy prices, secure their electrical supply, and solve a verity of challenges faced by specific localities across the United States. Furthermore, new electrical energy storage field evaluation projects that highlight the regional diversity of storage applications will be pursued. The data and experience from these projects will be used to develop and validate the analytical models, which will be shared with the stakeholder community through technical reports, presentations, and journal publications.

This request also supports design and construction planning for an OE Grid Storage Launchpad (GSL) aimed at accelerating materials development, testing, and independent evaluation of battery materials and battery systems for grid applications. The GSL will focus on early-stage materials and prototype battery systems (less than 100 KW) to identify and solve issues before moving to larger-scale systems and will standardize grid performance testing across the spectrum of battery materials, battery systems, inverters, auxiliary power, and battery management systems under grid use-case conditions. The GSL will provide an objective national resource to report battery testing performance under grid conditions and will integrate and coordinate researchers from universities and national labs together to rapidly solve crosscutting science and technology challenges. The GSL will also develop new capabilities to rapidly scale-up new materials for grid scale storage, deliver dedicated state of the art characterization capabilities that do not exist, and conduct realistic testing of design options in a laboratory environment. The GSL will incorporate the energy storage reliability testing capability. The existing center is focused on determining the appropriate method to test currently available grid storage technologies; the GSL will also provide independent validation of the entire storage system, from materials and chemicals to battery modules and power electronics and offer development solutions that can reduce the levelized cost of future systems.

Support of R&D activities through the Grid Modernization Laboratory Consortium (GMLC) will continue.

Advanced Energy Storage Initiative (AESI): AESI is a coordinated effort across DOE to accelerate energy storage R&D as a key to increasing energy security, reliability, and resilience. Leveraging the full suite of DOE technologies, AESI will focus DOE's efforts to take a broad, more holistic view of energy storage as a set of capabilities that enables flexibility of both generation and load in the conversion of energy resources to useful energy services. Building on OE, Energy Efficiency and Renewable Energy, Fossil Energy R&D, and Nuclear Energy activities, the initiative will develop a coordinated strategy for aligning DOE R&D and establish aggressive, yet achievable goals for cost competitive energy storage services.

OE's Energy Storage program's request supports grid-related AESI objectives and other OE R&D efforts are also complementary to AESI goals.

**Energy Storage
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Energy Storage				
Research	41,000	46,000	43,500	-2,500
Construction	...	...	5,000	+5,000
Total, Energy Storage	41,000	46,000	48,500	+2,500

SBIR/STTR:

- FY 2018 Enacted: SBIR: \$1,089; STTR \$153
- FY 2019 Enacted: SBIR/STTR: \$1,389
- FY 2020 Request: SBIR/STTR: \$1,313

**Energy Storage
Explanation of Major Changes (\$K)**

	FY 2020 Request vs FY 2019 Enacted
Research	
• Reduction in support of next generation flywheel technology	-2,500
• Reduction in support of a unified storage valuation model incorporating models developed at Sandia and PNNL during FY 2019	
• Reduction in supporting development of advanced “second use” applications	
Construction	
• Design and construction planning for OE Grid Storage Launchpad	+5,000
Total, Energy Storage	+2,500

Energy Storage

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Research \$46,000,000	\$43,500,000	-\$2,500,000
<ul style="list-style-type: none"> • Aqueous soluble organic (ASO) redox flow battery development plan targeting phenazine/ferricyanide systems capable of achieving 100 mA/cm² with a projected cost under \$200/kWh (year 3 of ASO roadmap) • Continued investigation of innovative chemistries such as reversible zinc, lithium, magnesium-based batteries, solid state electrolytes, and low-cost polymeric membranes • Mechanistic determination of battery materials degradation under grid duty cycles • Fundamental materials investigations into energy storage failures and development of mitigation strategies for improved safety • Develop novel state of health sensors and control algorithms for enhanced battery lifetimes • Develop monolithic silicon carbide semiconductor switch and advanced topologies for bi-directional power converters • Support development and deployment of multi-chemistry “second use” prototypes • Continue development of safety and reliability codes and standards for storage devices • Develop larger scale planning and valuation models for storage based on foundational use-case information from field deployments • Support additional storage installations aimed at providing lower cost energy services while also enabling enhanced reliability and resiliency to the local community 	<ul style="list-style-type: none"> • Demonstrate a 2 kW prototype stack of the novel aqueous soluble organic flow battery technology capable of achieving 200 mA/cm² with a projected 1 MW/4 MWh system cost of less than \$225/kWh • Demonstrate large format (300 Ah) zinc-manganese dioxide batteries with an energy density of 150Wh/L with a projected cell level costs below \$100/kWh • Continued development of sodium batteries capable of achieving less than \$100/kWh • Develop new power electronics and power converter topologies for efficient coupling between batteries and power electronics for improved power conversion optimized for aqueous batteries including flow batteries and zinc-based batteries • Develop control strategies and architectures for distributed control of energy storage for different control functions including grid stability, economic dispatch, and system reliability and safety • Validate novel control algorithms for enhanced battery lifetime for enhanced reliability and safety • Continue development of open source software tools for optimal sizing, location, and valuation of grid scale energy storage • Support validation of 3–4 new electrical energy storage field evaluation projects that highlight the regional diversity of storage applications • Develop and share analytical models validated through these field trials within the stakeholder community through technical reports, presentations, and journal publications 	<ul style="list-style-type: none"> • Reduction in support of next generation flywheel technology • Reduction in support of a unified storage valuation model incorporating models developed at Sandia and PNNL during FY 2019 • Reduction in supporting development of advanced “second use” applications

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Construction \$0	\$5,000,000	+\$5,000,000
	<ul style="list-style-type: none"> Complete evaluation of key elements of the conceptual design, cost, schedule, and initiate general acquisition approach for the OE Grid Storage Launchpad (CD-1) 	<ul style="list-style-type: none"> Support development of design and construction planning for the GSL

Construction Projects Summary (\$K)

	Total Project Cost (TPC)	Prior Years	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
20-OE-100 Grid Storage Launchpad						
Total Estimated Cost (TEC)	5,000 ^a	...	...	...	5,000	+5,000
Other Project Costs (OPC)	1,000 ^b	...	...	1,000	...	-1,000
TPC	6,000 ^a	...	...	1,000	5,000	+4,000

^a This project is pre-CD-2 and the preliminary cost estimates provided are for design only.

^b OPC is funded through laboratory overhead.

20-OE-100, Grid Storage Launchpad
Location to be determined
Project is for Design Only

1. Summary, Significant Changes, and Schedule and Cost History

Summary: The FY 2020 request for the Grid Storage Launchpad (GSL) is \$5,000,000 and will be used to initiate design efforts for a new building that will consolidate existing grid energy storage research capabilities with new characterization, validation and independent testing capability for next generation energy storage materials under grid operating conditions. The most recent DOE Order 413.3B Critical Decision (CD) is CD-0, Approve Mission Need, was approved on November 30, 2018.

A Federal Project Director with level II certification has been assigned to the project.

The scope of this project is to design and construct a facility and associated infrastructure to consolidate existing materials development research and new characterization and testing capabilities focused on grid scale energy storage research. The facility is needed to house critical research capabilities devoted to accelerated materials development, testing and independent validation of storage materials and systems for grid applications. These early stage validation and testing capabilities are not readily available in the private sector. The GSL will also complement current industry efforts by developing standardized grid testing protocols that the entire stakeholder community can use for performance validation of storage technologies. Finally, the GSL will provide new, dedicated capabilities—such as the in-operando storage characterization capability—that are critical to accelerate materials development and does not exist in industry.

Significant Changes: This construction project data sheet (CPDS) includes a new start for FY 2020.

Critical Milestone History

(Fiscal Quarter or Date)

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	D&D Complete	CD-4
FY 2020	11/30/2018	3Q FY 2019	1Q FY 2020	4Q FY 2020 ^a	1Q FY 2021 ^a	TBD	N/A	TBD

CD-0 – Approve Mission Need for a construction project with a conceptual scope and cost range

Conceptual Design Complete – Actual date the conceptual design was completed (if applicable)

CD-1 – Approve Alternative Selection and Cost Range

CD-2 – Approve Performance Baseline

Final Design Complete – Estimated/Actual date the project design will be/was complete

CD-3 – Approve Start of Construction

D&D Complete – Completion of D&D work

CD-4 – Approve Start of Operations or Project Closeout

Fiscal Year	Performance Baseline Validation
FY 2020	4Q FY 2020

^a This project is pre-CD-2 and the schedule estimates are preliminary.

Project Cost History

(Dollars in Thousands)

Fiscal Year	Total Estimated Cost (TEC), Design	TEC, Construction	TEC, Total	Other Project Costs (OPC), Except D&D ^a	OPC, Decontamination and Decommissioning (D&D)	OPC, Total ^b	Total Project Cost (TPC)
FY 2020	5,000	TBD	TBD	1,000	N/A	1,000	6,000

^b

2. Project Scope and Justification

Scope

The scope for the FY 2020 budget is for the design of a project to construct new capital assets, including utilities and infrastructure capabilities, capable of the development and testing of new materials for grid energy storage. A facility is needed to consolidate, modernize and expand critical research capabilities that will enable accelerated materials development, testing and independent validation of battery materials and systems for grid applications and complementary technologies. The GSL project design is intended to lead to construction and turn over of facilities and infrastructure that will provide nominally 70,000–100,000 gross square feet of wet chemistry, instrumentation, and computational space in 25–30 laboratory modules along with workstations for 70–100 research and support staff.

The Pacific Northwest National Laboratory (PNNL) has a shortage of onsite institutional laboratory space. The GSL offers relief from the shortage by providing modern agile research space that not only enables the missions of today but is readily adaptable to the needs of tomorrow. Consolidation of this research community also benefits related and ongoing work for other programs likely resulting in synergic and complementary outcomes. The analysis of alternatives will consider several alternatives including construction of a new structure at PNNL, renovation of existing space at PNNL, moving the capability to another national laboratory, and the status quo.

Justification

America’s security, economy, and sustained global leadership depend on a secure and resilient power grid. Through a mix of technology and policy solutions and in partnership with the private and public sectors, OE harnesses innovation for a stronger, more resilient North American energy system and a path forward to energy independence.

OE’s Advanced Grid Research and Development Division invests in next-generation technologies to support OE’s mission of ensuring a secure, resilient flow of power to the nation. The OE Advanced Grid Research and Development Division works closely with the private and public sectors to ensure the Nation’s critical energy infrastructure is secure and able to recover rapidly from disruptions. One of its priorities is the pursuit of megawatt scale energy storage capable of supporting regulation, ramping and energy management for bulk and distribution power systems. This includes working with other DOE offices to investigate and integrate new technologies for advancing megawatt scale storage with added resilience and control capabilities and working with the national laboratories to identify and pursue capabilities in flow batteries for grid scale energy storage.

Assuring grid security and resilience will require greater grid flexibility and the deployment of grid assets, like energy storage, that can buffer increased variable supply and demand efficiently. Development of grid scale energy storage, at levels to ensure the required resiliency and reliability of the future U.S. power grid, will require the development of new technologies that are more cost effective, safer, and durable. To help accomplish this goal, OE proposes the development of a Grid Storage Launchpad to enhance critical research capabilities for the development and testing of new grid energy storage materials. GSL development will help maintain U.S. R&D leadership in energy storage through validation, acceleration, and collaboration. The GSL will enable independent validation of next-generation grid energy storage materials and systems under realistic grid operating conditions. From benchtop to systems, the GSL will de-risk and accelerate new technology maturation by propagating rigorous grid performance requirements to all stages of storage development. By

^a Other project costs (OPC) are funded through laboratory overhead.

^b This project is pre-CD-2 and the preliminary funding estimates provided are for design only.

linking the DOE and storage R&D communities in a new collaboration facility, the GSL will lower barriers to solving key crosscutting challenges.

The GSL will provide a holistic set of storage development capabilities that does not exist in industry and is not currently accessible to the general R&D community. The GSL will promulgate rigorous grid-performance requirements throughout the R&D development cycle—from basic materials synthesis to testing of near-commercial prototypes—in order to accelerate the development lifetime and ensure continuous validation of new technologies. Current commercial capabilities, focused on later stage prototyping of known storage architectures and device testing, lack the GSL’s planned ability to validate new grid storage technologies at smaller scales and earlier technology maturity stages. The GSL will complement current industry efforts by developing standardized grid testing protocols that the entire stakeholder community can use for performance validation of storage technologies. Finally, the GSL will provide for new, dedicated capabilities, such as an in-operando storage characterization capability, that are critical to accelerate materials development and do not exist in industry. The GSL will also enable broader collaboration across DOE, university, and industry R&D communities than potential proprietary commercial efforts. Because the GSL offers a transformational approach for the accelerated validation of grid storage technologies, DOE stewardship is critical to ensure open access to these capabilities to enable US leadership in grid storage technologies.

The project is being conducted in accordance with the project management requirements in DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets.

3. Financial Schedule

(Dollars in Thousands)

	Budget Authority	Obligations	Costs ^a
Total Estimated Cost (TEC)			
Design			
FY 2020	5,000	5,000	5,000
Other Project Costs (OPC)^b			
FY 2019	1,000	1,000	1,000
Total Project Costs (TPC)			
FY 2019	1,000	1,000	1,000
FY 2020	5,000	5,000	5,000
Grand Total^c	6,000	6,000	6,000

^a Costs are estimates

^b OPC is funded through laboratory overhead.

^c This project is pre-CD-2 and preliminary funding estimates provided are for design only.

4. Details of Project Cost Estimate

(Dollars in Thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design			
Design	4,500	N/A	N/A
Contingency	500	N/A	N/A
Total Estimated Cost^a	5,000	N/A	N/A
Other Project Cost (OPC)			
OPC except D&D			
Conceptual Planning	100	N/A	N/A
Conceptual Design	900	N/A	N/A
Total, OPC^b	1,000	N/A	N/A
Total Project Cost^a	6,000	N/A	N/A
Total Contingency (TEC+OPC)	500	N/A	N/A

5. Schedule of Appropriations Requests

(Dollars in Thousands)

Request Year	Type	FY 2019	FY 2020	Total
FY 2020	TEC ^a	...	5,000	5,000
	OPC ^b	1,000	...	1,000
	TPC ^a	1,000	5,000	6,000

6. Related Operations and Maintenance Funding Requirements

To be determined.

7. D&D Information

To be determined.

8. Acquisition Approach

Once the preferred alternative has been selected, a key element of the CD-1 process, a complementary acquisition approach will be determined. Various acquisition approaches and project delivery methods are being evaluated to optimize the efficiency of the acquisition and maximize the scope delivered through this acquisition.

^a This project is pre-CD-2 and preliminary funding estimates provided are for design only.

^b Other Project Costs (OPC) are funded through laboratory overhead.

Transformer Resilience and Advanced Components

Overview

The Transformer Resilience and Advanced Components (TRAC) program supports modernization, hardening, and resilience of the grid by addressing the unique challenges facing transformers, critical components, and other grid hardware technologies responsible for carrying, controlling, and converting electricity from where it is generated to where it is needed. As the electric power system evolves and the threat environment changes, early-stage R&D can help power-system stakeholders understand the physical impact these changes have on vital grid components, address fundamental performance limits, and identify new requirements, functions, and features necessary to enable a more resilient and secure energy future. Research in advanced power electronics, materials, and sensors will provide the fundamental physical capabilities and enhancements in next-generation grid hardware required to accommodate a rapidly changing power system, ensure all-hazards resilience to a more complex threat environment, and enable new grid architectures and operating paradigms. Program activities will ultimately address the need for real and reactive power flow control, facilitate the integration of grid-scale energy storage, and increase system efficiency, stability, and resilience.

Transformers, power lines, and substation equipment are often exposed to the elements and are vulnerable to an increasing number of natural and man-made threats. To enhance the security, reliability, and resilience of the electric power system, the next-generation of these grid hardware technologies will need to be designed and built to withstand and rapidly recover from the impact of extreme terrestrial or space weather events, electrical disturbances, equipment failures, accidents and deliberate attacks, and other unknowns. Other important characteristics include flexibility and adaptability to address the wide range of designs and specifications across these critical assets, facilitating interchangeability and sharing in emergency situations as highlighted in the July 2017 National Academies Report, *Enhancing the Resilience of the Nation's Electricity System*.^a Additionally, greater deployment of distributed energy resources introduce new stresses from reverse power flows, increased harmonics, and challenges with protection coordination that can impact the reliability and lifetimes of current grid hardware, requiring new and expanded capabilities such as enhanced monitoring and embedded intelligence.

TRAC focuses on innovative designs, materials research, exploratory concepts (such as a high-voltage direct current backbone), and modeling and analysis to address the range of challenges associated with transformers and other grid components. Program activities, developed in close coordination with industry, aim to fill fundamental R&D gaps and encourage the adoption of new technologies and approaches. Next-generation solutions are urgently needed; the age of existing grid assets degrades their ability to withstand physical stresses and may result in higher failure rates that can lead to widespread outages and long restoration times. For example, failure of a large power transformer (LPT) (with 70% aged 25 years or older) can disrupt power to the equivalent of 500,000 homes and take over 12 months to procure a replacement. As a large percentage of these assets will be replaced in the near future, the timing is ripe for innovation to avoid reinstalling outdated technologies that are long-lived, expensive, and less resilient. Results of the TRAC program will help lay the foundation for the grid of the future by catalyzing advances in the underlying physical infrastructure.

Highlights of the FY 2020 Budget Request

TRAC will continue to address critical research needs for solid-state power substations (SSPS) with an emphasis on advanced materials, embedded sensors, and prototype converter building blocks.^b The high voltage, high power, and high reliability requirements of grid applications present unique challenges for these technologies. Greater utilization of high voltage power electronic converters within substations, including in hybrid and solid-state transformer applications, can provide power flow control capabilities and reactive power support, limit fault currents, and increase system reliability and resilience. Continued efforts in this cutting-edge technology concept can enable more flexible and adaptable designs that are interoperable with legacy systems, help reduce the criticality of substations, and facilitate integration of energy storage for enhanced resilience. Additionally, materials research to develop stronger and more efficient electrical conductors for transmission lines and cables will also be pursued.

Support of R&D activities through the Grid Modernization Laboratory Consortium (GMLC) will continue.

^a <https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system>

^b <https://energy.gov/oe/downloads/solid-state-power-substation-roadmapping-workshop-june-2017>

**Transformer Resilience and Advanced Components
Funding (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
7,000	7,000	9,000	+2,000

Transformer Resilience and Advanced Components

SBIR/STTR:

- FY 2018 Enacted: SBIR: \$224; STTR: \$31
- FY 2019 Enacted: SBIR/STTR \$243
- FY 2020 Request: SBIR/STTR: \$312

**Transformer Resilience and Advanced Components
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

+2,000

The request builds on material research and design innovations for next-generation grid hardware, moving towards prototypes for technologies and concepts related to solid-state power substations and advance conductors.

Transformer Resilience and Advanced Components

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Transformer Resilience and Advanced Components \$7,000,000	\$9,000,000	+\$2,000,000
<ul style="list-style-type: none"> • Fundamental and applied research in converter, control, and system architectures for modular and scalable solid-state power substation technologies and applications, including associated tools • Exploration and analysis of reactive power and control devices that complement energy storage technologies • Applied materials research to enhance the capabilities, packaging, and performance of components for high voltage power electronics 	<ul style="list-style-type: none"> • R&D of solid-state power substation converter building blocks suitable for multiple grid applications, such as power flow controllers, hybrid transformers, and integration of energy storage • Continue applied materials research to address converter component limitations associated with the high voltage, high power, and high reliability requirements of the grid • Initiate basic materials research in advance conductors for stronger and more efficient transmission lines and cables 	<ul style="list-style-type: none"> • The increase reflects the need to move beyond design studies, bench-scale testing, and basic materials research towards the development of hardware prototypes and the integration of component technologies • Fundamental materials research will also expand to include advance conductors

Transmission Permitting and Technical Assistance

Overview

The Transmission Permitting and Technical Assistance (TPTA) program's mission is to promote a secure and resilient electricity system through regulatory and policy solutions. TPTA's activities align with the priorities of the Administration, Department, and the Office of Electricity, which include regulatory reform and electricity policy. TPTA evaluates existing laws, policies, and regulations to better understand the regulatory landscapes, and provides technical assistance to Federal, State, tribal, territorial, and regional entities in their efforts to address the changing dynamics and uncertainties in the energy environment.

TPTA also implements a number of legal authorities and seeks to improve transmission infrastructure by facilitating better coordination between Federal agencies for transmission lines that require multiple Federal authorizations and by permitting transmission facilities crossing U.S. international borders. Other authorities include Congressionally-mandated periodic transmission congestion and smart grid studies, authorization of electricity exports, and supporting actions by the Secretary of Energy during electricity emergencies.

Within the United States, the electric grid and markets are undergoing rapid change. The changes arise from a range of challenges and opportunities created by new or improved technologies, changing customer and societal expectations, and structural changes in the electric industry. Some of these technologies are at the wholesale (bulk power) level, some are at the retail (distribution and customer) level, and some straddle the two. Other key factors driving current discussions include the continuing need for substantial utility investments and low load growth in many regions, changing policies and regulations across all jurisdictional landscapes, and new concerns about the structure of wholesale electricity markets. All of these challenges and opportunities must be balanced by regulators and other policy officials overseeing the Nation's electricity system while maintaining the security and resilience of the power grid. TPTA works closely with these decision-makers to address these challenges and meet its mission.

Highlights of the FY 2020 Budget Request

A secure and resilient power grid is vital to national security, a strong economy, and the services Americans rely on every day. During the last decade, the use of next-generation electricity system technologies have increased dramatically through, among other developments, the proliferation of low-emission renewable generation capabilities. Due to the increased frequency and sophistication of cyber and physical threats to our energy systems nationwide, however, consideration should be given to the economic viability of all types of generation, distribution, and transmission technologies for strategic investments that contribute to our national and economic security.

Questions about regulatory reform or strategic infrastructure investments continue to grow in urgency and importance. In response, TPTA will continue to support the institutional processes necessary to achieve a secure and resilient energy infrastructure. In FY 2020, TPTA will focus its technical assistance work to provide stakeholders an in-depth understanding of the resilience of the electricity and related infrastructure needed to know how to best modify existing market structures or build new resilience into the system. By providing robust tools and analyses and by using its convening role, TPTA will facilitate the information exchange amongst State electricity officials to promote prudent, strategic decision-making.

As potential infrastructure investments are identified to improve resilience and mitigate risks associated with energy systems interdependencies, TPTA will work with States to address these opportunities. TPTA will provide institutional support, such as evaluating regulatory and market-based policies, to help States and tribes make infrastructure investments that contribute to our national security. Specifically, TPTA will work with States and tribes to address critical infrastructure investments, including defense critical infrastructure served by regulated independently owned utilities governed by respective public service commissions, municipally owned utilities, and cooperatively owned utilities.

In addition to its resilience work, TPTA will support electricity infrastructure investment through analyses and related support to inform electricity resource planning-related decisions by State officials through their national and regional groups.

The issues affecting the grid are complex and vary from region to region. Therefore, additional technical and policy topics span a wide variety of current and future electricity-related issues, such as:

- Understanding the implication of interdependencies such as gas/electric, electric/IT, and energy/water;
- Evaluating regulations and policies affecting the energy sector;

- Examining approaches to rate design and compensation for wholesale and capacity markets;
- Managing risks by State electricity regulators and other State officials;
- Exploring incentive-based rates for investments in cyber and physical assets;
- Analyzing cost-benefit and valuation methods of electricity infrastructure investments; and
- Planning for future grid architecture.

Work in these issue areas will result in the development of tools, reports, workshops, analyses, and interstate discussions that can help Federal, State, tribal, territorial, and regional electricity officials make better informed decisions about their respective elements of the electricity system.

TPTA will also continue to carry out its regulatory responsibilities and evaluate regulatory reform to reduce the Federal burden associated with investing in our Nation’s electricity infrastructure in several areas:

- Preparing and publishing DOE’s annual Transmission Data Review, triennial national electric transmission congestion studies, and biennial Smart Grid Systems Reports;
- Conducting environmental review and technical analyses needed for Federal authorization of transmission projects that cross U.S. international borders;
- Coordinating Federal permitting by other agencies of new transmission infrastructure that involves Federal authorizations, as required by Section 216(h) of the Federal Power Act and in coordination with title 41 of the Fixing America’s Surface Transportation (FAST) Act;
- Evaluating any new applications under Section 1222 of the Energy Policy Act of 2005, which authorizes DOE to participate in third-party-financed transmission projects within the Western Area Power Administration (WAPA) and the Southwestern Power Administration (SWPA) regions;
- Supporting the Secretary of Energy during electricity emergencies when implementing Section 202(c) of the Federal Power Act; and
- Facilitating the Electricity Advisory Committee, established in accordance with the provisions of the Federal Advisory Committee Act (FACA).

FY 2018 Supplemental Appropriation

P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided \$13.0 million to the Office of Electricity and Office of Cybersecurity, Energy Security, and Emergency Response for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985. \$850 thousand of that was allocated for TPTA activities and was awarded as financial assistance to the Southern States Energy Board (SSEB). The SSEB is a non-profit, interstate compact organization created in 1960 and established under Public Laws 87-563 and 92-440. The SSEB is providing technical expertise and assistance to the Governor and Legislature of Puerto Rico in their efforts to establish a reliable, affordable, and sustainable electric energy grid for the island. This effort will assist and inform significant Federal and private spending for long-term Hurricane Maria recovery efforts regarding the Puerto Rico electricity system.

**Transmission Permitting and Technical Assistance
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Transmission Permitting and Technical Assistance	7,000	+850	7,000	7,000	...

**Transmission Permitting and Technical Assistance
Explanation of Major Changes (\$K)**

- Funding is proposed at the FY 2019 appropriations level

FY 2020 Request vs FY 2019 Enacted

...

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

Transmission Permitting and Technical Assistance

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Transmission Permitting and Technical Assistance \$7,000,000	\$7,000,000	\$0
<ul style="list-style-type: none"> • Implement recommendations identified from the Staff Report to the Secretary on Electricity Markets and Reliability (August 2017) • Develop tools for grid scenario discussions at the Federal, State, and local levels • Provide technical assistance on electricity-related topics, upon request, to assist States, regions, localities, and tribal entities by working with experts from industry, the national laboratories, electricity sector State organizations, and universities • Continue transmission permitting coordination requirements pursuant to Section 216(h) of the Federal Power Act and under title 41 of Fixing America’s Surface Transportation Act • Prepare and publish DOE’s annual Transmission Data Review and triennial national electric transmission congestion studies 	<ul style="list-style-type: none"> • Develop grid resilience tools and analyses to help State electricity officials promote prudent, strategic decision-making • Provide technical assistance to Federal, State, tribal, territorial, and regional entities for current and future electricity-related issues • Continue to implement regulatory responsibilities and evaluate regulatory reform to reduce Federal burden • Support for technical assistance work to provide stakeholders an in-depth understanding of the resilience of the electricity and related infrastructure • Provide institutional support to potential infrastructure investments that addresses the vulnerabilities of the North American energy system 	<ul style="list-style-type: none"> • Support for technical assistance work to provide stakeholders an in-depth understanding of the resilience of the electricity and related infrastructure • Provide institutional support to potential infrastructure investments that addresses the vulnerabilities of the North American energy system

Program Direction

Overview

Program Direction provides for the costs associated with the Federal workforce, including salaries, benefits, travel, training, building occupancy, IT services, security clearance, and other related expenses. It also provides for the costs associated with contractor services that, under the direction of the Federal workforce, support the Office of Electricity (OE) mission.

Salaries and Benefits support Federal employees who provide executive management, programmatic oversight, and analysis for the effective implementation of the OE program. This includes staff at Headquarters and at the National Energy Technology Laboratory (NETL). While OE funds NETL staff within its budget, the NETL Federal employees are included within the full-time equivalent (FTE) total for the Fossil Energy Research and Development account.

The FY 2020 budget request supports 10 additional FTEs for mission-critical OE work.

Travel includes transportation, subsistence, and incidental expenses that allow OE to effectively manage research and development programs and projects in the field; to provide the Department's electricity-related outreach to regions, states, and tribes with regard to planning needs and issues, policies, siting protocols, and new energy facilities.

Support Services includes contractor support directed by the Federal staff to perform administrative tasks and provide analysis to management. These efforts include issue-oriented support on science, engineering, environment, and economics that benefit strategic planning; technology and market analysis to improve strategic and annual goals; development of management tools and analyses to improve overall office efficiency; assistance with communications and outreach to enhance OE's external communication and responsiveness to public needs; development of program-specific information tools that consolidate corporate knowledge, performance tracking and inventory data, improve accessibility to this information, and facilitate its use by the entire staff; and also may include support for post-doctoral fellows (such as American Association for the Advancement of Science [AAAS] fellows) and Intergovernmental Personnel Act (IPA) assignments.

Other Related Expenses includes corporate IT support (DOE's Energy Information Technology Services [EITS] desktop services) and working capital fund (WCF) expenses, such as rent, supplies, copying, graphics, mail, printing, and telephones. It also includes equipment upgrades and replacements, commercial credit card purchases using simplified acquisition procedures where possible, security clearance expenses, and other needs.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental	FY 2018 Enacted (Comparable)^a	FY 2018 Supplemental (Comparable)	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction Summary							
Washington Headquarters							
Salaries and Benefits	12,770	+494	8,236	+494	8,565	10,783	+2,218
Travel	575	+90	325	+90	350	388	+38
Support Services	4,002	...	2,081	...	1,448	1,674	+226
Other Related Expenses	5,077	...	3,182	...	3,461	3,182	-279
Total, Washington Headquarters	22,424	+584	13,824	+584	13,824	16,027	+2,203
National Energy Technology Laboratory							
Salaries and Benefits	2,956	+50	1,698	+50	1,699	1,698	-1
Travel	300	...	180	...	180	180	...
Support Services	809	...	371	...	370	371	+1
Other Related Expenses	2,011	+29	927	+29	927	1,324	+397
Total, National Energy Technology Laboratory	6,076	+79	3,176	+79	3,176	3,573	+397
Total Program Direction							
Salaries and Benefits	15,726	+544	9,934	+544	10,264	12,481	+2,217
Travel	875	+90	505	+90	530	568	+38
Support Services	4,811	...	2,452	...	1,818	2,045	+227
Other Related Expenses	7,088	+29	4,109	+29	4,388	4,506	+118
Total, Program Direction	28,500	+663	17,000	+663	17,000	19,600	+2,600

^a The FY 2019 appropriation split the Electricity Delivery and Energy Reliability appropriation into two appropriations: OE and CESER. To allow an apples-to-apples comparison with the FY 2019 appropriation and FY 2020 requests, the comparable amounts for FY 2018 exclude amounts equivalent to what would have been in CESER, had the current budget structure been in place in FY 2018.

	FY 2018 Enacted	FY 2018 Supplemental	FY 2018 Enacted (Comparable) ^a	FY 2018 Supplemental (Comparable)	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Federal FTEs	75	+2	50	+2	52	62	+10
Additional FE FTEs at NETL supporting OE ^a	21	...	12	...	12	12	...
Total OE-funded FTEs	96	+2	62	+2	64	74	+10
Support Services and Other Related Expenses							
Support Services							
Technical Support	2,309	...	1,177	...	873	981	+108
Management Support	2,502	...	1,275	...	945	1,064	+119
Total, Support Services	4,811	...	2,452	...	1,818	2,045	+227
Other Related Expenses							
Other Services	2,789	+29	1,606	+29	1,606	1,043	-563
EITS Desktop Services	669	...	446	...	446	446	...
WCF	3,630	...	2,057	...	2,336	3,017	+681
Total, Other Related Expenses	7,088	+29	4,109	+29	4,388	4,506	+118

Program Direction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$17,000,000	\$19,600,000	+\$2,600,000
Salaries and Benefits \$10,264,000	\$12,481,000	+\$2,217,000
<ul style="list-style-type: none"> Salaries and Benefits support 64 FTEs at HQ and NETL that provide executive management, programmatic oversight, and analysis for the effective implementation of the OE program 	<ul style="list-style-type: none"> Salaries and Benefits support 74 FTEs at HQ and NETL that provide executive management, programmatic oversight, and analysis for the effective implementation of the OE program 	<ul style="list-style-type: none"> Increase is due to 10 new FTEs and an increase for benefits

^a OE funds 12 FTEs at FE's National Energy Technology Laboratory who support OE activities. The 12 FTEs are in FE's FTE totals and are not included in the OE FTE totals shown on the "Federal FTEs" line.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>Travel \$530,000</p> <ul style="list-style-type: none"> Travel includes transportation, subsistence, and incidental expenses that allow OE to effectively facilitate its mission 	<p>\$568,000</p> <ul style="list-style-type: none"> Travel includes transportation, subsistence, and incidental expenses that allow OE to effectively facilitate its mission 	<p>+\$38,000</p> <ul style="list-style-type: none"> Increase supports the increased OE staffing level
<p>Support Services \$1,818,000</p> <ul style="list-style-type: none"> Support Services includes contractor support directed by the federal staff to perform administrative tasks and provide analysis to management. Support Services may include support for post-doctoral fellows and Intergovernmental Personnel Act (IPA) assignments 	<p>\$2,045,000</p> <ul style="list-style-type: none"> Support Services includes contractor support directed by the federal staff to perform administrative tasks and provide analysis to management. Support Services may include support for post-doctoral fellows and Intergovernmental Personnel Act (IPA) assignments 	<p>+\$227,000</p> <ul style="list-style-type: none"> Increase is due to transition costs after a planned small business contract award
<p>Other Related Expenses \$4,388,000</p> <ul style="list-style-type: none"> Other Related Expenses includes EITS desktop services and WCF expense, such as rent, supplies, copying, graphics, mail, printing, and telephones. It also includes equipment upgrades and replacements, commercial credit card purchases using the simplified acquisition procedures to the maximum extent possible, security clearance expenses and other needs 	<p>\$4,506,000</p> <ul style="list-style-type: none"> Other Related Expenses includes EITS desktop services and WCF expense, such as rent, supplies, copying, graphics, mail, printing, and telephones. It also includes equipment upgrades and replacements, commercial credit card purchases using the simplified acquisition procedures to the maximum extent possible, security clearance expenses and other needs 	<p>+\$118,000</p> <ul style="list-style-type: none"> Increase is due to a small increase in OE's share of operational expenses at NETL

Electricity

Research and Development (\$K)^a

	FY 2018 Enacted	FY 2018 Enacted (Comparable)	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Basic	14,798	13,442	14,702	13,528	-1,174
Applied	98,760	68,033	75,110	65,219	-9,891
Development	64,393	48,126	45,933	79,080	+33,147
Total, R&D	177,951	129,601	135,745	157,827	+22,082

Electricity

Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) (\$K)

	FY 2018 Transfer	FY 2018 Transfer (Comparable)^b	FY 2019 Enacted Projected Transfer	FY 2020 Request Projected Transfer	FY 2020 Request vs FY 2019 Enacted
Transmission Reliability and Resilience	1,403	1,403	1,273	2,320	+1,047
Resilient Distribution Systems	1,287	1,287	1,313	905	-408
Cybersecurity for Energy Delivery Systems	1,563	...	...	...	...
Energy Storage	1,242	1,242	1,389	1,313	-76
Transformer Resilience and Advanced Components	255	255	243	312	+69
Total, SBIR/STTR	5,750	4,187	4,218	4,850	+632

^a R&D reporting includes a proportional share of program direction funding in addition to direct R&D funding.

^b The FY 2019 appropriation split the Electricity Delivery and Energy Reliability appropriation into two appropriations: Electricity Delivery and Cybersecurity, Energy Security, and Emergency Response (CESER). To allow an apples-to-apples comparison with FY 2019 and the FY 2020 request, the comparable amounts for FY 2018 exclude amounts for the Cybersecurity for Energy Delivery Systems program, equivalent to what would have been in CESER, had the proposed structure been in place in FY 2018.

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Electricity	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Argonne National Laboratory			
Electricity			
Transmission Reliability and Resilience	5,668	1,320	9,300
Resilient Distribution Systems	4,015	1,948	2,000
Cybersecurity for Energy Delivery Systems	426	0	0
Transmission Permitting and Technical Assistance	390	0	0
Infrastructure Security & Energy Restoration	1,070	0	0
Total, Electricity	11,569	3,268	11,300
Total, Argonne National Laboratory	11,569	3,268	11,300
Brookhaven National Laboratory			
Electricity			
Transmission Reliability and Resilience	700	700	700
Resilient Distribution Systems	85	0	0
Cybersecurity for Energy Delivery Systems	1,689	0	0
Total, Electricity	2,474	700	700
Total, Brookhaven National Laboratory	2,474	700	700
Idaho National Laboratory			
Electricity			
Transmission Reliability and Resilience	325	250	1,000
Resilient Distribution Systems	967	200	200
Cybersecurity for Energy Delivery Systems	18,452	0	0
Transformer Resilience and Advanced Components	14	221	300
Infrastructure Security & Energy Restoration	328	0	0
Total, Electricity	20,086	671	1,500
Total, Idaho National Laboratory	20,086	671	1,500
Idaho Operations Office			
Electricity			
Resilient Distribution Systems	68	0	0
Transformer Resilience and Advanced Components	68	0	0
Total, Electricity	136	0	0
Total, Idaho Operations Office	136	0	0

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Electricity	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Lawrence Berkeley National Laboratory			
Electricity			
Transmission Reliability and Resilience	2,698	1,871	3,000
Resilient Distribution Systems	1,429	300	1,200
Cybersecurity for Energy Delivery Systems	300	0	0
Energy Storage	84	0	0
Transmission Permitting and Technical Assistance	2,431	660	1,500
Total, Electricity	6,942	2,831	5,700
Total, Lawrence Berkeley National Laboratory	6,942	2,831	5,700
Lawrence Livermore National Laboratory			
Electricity			
Transmission Reliability and Resilience	2,985	1,180	9,000
Resilient Distribution Systems	1,875	175	1,300
Cybersecurity for Energy Delivery Systems	3,900	0	0
Energy Storage	400	0	0
Infrastructure Security & Energy Restoration	100	0	0
Total, Electricity	9,260	1,355	10,300
Total, Lawrence Livermore National Laboratory	9,260	1,355	10,300
Los Alamos National Laboratory			
Electricity			
Transmission Reliability and Resilience	2,122	1,200	6,000
Resilient Distribution Systems	1,779	100	700
Energy Storage	400	0	0
Infrastructure Security & Energy Restoration	600	0	0
Total, Electricity	4,901	1,300	6,700
Total, Los Alamos National Laboratory	4,901	1,300	6,700
National Energy Technology Lab			
Electricity			
Transmission Reliability and Resilience	7,020	1,000	800
Resilient Distribution Systems	2,331	6,982	0
Cybersecurity for Energy Delivery Systems	34,141	0	0
Transformer Resilience and Advanced Components	6,139	0	750
Transmission Permitting and Technical Assistance	2,250	930	1,600
Infrastructure Security & Energy Restoration	1,464	0	0
Program Direction	6,154	3,176	3,574
Total, Electricity	59,499	12,088	6,724
Total, National Energy Technology Lab	59,499	12,088	6,724

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Electricity	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
National Renewable Energy Laboratory			
Electricity			
Transmission Reliability and Resilience	1,185	410	2,000
Resilient Distribution Systems	4,054	2,075	3,000
Cybersecurity for Energy Delivery Systems	1,775	0	0
Transmission Permitting and Technical Assistance	38	85	100
Infrastructure Security & Energy Restoration	100	0	0
Total, Electricity	7,152	2,570	5,100
Total, National Renewable Energy Laboratory	7,152	2,570	5,100
Oak Ridge Institute for Science & Education			
Electricity			
Cybersecurity for Energy Delivery Systems	178	0	0
Transformer Resilience and Advanced Components	33	0	0
Total, Electricity	211	0	0
Total, Oak Ridge Institute for Science & Education	211	0	0
Oak Ridge National Laboratory			
Electricity			
Transmission Reliability and Resilience	5,379	4,450	12,500
Resilient Distribution Systems	6,386	2,422	5,000
Cybersecurity for Energy Delivery Systems	700	0	0
Energy Storage	3,750	3,000	3,000
Transformer Resilience and Advanced Components	501	0	3,000
Transmission Permitting and Technical Assistance	350	100	0
Infrastructure Security & Energy Restoration	2,765	0	0
Total, Electricity	19,831	9,972	23,500
Total, Oak Ridge National Laboratory	19,831	9,972	23,500
Pacific Northwest National Laboratory			
Electricity			
Transmission Reliability and Resilience	8,513	5,060	13,000
Resilient Distribution Systems	12,169	6,609	9,000
Cybersecurity for Energy Delivery Systems	10,951	0	0
Energy Storage	15,000	15,400	20,000
Transformer Resilience and Advanced Components	95	0	950
Transmission Permitting and Technical Assistance	715	950	1,500
Infrastructure Security & Energy Restoration	1,324	0	0
Total, Electricity	48,767	28,019	44,450
Total, Pacific Northwest National Laboratory	48,767	28,019	44,450

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Electricity	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Richland Operations Office			
Electricity			
Cybersecurity for Energy Delivery Systems	200	0	0
Infrastructure Security & Energy Restoration	1,411	0	0
Total, Electricity	1,611	0	0
Total, Richland Operations Office	1,611	0	0
Sandia National Laboratories			
Electricity			
Transmission Reliability and Resilience	3,330	2,000	5,000
Resilient Distribution Systems	3,459	1,800	2,500
Cybersecurity for Energy Delivery Systems	700	0	0
Energy Storage	19,663	20,978	21,000
Transformer Resilience and Advanced Components	15	0	1,000
Transmission Permitting and Technical Assistance	140	135	0
Infrastructure Security & Energy Restoration	760	0	0
Total, Electricity	28,067	24,913	29,500
Total, Sandia National Laboratories	28,067	24,913	29,500
Savannah River Operations Office			
Electricity			
Transmission Reliability and Resilience	100	0	0
Infrastructure Security & Energy Restoration	956	0	0
Total, Electricity	1,056	0	0
Total, Savannah River Operations Office	1,056	0	0
Stanford Site Office			
Electricity			
Transmission Reliability and Resilience	200	200	1,000
Resilient Distribution Systems	52	26	0
Total, Electricity	252	226	1,000
Total, Stanford Site Office	252	226	1,000

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Electricity	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Washington Headquarters			
Electricity			
Transmission Reliability and Resilience	4,762	19,359	7,200
Resilient Distribution Systems	1,931	17,363	3,000
Cybersecurity for Energy Delivery Systems	2,372	0	0
Energy Storage	1,703	6,622	4,500
Transformer Resilience and Advanced Components	135	6,779	3,000
Transmission Permitting and Technical Assistance	1,236	4,140	2,300
Infrastructure Security & Energy Restoration	3,022	0	0
Program Direction	23,006	13,824	16,026
Total, Electricity	38,167	68,087	36,026
Total, Washington Headquarters	38,167	68,087	36,026
Western Area Power Administration			
Electricity			
Cybersecurity for Energy Delivery Systems	45	0	0
Transmission Permitting and Technical Assistance	300	0	0
Infrastructure Security & Energy Restoration	1,000	0	0
Program Direction	3	0	0
Total, Electricity	1,348	0	0
Total, Western Area Power Administration	1,348	0	0
Total, Electricity	261,329	156,000	182,500

**Cybersecurity,
Energy Security, and
Emergency Response**

**Cybersecurity,
Energy Security, and
Emergency Response**

**Cybersecurity, Energy Security, and Emergency Response
Proposed Appropriation Language**

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for energy sector cybersecurity, energy security, and emergency response activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, [~~\$120,000,000~~] *\$156,500,000*, to remain available until expended: Provided, That of such amount, \$11,500,000 shall be available until September 30, [~~2020~~] *2021*, for program direction. (*Energy and Water Development and Related Agencies Appropriations Act, 2019*)

Public Law Authorizations

Public Law 95–91, “Department of Energy Organization Act”, 1977

Public Law 109-58, “Energy Policy Act of 2005”

Public Law 110-140, “Energy Independence and Security Act, 2007”

Public Law 114-94, “Fixing America’s Surface Transportation Act”, 2015

**Cybersecurity, Energy Security, and Emergency Response
(\$K)**

FY 2018 Enacted	FY 2018 Supplemental ^a	FY 2018 Enacted (Comparable) ^b	FY 2018 Supplemental (Comparable) ^{ab}	FY 2019 Enacted	FY 2020 Request
...	...	99,329	+2,900	120,000	156,500

Overview

Cybersecurity, Energy Security, and Emergency Response (CESER) leads the Department’s efforts to secure U.S. energy infrastructure against all hazards, reduce the risks of and impacts from cyber events and other disruptive events, and assist with restoration activities. CESER is the Office responsible for DOE’s responsibilities as lead agency for Emergency Support Function #12 (Energy), or ESF #12, under the National Response Framework, and is the Energy Sector-Specific Agency for national efforts to enhance the preparedness, resiliency, and recovery of the U.S. energy infrastructure from all threats and hazards.

Due to the critical role the energy sector plays across Federal, State, and local jurisdictions, CESER programs work in an integrated manner in partnership with industry and other stakeholders, as well as other DOE offices, to enhance the resilience (the ability to withstand and quickly recover from disruptions and maintain critical function) and security (the ability to reduce risks in the protection system assets and critical functions from unauthorized access and actions) of the U.S. energy infrastructure. Reliable and resilient energy infrastructure is critical to U.S. economic competitiveness, innovation, and leadership.

Within the appropriation, CESER funds:

- Research and Development (R&D) to deliver game-changing tools and technologies that help utilities secure and reduce risks to today’s energy infrastructure from advanced cyber threats and design next-generation systems that are built from inception to automatically detect, reject, and withstand cyber incidents, regardless of the threat.
- Public and private-sector partnerships to strengthen the energy sector’s cybersecurity posture, leveraging DOE-supported tools, guidelines, outreach, training, and technical assistance.
- Emergency preparedness and response, supporting the energy sector, to pursue enhancements to national efforts, in cooperation with public and private-sector stakeholders, for preparedness, resilience, and recovery of U.S. energy infrastructure from all threats and hazards.

Highlights and Major Changes in the FY 2020 Budget Request

- **Cybersecurity for Energy Delivery Systems** (\$75,000,000; -\$14,500,000) seeks to accelerate and expand efforts to strengthen the energy infrastructure against cyber threats and mitigate vulnerabilities. Working closely with the energy sector and our government partners, the request focuses on enhancing the speed and effectiveness of threat and vulnerability information sharing, including bi-directional machine-to-machine information sharing, and accelerating game-changing R&D to mitigate cyber incidents in today’s systems and to develop next-generation resilient energy delivery systems while developing analyses to quantify the resulting relative risk reduction. For instance, research could accelerate development of artificial intelligence (AI) techniques for critical energy delivery infrastructure, such as machine learning using data generated by the underlying physical process of energy delivery as well as data generated by the cyber-systems that control that physical process, to provide for an automatic response to cyber-attack. Such AI

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

^b The FY 2019 appropriation split the Electricity Delivery and Energy Reliability appropriation into two appropriations: Electricity Delivery and Cybersecurity, Energy Security, and Emergency Response (CESER). To allow an apples-to-apples comparison with FY 2019 and the FY 2020 request, the comparable amounts for FY 2018 reflect amounts for the CEDS and ISER programs, and a portion of Program Direction funding, equivalent to what would have been in CESER, had the current structure been in place in FY 2018.

techniques might allow for energy delivery systems or components, such as generation plants, to automatically adapt operations and survive a cyber-attack that would otherwise disrupt energy delivery. The reduction from the FY 2019 appropriation is due to moving funding for the energy delivery system testing and analysis laboratory from Cybersecurity and Energy Delivery Systems (CEDS) to Infrastructure Security and Energy Restoration (ISER) for operationalizing the results of R&D initiatives. The CEDS request includes a \$10,000,000 increase for an Advanced Threat Mitigation initiative to detect and mitigate high-risk threats faster by dramatically improving the speed and effectiveness of public-private information sharing and a \$10,000,000 increase to demonstrate and refine prototype cybersecurity solutions to reduce cyber-risk for energy sector entities that provide power to military and government installations. This initiative will support the Cyber Analytics Tools and Techniques (CATT™) program, which is designed to provide the energy sector with situational awareness and actionable information to support discovery and mitigation of advance cyber threats to the U.S. energy infrastructure enriched with classified threat information and unique analytical tradecraft owned by the U.S. Government. These increases are offset by reductions in two activities that were fully funded in FY 2019: DarkNet and Automated System R&D.

- **Infrastructure Security and Energy Restoration** (\$70,000,000; +\$51,000,000) coordinates a national effort to secure U.S. energy infrastructure against all hazards, reduce impacts from disruptive events, and assist industry with restoration activities. ISER delivers critical capabilities including energy sector emergency response and recovery (including emergency response of a cyber nature); near-real-time situational awareness and information sharing about the status of the energy systems to improve risk management; analysis of evolving threats and hazards to energy infrastructure; and technical assistance that incorporates exercises in order to strengthen Federal, regional, State, local, tribal, and territorial (SLTT) abilities to work together to prepare for and mitigate the effects of an energy sector emergency. By working with the SLTT energy community to plan and develop mitigations, the Nation's energy systems will become more secure and resilient. The ISER request includes \$30,000,000 to establish a national physical energy system and component testing capability designed specifically to look at the vulnerabilities of the energy sector from threats such as electromagnetic pulses (EMP) and geomagnetic disturbances (GMD) and \$15,000,000 to support an energy delivery system testing and analysis laboratory that was previously funded in CEDS.

FY 2018 Key Accomplishments

Multiyear Plan (MYP) for Energy Sector Cybersecurity: CESER released the DOE MYP for Energy Sector Cybersecurity, which lays out an integrated strategy to reduce cyber risks in the U.S. energy sector by pursuing high-priority activities coordinated with other DOE offices and with the strategies, plans, and activities of the Federal Government, including the National Cyber Strategy, and the energy sector. The MYP is informed by the energy industry's highest-priority needs and identifies the goals, objectives, and activities that DOE is pursuing over the next five years to reduce the risk of energy disruptions due to cyber incidents. The MYP envisions resilient energy delivery systems designed, installed, operated, and maintained to survive a cyber-attack while sustaining critical functions.

Emergency Response: Under DOE's role as the Sector-Specific Agency for the energy sector, ISER worked with other Federal agencies to respond to multiple catastrophic hurricanes, two catastrophic wildfires, and a volcanic eruption. CESER's ESF #12 was activated for 347 consecutive days, played an integral role in restoration, recovery, and energy security efforts in at least eight states, and became a critical asset as energy experts in support of Regions IV, VI, and IX. CESER's expertise in the power industry, restoration, and rebuilding of energy systems was also essential to the missions on Puerto Rico and the U.S. Virgin Islands. DOE deployed over 100 personnel, including ESF #12 responders and subject matter experts.

Enhanced energy sector situational awareness capabilities: ISER significantly boosted the capabilities of ISER's situational awareness platform, EAGLE-I. New features implemented include hurricane electric outage forecasting and post-outage damage assessment imagery.

Clear Path VI Exercise: DOE held its flagship energy sector emergency response exercise, Clear Path. Industry and government response partners participated in Clear Path VI to advance lessons learned from real-world energy sector responses, energy focused exercises, industry recommendations, and to focus on cross-sector industry and government coordination. This year's iteration of Clear Path was tied to the Federal Emergency Management Agency's National Level Exercise 2018. It was held in Houston, TX, and ultimately assisted with response efforts during Hurricane Harvey.

Cyber Incident Response Checklist and Guidance for Utilities and Governments: ISER developed a DOE Cyber Incident Response Playbook, checklists, pre-agreed upon incident response language to facilitate assistance to energy utilities, and guidance to help utilities and government prepare for a more streamlined exchange of information during cyber incident

response engagements. ISER is sharing these documents with the broader energy industry through the Sector Coordinating Councils and the Information Sharing and Analysis Centers and posting on the CESER website.

Faster cyber-attack detection: A partnership with General Electric has resulted in a commercially viable, field demonstrated, self-learning and resilient cyber-attack/anomaly automatic detection and accommodation (ADA) technology to provide uninterrupted, equipment safe, controlled power generation to the grid even in the presence of attacks. This ADA system is integral to the defense-in-depth strategy to support improved resilience in the national critical energy infrastructure. The attack detection time was 50 ms, fast enough to qualify as real-time in a control loop.

Secure Quantum Communications Breakthrough: Los Alamos National Laboratory (LANL) recently achieved a significant breakthrough in secure quantum communications. The LANL team is leveraging the capabilities of quantum communications to transmit secret keys for use in traditional cryptographic algorithms. The principles of quantum physics reveal any attempted interception of the secret key as it is exchanged between trusted parties operating critical energy delivery control systems at the moment the adversarial intrusion is attempted. LANL's breakthrough will substantially reduce the cost of quantum key exchange systems and will thereby lower the barrier to widespread deployment of this technology throughout the energy sector.

Secure Patch and Update for Control Systems: Through an R&D partnership with the CEDS program, FoxGuard Solutions has developed a solution to streamline the difficult task of patching/updating devices used in energy delivery control systems. This is particularly important in cases when patches and updates mitigate security vulnerabilities that may be exploited by an adversary. In FY 2018, FoxGuard Solutions launched the Patch Gap Analysis element of the Patch and Update Management Program (PUMP) as a commercially available solution for the energy industry. FoxGuard currently has 10 utility customers who have purchased and Patch Availability Reporting and is supporting over 250 different ICS vendors and suppliers, over 1,200 devices including operating systems, 3rd party applications, networks, and field devices and has cataloged more than 350 end-of-support devices for the industry.

Detect Cyber Attack in Distribution Systems: Lawrence Berkeley National Laboratory licensed the "Stream-Processing Architecture for Real-time Cyber-Physical Security" software as open source. This software was developed under the CEDS project "Cyber Security of Power Distribution Systems by Detecting Differences between Real-time Micro-Synchrophasor (μ PMU) Measurements and Cyber-Reported SCADA," which compares μ PMU sensor output with models of expected behavior to look for discrepancies and identify cyber-attacks on the distribution grid.

Cybersecurity for High Voltage Direct Current Systems: ABB Inc., partnering with the CEDS program on a project titled "Cyber Attack Resilient High Voltage Direct Current (HVDC) System," developed "Rule Based Anomaly Detection for Securing Telecommunicated Operational Data in HVDC System." This tool addresses the concern of an attacker injecting false data between the communication of the rectifier and inverter for HVDC stations. This false data could mimic a fault between the two stations and lead to the protective action of shutting down the line. ABB's solution is to determine the fault type at the rectifier station for verification of the data sent from the inverter station. ABB demonstrated this tool at the Bonneville Power Administration Celilo HVDC converter station replica system.

Cybersecure Configuration of Control System Equipment: Secure Policy-Based Configuration Framework (PBCONF), developed in partnership with the CEDS program, has been released open source via Github.com. PBCONF is an extensible, open-source, policy-based configuration framework to support the secure configuration and remote access of modern and legacy devices from a variety of vendors. The open-source framework will combine a policy engine with a translation engine to address the interoperability challenges of various remote access control methods and provide utilities with a single, organization-wide view of the security configuration of their power delivery devices.

**Cybersecurity, Energy Security, and Emergency Response
Funding by Congressional Control (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental	FY 2018 Enacted (Comparable)	FY 2018 Supplemental (Comparable)	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Cybersecurity for Energy Delivery Systems	75,829	...	89,500	75,000	-14,500
Infrastructure Security and Energy Restoration Program Direction	12,000	+2,900	19,000	70,000	+51,000
	11,500	...	11,500	11,500	...
Total, Cybersecurity, Energy Security, and Emergency Response	99,329	+2,900	120,000	156,500	+36,500
Federal Full Time Equivalent Employees (FTEs)	25	...	25	27	+2
Additional FE FTEs at NETL supporting CESER ^a	9	...	9	9	...
Total CESER-funded FTEs	34	...	34	36	+2

SBIR/STTR:

- FY 2018 Enacted (comparable): SBIR: \$1,397; STTR: \$193
- FY 2019 Request: SBIR/STTR: \$1,586
- FY 2020 Request: SBIR/STTR: \$1,171

^a CESER funds FTEs at FE's National Energy Technology Laboratory who are FE employees, but support CESER activities. The FTEs are in FE's FTE totals and are not included in the CESER's FTE totals shown on the "Federal Full Time Equivalent Employees (FTEs)" line.

The tables below shows the funding allocation between the two offices under the FY 2018 enacted budget structure and the budget structure in the FY 2019 appropriation and FY 2020 request.

**FY 2018 Enacted Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Cybersecurity, Energy Security, and Emergency Response	Electricity	Total
Transmission Reliability and Resilience	...	39,000	39,000
Resilient Distribution Systems	...	38,000	38,000
Cybersecurity for Energy Delivery Systems	75,829	...	75,829
Energy Storage	...	41,000	41,000
Transformer Resilience and Advanced Components	...	7,000	7,000
Transmission Permitting and Technical Assistance	...	7,000	7,000
Infrastructure Security and Energy Restoration Program Direction	12,000	...	12,000
	11,500	17,000	28,500
Total	99,329	149,000	248,329

**FY 2018 Supplemental Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Cybersecurity, Energy Security, and Emergency Response	Electricity	Total
Transmission Reliability and Resilience	...	+5,987	+5,987
Resilient Distribution Systems	...	+2,600	+2,600
Transmission Permitting and Technical Assistance	...	+850	+850
Infrastructure Security and Energy Restoration Program Direction	+2,900	...	+2,900
	...	+663	+663
Total	+2,900	+10,100	+13,000

**FY 2019 Enacted Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Cybersecurity, Energy Security, and Emergency Response	Electricity	Total
Transmission Reliability and Resilience	...	13,000	13,000
Resilient Distribution Systems	...	10,000	10,000
Cybersecurity for Energy Delivery Systems	70,000	...	70,000
Energy Storage	...	8,000	8,000
Transformer Resilience and Advanced Components	...	5,000	5,000
Transmission Permitting and Technical Assistance	...	6,000	6,000
Infrastructure Security and Energy Restoration	18,000	...	18,000
Program Direction	7,800	19,309	27,109
Total	95,800	61,309	157,109

**FY 2020 Request to Congress Comparability Matrix
(\$K)**

FY 2018 Structure \ Current Structure	Cybersecurity, Energy Security, and Emergency Response	Electricity	Total
Transmission Reliability and Resilience	...	70,500	70,500
Resilient Distribution Systems	...	27,900	27,900
Cybersecurity for Energy Delivery Systems	75,000	...	75,000
Energy Storage	...	48,500	48,500
Transformer Resilience and Advanced Components	...	9,000	9,000
Transmission Permitting and Technical Assistance	...	7,000	7,000
Infrastructure Security and Energy Restoration	70,000	...	70,000
Program Direction	11,500	19,600	31,100
Total	156,500	182,500	339,000

Cybersecurity for Energy Delivery Systems

Overview

The Nation's energy infrastructure is a major cyberattack target for malicious external actors. Over the past decade, the frequency and sophistication of cyber-attacks have increased as adversaries advanced their tactics from scanning to reconnaissance to full compromise of critical energy control systems. Given the Nation's growing dependence on electricity and fuels and increasing interdependencies with communication systems and other critical infrastructures, a major attack could cause wide-ranging national security and economic impacts. Cyber risks from operator error, software upgrades, and equipment failures have also grown as the Nation's electricity and fuel delivery systems have become more complex and interdependent. As a result, energy cybersecurity and resilience are among the Nation's most urgent security challenges.

The 2015 and 2016 cyber-attacks on the Ukraine electrical distribution system demonstrated the vulnerability of power grids to cyber events and the advanced capabilities of our cyber adversaries. The 2015 attack knocked out power to 225,000 customers for several hours. Attackers used spear phishing emails to gain initial access to utility information technology (IT) networks. The hackers then went undetected for nine months as they stole credentials using keystroke loggers, identified hosts and devices, and hijacked the SCADA (supervisory control and data acquisition) data management system (DMS) to systematically open breakers and cause a power outage. The attackers' ability to perform long-term reconnaissance operations and execute a highly synchronized, multistate, multisite attack represents a step change in sophistication and intent. Subsequent cyber-attacks targeting U.S. energy systems have shared some traits with those seen during the Ukraine events.

Securing and managing cyber risk to operating systems within the energy sector and ensuring reliable energy delivery is a major challenge for the U.S. and our global partners. The dramatic increase across multiple attack vectors, such as probes, innovative social engineering, and malware exploits, has strained the financial, technical, and human resources of energy companies as they continuously adjust to manage a new risk paradigm. The rapid pace of technology and market changes is also transforming the energy business. Grid modernization is introducing new technologies to better manage increasingly complex transmission and distribution systems. Advanced information and communications technologies that improve reliability, increase situational awareness, enhance asset management, and speed recovery from unplanned outages are being widely deployed. While benefits of these new cyber-based systems have been clearly demonstrated, they also increase the cyber-attack surface and require innovative cyber risk management approaches and continuous monitoring to ensure appropriate levels of risk management and security. Simply put, the rapid pace of change in the cyber-physical control of energy systems, coupled with the advancing cyber exploit capabilities of our adversaries, have made it extremely challenging for the energy sector to stay ahead of the escalating cyber risk landscape they face.

DOE has been collaborating with the energy sector for nearly two decades in a voluntary public-private partnership to identify and mitigate physical and cyber risks to energy systems. Through this partnership, DOE has earned the trust of energy companies and helped accelerate the mutual exchange of information and deployment of new technology, tools, and best practices to improve security and resilience. The Cybersecurity for Energy Delivery Systems (CEDS) program partnered with the energy sector and Federal agencies in 2006 and again in 2011 to develop the *Roadmap to Achieve Energy Delivery Systems Cybersecurity*, which guides public and private investments to achieve the common vision of resilient energy delivery control systems that are designed, installed, operated, and maintained to survive any type of incident while sustaining critical functions.^a

The *National Cyber Strategy of the United States*^b demonstrates the Administration's commitment to strengthening our Nation's cybersecurity capabilities, specifically securing critical infrastructure. This strategy will help align Cybersecurity, Energy Security, and Emergency Response (CESER) efforts, prioritize actions and refine our role/responsibility. In FY 2017–2018, to effectively integrate DOE's responsibilities for energy cybersecurity efforts, CESER collaborated across the Department and with the private sector to develop the *DOE Multiyear Plan for Energy Sector Cybersecurity* (MYP), which aims to reduce cyber risks in the U.S. energy sector through coordinated, focused activities. The MYP is the third tier in national cybersecurity plans, which start with the National Cyber Strategy, and cascading to the DOE Cybersecurity Plan and

^a https://energy.gov/sites/prod/files/Energy%20Delivery%20Systems%20Cybersecurity%20Roadmap_finalweb.pdf

^b <https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Cyber-Strategy.pdf>

then to the MYP. The MYP builds upon priorities from the *Roadmap* and provides a common organizing framework integrating DOE efforts in concert with energy sector owners and operators and key stakeholders.

The MYP outlines a comprehensive program that guides the Department's investments focused on three goals:

- Strengthen energy sector cybersecurity preparedness;
- Coordinate cyber incident response and recovery; and
- Accelerate game-changing R&D of resilient energy delivery systems.

The efforts and initiatives pursued under this budget are aligned with the National Cyber Strategy and MYP goals to reduce the risk of energy disruptions due to multiple threats and events. Enhancing the reliability and resilience of the Nation's energy infrastructure cannot be achieved without both near- and long-term activities to strengthen our national cybersecurity posture.

The Budget Request for CEDS focuses on two key activities:

- Enhancing the speed and effectiveness of threat and vulnerability information sharing, including bi-directional machine-to-machine information sharing and
- Accelerating game-changing R&D to mitigate cyber incidents in today's systems and to develop next-generation resilient energy delivery systems while developing analyses to quantify the resulting relative risk reduction.

CEDS supports a research and development (R&D) portfolio to address the energy sector's key technology challenges as described in the Roadmap. National laboratory participation in CEDS research projects also ensures critical skill sets remain current and sustains core capabilities to strengthen the continuous development of future energy delivery systems. CEDS efforts engage energy sector stakeholders from the earliest stages and align with initiatives and requirements outlined in the Roadmap strategy to ensure that CEDS is addressing the identified problem sets and needs. This approach enables the continuous transition of long-term innovative early-stage research from the national laboratories and academia into capabilities that the energy sector and supporting private sector entities can put into practice or incorporate into their product roadmaps to reduce cyber risk. The dynamic threat landscape, continuous advances in energy delivery system technologies, and the use of legacy devices in ways not previously envisioned underscore the importance of this continuous transition. Research could accelerate development of artificial intelligence (AI) techniques for critical energy delivery infrastructure, such as machine learning using data generated by the underlying physical process of energy delivery as well as data generated by the cyber-systems that control that physical process, to provide for an automatic response to cyber-attack. Such AI techniques might allow for energy delivery systems or components, such as generation plants, to automatically adapt operations and survive a cyber-attack that would otherwise disrupt energy delivery. In addition, CEDS R&D provides strategic leadership on cybersecurity aspects of the energy sector's operational security, IT/operational technology (OT) interdependencies, asset protection, baseline practices, risk management, situational awareness, incident management, and other issues needed to achieve the Roadmap vision.

Highlights of the FY 2020 Budget Request

The request reflects the critical need to accelerate and expand efforts to strengthen the energy infrastructure against cyber threats and mitigate vulnerabilities. Working closely with the energy sector and our government partners, the request focuses on the following key areas:

- **Strengthen Energy Sector Cybersecurity Preparedness**

DOE strengthens the energy sector's cybersecurity posture through public and private sector partnerships that leverage DOE-supported tools, guidelines, outreach, training, and technical assistance. DOE accomplishes this through close coordination with the CEO-led Electricity Subsector Coordinating Council (ESCC) and Oil and Natural Gas Subsector Coordinating Council (ONG SCC).

- ✓ **The Advanced Threat Mitigation** initiative supports the Cyber Analytics Tools and Techniques (CATT™) and Cybersecurity for the Operational Technology Environment (CYOTE™) experiences and concepts. This initiative will use the latest available technology and architecture and innovative partnerships with the energy sector to provide the enhanced cyber protection for the energy sector. The CATT initiative will address both IT and OT infrastructure, and is designed to provide the energy sector with situational awareness and actionable information to support discovery and mitigation of advance cyber threats to U.S. energy infrastructure enriched with classified threat information unique analytical tradecraft owned by the U.S. Government. The vision is to dramatically increase the

footprint across the energy sector infrastructure and to gain a higher level of threat detection capability. The request will allow for near-real-time capability for energy owners and operators to voluntarily share cyber threat data, analyze this data, and receive machine-to-machine mitigation measures. The program will continue developing an advanced information sharing model—advancing technology, policy, and partnerships—to improve speed, reduce cost, and increase industry participation.

- ✓ **The Cybersecurity for the Operational Technology Environment Pilot** monitors utility data in the complex OT environment to identify malicious actions using an efficient approach that manages data by exception. The request expands the CYOTE approach to include additional utilities and apply the results and lessons learned from the OT pilot. While the current CRISP program monitors IT networks, CYOTE aims to design an industry-led approach for collecting and sharing OT data, which will be enhanced by special insights from the U.S. Intelligence Community and DOE national laboratories to deliver actionable information to utility operators.

- **Accelerate game-changing R&D of Energy Delivery Systems Able to Survive a Cyber-Attack**

CESER's R&D portfolio aims to deliver game-changing tools and technologies that help utilities secure today's energy infrastructure from advanced cyber threats and design next-generation future systems that are built from the start to automatically detect, reject, and withstand cyber incidents, regardless of the threat. The Department will continue to develop continuous monitoring tools and secure control system communications.

- ✓ The request supports a competitive solicitation for energy sector-led R&D to redesign the architecture to survive a cyber-attack, placing the energy sector's cyber-defender at an advantage by using operational data and the physics of energy delivery to research, develop, and demonstrate tools and technologies that prevent, detect, and mitigate cyber incidents in today's and tomorrow's energy delivery systems. For instance, power grid components such as power plants or protective relays could use physics to automatically detect a cyber-attack, identify compromised sensors, and use the remaining trustworthy sensors to sustain critical functions. This approach avoids malware and malicious command impacts through managing by exception: recognizing and rejecting actions that would cause harmful departures from normal grid operations. Power systems or ONG delivery systems or devices could automatically detect a cyber-attack and shift to a simpler control system, part of a redundant architecture that sustains critical functions while the cyber-attack is isolated and eradicated.
- ✓ The request supports a competitive solicitation that will refine fully functional prototypes of cybersecurity solutions with established research and demonstration partnerships. These installations will reduce cyber-risk for energy sector entities that provide power to military and government installations while accelerating the transition of cybersecurity solutions to operational environments throughout the energy sector.
- ✓ The request supports national laboratory early-stage R&D in energy delivery control system cybersecurity that will strengthen and maintain core capabilities for the energy sector. This approach advances the state of the art in today's systems, while recognizing that developing cybersecurity solutions to stay ahead of the latest threat is a reactionary cycle that must be broken. Innovative R&D to develop self-healing systems can disrupt this cycle and change the game for energy delivery system cybersecurity, even as the threat advances and the attack surface increases. Today is the time to design cybersecurity into future grid scenarios. Grid operations are rapidly evolving to integrate millions of new smart grid devices and distributed energy resources, and legacy devices are often being used in ways never previously envisioned. As operation of the grid becomes increasingly complex and distributed, new energy delivery system designs with built-in cyber resilience will be essential. CEDS R&D helps secure our Nation's energy infrastructure from cyber-attack, which is critical to national security, but for which an individual energy sector organization would likely be unable to support a business case.
- ✓ The R&D focus areas include early-stage technologies such as those that:
 - Focus on data and physics to redesign the architecture presently being used that exposes the energy grid to cyber threats. For instance, develop near-term actionable strategies for mitigation of physical consequences that might result from cyber-attack by using technology, design modifications, or operational considerations to protect national critical infrastructure, such as the transmission system and energy delivery operational communications platforms.

- Prevent a cyber-incident by decreasing the cyber-attack surface of energy delivery systems and components, blocking attempted misuse of the energy delivery system at every level, or decreasing the risk posed by malicious functionality.
- Detect a cyber-incident by providing for real-time continuous cybersecurity situational awareness at all energy delivery system levels that recognizes attempts to execute either unwanted functionality that the energy delivery system was not designed to support or anomalous behavior within an energy delivery system's functionality.
- Mitigate a cyber-incident by distinguishing a disruption of energy delivery resulting from a cyber incident, from a disruption resulting from a different cause, characterizing the extent and consequences of a cyber incident to support response actions and providing for automated response.
- Advance cyber resilience by designing cybersecurity into emerging power system device for future grid scenarios from the start or designing power systems and components to automatically recognize, and reject, attempted misuse.

**Cybersecurity for Energy Delivery Systems
Funding^a (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Cybersecurity for Energy Delivery Systems	75,829	89,500	75,000	-14,500

SBIR/STTR:

- FY 2018 Enacted: SBIR: \$1,397; STTR \$193
- FY 2019 Enacted: SBIR/STTR \$1,586
- FY 2020 Request: SBIR/STTR: \$1,171

**Cybersecurity for Energy Delivery Systems
Explanation of Major Changes (\$K)**

	FY 2020 Request vs FY 2019 Enacted
• The Advanced Threat Mitigation initiative will detect and mitigate high-risk threats faster by dramatically improving the speed and effectiveness of public-private information sharing	+10,000
• The request supports demonstrating and refining prototype cybersecurity solutions to reduce cyber-risk for energy sector entities that provide power to military and government installations	+10,000
• The energy delivery system testing and analysis laboratory initiative is moved from CEDS to Infrastructure Security and Energy Restoration (ISER) for operationalizing the results of R&D initiatives	-14,500
• The FY 2019 Congressionally directed DarkNet project to secure communications based on optical fibers and develop communication technologies to secure existing networks is fully funded in FY 2019	-10,000
• The FY 2019 Congressionally directed Automated System R&D project primarily to improve consequence prioritization process to simplify and isolate automated systems and remove vulnerabilities is fully funded in FY 2019	-10,000
Total, Cybersecurity for Energy Delivery Systems	-14,500

^a FY 2018 appropriations were provided in the Electricity Delivery and Energy Reliability appropriation account. FY 2019 appropriations and the FY 2020 request are in the CESER appropriation account, per the restructuring in the FY 2019 appropriation.

Cybersecurity for Energy Delivery Systems

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Cybersecurity for Energy Delivery Systems \$89,500,000	\$75,000,000	-\$14,500,000
<ul style="list-style-type: none"> • Advance game-changing R&D by focusing on two key activities: <ul style="list-style-type: none"> ✓ Support strategic partnerships with national laboratories to sustain core capabilities ✓ Industry-led partnership competitive Funding Opportunity Announcement (FOA) • Continue the CATT effort including migration of additional utilities on the basis of lessons learned and improve the efficiency and effectiveness of CATT with enrichment of Intelligence Community IT expertise • Expand the CYOTE approach to other utilities and apply the results of the OT pilot completed during FY 2018 	<ul style="list-style-type: none"> • Advance game-changing R&D by focusing on two key activities: <ul style="list-style-type: none"> ✓ Support strategic partnerships with national laboratories to sustain core capabilities ✓ Issue Industry-led partnership competitive Funding Opportunity Announcement (FOA) ✓ Support a competitive solicitation to refine fully functional prototypes of cybersecurity solutions • Continue the Advanced Threat Mitigation effort to develop an advanced information sharing model <ul style="list-style-type: none"> ✓ Advance technology, policy, and partnerships to improve speed, reduce cost, and engage additional industry participants • Implement CATT initiatives to additional utilities to broaden the base to operationalize lessons learned • Implement the expansion of the CYOTE approach to other utilities and apply the results of the OT pilot 	<ul style="list-style-type: none"> • Advanced game-changing R&D is increased with a greater focus on the demonstration and refinement of CEDS Fully Functional Solutions within the Department of Defense (DOD) Operational Technologies (OT) environment. • Advanced Threat Mitigation provides greater support for the advanced information sharing initiative

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> • Fully operationalize an initial national supply chain assessment capability using national laboratory infrastructure to provide the flexibility to analyze a fraction of exploits, malware, and cyber vulnerabilities in OT systems in safe research environments to enhance visibility into supply chain vulnerabilities in the energy operational technology environment <ul style="list-style-type: none"> ✓ This funding will support development of easily reconfigurable test-beds and dissection of energy components supplied by industry to analyze and track hardware and software vulnerabilities inherent across components at the distribution and transmission-scale • The Congressionally directed DarkNet project will develop secure communications based on optical fibers and develop communication technologies to secure existing networks • The Congressionally directed Automated System R&D project will improve consequence prioritization processes to simplify and isolate automated systems and remove vulnerabilities 	<ul style="list-style-type: none"> • No activities • No activities • No activities 	<ul style="list-style-type: none"> • The national supply chain assessment capability is moved from CEDS to ISER in FY 2020 • The DarkNet project is fully funded in FY 2019 • The Automated System R&D project is fully funded in FY 2019

Infrastructure Security and Energy Restoration

Overview

The Infrastructure Security and Energy Restoration (ISER) program coordinates a national effort to secure U.S. energy infrastructure against all hazards, reduce impacts from disruptive events, and assist industry with restoration activities. ISER works closely with the electricity and oil and natural gas industries; other Federal agencies; State, Local, Tribal, and Territorial (SLTT) communities; and DOE's national laboratories to advance national energy security and prepare for, respond to, and recover from evolving threats and events.

ISER is responsible for executing DOE's Energy Sector Specific Agency (SSA) and Emergency Support Function-12 (ESF #12) (Energy) roles and providing DOE's support to the Infrastructure Systems Recovery Support Function.^a ISER also serves as the point of entry for the private sector when collaborating with DOE and the Federal Government.

To meet its mission and support its stakeholders, ISER delivers critical capabilities including energy sector emergency response and recovery to all hazards (including emergency response of a cyber nature); near-real-time situational awareness and information sharing about the status of the energy systems to improve risk management; analysis of evolving threats and hazards to energy infrastructure; and technical assistance that incorporates exercises in order to strengthen Federal, regional, State, tribal, and territorial abilities to work together to prepare for and mitigate the effects of an energy sector emergency.

Highlights of the FY 2020 Budget Request

The budget request supports the National Cyber Strategy and energy sector security and resilience in coordination with our government and industry partners in the delivery of emergency response coordination, energy sector situational awareness, and cyber preparedness and incident coordination as stipulated in the 2015 Fixing America's Surface Transportation (FAST) Act, as well as by seeding public-private partnerships at national laboratories to advance the Department and its partners' efforts to prepare for, mitigate, respond to, and recover from all threats and hazards facing the U.S. energy sector.

Expand Emergency Support Function 12 Capacity: In FY 2020, ISER will maintain its ability to support industry and the interagency during major events, such as hurricanes, wildfires, and cyber-attacks, and will develop subject-specific training for responders that they can utilize and draw upon when responding to events. We will focus on expanding familiarity with and capability to support remote location responses, educating responders to changing energy sector interdependencies, and expanding access to available subject matter expertise across DOE.

Improve Energy Sector Situational Awareness Capabilities: ISER is home to EAGLE-I, the Federal Government's situational awareness tool for national power outages. ISER will expand the current configuration of EAGLE-I and work to ensure its continued usefulness as a collaborative platform for historic and real time data collection, integration, and curation across the public and private sectors. EAGLE-I will leverage cloud infrastructure to facilitate access to existing models and data sets to expand its capabilities and value to response partners. EAGLE-I will incorporate machine learning for all-hazards event characterization and consequence analysis (including cyber). It will take advantage of high-performance computing technologies to analyze large data sets (such as historical outages and infrastructure interdependencies), which will improve energy sector impact prediction capabilities.

Ensure Energy Sector Cybersecurity Coordination and Preparedness: ISER will continue to build a coordinated emergency management response effort for cyber events, as identified in Presidential Policy Directive 41 (PPD-41) and the FAST Act, as part of its all-hazards approach to incident response for the energy sector. ISER will leverage the DOE-wide cyber incident response plan developed in FY 2018 to use all available resources in supporting response and preparation for cyber events. During FY 2020, ISER will leverage participation in both industry-focused cyber exercises (Liberty Eclipse) and internally focused, no-notice cyber exercises to identify improvements to policies, procedures, and capabilities. ISER will continue working with DHS to proactively connect energy companies to DHS response teams before a disaster, which should enable more rapid response to cyber incidents, and will work toward the goal of obtaining pre-approved requests for technical assistance from the most critical U.S. utilities. ISER will also expand its CyberForce™ competition to support development of the energy sector's cyber defense workforce Nation-wide.

^a The Infrastructure Systems Recovery Support Function is described at https://www.fema.gov/pdf/recoveryframework/infrastructure_system_rsf.pdf.

Maintain and Develop Cyber Operation Tools: CEDS funding in FY 2019 and before developed operational tools that are now being moved to implementation, deployment, or both within ISER. Along with maintaining previously developed tools, ISER will continue to evolve the operational capabilities available before and during cyber events. ISER will seek to use technologies to accelerate response and recovery by maintaining situational awareness and enabling operations in degraded states. By developing technology to support cybersecurity personnel, including energy sector operators and engineers, ISER will bolster the Nation's defense of critical energy systems.

Cybersecurity Testing for Resilience and Control Systems: The Cybersecurity Testing for Resilience and Control Systems (CyTRICS™) program will serve as a central capability for DOE's efforts to increase energy sector cybersecurity and reliability through testing and enumeration of critical components to identify embedded cyber vulnerabilities across. Analysis of test results will identify systemic and supply chain risks and vulnerabilities to the sector by correlating collected test data and enriching it with other data sources and methods. DOE will collaborate with other Federal partners, national laboratories, and industry to identify key energy sector industrial control systems components and apply a targeted, collaborative approach to these efforts.

Continue engagement with SLTT Entities. When a major disaster strikes, the restoration of energy systems depends on the planning and coordinated response effectiveness of local, State, multi-State, tribal, territorial, and national responses. In FY 2020, the SLTT Energy Assurance program will continue to support technical assistance engagement for coordinated risk analysis and planning with States and territories that improves preparedness for all hazards, including hurricanes, fuel emergencies, and cyber events. With additional funding in this area, ISER will pilot the creation of a data hub for SLTT energy assurance technical assistance and workforce development. In past years, DOE has provided grants and technical assistance to States to develop and refine energy assurance plans, build in-house expertise on infrastructure interdependencies and vulnerabilities, and address new technologies and challenges such as cybersecurity. However, these efforts quickly become outdated, while energy sector threats continue to evolve and grow.^a The establishment of an SLTT national capability will allow the Department to promote targeted initiatives designed to reskill the energy and emergency management workforce to address the security threats, including cyber, of today and the future. The SLTT capability would provide streamlined access to the advanced energy sector analysis, knowledge, and capabilities needed to assist States, localities, tribes, and territories in ensuring the security of national energy supplies. By ensuring that plans, tools, and trained personnel are in place prior to catastrophic events, the national capability will alleviate challenges faced during Federal response support during events such as Hurricane Katrina and Superstorm Sandy, and serve as a standing resource for securing energy infrastructure.

Establish a National Physical Energy System and Component Testing Capability: Historically, DOE and NNSA have led efforts to understand the effects of electromagnetic radiation on a variety of components. As a result, DOE and its laboratories have made progress in leveraging other research to investigate electromagnetic pulse (EMP) effects on energy system components. However, there are several areas where significant advancements in assessment techniques could improve our understanding of EMP impacts to energy systems. The ability to perform the full assessment process (particularly testing at scale of energized large power transformers) does not reside within one single entity and will require a partnership with various subject matter experts, equipment manufacturers, national laboratories, and academia. To meet this need, ISER will establish a national physical energy system and component testing capability, designed specifically to look at the vulnerabilities of the energy sector from threats such as EMP and geomagnetic disturbances (GMD).

FY 2018 Supplemental Appropriation

ISER provided funding to Los Alamos (LANL), Sandia (SNL), Brookhaven (BNL), Berkeley (LBNL), Livermore (LLNL), Idaho (INL), Argonne (ANL), and Pacific Northwest (PNNL) National Laboratories to create and integrate energy sector situational awareness informational products into EAGLE-I, DOE's near-real-time national electric outage mapping capability located at Oak Ridge National Laboratory (ORNL). Products include data analytics and modeling of energy sector infrastructure in U.S. island territories, including Puerto Rico. As a result, both Puerto Rico and U.S. Virgin Islands assets will be included and available to assist responders in future events. Both territories' emergency response organizations will be given EAGLE-I accounts. Infrastructure information, models, and predictive capabilities added to EAGLE-I through this supplemental funding will provide lasting benefit to future island response efforts.

^a National Association of State Energy Officials, "Energy Assurance Planning," accessed June 6, 2018, <http://www.naseo.org/energyassurance>.

**Infrastructure Security and Energy Restoration
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Infrastructure Security and Energy Restoration	12,000	+2,900	19,000	70,000	+51,000

**Infrastructure Security and Energy Restoration
Explanation of Major Changes (\$K)**

	FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> Strengthen ISER capabilities for response coordination for natural and intelligent adversary events, including a development process with exercises for validation. 	+2,000
<ul style="list-style-type: none"> Increase access to technical assistance and advanced capabilities needed to assist States, localities, tribes, territories, and regions in protecting the security of nationally significant energy supplies. Initial focus would be on emerging efforts like improved situational awareness and technical assistance for informed planning that benefits both local jurisdictions and Federal preparedness and response efforts. 	+2,000
<ul style="list-style-type: none"> Expand EAGLE-I related capabilities through integration with existing models, data sets, and machine-learning capabilities for all-hazards event characterization and consequence analysis. 	+2,000
<ul style="list-style-type: none"> Continue funding cyber operation tools that were transitioned from CEDS and evolve the operational capabilities used to respond to cyber events. 	+15,000
<ul style="list-style-type: none"> Establish a National Physical Energy System and Component Testing Capability (EMP, GMD and other). 	+30,000
Total, Infrastructure Security and Energy Restoration	+51,000

^a P.L. 115–123, Division B, Subdivision 1, the Further Additional Supplemental Appropriations Act for Disaster Relief Requirements Act, 2018, provided additional funding for expenses related to the consequences of Hurricanes Harvey, Irma, and Maria as an emergency requirement pursuant to the Balanced Budget and Emergency Deficit Control Act of 1985.

Infrastructure Security and Energy Restoration

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>Infrastructure Security and Energy Restoration \$19,000,000</p> <ul style="list-style-type: none"> • <i>ESF 12 Responsibilities:</i> Expand implementation of the regionalized approach to provide volunteer emergency responders, which proved very successful in improving response and cooperation with the DHS Office of Infrastructure Protection and FEMA <ul style="list-style-type: none"> • Develop an annex to emergency response procedures focused on how to provide support to remote locations— islands, Alaska, etc. • <i>SSA Responsibilities:</i> Continue work with the ESCC and ONGSCC to identify gaps in their ability to address cyber, physical and supply chain vulnerabilities that require the capabilities of DOE national laboratories <ul style="list-style-type: none"> • Clarify a public-private partnership approach to establishing these capabilities 	<p align="center">\$70,000,000</p> <ul style="list-style-type: none"> • <i>ESF 12 Responsibilities:</i> Maintain cadre of trained volunteer emergency responders, focusing efforts on: <ul style="list-style-type: none"> • Expanding capabilities internally and for response partners to support energy issues in remote locations and to address changing hazards • Educating responders to evolving adversarial threats and energy sector interdependencies • Expanding access to available DOE subject matter expertise, including from DOE’s Power Marketing Administrations • <i>SSA Responsibilities:</i> Continue work with the ESCC and ONGSCC to identify gaps for addressing cyber, physical, and supply chain risks <ul style="list-style-type: none"> • Create a national laboratory partnership to address at-scale understanding of energy component function during events including EMP and GMD • Support owners and operators of critical infrastructure at greatest risk (Section 9 of E.O. 13686) to pilot new capabilities for energy security 	<p align="center">+\$51,000,000</p> <ul style="list-style-type: none"> • Maintain the expanded cadre of volunteers and provide new tools and subject specific training to expedite response support • Focus on enabling automated streams of information sharing for responders to improve decision-making during events • Increase energy sector specific cyber knowledge for coordination between the National Response Framework (ESF #12) and cyber response (PPD-41) • Fund a full-scale component test capability to evaluate energy sector systems functionality during national events like ground-induced current caused by EMP and GMD • Grow CyTRICS to increase the number of critical energy components tested for supply chain threats per year

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> • <i>Exercises</i>: Conduct Clear Path VII and continue to engage SLTT entities and enhance their access to situational awareness information through EAGLE-I <ul style="list-style-type: none"> • Conduct at least one cyber exercise • <i>Situational Awareness and Emergency Response Tools</i>: Maintain EAGLE-I as the Federal source for near-real-time situational awareness of energy infrastructure <ul style="list-style-type: none"> • Build out additional capability to address industry interest in damage assessments and for SLTT coordinated situational awareness and to support State and Regional Energy Sector exercises • <i>Emergency Response of a Cyber Nature</i>: Build out the effective, timely, and coordinated cyber event management capability with a focus on developing “pre-cooked” tools and agreements with industry to enable more rapid response to cyber events and on redundant communications, dedicated transmission, and increased security for defense critical electric infrastructure <ul style="list-style-type: none"> • Establish coordination mechanisms to DHS, and other Federal agencies, to provide assistance with subject matter expertise in the intersection of cyber threats and energy sector industrial control systems 	<ul style="list-style-type: none"> • <i>Exercises, Competitions and Workshops</i>: Conduct <i>Clear Path VIII</i> and <i>Liberty Eclipse II</i> with a focus on the connection between internal and external emergency response of a cyber nature <ul style="list-style-type: none"> • Host CyberForce energy sector cyber defense competition and CyberStrike workshops, which provide hands-on lessons learned from the 2015 cyber-attack on the Ukrainian grid • <i>Situational Awareness and Emergency Response Tools</i>: Expand EAGLE-I functionality and maintain its status as the Federal source for near-real-time situational awareness of energy infrastructure <ul style="list-style-type: none"> • Improve State and local government tools to better prepare for a coordinated response requiring Federal support • <i>Emergency Response of a Cyber Nature</i>: Exercise application of an effective, timely, and coordinated cyber event management capability <ul style="list-style-type: none"> • Expand engagement with industry to include technical assistance agreements with the most critical electric utilities to enable rapid response to cyber incidents • Grow operation and testing of research and development results with partners to add capabilities to the energy sector for better cyber response 	<ul style="list-style-type: none"> • Expand engagement with industry and States via exercises, focusing on cyber events • Expand CyberForce to an annual event and CyberStrike to reflect new lessons learned for small- and medium-sized utility operators • Expand EAGLE-I for historic and real-time data collection and integration across the public and private sectors for improved decision making and incorporate machine learning for all-hazards event characterization and consequence analysis • Coordinate funding with the Grid Modernization Lab Consortium to address gaps identified through exercises and response • Increase level of effort, moving to next level of granularity in cooperative activity with industry • Continue funding cyber operation tools that were transitioned from CEDS and evolve the operational capabilities used to respond to cyber events • Expand the capabilities available to expedite response and restoration to all hazards, including a cyber events in the energy sector • Increase availability of subject matter expertise at the intersection of cyber threats and energy sector industrial control systems to support all incidents affecting the electricity, oil, and natural gas subsectors • Expand the adoption of new cyber situational awareness tools (Cyber Analytics Tools and Techniques, or CATT™)

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> <i>New and Emerging Threats:</i> Expand work on evolving adversarial threats and natural hazards including EMP, space weather, cyber, physical, and supply chain vulnerabilities 	<ul style="list-style-type: none"> <i>New and Emerging Threats:</i> Establish a national physical energy system and component testing capability in partnership with industry, designed specifically to look at the vulnerabilities of the energy sector from threats such as EMP and GMD 	<ul style="list-style-type: none"> This long-term national security capability would enable testing full-scale energy systems, including energized large power transformers, for grid-scale impacts from evolving adversarial threats and natural hazards

Program Direction

Overview

Program Direction provides for the costs associated with the Federal workforce, including salaries, benefits, travel, training, and other related expenses. It also provides for the costs associated with contractor services that, under the direction of the Federal workforce, support the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) mission.

Salaries and Benefits support Federal employees who provide executive management, programmatic oversight, and analysis for the effective implementation of the CESER program. This includes staff at Headquarters and at the National Energy Technology Laboratory (NETL). While CESER funds NETL staff within its budget, the NETL Federal employees are included within the full-time equivalent (FTE) total for the Fossil Energy Research and Development account.

CESER Federal staff provide oversight for a wide range of cyber and emergency response functions and programs. These include guiding a multi-million dollar R&D program; staffing and managing the Department's all hazard energy sector emergency response function; training and coordinating a cadre of more than 100 volunteer energy sector emergency responders; overseeing annual programs of energy sector exercises, workshops, interagency and industry engagement, and coordination with states and localities before and during emergencies; and the development of reports and analyses on threats and hazards to the energy sector. Increased need is seen in the area of cyber preparedness and incident response. Federal staff also support crosscutting functions, including budgeting, procurement, contracting, and human resources.

When Presidential Disaster Declarations are activated, CESER staff are called upon under the National Response Framework, to provide trained staff support for Federal Emergency Management Agency (FEMA) Emergency Support Function 12 (ESF-12) mission. During these activations, CESER is reimbursed by FEMA for overtime expenses; CESER responders' base pay is funded from this CESER Program Direction budget.

Travel includes transportation, subsistence, and incidental expenses that allow CESER to effectively deliver on its mission. Major drivers of travel include the need to oversee R&D programs and projects in the field; attend industry, interagency and regional state government energy sector emergency response coordination meetings; and conduct emergency response training for responders in conjunction with DHS regional response centers. FEMA reimburses DOE for all travel associated with a Presidential Disaster Declaration.

Support Services includes contractor support directed by the Federal staff to perform administrative tasks and provide analysis to management and may also include support for post-doctoral fellows (such as American Association for the Advancement of Science [AAAS] fellows) and Intergovernmental Personnel Act (IPA) assignments.

Other Related Expenses includes equipment upgrades and replacements, office furniture, commercial credit card purchases using simplified acquisition procedures when possible, and other needs.

Highlights of the FY 2020 Budget Request

The budget request supports 2 additional FTEs to support mission critical work.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Enacted (Comparable) ^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction Summary					
Washington Headquarters					
Salaries and Benefits	...	4,534	4,586	4,951	+365
Travel	...	250	250	250	...
Support Services	...	1,921	1,743	1,378	-365
Other Related Expenses	...	1,895	2,021	2,021	...
Total, Washington Headquarters	...	8,600	8,600	8,600	...
National Energy Technology Laboratory					
Salaries and Benefits	...	1,258	1,258	1,258	...
Travel	...	120	120	120	...
Support Services	...	438	438	438	...
Other Related Expenses	...	1,084	1,084	1,084	...
Total, National Energy Technology Laboratory	...	2,900	2,900	2,900	...
Total Program Direction					
Salaries and Benefits	...	5,792	5,844	6,209	+365
Travel	...	370	370	370	...
Support Services	...	2,359	2,181	1,816	-365
Other Related Expenses	...	2,979	3,105	3,105	...
Total, Program Direction	...	11,500	11,500	11,500	...

^a The FY 2019 appropriation split the Electricity Delivery and Energy Reliability appropriation into two appropriations: Electricity Delivery and Cybersecurity, Energy Security, and Emergency Response (CESER). To allow an apples-to-apples comparison with the FY 2019 appropriation and FY 2020 request, the comparable amounts for FY 2018 reflect amounts equivalent to what would have been in CESER, had the FY 2019 structure been in place in FY 2018.

	FY 2018 Enacted	FY 2018 Enacted (Comparable) ^a	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Federal FTEs	...	25	25	27	+2
Additional FE FTEs at NETL supporting CESER ^a	...	9	9	9	...
Total CESER-funded FTEs	...	34	34	36	+2
Support Services and Other Related Expenses					
Support Services					
Technical Support	...	1,132	1,047	872	-175
Management Support	...	1,227	1,134	944	-190
Total, Support Services	...	2,359	2,181	1,816	-365
Other Related Expenses					
Other Services	...	1,183	1,182	1,182	...
EITS Desktop Services	...	223	223	223	...
WCF	...	1,573	1,700	1,700	...
Total, Other Related Expenses	...	2,979	3,105	3,105	...

Program Direction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$11,500,000	\$11,500,000	\$0
Salaries and Benefits \$5,844,000	\$6,209,000	+\$365,000
<ul style="list-style-type: none"> Salaries and benefits support 34 FTEs at HQ and NETL that provide executive management, programmatic oversight, and analysis for the effective implementation of the CESER program 	<ul style="list-style-type: none"> Salaries and benefits support 36 FTEs at HQ and 9 FTEs at NETL that provide executive management, programmatic oversight, and analysis for the effective implementation of the CESER program 	<ul style="list-style-type: none"> Salaries and Benefits increase is due to 2 additional FTEs in 2020 facilitating better project management and supporting the growth of CESER program activities

^a CESER funds 9 FTEs at FE's National Energy Technology Laboratory who support CESER activities. The 9 FTEs are in FE's FTE totals and are not included in the CESER FTE totals shown on the "Federal FTEs" line.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Travel \$370,000 <ul style="list-style-type: none"> Travel includes transportation, subsistence, and incidental expenses that allow CESER to effectively facilitate its mission 	\$370,000 <ul style="list-style-type: none"> Travel includes transportation, subsistence, and incidental expenses that allow CESER to effectively facilitate its mission 	\$0 <ul style="list-style-type: none"> No change
Support Services \$2,181,000 <ul style="list-style-type: none"> Support Services includes contractor support directed by the Federal staff to provide analysis to management Support Services may include support for post-doctoral fellows and Intergovernmental Personnel Act (IPA) assignments 	\$1,816,000 <ul style="list-style-type: none"> Support Services includes contractor support directed by the Federal staff to provide analysis to management Support Services may include support for post-doctoral fellows and IPA assignments 	-\$365,000 <ul style="list-style-type: none"> Support service usage is reduced
Other Related Expenses \$3,105,000 <ul style="list-style-type: none"> Other Related Expenses includes equipment upgrades and replacements, office furniture, minor construction, commercial credit card purchases using simplified acquisition procedures when possible, and other needs 	\$3,105,000 <ul style="list-style-type: none"> Other Related Expenses includes equipment upgrades and replacements, office furniture, minor construction, commercial credit card purchases using simplified acquisition procedures when possible, and other needs 	\$0 <ul style="list-style-type: none"> No change

Cybersecurity, Energy Security, and Emergency Response

Research and Development (\$K)^a

	FY 2018 Enacted	FY 2018 Enacted (Comparable)^b	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Basic	...	1,356	989	1,295	+306
Applied	...	30,727	36,284	18,564	-17,720
Development	...	16,267	11,859	15,542	+3,683
Total, R&D	...	48,350	49,132	35,401	-13,731

Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) (\$K)

	FY 2018 Transfer	FY 2018 Transfer (Comparable)^b	FY 2019 Enacted Projected Transfer	FY 2020 Request Projected Transfer	FY 2020 Request vs FY 2019 Enacted
Cybersecurity for Energy Delivery Systems	...	1,562	1,586	1,171	-415

^a R&D reporting includes a proportional share of program direction funding in addition to direct R&D funding.

^b The FY 2019 Budget Request proposes to split the Electricity Delivery and Energy Reliability appropriation into two appropriations: Electricity Delivery and Cybersecurity, Energy Security, and Emergency Response (CESER). To allow an apples-to-apples comparison with the FY 2019 request, the comparable amounts for FY 2018 reflect amounts for the Cybersecurity for Energy Delivery Systems program, equivalent to what would have been in CESER, had the proposed FY 2019 structure been in place in FY 2018.

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Cybersecurity, Energy Security, and Emergency Resp	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Argonne National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	1,865	5,000
CEDS	0	150	900
Total, Cybersecurity, Energy Security, and Emergency Resp	0	2,015	5,900
Total, Argonne National Laboratory	0	2,015	5,900
Idaho National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	250	7,000
CEDS	0	13,000	3,000
Total, Cybersecurity, Energy Security, and Emergency Resp	0	13,250	10,000
Total, Idaho National Laboratory	0	13,250	10,000
Lawrence Berkeley National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
CEDS	0	1,700	0
Total, Lawrence Berkeley National Laboratory	0	1,700	0
Lawrence Livermore National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	350	4,000
CEDS	0	2,400	2,600
Total, Cybersecurity, Energy Security, and Emergency Resp	0	2,750	6,600
Total, Lawrence Livermore National Laboratory	0	2,750	6,600
Los Alamos National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	500	2,500
CEDS	0	1,000	0
Total, Cybersecurity, Energy Security, and Emergency Resp	0	1,500	2,500
Total, Los Alamos National Laboratory	0	1,500	2,500
National Energy Technology Lab			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	1,400	5,250
CEDS	0	32,070	51,400
Program Direction	0	2,984	2,802
Total, Cybersecurity, Energy Security, and Emergency Resp	0	36,454	59,452
Total, National Energy Technology Lab	0	36,454	59,452

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Cybersecurity, Energy Security, and Emergency Resp	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
National Renewable Energy Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	50	4,000
Total, National Renewable Energy Laboratory	0	50	4,000
Oak Ridge Institute for Science & Education			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	210	1,600
Total, Oak Ridge Institute for Science & Education	0	210	1,600
Oak Ridge National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	2,950	5,500
CEDS	0	10,800	1,300
Total, Cybersecurity, Energy Security, and Emergency Resp	0	13,750	6,800
Total, Oak Ridge National Laboratory	0	13,750	6,800
Pacific Northwest National Laboratory			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	425	3,500
CEDS	0	6,050	3,300
Total, Cybersecurity, Energy Security, and Emergency Resp	0	6,475	6,800
Total, Pacific Northwest National Laboratory	0	6,475	6,800
Richland Operations Office			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	1,415	3,000
Total, Richland Operations Office	0	1,415	3,000
Sandia National Laboratories			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	1,125	11,150
CEDS	0	1,600	1,800
Total, Cybersecurity, Energy Security, and Emergency Resp	0	2,725	12,950
Total, Sandia National Laboratories	0	2,725	12,950
Savannah River Operations Office			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	400	5,000
Total, Savannah River Operations Office	0	400	5,000

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Cybersecurity, Energy Security, and Emergency Resp	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Washington Headquarters			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	8,060	11,500
CEDS	0	20,575	10,700
Program Direction	0	8,516	8,698
Total, Cybersecurity, Energy Security, and Emergency Resp	0	37,151	30,898
Total, Washington Headquarters	0	37,151	30,898
Western Area Power Administration			
Cybersecurity, Energy Security, and Emergency Resp			
Infrastructure Security and Energy Restoration (ISER)	0	0	1,000
CEDS	0	155	0
Total, Cybersecurity, Energy Security, and Emergency Resp	0	155	1,000
Total, Western Area Power Administration	0	155	1,000
Total, Cybersecurity, Energy Security, and Emergency Resp	0	120,000	156,500

Naval Petroleum and Oil Shale Reserves

Naval Petroleum and Oil Shale Reserves

**Naval Petroleum and Oil Shale Reserves
Proposed Appropriation Language**

For Department of Energy expenses necessary to carry out naval petroleum and oil shale reserve activities, [\$10,000,000] \$14,000,000 to remain available until expended: *Provided*, That notwithstanding any other provision of law, unobligated funds remaining from prior years shall be available for all naval petroleum and oil shale reserve activities.

Explanation of Changes

New FY 2020 budget authority of \$14 million will fund continued environmental assessment and remediation activity at the Naval Petroleum Reserve No. 1 (NPR-1) site.

Public Law Authorizations

- P.L. 94-258, U.S. Naval Petroleum Reserves Production Act of 1977
- P.L. 95-91, U.S. Department of Energy Organization Act of 1977
- P.L. 104-106, The National Defense Authorization Act For Fiscal Year 1996
- P.L. 105-261, The Strom Thurmond National Defense Act for Fiscal Year 1999
- P.L. 109-58, Energy Policy Act of 2005

**Naval Petroleum and Oil Shale Reserves
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
4,900	10,000	14,000	+4,000

Overview

The Naval Petroleum and Oil Shale Reserves (NPOSR) program manages five legal agreements that were executed as part of the 1998 sale of Naval Petroleum Reserve 1 (NPR-1) in Elk Hills, California. The legal agreements direct post-sale work, including environmental restoration and remediation, contract closeout, and records disposition. Legal agreements also include payment for post-employment medical and dental benefits to former NPR-1 Management & Operating (M&O) contractor employees. The NPR-1 program continues to work towards closing out the remaining environmental findings at the site, as required by the 2008 agreement between the Department of Energy (DOE) and the California Department of Toxic Substances Control (DTSC).

DOE also operated Naval Petroleum Reserve 3 (NPR-3) and the Rocky Mountain Oilfield Testing Center (RMOTC), co-located near Casper, Wyoming, until its sale in January 2015. DOE retains responsibility for Industrial Landfill number 2 (IND-2) located at NPR-3 until a closure permit is issued by the Wyoming Department of Environmental Quality (WDEQ). Landfill remediation activities were completed in FY 2017 and ground water sampling began in compliance with WDEQ requirements. The period of sampling will be specified by WDEQ but is expected to continue for three to six years. No new FY 2020 Budget Authority is required for NPR-3.

Highlights and Major Changes in the FY 2020 Budget Request

NPR-1 program will continue working with the California DTSC and other stakeholders on the environmental remediation and cultural resource activities in accordance with the 2008 DTSC Corrective Action Consent Agreement to obtain a status of No Further Action (NFA) required for all 131 Areas of Concern (AOC). Also included is the payment to former NPR-1 M&O contractor employees for post-employment medical and dental benefits.

NPR-3 will continue groundwater sampling activities for the landfill closure with oversight by the Washington Headquarters office.

**Naval Petroleum and Oil Shale Reserves
Funding by Congressional Control (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Naval Petroleum and Oil Shale Reserves				
Production Operations	18,200	8,000	12,000	+4,000
Management	2,000	2,000	2,000	0
Use of Prior Year Balances	-15,300	0	0	0
Total, Naval Petroleum and Oil Shale Reserves	4,900	10,000	14,000	+4,000
Federal FTEs	4	4	4	

Naval Petroleum and Oil Shale Reserves Production Operations

Overview

The NPR-1 program continues to work towards closing out the remaining environmental restoration and remediation activities for 131 AOCs, as required by the 2008 agreement between DOE and California's DTSC. DOE will continue the monitoring and oversight of environmental remediation of the Elk Hills site and the work on records disposition.

The NPR-3 program will continue post-sale activities for the closure of the landfill using prior-year balances. No new FY 2020 Budget Authority is required for NPR-3.

Highlights of the FY 2020 Budget Request

The program will continue the ongoing activities to attain release from the remaining environmental findings related to the sale of NPR-1. All AOCs have undergone an initial investigation and the program has made recommendations to California's DTSC for either NFA status, additional field work investigation, or remedial action.

Of the 131 AOCs for which DOE is responsible for environmental cleanup, as of December 10, 2018, 84 AOCs have received NFA certification from California's DTSC, and 6 AOCs are under DTSC review for NFA certification. The remaining 41 AOCs require remediation. The FY 2020 request includes funding that supports remediation of 5 AOCs and 6 sub-AOCs.

**Production Operations
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
NPR-1 Closeout	16,600	8,000	12,000	+4,000
NPR-3 Disposition	1,600	0	0	0
Use of Prior Year Balances	-15,300	0	0	0
Total, Production Operations	2,900	8,000	12,000	+4,000

Production Operations
Explanation of Major Changes
(\$K)

FY 2020 Request vs FY 2019 Enacted

NPR-1 Closeout FY 2020 budget authority will finance continued environmental assessment and remediation activity, in accordance with NPR-1 post-sale legal agreements. Increased funding is required to address the substantial financial needs of NPR-1's remediation profile.	+4,000
NPR-3 Disposition: No FY 2020 Budget Authority is requested. NPR-3 ongoing post-sale remediation monitoring activities will continue through NPR-3 closeout in three to six years.	0
<hr/>	
Total, Production Operations	+4,000

Production Operations

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Production and Operations \$8,000,000	\$12,000,000	+\$4,000,000
NPR-1 Closeout: \$8,000,000	\$12,000,000	+\$4,000,000
Program will continue the ongoing activities to attain release from the remaining environmental findings related to the sale of NPR-1. Funds implementation/reporting of three remedial action work plans and remediation of one AOC leading to No Further Action status.	Program will continue the ongoing activities to attain release from the remaining environmental findings related to the sale of NPR-1. The FY 2020 request includes funding that supports remediation of 5 AOCs and 6 sub-AOCs.	Increased funding is required to address the substantial financial needs of NPR-1's remediation profile.
NPR-3 Disposition: \$0	NPR-3 Disposition: \$0	\$0
Disposition completed; post-sale remediation monitoring activities for the landfill are ongoing.	Disposition completed; post-sale remediation monitoring activities for the landfill are ongoing.	No change.

Naval Petroleum and Oil Shale Reserves Management

Overview

Management provides the Federal staffing resources and associated costs required to provide overall direction and execution of the NPOSR. There are a variety of inherently governmental functions, such as program management, contract administration, and budget formulation and execution that require a dedicated Federal workforce. NPOSR uses contractor support services and other related expenses to support the field environmental assessment, remediation and management of the program.

Highlights of the FY 2020 Budget Request

The NPR-1 funding supports Federal staff that provide oversight, monitor environmental clean-up, and manage disposition activities. The sales agreement also includes payments to former NPR-1 M&O contractor employees for post-medical and dental benefits.

NPR-3/RMOTC final office closeout was completed December 30, 2015; however, administrative oversight of the landfill closure will continue to be conducted by the Department of Energy Headquarters office. No new FY 2020 Budget Authority is required for NPR-3.

**Management
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Washington Headquarters				
Salaries and Benefits	525	525	525	---
Travel	50	50	50	---
Support Services	425	425	425	---
Other Related Expenses	1,000	1,000	1,000	---
Total, Washington Headquarters	2,000	2,000	2,000	0
NPR – Wyoming				
Salaries and Benefits	---	---	---	---
Travel	---	---	---	---
Support Services	---	---	---	---
Other Related Expenses	---	---	---	---
Total, NPR – Wyoming	0	0	0	0
Total Management				
Salaries and Benefits	525	525	525	---
Travel	50	50	50	---
Support Services	425	425	425	---
Other Related Expenses	1,000	1,000	1,000	---
Total, Management	2,000	2,000	2,000	0
Federal FTEs	4	4	4	
Support Services				
Technical Support				
Environmental, Safety, Security & Health	---	---	---	---
Technical Services	400	400	400	---
Total, Technical Support	400	400	400	0
Management Support				
Business Administration	---	---	---	---
IT Support	25	25	25	---
Total Management Support	25	25	25	0

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Total, Support Services	425	425	425	0
Other Related Expenses				
Rent to Others	0	0	0	0
Communications, Utilities & Misc.	0	0	0	0
Other Services	1,000	1,000	1,000	0
Operation and Maintenance of Equipment	0	0	0	0
Supplies and Materials	0	0	0	0
Total, Other Related Expenses	1,000	1,000	1,000	0

Management

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Management \$2,000,000	\$2,000,000	\$0
Salaries and Benefits \$525,000	\$525,000	\$0
Continue monitoring activities at NPR-1 (cultural resources mitigation, environmental clean-up, oversight and audit). No new FY 2019 budget authority is requested for NPR-3.	Continue monitoring activities at NPR-1 (cultural resources mitigation, environmental clean-up, oversight and audit). No new FY 2020 budget authority is required for NPR-3.	No change.
Travel \$50,000	\$50,000	\$0
Federal travel will be required for environmental cleanup at NPR-1. No new FY 2019 budget authority is requested for NPR-3.	Federal travel will be required for environmental cleanup at NPR-1. No new FY 2020 budget authority is required for NPR-3.	No change.
Support Services \$425,000	\$425,000	\$0
Support Services for environmental clean-up of NPR-1. No new FY 2019 budget authority is requested for NPR-3.	Support Services for environmental clean-up of NPR-1. No new FY 2020 budget authority is required for NPR-3.	No change.
Other Related Expenses \$1,000,000	\$1,000,000	\$0
As in prior years, funding provides for post-employment medical and dental benefits for former M&O contractor employees at NPR 1. No new FY 2019 budget authority is requested for NPR-3.	As in prior years, funding provides for post-employment medical and dental benefits for former M&O contractor employees at NPR 1. No new FY 2020 budget authority is required for NPR-3.	No change.

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Naval Petroleum and Oil Shale Reserves	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Naval Petroleum Reserve No 1			
Naval Petroleum and Oil Shale Reserves			
Productions Operations	16,600	8,000	12,000
Management	1,000	1,000	1,000
Total, Naval Petroleum and Oil Shale Reserves	17,600	9,000	13,000
Total, Naval Petroleum Reserve No 1	17,600	9,000	13,000
Naval Petroleum Reserve No 3			
Naval Petroleum and Oil Shale Reserves			
Productions Operations	1,600	0	0
Total, Naval Petroleum Reserve No 3	1,600	0	0
Washington Headquarters			
Naval Petroleum and Oil Shale Reserves			
Management	1,000	1,000	1,000
Total, Washington Headquarters	1,000	1,000	1,000
Total, Naval Petroleum and Oil Shale Reserves	20,200	10,000	14,000

Strategic Petroleum Reserve

Strategic Petroleum Reserve

**Strategic Petroleum Reserve
Proposed Appropriation Language**

For Department of Energy expenses necessary for Strategic Petroleum Reserve facility development and program management activities pursuant to the Energy Policy and Conservation Act (42 U.S.C. 6201 et seq.), [~~\$235,000,000~~] *\$174,000,000*, to remain available until expended.

Explanation of Changes

Decrease reflects reductions to the Cavern Integrity Program, Major Maintenance Program, preventive/corrective maintenance activities, and technical support service activities.

Public Law Authorizations

Public Law 109-58, "Energy Policy Act of 2005"

Strategic Petroleum Reserve

(\$K)

FY 2018 Enacted	FY 2018 Supplemental	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
252,000 ¹	8,716	235,000 ¹	174,000	-61,000

Overview

The Strategic Petroleum Reserve (SPR) protects the U.S. economy from disruptions in critical petroleum supplies and meets the U.S. obligations under the International Energy Program (Energy Policy and Conservation Act, P.L. 94-163, as amended, Section 151). The SPR benefits the United States by providing an insurance policy against potential interruptions in U.S. petroleum supplies, whether originating from domestic or international supply disruptions, natural disasters, sabotage, or acts of terrorism.

FY 2020 funds support the program's operational readiness and drawdown capabilities. The SPR will continue conducting multiple non-emergency crude oil sales in FY 2020 as directed by sections 403 and 404 of the Bipartisan Budget Act of 2015 (P.L. 114-74) and Consolidated Appropriations Act, 2018 (P.L. 115-141, Section 501). In accordance with the Bipartisan Budget Act of 2015, Section 403 directs the sale of 5 million barrels in FY 2020, while Section 404 authorizes DOE, subject to appropriation, to sell SPR oil up to the authorized revenue ceiling to fund the SPR Modernization Program, to include up to \$450 million in FY 2020. Under Section 501 of the Consolidated Appropriations Act, 2018, the Secretary of Energy is directed to drawdown and sell a total of 10 million barrels of SPR crude oil during the time period encompassing FYs 2020 and 2021.

The SPR program received supplemental disaster relief funding of \$8.7 million in FY 2018 to address damages sustained during Hurricane Harvey, principally replacement of a section of the leased SPR Bryan Mound 30" pipeline to Jones Creek.

Consistent with both the FY 2018 and FY 2019 budget requests, the Administration is proposing to disestablish the Northeast Gasoline Supply Reserve in the FY 2020 budget. Accordingly, the Secretary of Energy will disestablish the NGSR and draw down and sell that reserve's one million barrels of refined petroleum product from the Strategic Petroleum Reserve during fiscal year 2020 with \$27 million of the proceeds from the sale to be deposited into the SPR Petroleum Account for congressionally-mandated crude oil sale costs and shall remain available until expended. Any proceeds in excess of \$27 million collected from the sale of refined petroleum product shall be deposited into the general fund of the Treasury during fiscal year 2020.

In FY 2018 and FY 2019 Enacted Appropriations, Congress provided funding for the continuation of commercial leases for the Northeast Gasoline Supply Reserve (NGSR) as part of the SPR Appropriation. The NGSR was administratively established in 2014 as part of the Strategic Petroleum Reserve (SPR) to ease regional shortages resulting from sudden/unexpected supply interruptions (i.e., Superstorm Sandy). The NGSR consists of 1 million barrels of gasoline blendstock stored in leased commercial storage terminals located at South Portland, Maine; Revere, Massachusetts; and, Raritan Bay, New Jersey. The NGSR is not cost efficient or operationally effective. An Annual Coordinating Meeting of Entity Stockholders (ACOMES) benchmarking study of other oil stockpiling countries indicates that NGSR operating costs are twice as much as the next highest-cost country's gasoline reserve, and four times as costly as the third highest-cost country's gasoline reserve. Additionally, the NGSR represents less than one day of gasoline consumption in the Northeast.

Highlights and Major Changes in the FY 2020 Budget Request.

The SPR Program will pursue the following major activities in FY 2020:

- Conduct cavern wellbore diagnostic and remediation activities utilizing 1 workover rig and crew that includes 5 cavern wellbore workovers. Continue Mechanical Integrity Testing required for cavern wells and adjust priority planned schedule to accommodate any that have either failed hydraulically or failed 5-year state-required testing cycle.
- Conduct equipment and facility maintenance for drawdown capability.
- Continuation of legislatively directed non-emergency multi-year oil sales.

¹ FY 2018 and 2019 Appropriation includes funding of \$29 million directed to Northeast Gasoline Supply Reserve to maintain annual lease. Remaining funding is for the operations of the Strategic Petroleum Reserve.

- Supports Security Program and maintenance of security related infrastructure items.

Major changes from FY 2019 includes the utilization of one rig and workover rig crew to perform 5 cavern wellbore workovers within the Cavern Integrity Program compared to 11 workovers in FY 2019. Unanticipated cavern issues will require reprioritization of projects to fund emergency repairs with consideration to tasks being completed for normal operations, multi-year oil sales and the Life Extension II Project. Compared to FY 2019 where 14 Major Maintenance construction projects are planned, FY 2020 will be reduced to 7 projects along with reductions in technical support services and Information Technology (IT) life-cycle replacements and upgrades. An increase to the Security Program to support Physical Security Personnel and maintenance of security related infrastructure items supporting Physical Security is included.

Cybersecurity: DOE is engaged in three categories of cyber-related activities: protecting the DOE enterprise from a range of cyber threats that can adversely impact mission capabilities; bolstering the U.S. Government’s capabilities to address cyber threats; and, improving cybersecurity in the electric power subsector and the oil and natural gas subsector. The cybersecurity crosscut supports central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center for incident response and the implementation of Department-wide Identity Credential and Access Management.

	Cyber-security	Total
Facilities Development and Operations	3,235	3,235

**Strategic Petroleum Reserve
Funding by Congressional Control (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Strategic Petroleum Reserve					
Facilities Development and Operations	194,914	8,716	180,026	148,980	-31,046
Management	28,086	0	25,974	25,020	-954
Northeast Gasoline Supply Reserve	29,000	0	29,000	0	-29,000
Total, Strategic Petroleum Reserve	252,000	8,716	235,000	174,000	-61,000
Federal FTEs	126		126	126	

Strategic Petroleum Reserve

Overview

The Strategic Petroleum Reserve (SPR) protects the U.S. economy from disruptions in critical petroleum supplies and meets the U.S. obligations under the International Energy Program (Energy Policy and Conservation Act, P.L. 94-163, as amended, Section 151). The SPR benefits the United States by providing an insurance policy against potential interruptions in U.S. petroleum supplies whether originating from domestic and international supply disruptions, natural disasters, sabotage, and acts of terrorism.

The SPR has 649 million barrels of crude oil inventory (as of December 31, 2018) stored in underground cavern storage, providing the United States with multiple geostrategic benefits, and anchoring the world's collective energy security system. A release of petroleum from the SPR can mitigate the potential economic damage of an actual disruption in international or domestic petroleum supplies and the accompanying price increases. The SPR avails the United States of international emergency assistance through its participation in the International Energy Agency (IEA) energy supply security initiatives. IEA members are required to maintain 90 days' worth of net petroleum import protection in government-owned and/or commercial stocks, and have a commitment to participate with other stockholding nations in a coordinated release of stocks in the event of a major supply disruption. The inventory of 649 million barrels of crude oil as of the end of 2018 would provide about 519 days of 2019 net import protection (based on net petroleum imports of 1.25 million barrels estimated in the U.S. Energy Information Administration's December 2018 Short-Term Energy Outlook). The SPR has a maximum drawdown capability of over 4 million barrels per day, which could be made available in the event of an IEA collective action. The United States percentage share of an IEA collective action release is 40.8%, as of November 2018.

To accomplish its mission and address the challenges outlined above, the SPR program is organized into two subprograms: Facilities Development and Operations, and Management. The Facilities Development and Operations subprogram funds all requirements associated with developing and maintaining facilities for the storage of petroleum, operations activities associated with placing petroleum into storage, and operational readiness initiatives associated with drawing down and distributing the inventory within 13 days' notice in the event of an emergency. The Management subprogram funds personnel and administrative expenses related to maintaining the Project Management Office (New Orleans, LA) and the Program Office (Washington, DC), as well as contract services required to support management and technical analysis of program initiatives and issues.

Highlights of the FY 2020 Budget Request

SPR's underground storage caverns require maintenance to assure their storage capability and integrity. Ongoing oil sale activities increase equipment usage and run times and will require consistent preventive, predictive and corrective maintenance to prevent or address equipment failures.

Cavern Integrity

The Casing Inspection and Cavern Remediation Program was developed in 2010 to remediate the anomalies in wellbore casings. This is necessary to maintain the required level of operational and drawdown capability. Cavern remediation and diagnostic workovers anticipate and remediate cavern wellbore failures that cause caverns to be removed from service, and in preventing potential environmental releases.

Maintenance and Major Maintenance

Maintenance of SPR equipment and facilities are provided to support drawdown readiness in a safe and environmentally compliant manner. Major Maintenance and Maintenance of facilities and equipment will require ongoing monitoring with increased usage due to multi-year oil sales. It includes the maintenance of infrastructure items that support Physical Security.

Crude Oil Degas Program

Degas of crude oil at the West Hackberry site is scheduled for completion in FY 2019. The Degas Plant decommission and disassembly is planned to start in FY 2019 with completion in early FY 2020.

Major changes in FY 2020 include reduced Major Maintenance planned construction projects, preventive and corrective maintenance, and equipment and facility maintenance. An increase to the Security Program to support Physical Security Personnel and maintenance of security related infrastructure items supporting Physical Security is included. Cavern Integrity Program will perform 5 cavern wellbore well workovers. Unanticipated cavern issues will require reprioritization of projects to fund emergency repairs.

**Strategic Petroleum Reserve
Funding (\$K)**

	FY 2018 Enacted	FY 2018 Supplemental	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Strategic Petroleum Reserve					
Facilities Development and Operations	194,914	8,716	180,026	148,980	-31,046
Management	28,086	0	25,974	25,020	-954
Northeast Gasoline Supply Reserve	29,000	0	29,000	0	-29,000
Total, Strategic Petroleum Reserve	252,000	8,716	235,000	174,000	-61,000

**Strategic Petroleum Reserve
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

Facilities Development and Operations: The request reflects decreases to the Cavern Integrity Program (-\$8,271); the Maintenance Program to include preventive/corrective maintenance related to corrosion and life-cycle maintenance tasks and includes an offsetting increase for the maintenance of infrastructure items that support Physical Security (-\$5,208); reductions to the Major Maintenance Projects (-\$4,316); IT life-cycle upgrades and replacements for support systems projects and contractor service support (-\$14,727); and an increase for the Physical Security Program for all sites (+\$1,476). **-31,046**

Management: The request reflects a decrease for hurricane planning activities, technical support services and analytical materials. **-954**

Total, Strategic Petroleum Reserve **-32,000**

**Strategic Petroleum Reserve
Facilities Development and Operations**

Description

The Facilities Development and Operations subprogram funds activities to maintain the SPR’s operational readiness capability for successful drawdowns and operate the sites in a safe, secure, and environmentally acceptable manner. Despite a significant reduction in U.S. reliance on imported petroleum, with significant global reserves in regions of the world subject to political unrest, the United States economy remains vulnerable to price increases related to petroleum supply disruptions. The SPR’s stockpile of petroleum products diminishes this vulnerability to the effects of supply disruptions.

The SPR’s underground storage caverns require maintenance to assure their storage capability and integrity. Surface and sub-surface infrastructure and systems that must be maintained to meet operational readiness requirements have been identified, and are funded in this subprogram.

Facilities Development and Operations

Activities and Explanation of Changes		
FY 2019 Enacted	FY 2020 Requested	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Facilities Development and Operations		
\$180,026,000	\$148,980,000	-\$31,046,000
<i>Casing Inspections and Remediations</i>	<i>Casing Inspections and Remediations</i>	<i>Casing Inspections and Remediations (-\$8,271)</i>
<ul style="list-style-type: none"> Funding level supports 1 cavern workover rig and leased crew to execute 11 cavern wellbore diagnostic workover and the required overhaul/maintenance of DOE Rig scheduled every five years. 	<ul style="list-style-type: none"> Funding level supports 1 cavern workover rig and leased crew to execute 5 cavern wellbore diagnostic workovers. 	<ul style="list-style-type: none"> Decrease from 11 to 5 wellbore diagnostic workovers utilizing one leased rig and crew for cavern integrity operations to insure drawdown capability.
<i>Major Maintenance</i>	<i>Major Maintenance</i>	<i>Major Maintenance (-\$4,316)</i>
<ul style="list-style-type: none"> Continue approach to repair, replace, or upgrade equipment including Security, Environmental, Safety & Health (ESH), Drawdown and Non-Drawdown critical systems. 	<ul style="list-style-type: none"> Continue approach to repair, replace, or upgrade equipment including Security, Environmental, Safety & Health (ESH), Drawdown and Non-Drawdown critical systems. 	<ul style="list-style-type: none"> Reduced funding level from FY 2019 leaves seven construction project remaining that supports operational readiness, given multi-year oil sales. The remaining five planned construction projects will increase the deferred maintenance project listing.
<i>Maintenance</i>	<i>Maintenance</i>	<i>Maintenance (-\$5,208)</i>
<ul style="list-style-type: none"> Provides maintenance of the SPR equipment and 	<ul style="list-style-type: none"> Provides reduced level of 	<ul style="list-style-type: none"> Decrease for preventive/corrective

facilities to support drawdown readiness in a safe and environmentally compliant manner.	preventive/corrective/predictive maintenance of the SPR equipment and facilities to support drawdown readiness in a safe and environmentally compliant manner.	maintenance of pumps, motors, valves, and actuators of drawdown critical equipment while maintaining an acceptable level of risk of equipment failures which could affect drawdown operations. Includes an offsetting increase for the maintenance of infrastructure items that support Physical Security.
<p><i>Security</i></p> <ul style="list-style-type: none"> • Protect and defend personnel, property and resources against assault, sabotage, vandalism, theft, trespass and compromise of sensitive as well as classified information. 	<p><i>Security</i></p> <ul style="list-style-type: none"> • Protect and defend personnel, property and resources against assault, sabotage, vandalism, theft, trespass and compromise of sensitive as well as classified information. 	<p><i>Security (+\$1,476)</i></p> <ul style="list-style-type: none"> • An increase to the Security Program will provide for a safe and secure workplace to meet DOE and Federal requirements for the protection of resources and information and ensuring drawdown readiness.
<p><i>Data Systems & Support</i></p> <ul style="list-style-type: none"> • Data Systems to support the mission of drawdown readiness, processing, sale and receipt of goods (oil), communications, reporting, providing protection from malware and computer viruses, and all other activity associated with the use of data and information systems. 	<p><i>Data Systems & Support</i></p> <ul style="list-style-type: none"> • Data Systems to support the mission of drawdown readiness, processing, sale and receipt of goods (oil), communications, reporting, providing protection from malware and computer viruses, and all other activity associated with the use of data and information systems. 	<p><i>Data Systems & Support (-\$14,727)</i></p> <ul style="list-style-type: none"> • Funding level reflects a decrease for FY 2020 replacement of life-cycle site operations equipment due to prior replacement level in FY 2019 and reduced technical services support.

**Strategic Petroleum Reserve
Capital Summary² (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Capital Operating Expenses Summary (including MIE)				
Capital Equipment > \$500K (including MIE)	6,447	8,594	5,766	-2,828
Plant Projects (GPP >\$10M)	0	0	0	0
Total, Capital Operating Expenses	6,447	8,594	5,766	-2,828
Capital Equipment > \$500K (including MIE)				
Total Non-MIE Capital Equipment (>\$500K)	4,943	8,594	5,766	-2,828
Replace Foam Deluge Piping (BC-1591)	1,504	0	0	0
Total, Capital Equipment (including MIE)	6,447	8,594	5,766	-2,828
Plant Projects (GPP - Total Estimated Cost >\$10M)				
Total, Plant Projects (GPP – Total Estimated Cost)	0	0	0	0
Total, Capital Summary	6,447	8,594	5,766	-2,828

² This list of projects is illustrative and can be adjusted based on operational requirements, priorities, and/or funding.

**Strategic Petroleum Reserve
Capital Summary³ Outyears (\$K)**

	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Capital Operating Expenses Summary (including MIE)				
Capital Equipment > \$500K (including MIE)	9,053	9,397	9,028	9,562
Plant Projects (GPP >\$10M)	0	0	0	0
Total, Capital Operating Expenses	9,053	9,397	9,028	9,562
Capital Equipment > \$500K (including MIE)				
Total Non-MIE Capital Equipment (>\$500K)	9,053	9,397	9,028	9,562
Total, Capital Equipment (including MIE)	9,053	9,397	9,028	9,562
Plant Projects (GPP - Total Estimated Cost >\$10M)				
Total, Plant Projects (GPP – Total Estimated Cost)	0	0	0	0
Total, Capital Summary	9,053	9,397	9,028	9,562

³ This list of projects is illustrative and can be adjusted based on operational requirements, priorities, and/or funding.

Strategic Petroleum Reserve Management

Overview

Management provides funding for the salaries and related requirements of the Headquarters federal workforce responsible for providing programmatic policy, planning and oversight, to include strategic project planning, budget formulation and financial management, operations, engineering, safety, security, and technical analysis of programmatic activity of the SPR. The additional Federal workforce of the SPR Project Management Office directs program execution and establishes technical performance standards as well as scope, cost, and schedule milestones for the Management and Operations contractor.

Highlights of the FY 2020 Budget Request

The Federal staff remains at 126 FTEs with additional technical support contractors. Travel is for operational field support and oversight, including site and vendor visits. Other related expenses include field building leases and telecommunications activities.

**Management
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction Summary				
Washington Headquarters				
Salaries and Benefits	5,476	5,476	5,476	0
Travel	130	130	100	-30
Support Services	2,247	2,140	1,337	-803
Other Related Expenses	1,147	1,254	1,087	-167
Total, Washington Headquarters	9,000	9,000	8,000	-1,000
Strategic Petroleum Reserve Project Management Office				
Salaries and Benefits	14,496	14,664	14,664	0
Travel	447	443	587	+144
Support Services	483	525	461	-64
Other Related Expenses	3,660	1,342	1,308	-34
Total, SPR Project Management Office	19,086	16,974	17,020	+46
Total Management				
Salaries and Benefits	19,972	20,140	20,140	0
Travel	577	573	687	+114
Support Services	2,730	2,665	1,798	-867
Other Related Expenses	4,807	2,596	2,395	-201
Total, Management	28,086	25,974	25,020	-954
Federal FTEs	126	126	126	0

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Support Services				
Technical Support				
Economic & Environmental Analysis	560	570	570	0
Total, Technical Support	560	570	570	0
Management Support				
Training and OPM Recruitment	172	157	150	-7
Technical Support	1,998	1,938	1,078	-860
Total Management Support	2,170	2,095	1,228	-867
Total, Support Services	2,730	2,665	1,798	-867
Other Related Expenses				
Rent to Others	635	653	609	-44
Communications, Utilities, Misc.	72	100	75	-25
Other Services	3,675	1,418	1,286	-132
Supplies and Materials	50	50	50	0
Equipment	375	375	375	0
Total, Other Related Expenses	4,807	2,596	2,395	-201

Management

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Management \$25,974,000	\$25,020,000	-\$954,000
Salaries and Benefits \$20,140,000	\$20,140,000	+\$0
The funding supports salaries and benefits for 126 FTEs and associated costs required to provide overall direction and execution of the SPR. The SPR mission is carried out by a workforce composed largely of M&O contractors, although there are a variety of functions that are inherently governmental (i.e., program management, contract administration, budget formulation, and interagency/international coordination) that require a dedicated Federal workforce.	The funding supports salaries and benefits for 126 FTEs and associated costs required to provide overall direction and execution of the SPR. The SPR mission is carried out by a workforce composed largely of M&O contractors, although there are a variety of functions that are inherently governmental (i.e., program management, contract administration, budget formulation, and interagency/international coordination) that require a dedicated Federal workforce.	No change.
Travel \$573,000	\$687,000	+\$114,000
Provides travel to assure capability to achieve Level 1 Performance criteria for drawdown and distribution of the Reserve.	Provides travel to assure capability to achieve Level 1 Performance criteria for drawdown and distribution of the Reserve.	Increase reflects travel related to recruitment and training of new employees.
Support Services \$2,665,000	\$1,798,000	-\$867,000
Activities support project-planning efforts to maintain technical, mission essential support capabilities.	Activities support project-planning efforts to maintain technical, mission essential support capabilities.	Decrease reflects reduced project-planning efforts for technical analyses which support programmatic planning and capability requirements.
Other Related Expenses \$2,596,000	\$2,395,000	-\$201,000
Provides teleconferencing capabilities between sites; field site building leases; and contingency for DOE field employee evacuation expenses in the event of a hurricane.	Provides teleconferencing capabilities between sites; field site building leases; analytical support services and materials; Information Technology (IT) hardware and software materials and services support; and contingency for DOE field employee evacuation expenses in the event of a hurricane.	Decrease for analytical support services and materials, IT hardware and software materials and services.

**Strategic Petroleum Reserve
Facilities Maintenance and Repair**

The SPR Program’s Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. The Facilities Maintenance and Repair activities funded by this budget and displayed below are intended to halt asset condition degradation.

Costs for Direct-Funded Maintenance and Repair (including Deferred Maintenance Reduction) (\$K)

	FY 2018 Actual Cost	FY 2018 Planned Cost	FY 2019 Planned Cost	FY 2020 Planned Cost
Strategic Petroleum Reserve	47,257	38,532	38,887	28,406
Total, Direct-Funded Maintenance and Repair	47,257	38,532	38,887	28,406

Report on FY 2018 Expenditures for Maintenance and Repair

This report responds to legislative language set forth in Conference Report (H.R. 108-10) accompanying the Consolidated Appropriations Resolution, 2003 (Public Law 108-7) (pages 886-887), which requests the Department of Energy provide an annual year-end report on maintenance expenditures to the Committees on Appropriations. This report compares the actual maintenance expenditures in FY 2018 to the amount planned for FY 2018, including congressionally directed changes.

Total Costs for Maintenance and Repair (\$K)

	FY 2018 Actual Cost	FY 2018 Planned Cost
Strategic Petroleum Reserve	47,257	38,532
Total, Direct-Funded Maintenance and Repair	47,257	38,532

**Strategic Petroleum Reserve
Safeguards and Security (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Protective Forces	17,755	18,354	21,355	+3,001
Physical Security Systems	1,070	1,067	1,193	+126
Information Security	234	232	251	+19
Cyber Security	2,111	3,175	3,235	+60
Personnel Security	662	598	580	-18
Material Control and Accountability	0	0	0	0
Research and Development	0	0	0	0
Program Management	1,413	1,464	1,713	+249
Security Investigations	0	0	0	0
Transportation Security	0	0	0	0
Construction	0	0	1,764	+1,764
Total, Safeguards and Security	23,245	24,890	30,091	+5,201

**18-E-001, Strategic Petroleum Reserve (SPR) Modernization
Various locations**

Project Data Sheet is for Design and Construction

1. Summary, Significant Changes, and Schedule and Cost History

Summary

Initially, the SPR Modernization Program was comprised of two subprograms: the Life Extension Phase II (LE2) project, and the Marine Terminal Distribution Capability Enhancements (MTE) project; however, the MTE project has since been cancelled. The LE2 subprogram will modernize aging SPR infrastructure through systems upgrades and associated equipment replacement to ensure continued ability to meet mission requirements for the next 25 years. LE2 activities will occur at the Bryan Mound, Big Hill, West Hackberry, and Bayou Choctaw storage sites.

The Energy Security and Infrastructure Modernization (ESIM) Fund was established as the funding source for the SPR Modernization Program. The ESIM fund contains offsetting collections from the sale of SPR crude up to the authorized annual revenue ceiling. These sales are limited to the period of fiscal years 2017 through 2020.

Significant Changes

LE2 Project:

This Construction Project Data Sheet (CPDS) is an update from Fiscal Year 2019 and does not include a new start for the budget year. The Administration's FY 2019 Budget Request included a provision proposing changes that would reduce funding for SPR modernization to \$1 billion. The St. James Terminal site has been deleted from the LE2 scope due to the Administration's cancellation of the MTE project. Based on continued site operations during scope development and finalization, adjustments have been made, the most significant of which is the addition of drilling 18 new wells into existing caverns at three sites to address resiliency issues identified in the Long Term Strategic Review. The new wells had previously been left un-addressed due to funding limitations of \$2 billion, which was to be used for the combination of the LE2 project and the MTE project (together they made up the ESIM Fund). With the cancellation of the MTE project, the Program thought it prudent to address this unresolved resiliency issue from the LTSR. The Program is in the process of obtaining approval for the revised cost range of \$1.1 billion - \$1.6 billion to address the increased scope.

The most recent DOE O 413.3B approved Critical Decision (CD) for LE2 is CD-1 that was approved 22 December 2016 with a total project cost range of \$750 million to \$1.4 billion and a CD-4 completion date range of September 2022 to September 2024. A Federal Project Director (FPD) has been assigned to this project and has approved this Construction Project Data Sheet (CPDS). The delta between the \$1.4 billion funding level and the \$1.6 billion upper range of the project will be addressed in the final year of oil sales.

MTE Project:

The Marine Terminal Distribution Capability Enhancements project scope did not receive Congressional funding authority in fiscal year 2018. On May 21, 2018, the Under Secretary of Energy signed a memorandum approving the cancellation of the Strategic Petroleum Reserve Marine Terminal Distribution Capability Enhancement project.

The most recent DOE O 413.3B Critical Decision (CD) for MTE is CD-0 that was approved by the Deputy Secretary of Energy on August 12, 2016, with a preliminary cost range of \$0.5 billion to \$1.5 billion and a CD-4 range of FY 2024 to 2025.

Life Extension Phase II:

Critical Milestone History

	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2018*	10/30/15	09/01/16	12/22/16	3 rd Qtr 2019	3 rd Qtr 2019	3 rd Qtr 2019	4th Qtr 2024
FY 2019*	10/30/15	09/01/16	12/22/16	3 rd Qtr 2019	3 rd Qtr 2019	3 rd Qtr 2019	4th Qtr 2024
FY 2020*	10/30/15	09/01/16	12/22/16	4 th Qtr 2020	4 th Qtr 2020	4 th Qtr 2020	4th Qtr 2024

CD-0 – Approved Mission Need for a construction project with a conceptual scope and cost range

Conceptual Design Complete – Actual date the conceptual design was completed (if applicable)

CD-1 – Approve Alternative Selection and Cost Range

CD-2 – Approve Performance Baseline

Final Design Complete – Estimated/Actual date the project design will be/was complete(d)

CD-3 – Approve Start of Construction

D&D Complete –Completion of D&D work

CD-4 – Approve Start of Operations or Project Completion

PB – Indicates the Performance Baseline

***Project does not have CD-2 approval and has not been baselined.**

The costs are only estimates and consistent with the high end of the cost ranges.

Fiscal Year	Performance Baseline Validation	CD-3A	CD-3B
FY 2017		07/14/17	
FY 2018			
FY 2019			10/22/18
FY 2020	TBD		

CD-3A – Approve Long-Lead Procurements, Original Scope

CD-3B – Approve Long-Lead Procurements, Revised Scope

Project Cost History

	TEC, Design (\$000)	TEC, Construction (\$000)	TEC, Total (\$000)	OPC Except D&D (\$000)	OPC, D&D (\$000)	OPC, Total (\$000)	TPC (\$000)
FY 2018	\$100,628	\$1,299,372	\$1,400,000	\$6,711	\$0	\$6,711	\$1,406,711
FY 2019	\$199,749*	\$800,251	\$1,000,000**	\$5,250	\$0	\$5,250	\$1,005,250
FY 2020	\$276,383	\$1,163,617***	\$1,440,000***	\$5,250	\$0	\$5,250	\$1,445,250***

The costs are only estimates as of January 2019 and consistent with the high end of the cost ranges. No construction funds, except for approved long lead procurement, will be used until the project performance baseline for each subproject has been validated and CD-3 has been approved.

*The increase in design cost is due to: 1) competing the design contract instead of using a reach-back contract to the M&O contractor partner; 2) adding fee to competed contract; 3) adding escalation to schedule delay caused by competing design contract; and 4) adding engineering cost associated with additional scope (deleted scope was represented completely in construction cost).

** The maximum of range project cost of \$1.4B was approved at CD-1; however, a new project cost will be established at CD-2 to align with the Administration’s proposed \$1B funding limitation.

***The Project Scope has been expanded to include drilling 18 new wells at two sites. The costs for FY2020 entry have been revised to reflect the increase in scope.

2. Project Scope and Justification

Scope

The Strategic Petroleum Reserve-Life Extension 2 (SPR-LE2) project involves work at four storage sites: Bryan Mound, Big Hill, West Hackberry, and Bayou Choctaw. The SPR-LE2 project will be managed as four projects based on site location for baseline development, field execution, and project completion. Completion of the SPR-LE2 project will extend SPR key equipment and infrastructure capabilities for an additional 25 years and assure the required drawdown of 4.4 million barrels per day. The scope at each of the four SPR storage facilities includes modernization of aging SPR infrastructure through systems upgrades and associated equipment replacement including repair or replace crude oil transfer systems, raw water systems, brine disposal systems, drilling 18 new cavern wells, power distribution and lighting systems, and physical security systems. It also includes building and installing a new degasification plant at the Bayou Choctaw site.

Justification

In August 2016, the Department of Energy published a Long-Term Strategic Review (LTSR) of SPR capabilities and infrastructure. The LSTR compared current operational capability to Level 1 Technical and Performance Criteria and identified gaps within the storage site infrastructure and distribution system necessary to provide the design delivery rate of 4.4 million barrels per day, now and for the next 25 years. The results indicated that a significant investment in infrastructure and process equipment is critical to ensure the SPR can maintain readiness, meet mission requirements, and operate in an environmentally responsible manner. The SPR-LE2 Project addresses these requirements. Current surface assets and systems are more than halfway through their original design life of 25 years and early analysis suggests the required Life Extension Program (LEP) could take up to six years to complete. Revitalization of many, but not all, of those assets and systems last occurred from 1995 to 2000 under the first LEP. As these assets continue to age, modernization will be required – either through additional maintenance and/or repair, or outright replacement.

The project is being conducted in accordance with the project management requirements in DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets.

Preliminary Key Performance Parameters (KPPs)

The Threshold KPPs represent the minimum acceptable performance that the project must achieve. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Project Completion. The Objective KPPs represent the desired project performance. The preliminary KPPs will be finalized when the project is baselined at CD-2.

Preliminary Performance Measure	Threshold	Objective
Raw Water Withdrawal Rate	TBD	4.5 MMBD*
Peak Sustained Drawdown Rate	TBD	4.4 MMBD*
Site Fill Rate	TBD	605 MBD**

*MMBD is Million Barrels per day.

**MBD is Thousand Barrels per day.

3. Project Cost and Schedule

Financial Schedule

(dollars in thousands)

	Appropriations	Obligations	Costs
Total Estimated Cost (TEC)			
Design			
FY 2015	N/A	\$0	\$0
FY 2016	N/A	\$0	\$0
FY 2017	N/A	\$137,215	\$4,159
FY 2018	N/A	\$130,732	\$58,950
FY 2019	N/A	\$6,177	\$67,962
FY 2020	N/A	\$2,259	\$113,173
FY 2021	N/A	\$0	\$18,162
FY 2022	N/A	\$0	\$7,977
FY 2023	N/A	\$0	\$3,200
FY 2024	N/A	\$0	\$2,800
Total, Design a	N/A	\$276,383	\$276,383
Construction			
FY 2015	N/A	\$0	\$0
FY 2016	N/A	\$0	\$0
FY 2017	N/A	\$27,400	\$0
FY 2018 b	N/A	\$323,929	\$569
FY 2019	N/A	\$364,547	\$6,681
FY 2020	N/A	\$447,741	\$87,533
FY 2021	N/A	\$0	\$498,715
FY 2022	N/A	\$0	\$393,285
FY 2023	N/A	\$0	\$118,682
FY 2024	N/A	\$0	\$58,152
Total, Construction	N/A	\$1,163,617	\$1,163,617
TEC			
FY 2015	N/A	\$0	\$0
FY 2016	N/A	\$0	\$0
FY 2017	N/A	\$164,615	\$4,159
FY 2018	N/A	\$454,661	\$59,519
FY 2019	N/A	\$370,724	\$74,643
FY 2020	N/A	\$450,000	\$200,706
FY 2021	N/A	\$0	\$516,877
FY 2022	N/A	\$0	\$401,262
FY 2023	N/A	\$0	\$121,882
FY 2024	N/A	\$0	\$60,952
Total, TEC	N/A	\$1,440,000	\$1,440,000

(dollars in thousands)

	Appropriations	Obligations	Costs
Other Project Cost (OPC)			
FY 2015 c,d	88	\$88	\$88
FY 2016 c,d	4190	\$4,190	\$4,190
FY 2017 d	972	\$972	\$699
FY 2018 d	0	\$0	\$273
FY 2019	\$0	\$0	\$0
FY 2020	0	\$0	\$0
FY 2021	0	\$0	\$0
FY 2022	0	\$0	\$0
FY 2023	0	\$0	\$0
FY 2024	0	\$0	\$0
Total, OPC	\$5,250	\$5,250	\$5,250
Total Project Cost (TPC)			
FY 2015	\$88	\$88	\$88
FY 2016	\$4,190	\$4,190	\$4,190
FY 2017 e	\$340,972	\$165,587	\$4,858
FY 2018 f	\$350,000	\$454,661	\$59,792
FY 2019 g	\$300,000	\$370,724	\$74,643
FY 2020	\$450,000	\$450,000	\$200,706
FY 2021	\$0	\$0	\$516,877
FY 2022	\$0	\$0	\$401,262
FY 2023	\$0	\$0	\$121,882
FY 2024	\$0	\$0	\$60,952
Total, TPC d,h	\$1,445,250	\$1,445,250	\$1,445,250

a: DOE and DOE support labor; M&O project support

b: Bayou Choctaw CD-3A Degas Plant

c: Includes costs for Office of Project Management

d: Funding requirements are included in the Facilities Appropriation 089X0218.

e: FY2017 Omnibus authorized oil sales target of \$340,000,000 (Appropriation). Actual proceeds were \$323,196,000.

f: FY2018 Omnibus authorized oil sales target of \$350,000,000 (Appropriation). Actual proceeds were \$347,828,623

g: Includes costs for Office of Project Management EIR which will be funded from the DOE Contingency within LE 2 funds

h: The Total Project Cost (TPC) of \$1.4B was approved at CD-1; however, a new TPC is being established prior to CD-2 to account for additional scope, the cancellation of the MTE Project, and the additional required funding to complete LE2. The TPC for obligations and costs is the total of funds from Facilities Appropriation and funding received through the sale of SPR crude oil.

Note: Project is being funded through the sale of SPR crude oil and not through the normal congressional appropriations process.

Details of Project Cost Estimate at High Range at CD-1

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design (PED)			
Design	\$287,681	\$235,388	N/A
Contingency	\$25,016	\$21,306	N/A
Total, PED	\$312,697	\$256,694	N/A
Land Acquisition			
Construction			
Site Facilities Construction	\$293,276	\$295,636	N/A
Off-Site Facilities	\$26,661	\$150,994	N/A
Drilling/Wellhead/Casings	\$333,268	\$51,337	N/A
Pipeline Construction	\$199,961	\$119,388	N/A
Construction Management	\$133,307	\$95,690	N/A
Project Support	\$159,970	\$153,605	N/A
Contingency	\$186,630	\$276,656	N/A
Total, Construction	\$1,333,073	\$1,143,306	N/A
Total, TEC	\$1,645,770	\$1,400,000	N/A
Contingency, TEC	\$211,646	\$297,962	N/A
Other Project Cost (OPC)			
OPC except D&D			
Conceptual Design	\$1,366	\$1,366	N/A
Other OPC Costs	\$3,884	\$3,884	N/A
Start-up	\$0	\$0	N/A
Contingency	\$0	\$0	N/A
Total, OPC except D&D	\$5,250	\$5,250	N/A
D&D			
D&D			N/A
Contingency			N/A
Total, D&D	\$0	\$0	N/A
Total, OPC	\$5,250	\$5,250	N/A
Contingency, OPC	\$0	\$0	N/A
Total, TPC	\$1,651,020	\$1,405,250	N/A
Total, Contingency	\$211,646	\$297,962	N/A

Note: Project is being funded through the sale of SPR crude oil and not through the normal congressional appropriations process.

Schedule of Appropriations Requests

Section 404 of the Bipartisan Budget Act authorizes drawdown and sale of SPR crude oil over four fiscal years (FY2017 - FY2020) to finance SPR modernization. This CPDS reflects the high end of the cost ranges. The Total Project Cost (TPC) of \$1.4B was approved at CD-1; however, a new TPC is being established prior to CD-2 to account for additional scope, the cancelation of the MTE Project, and the additional required funding to complete LE2. The intent is to execute SPR modernization within the authorized revenue ceiling proposed in the FY 2020 budget request shown below.

(\$000)											
Request	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	Total
FY 2018	TEC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	OPC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	TPC	\$ -	\$ -	\$375,400	\$350,000	\$174,600	\$100,000	\$ -	\$ -	\$ -	\$1,000,000
FY 2019	TEC	\$ -	\$ -	\$ 340,000 *	\$ 350,000	\$ 300,000	\$ 10,000	\$ -	\$ -	\$ -	\$1,000,000
	OPC	\$ 88	\$ 4,190	\$ 972	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$5,250
	TPC	\$ 88	\$ 4,190	\$ 340,972	\$ 350,000	\$ 300,000	\$ 10,000	\$ -	\$ -	\$ -	\$1,005,250
FY 2020	TEC	\$ -	\$ -	\$ 340,000 *	\$ 350,000 **	\$ 300,000	\$ 450,000	\$ -	\$ -	\$ -	\$1,440,000
	OPC	\$ 88	\$ 4,190	\$ 972	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$5,250
	TPC	\$ 88	\$ 4,190	\$ 340,972	\$ 350,000	\$ 300,000	\$ 450,000	\$ -	\$ -	\$ -	\$1,445,250

* FY2017 Omnibus authorized oil sales target of \$340,000,000 (Appropriation). Actual proceeds were \$323,196,000.

** FY2018 Omnibus authorized oil sales target of \$350,000,000 (Appropriation). Actual proceeds were \$347,828,623.

4. Related Operations and Maintenance Funding Requirements

Not applicable for PED.

Start of Operation or Beneficial Occupancy (fiscal quarter or date)	Establish at CD-2
Expected Useful Life (number of years)	25
Expected Future Start of D&D of this capital asset (fiscal quarter)	N/A

(Related Funding requirements)

(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Current Total Estimate	Previous Total Estimate	Current Total Estimate	Previous Total Estimate
Operations		N/A		N/A
Maintenance & Repair		N/A		N/A
Total *		N/A		N/A

* Funding requirements are included in the Facilities Appropriation 089X0218.

5. D&D Information

This project does not require D&D funding.

6. Acquisition Approach

The existing Strategic Petroleum Reserve Management and Operating Contractor did procure the Architect-Engineer contractor and will procure all Government Furnished Property and firm fixed priced construction contracts.

SPR Petroleum Account
Proposed Appropriation Language

Notwithstanding sections 161 and 167 of the Energy Policy and Conservation Act (42 U.S.C. 6241, 6247), the Secretary of Energy shall draw down and sell one million barrels of refined petroleum product from the Strategic Petroleum Reserve and, notwithstanding 31 U.S.C. 3302, \$27,000,000 of proceeds from such sale shall be deposited in the SPR Petroleum Account and shall remain available until expended: Provided, That any proceeds in excess of \$27,000,000 collected from such sale shall be deposited into the general fund of the Treasury during fiscal year 2020: Provided further, That upon the completion of such sale, the Secretary shall carry out the closure of the Northeast Gasoline Supply Reserve. (Energy and Water Development and Related Agencies Appropriations Act, 2019.)

Explanation of Changes

The Department is requesting authorization to deposit into the SPR Petroleum Account up to \$27 million in proceeds from the proposed sale of one-million barrels of refined petroleum product (gasoline blendstock) from the Strategic Petroleum Reserve (SPR). Proceeds will be used as a source of funding for drawdown costs related to Congressionally-directed, multi-year sales of crude oil from the SPR. The current drawdown cost estimate for FY 2020 sales of SPR crude oil is approximately \$10.2 million. Balances in excess of FY 2020 drawdown costs will be apportioned and allotted to future fiscal years for continuing drawdown sales.

Public Law Authorizations

Energy Policy and Conservation Act, Public Law 94-163, as amended.

**SPR Petroleum Account
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
8,400	10,000	0 ¹	0

Overview

The SPR Petroleum Account funds activities related to the acquisition, transportation, and injection of petroleum products into the Strategic Petroleum Reserve; test sales of petroleum products from the Reserve; and, the drawdown, sale, and delivery of petroleum products from the Reserve.

Highlights and Major Changes in the FY 2020 Budget Request

Sections 403 and 404 of the Bipartisan Budget Act of 2015 (P.L. 114-74) and Section 501 of the Consolidated Appropriations Act of 2018 (P.L. 115-141) direct non-emergency, multi-year oil sales. To finance drawdown costs associated with mandatory sales of SPR crude oil, the Department requests authorization to deposit into the SPR Petroleum Account up to \$27 million in proceeds from the proposed sale of one-million barrels of gasoline blendstock from the SPR.

¹ The FY 2020 budget request does not include a request for direct appropriations; instead, the Department is requesting authorization to deposit up to \$27 million in proceeds from the proposed sale of one-million barrels of refined petroleum product (gasoline blendstock) from the Strategic Petroleum Reserve.

SPR Petroleum Account
Funding by Congressional Control
(\$K)

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
SPR Petroleum Account				
Petroleum Acquisition, Transportation and Drawdown	11,400	10,000	10,200	+200
Use of Refined Petroleum Product Sale Proceeds	0	0	-10,200	-10,200
Use of Prior Year Balances	-3,000	0	0	0
Total, SPR Petroleum Account	8,400	10,000	0	-10,000
Federal FTEs	0	0	0	0

SPR Petroleum Account

Overview

The SPR Petroleum Account funds activities related to the acquisition, transportation, and injection of petroleum products into the Strategic Petroleum Reserve; test sales of petroleum products from the Reserve; and, the drawdown, sale, and delivery of petroleum products from the Reserve. SPR Petroleum Account activities can include: 1) the incremental costs of withdrawing oil from the storage caverns and transporting it to the sales point where purchasers take title; 2) petroleum inventory acquisitions and associated transportation costs; 3) U.S. Customs duties; and 4) terminal throughput charges and other related miscellaneous costs.

SPR Oil Acquisition/Transportation/Drawdown

As of August 2018, the SPR crude oil inventory is 660 million barrels. Currently, the Department is undergoing a series of non-emergency, multi-year oil sales pursuant to the Bipartisan Budget Act (BBA) of 2015 (Public Law 114-74), the 21st Century Cures Act (Public Law 114-255), the Fixing America's Surface Transportation (FAST) Act (Public Law 114-94), the Act to provide for reconciliation pursuant to titles II and V of the concurrent resolution on the budget for fiscal year 2018 (Public Law 115-97), the Bipartisan Budget Act of 2018 (P.L. 115-123), and the Consolidated Appropriations Act of 2018 (P.L. 115-141). Drawdown and sales are scheduled as follows:

- From FY 2018 through FY 2025 (eight consecutive years) – sell 58 million barrels of crude oil, with 5 million barrels to be sold in FY 2018. Proceeds will be deposited into the General Fund of the Treasury (BBA, Section 403).
- From FY 2017 through FY 2020 (four consecutive years) – sell the required volumes of SPR inventory to raise up to the authorized revenue ceiling to be deposited into the Energy Security and Infrastructure Modernization Fund (BBA, Section 404). In FY 2017, 6.3 million barrels were sold; in FY 2018, 4.7 million barrels were sold, with revenues for both years totaling approximately \$671.0 million.
- From FY 2017 through FY 2019 (three consecutive years) – sell 10 million barrels of crude oil in FY 2017, 9 million barrels in FY 2018, and 6 million barrels in FY 2019, for a total of 25 million barrels. Proceeds will be deposited in the General Fund of the Treasury (21st Century Cures Act, Section 5010).
- From FY 2023 through FY 2025 (three consecutive years) – sell 16 million barrels of crude oil in FY 2023, 25 million barrels in FY 2024, and 25 million barrels in FY 2025, for a total of 66 million barrels. Proceeds will be deposited in the General Fund of the Treasury (Fixing America's Surface Transportation Act, Section 32204).
- From FY 2026 through FY 2027, sell 7 million barrels of crude oil. Proceeds shall be deposited in the General Fund of the Treasury during the fiscal year in which the sale occurs (An Act to provide for reconciliation pursuant to titles II and V of the concurrent resolution on the budget for fiscal year 2018, Section 20003).
- From FY 2020 through FY 2021, sell 10 million barrels of crude oil. Proceeds will be deposited in the General Fund of the Treasury (Consolidated Appropriations Act, 2018, Section 501).
- From FY 2022 through FY 2027, sell 100 million barrels of crude oil. Proceeds will be deposited in the General Fund of the Treasury (Bipartisan Budget Act of 2018, Section 30204).

This FY 2020 budget request assumes the Department will receive authorization to deposit into the SPR Petroleum Account up to \$27 million in proceeds from the proposed sale of one-million barrels of gasoline blendstock from the SPR to provide a source of funding for drawdown costs related to multi-year sales of SPR crude oil. The current drawdown cost estimate for FY 2020 is approximately \$10.2 million. Balances in excess of FY 2020 drawdown costs will be apportioned and allotted to future fiscal years.

**SPR Petroleum Account
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
SPR Petroleum Account				
Petroleum Acquisition, Transportation and Drawdown	11,400	10,000	10,200	+200
Use of Refined Petroleum Product Sale Proceeds	0	0	-10,200	-10,200
Use of Prior Year Balances	-3,000	0	0	0
Total, SPR Petroleum Account	8,400	10,000	0	-10,000

**SPR Petroleum Account
Explanation of Major Changes**

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
SPR Petroleum Account		
Petroleum Acquisition, Transportation and Drawdown \$10,000,000	\$0	-\$10,000,000
<i>Non-Emergency Drawdown</i> <ul style="list-style-type: none"> To finance drawdown costs associated with mandatory sales of SPR crude oil, the Department received a direct appropriation of \$10 million in FY 2019. 	<ul style="list-style-type: none"> The Department requests authorization to deposit into the SPR Petroleum Account up to \$27 million in proceeds from the proposed sale of one-million barrels of gasoline blendstock from the SPR to fund the cost of drawdown operations. 	<ul style="list-style-type: none"> In lieu of a request for direct appropriation, this FY 2020 request seeks authorization to deposit up to \$27 million from a requested sale of one-million barrels of gasoline blendstock from the SPR to raise funding for drawdown operations.

Energy Security and Infrastructure Modernization Fund
Proposed Appropriation Language

As authorized by section 404 of the Bipartisan Budget Act of 2015 (Public Law 114–74; 42 U.S.C. 6239 note), the Secretary of Energy shall draw down and sell not to exceed [\$300,000,000]\$450,000,000 of crude oil from the Strategic Petroleum Reserve in fiscal year 2020: Provided further, That the proceeds from such drawdown and sale shall be deposited into the "Energy Security and Infrastructure Modernization Fund" during fiscal year 2020: Provided further, That such amounts shall be made available and shall remain available until expended for necessary expenses to carry out the Life Extension II project for the Strategic Petroleum Reserve.

Explanation of Changes

Reflects the financing structure of multi-year (FY 2017 – FY 2020) oil sales that will support SPR Modernization Program activities totaling approximately \$1.445 billion over the life of the currently-scoped project.

Public Law Authorizations

Public Law 114-74, "Bipartisan Budget Act of 2015"

**Energy Security and Infrastructure Modernization Fund
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
350,000	300,000	450,000	+150,000

Overview

Section 404 of the Bipartisan Budget Act of 2015 directed the Secretary to establish an SPR Modernization Program to protect the United States economy from the impacts of emergency supply disruptions. The Energy Security and Infrastructure Modernization (ESIM) Fund was established in 2016 for the purpose of providing for the construction, maintenance, repair, and replacement of SPR facilities and associated capital equipment. In establishing the ESIM Fund, Congress made the following findings: 1. The SPR is one of the nation’s most valuable energy security assets; 2. The age and condition of the SPR have diminished its value as a federal energy security asset; 3. Global oil markets and the location and amount of U.S. oil production and refining capacity have dramatically changed in the 40 years since the establishment of the SPR; and 4. Maximizing the energy security value of the SPR requires a modernized infrastructure that meets the drawdown and distribution needs of changed domestic and international oil and refining market conditions.

Section 404 also authorizes the drawdown and sale of crude oil from the Strategic Petroleum Reserve (SPR) up to \$2 billion worth of SPR crude oil over four fiscal years (2017 through 2020) to finance an SPR Modernization Program.

The Life Extension Phase II project will modernize aging SPR infrastructure through systems upgrades and equipment replacement to ensure the SPR is able to meet mission requirements and maintain operational readiness for the next several decades.

Highlights and Major Changes in the FY 2020 Budget Request

The FY 2020 funding level continues the financing structure for multi-year (FY 2017 – FY 2020) oil sales that support an effective SPR Modernization Program. The Life Extension Phase II scope has been revised to include a Cavern Well Drilling Program that will provide at least 2 wells at every cavern. This improvement will increase the SPR’s operational resiliency and drawdown capability, should any single well be out of service.

**Energy Security and Infrastructure Modernization Fund
Funding by Congressional Control
(\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Energy Security and Infrastructure Modernization Fund				
Oil Sale Revenue Targets	350,000	300,000	450,000	+150,000
Crude Oil Sales Revenue Offsetting Collections	-350,000	-300,000	-450,000	-150,000
Total, Energy Security and Infrastructure Modernization Fund	0	0	0	
Federal FTEs	19	19	15	-4

Energy Security and Infrastructure Modernization Fund

Overview

Section 404 of the Bipartisan Budget Act of 2015 authorizes the drawdown and sale of crude oil from the Strategic Petroleum Reserve (SPR) up to the amount of the authorized revenue ceiling over four fiscal years (FY 2017 – FY 2020) to finance the modernization of the SPR. The Energy Security and Infrastructure Modernization Fund was established in FY 2016 to provide for the construction, maintenance, repair, and replacement of SPR facilities for the purpose of funding an SPR Modernization Program.

The Life Extension Phase II program will modernize aging SPR infrastructure through systems upgrades and associated equipment replacement to ensure that the Reserve is able to meet its mission requirements and maintain operational readiness for the next several decades. The Major Milestones (approved and estimated) for the SPR Modernization Program project, which has yet to be baselined, are as follows:

Life Extension Phase II Critical Decisions (CD):

- CD-0 Approve Mission Need – FY 2016 (Approved October 2015)
- CD-1 Approve Alternative Selection and Cost Range (Approved December 2016)
- CD-3A Approve Long Lead Time Equipment Procurement Items (Bryan Mound, Big Hill, West Hackberry) (Approved July 2017)
- CD-3A Approve Long Lead Time Equipment Procurement Items (Bayou Choctaw) – FY 2018
- CD-2 Approve Performance Baseline– FY 2020
- CD-3 Approve Start of Construction– FY 2020
- CD-4 Approve Project Completion (Big Hill, Bayou Choctaw, Bryan Mound) – FY 2023
- CD-4 Approve Project Completion (West Hackberry) – FY 2024

Although Section 404 (d) (2) (B) (ii) of the Act notes that maintenance of the cavern storage integrity may be included as part of the SPR Modernization Program, the current scope of work for the Life Extension Phase II Project does not include maintenance of cavern storage integrity. Expenditures for operations and maintenance activities not directly related to the SPR Modernization Program continue to be financed through the SPR Facilities Account, including the Cavern Storage Integrity subprogram. Because final estimated costs will not be determined until the technical baselines are set for both projects upon approval of CD-2, it would be premature to utilize ESIM funds to finance cavern storage integrity maintenance activities not included in the project scope of work for SPR Modernization Program Projects.

Life Extension: The Life Extension Phase II project will extend SPR equipment and infrastructure capabilities for an additional 25 years. The project involves work at the Bryan Mound, Big Hill, West Hackberry, and Bayou Choctaw storage sites. The major components of work activities at each site are:

- Bryan Mound and Big Hill: Process Piping, Pipelines, Process & Rotating Equipment
- West Hackberry: Brine System, Civil and Security Systems, Process Piping, and Process Equipment
- Bayou Choctaw: Brine Disposal System, Degas Plant, Roadways and Lighting, Security and Electrical Systems
- Cavern Secondary Well Drilling Program at Bryan Mound, Bayou Choctaw, and West Hackberry sites.

**Energy Security and Infrastructure Modernization Fund
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Energy Security and Infrastructure Modernization Fund				
Oil Sale Revenue Targets	350,000	300,000	450,000	+150,000
Crude Oil Sales Revenue Offsetting Revenue Collections	-350,000	-300,000	-450,000	-150,000
Total, Energy Security and Infrastructure Modernization Fund	0	0	0	0

Energy Security and Infrastructure Modernization Fund
Explanation of Major Changes (\$K)

FY 2020 Request vs FY 2019 Enacted

Oil Sale Revenue Targets: The increased ESIM oil sale target is needed in FY 2020—the final year to raise revenue for the ESIM Fund—to ensure a sufficiency of funding over the life of the SPR Modernization Program.

Total, Energy Security and Infrastructure Modernization Fund

+150,000

**Energy Security and Infrastructure Modernization Fund
Life Extension Phase II**

Description

The Life Extension Phase II subprogram funds activities to modernize aging SPR infrastructure through systems upgrades and associated equipment replacement to ensure the ability to maintain operational and drawdown readiness capability. The scope of work includes system upgrades and associated equipment replacement for the following systems:

- Crude oil transfer systems
- Raw water systems
- Power distribution and electrical systems
- Physical security systems
- Firefighting systems
- Crude oil processing (degasification) plant
- Auxiliary systems and facilities

FY 2020 activities continue procurement of government furnished equipment with long lead times as well as project design, geotechnical and geo-mechanical analyses, surveys, permitting, Title II and III engineering services, real estate and right-of-way issues, wetland mitigation, and permitting. The project technical baseline, to include final scope of work, cost, and schedule, will be set at CD-2 approval, currently scheduled for the 2nd Quarter of FY 2020. The project's scope of work was revised to include the Cavern Secondary Well Drilling Program.

FY 2020 Key Milestones

• FY 2020 Anticipated Major Milestones:

- | | |
|---|---------------|
| • Complete Project Design(BC, BH, BM) | January 2020 |
| • CD-2, Approve Performance Baseline (BC, BH, BM) | January 2020 |
| • CD-3, Approve Start of Construction/Project Execution(BC, BH, BM) | January 2020 |
| • Award Construction Contracts (BC, BH, BM) | February 2020 |
| • Complete Project Design(WH) | March 2020 |
| • CD-2, Approve Performance Baseline (WH) | April 2020 |
| • CD-3, Approve Start of Construction/Project Execution(WH) | April 2020 |
| • Award Construction Contracts (WH) | May 2020 |

**Energy Security and Infrastructure Modernization Fund
Activities and Explanation of Changes**

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
SPR Modernization		
\$300,000,000	\$450,000,000	+150,000,000
<ul style="list-style-type: none"> Provides the third year of revenue targets from crude oil sales. Collection of oil sale receipts will be allocated towards the project's Total Estimated Cost in support of construction; construction management; and project management. 	<ul style="list-style-type: none"> Provides the fourth and final year of revenue targets from crude oil sales. Collection of oil sale receipts will be allocated towards the project's Total Estimated Cost in support of construction; construction management; and project management. 	<ul style="list-style-type: none"> Increase in the level of oil sale proceeds required to meet the Life Extension Phase II obligation schedule.

Management

Funding (\$K)

ESIM Program Direction

Salaries and Benefits

Travel

Other Related Expenses

Total, Management

Federal FTEs

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
2,763	2,860	2,079	-781
41	46	50	+4
100	100	350	+250
2,904	3,006	2,479	-527
19	19	15	-4

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Strategic Petroleum Reserve	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
National Energy Technology Lab			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	456	446	466
Total, National Energy Technology Lab	456	446	466
Oak Ridge National Laboratory			
SPR Econometric Modelling Support			
Management	560	570	570
Total, Oak Ridge National Laboratory	560	570	570
Sandia National Laboratories			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	3,570	3,652	3,294
Total, Sandia National Laboratories	3,570	3,652	3,294
SPRO PMO			
FY 2018 Emergency Supplemental			
SPR - Facilities Development	8,716	0	0
Total, SPRO PMO	8,716	0	0
Strategic Petroleum Reserve - Bayou Choctaw			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	14,985	13,523	13,785
Total, Strategic Petroleum Reserve - Bayou Choctaw	14,985	13,523	13,785
Strategic Petroleum Reserve - Big Hill			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	22,879	22,176	18,404
Total, Strategic Petroleum Reserve - Big Hill	22,879	22,176	18,404
Strategic Petroleum Reserve - Bryan Mound			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	20,144	25,473	17,634
Total, Strategic Petroleum Reserve - Bryan Mound	20,144	25,473	17,634
Strategic Petroleum Reserve - West Hackberry			
SPR Geotechnical Analytical Support			
SPR - Facilities Development	23,972	24,093	22,481
Total, Strategic Petroleum Reserve - West Hackberry	23,972	24,093	22,481

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Strategic Petroleum Reserve	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Strategic Petroleum Reserve Project Office			
 SPR Geotechnical Analytical Support			
SPR - Facilities Development	108,908	90,663	72,916
 SPR Econometric Modelling Support			
Management	19,086	16,974	17,020
Total, Strategic Petroleum Reserve Project Office	127,994	107,637	89,936
Undesignated Lab/Plant/Installation			
 SPR Geotechnical Analytical Support			
Northeast Gasoline Supply Reserve	29,000	29,000	0
Total, Undesignated Lab/Plant/Installation	29,000	29,000	0
Washington Headquarters			
 SPR Econometric Modelling Support			
Management	8,440	8,430	7,430
Total, Washington Headquarters	8,440	8,430	7,430
Total, Strategic Petroleum Reserve	260,716	235,000	174,000

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Strategic Petroleum Reserve - Petroleum Account			
Strategic Petroleum Reserve Project Office			
SPR - Petroleum Account			
Oil Acquisition and Transportation	11,400	10,000	0
Total, Strategic Petroleum Reserve Project Office	11,400	10,000	0
Total, Strategic Petroleum Reserve - Petroleum Account	11,400	10,000	0

**Northeast Home
Heating Oil
Reserve**

**Northeast Home
Heating Oil
Reserve**

**Northeast Home Heating Oil Reserve
Proposed Appropriation Language**

Notwithstanding section 183 of the Energy Policy and Conservation Act (42 U.S.C. 6250b), the Secretary of Energy shall draw down and sell all barrels of petroleum distillate from the Northeast Home Heating Oil Reserve during fiscal year 2020: Provided, That notwithstanding section 184 of the Energy Policy and Conservation Act (42 U.S.C. 6250c), all proceeds collected from such sale shall be deposited into the general fund of the Treasury during fiscal year 2020: Provided further, That upon the completion of such sale, the Secretary shall carry out the closure of the Northeast Home Heating Oil Reserve.

Explanation of Changes

No new budget authority is required in FY 2020 to maintain the Northeast Home Heating Oil Reserve, as the Budget proposes to disestablish the reserve and sell the one-million barrels of government-owned ultra-low sulfur distillate.

Public Law Authorizations

- P.L. 109-58, Energy Policy Act of 2005

Northeast Home Heating Oil Reserve
 (\$K)

FY 2018 Enacted ¹	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
6,500	10,000	0	-10,000

Overview

The Northeast Home Heating Oil Reserve (NEHHOR) was established in 2000 as a short-term supplement to the Northeast commercial system’s supply of heating oil, and was to be used in the event of a supply interruption during severe winter weather. Since the reserve was established, however, it has not been used for its intended purpose. Moreover, the NEHHOR costs the Federal government approximately \$10 million each year in commercial leasing costs. The current leased commercial storage contracts went into effect on April 1, 2016, with the final option year extending through March 31, 2020. The Department does not plan on soliciting new leased commercial storage contracts after the expiration of the current contracts.

Highlights and Major Changes in the FY 2020 Budget Request

FY 2020 activities will focus on disestablishing the NEHHOR and selling its one-million barrels of ultra-low sulfur distillate for deficit reduction.

¹ Prior-year balances of \$3.5 million were used to supplement new FY 2018 budget authority.

**Northeast Home Heating Oil Reserve
Funding by Congressional Control (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Northeast Home Heating Oil Reserve

Northeast Home Heating Oil Reserve	10,000	10,000	0	-10,000
Subtotal, Northeast Home Heating Oil Reserve	10,000	10,000	0	-10,000
Use of Prior Year Balances	-3,500	0	0	0
Total, Northeast Home Heating Oil Reserve	6,500	10,000	0	-10,000
Federal FTEs	0	0	0	

Northeast Home Heating Oil Reserve

Overview

In 2000, the NEHHOR was created to provide protection from severe heating oil supply disruptions throughout the Northeast. The NEHHOR was designed to augment, but not replace, commercial supplies during an emergency. However, the NEHHOR has not been used for its intended purpose since it was established, and the Department does not believe the reserve is a worthy investment. For this reason, the Department requests authority to disestablish the NEHHOR, and is not requesting an FY 2020 appropriation.

Highlights of the FY 2020 Budget Request

FY 2020 activities will focus on disestablishing the NEHHOR and selling its one-million barrels of ultra-low sulfur distillate for deficit reduction.

**Northeast Home Heating Oil Reserve
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Northeast Home Heating Oil Reserve				
Commercial Leases	9,200	9,200	0	-9,200
Information Technology Support	700	700	0	-700
Quality Control and Analysis	100	100	0	-100
Subtotal, Northeast Home Heating Oil Reserve	10,000	10,000	0	-10,000
Use of Prior Year Balances	-3,500	0	0	0
Total, Northeast Home Heating Oil Reserve	6,500	10,000	0	-10,000

**Northeast Home Heating Oil Reserve
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

Northeast Home Heating Oil Reserve: No new budget authority is required in FY 2020 to maintain the Northeast Home Heating Oil Reserve, as the Department is requesting authority to disestablish the reserve and sell the one-million barrels of government-owned ultra-low sulfur distillate.

-10,000

Total, Northeast Home Heating Oil Reserve

-10,000

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Northeast Home Heating Oil Reserve Account			
Undesignated Lab/Plant/Installation			
Northeast Home Heating Oil Reserve			
Northeast Home Heating Oil Reserve	9,076	9,038	0
Total, Undesignated Lab/Plant/Installation	9,076	9,038	0
Washington Headquarters			
Northeast Home Heating Oil Reserve			
Northeast Home Heating Oil Reserve	924	962	0
Total, Washington Headquarters	924	962	0
Total, Northeast Home Heating Oil Reserve Account	10,000	10,000	0

Power Marketing Administrations

Power Marketing Administrations

Power Marketing Administrations

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Southeastern Power Administration

Southeastern Power Administration

**Southeastern Power Administration
Proposed Appropriation Language**

For expenses necessary for operation and maintenance of power transmission facilities and for marketing electric power and energy, including transmission wheeling and ancillary services, pursuant to section 5 of the Flood Control Act of 1944 (16 U.S.C. 825s), as applied to the southeastern power area, [\$6,500,000] \$6,597,000, including official reception and representation expenses in an amount not to exceed \$1,500, to remain available until expended: *Provided*, That notwithstanding 31 U.S.C. 3302 and section 5 of the Flood Control Act of 1944, up to [\$6,500,000] \$6,597,000, collected by the Southeastern Power Administration from the sale of power and related services shall be credited to this account as discretionary offsetting collections, to remain available until expended for the sole purpose of funding the annual expenses of the Southeastern Power Administration: *Provided further*, That the sum herein appropriated for annual expenses shall be reduced as collections are received during the fiscal year so as to result in a final fiscal year [2019] 2020 appropriation estimated at not more than \$0: *Provided further*, That, notwithstanding 31 U.S.C. 3302, up to [\$55,000,000] \$65,715,000 collected by the Southeastern Power Administration pursuant to the Flood Control Act of 1944 to recover purchase power and wheeling expenses shall be credited to this account as offsetting collections, to remain available until expended for the sole purpose of making purchase power and wheeling expenditures: *Provided further*, That for purposes of this appropriation, annual expenses means expenditures that are generally recovered in the same year that they are incurred (excluding purchase power and wheeling expenses).

Explanation of Changes

No changes.

Public Law Authorizations:

Public Law 78-534, Flood Control Act of 1944

Public Law 95-91, DOE Organization Act of 1977, Section 302

Public Law 101-1-1, Title III, Continuing Fund (amended 1989)

Public Law 102-486, Energy Policy Act of 1992

Southeastern Power Administration

	(\$K)	
	FY 2019 Enacted	FY 2020 Request
Gross	75,324	87,016
Offsets	-75,324	-87,016
Net BA	0	0

Overview

Southeastern Power Administration (Southeastern or SEPA) exists to carry out the functions assigned by the Flood Control Act of 1944: to market the electric power and energy generated by the Federal reservoir projects to public bodies and cooperatives in the southeastern United States in a professional, innovative, customer-oriented manner, while continuing to meet the challenges of an ever-changing electric utility environment through continuous improvement. Southeastern provides 485 public power customers with 3,392 megawatts of hydroelectric capacity from 22 Federal multipurpose projects, operated by the U.S. Army Corps of Engineers (Corps) at cost based rates.

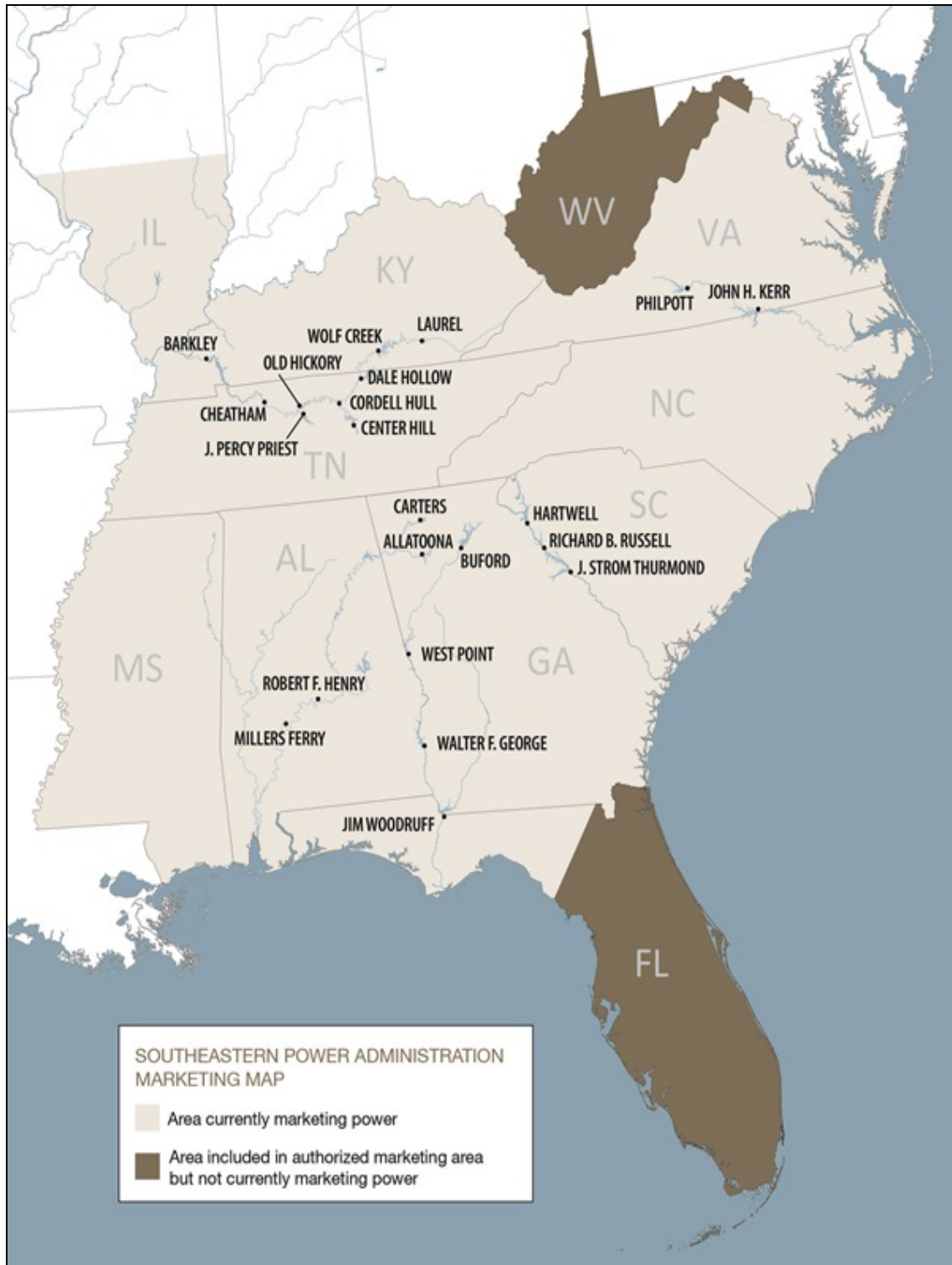
Annually, Southeastern produces an average of 7,613 gigawatt-hours of clean renewable hydroelectric energy. Southeastern maintains and upgrades its energy infrastructure to ensure reliable and efficient delivery of Federal power. Southeastern promotes energy efficiency, renewable energy, and sound management of the dispatch and distribution of Federal hydroelectric power resources in the southeastern United States while also meeting national utility performance standards and balancing the diverse interests of other water resource stakeholders. This budget submission enables Southeastern to promote the effective management of hydroelectric resources.

Program Direction supports day-to-day agency operation and Purchase Power and Wheeling supports acquisition of replacement and pumping power along with contractually-required transmission services. Consistent with the authority provided in the FY 2010 Energy and Water Appropriations, the FY 2020 Budget provides funding for annual expenses (Program Direction) through discretionary offsetting collections derived from power receipts collected to recover those expenses.

Highlights and Major Changes in the FY 2020 Budget Request

Southeastern’s request for FY 2020 increases Purchase Power and Wheeling (+\$11.595 million), reflecting changes in transmission rates and rainfall estimates, and increases Program Direction (+\$0.097 million) based on more accurate cost estimates. The FY 2020 budget request includes a proposal to change SEPA’s statutory rate structure requirement from cost recovery to a market based structure. The FY 2020 budget request also seeks authority for SEPA to use Administratively Determined (AD) pay for power dispatcher employees in order to better recruit and retain qualified and experienced dispatchers.

Service Area Map



**Southeastern Power Administration
Funding by Congressional Control (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Southeastern Power Administration				
Purchase Power and Wheeling (PPW)	66,070	68,824	80,419	11,595
Program Direction (PD)	6,379	6,500	6,597	97
Subtotal, Southeastern Power Administration	72,449	75,324	87,016	11,692
Offsetting Collections, PPW	-51,000	-55,000	-65,715	-10,715
Alternative Financing, PPW	-15,070	-13,824	-14,704	-880
Offsetting Collections, Annual Expenses, PD	-6,379	-6,500	-6,597	-97
Use of Prior Year Balances, PD	0	0	0	0
Total, Southeastern Power Administration	0	0	0	0
Federal FTEs	44	44	44	0

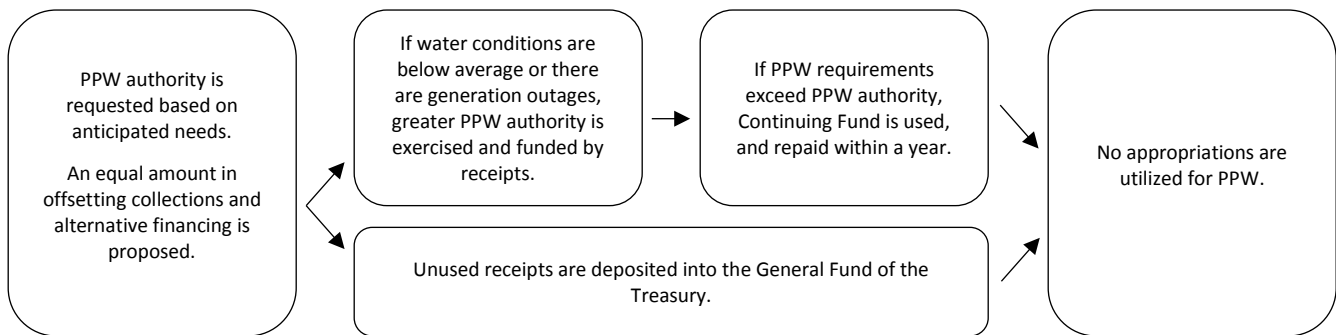
Purchase Power and Wheeling

Overview

The mission of Purchase Power and Wheeling (PPW) is to provide funding for acquisition of transmission services, ancillary services for the system, pumping energy for the Richard B. Russell and Carters Pumped Storage units, and support of the Jim Woodruff Project. Southeastern must purchase power on the open market when its Federal generating assets cannot provide enough power to fulfill its contracts with its customers.

Additionally, because Southeastern does not own or operate any transmission infrastructure, transmission expenses are based on contracts with area transmission providers to deliver specified amounts of Federal power from the hydropower projects to Federal power customers. Southeastern has access to a continuing fund for emergency expenses necessary to ensure continuity of service. Southeastern has implemented a plan to repay any Purchase Power and Wheeling expenditures made through the Continuing Fund within one year.

The FY 2020 request uses customer receipts and net billing to pay for purchase power and wheeling expenses at no cost to the Federal Treasury. Some customers, acting independently or in partnerships, acquire replacement power and transmission services directly from suppliers. Southeastern will continue to assist its customers by arranging funding for these activities through alternative financing instruments, as needed.



Highlights of the FY 2020 Budget Request

The PPW subprogram supports Southeastern's mission to market and deliver reliable, cost-based hydroelectric power and related services. PPW enables Southeastern to wheel Federal power to preference customers, purchase replacement power, and acquire pumping energy to maximize the efficiency and benefits of Southeastern's hydropower resources. Power and services are marketed at rates designed to provide recovery of expenses and Federal investment, as established by law. The FY 2020 budget request includes a proposal to change SEPA's statutory rate structure requirement from cost recovery to a market based structure.

**Purchase Power & Wheeling
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Purchase Power				
Replacement Power	3,797	3,797	8,633	4,836
Russell Project pumping power	9,166	11,584	12,354	770
Carters Project pumping power	8,489	9,439	11,739	2,300
Jim Woodruff Project support	2,600	2,600	2,600	0
Total, Purchase Power	24,052	27,420	35,326	7,906
Wheeling				
Wheeling service charges	37,254	36,664	40,353	3,689
Ancillary Services	4,764	4,740	4,740	0
Total, Wheeling	42,018	41,404	45,093	3,689
Total, Purchase Power and Wheeling	66,070	68,824	80,419	11,595
Alternative Financing				
Net Billing	-15,070	-13,824	-14,704	-880
Subtotal, Purchase Power and Wheeling	51,000	55,000	65,715	10,715
Offsetting Collections Realized	-51,000	-55,000	-65,715	-10,715
Total, Purchase Power and Wheeling Budget Authority	0	0	0	0

**Southeastern Power Administration
Purchase Power and Wheeling
(\$K)**

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Purchase Power and Wheeling \$68,824	\$80,419	+\$11,595
Purchase Power \$27,420	\$35,326	+\$7,906
<ul style="list-style-type: none"> • On-Peak Replacement Power, purchased to meet contract minimum service in drought conditions. • Off-Peak Pumping Power, purchased to supplement stream flow energy demand. • Jim Woodruff System Generating Support required for high river flows at low head plant. 	<ul style="list-style-type: none"> • Continuing activities from prior year. 	<ul style="list-style-type: none"> • The increase reflects anticipated needs based on projected market prices.
Wheeling \$41,404	\$45,093	+\$3,689
<ul style="list-style-type: none"> • Transmission expenses based on contracts with area transmission providers to deliver specified amounts of Federal power from the hydropower projects to Federal power customers. 	<ul style="list-style-type: none"> • Continued funding supports ongoing activities. 	<ul style="list-style-type: none"> • The increase is due to variations in transmission rates.

Program Direction

Overview

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Southeastern Power Administration. Provision is made for negotiation and administration of transmission and power contracts, collections of revenues, accounting and budget activities, development of wholesale power rates, amortization of the Federal power investment, energy efficiency and competitiveness programs, investigation and planning of proposed water resources projects, scheduling and dispatch of power generation, scheduling storage and release of water, administration of contractual operation requirements, and determination of methods of operating generating plants individually and in coordination with others to obtain maximum allowable utilization of resources.

Highlights of the FY 2020 Budget Request

The FY 2020 Budget Request provides for the continuation of Southeastern's activities related to Program Direction at the level necessary to meet mission requirements. In FY 2020, Southeastern is seeking authority for Administratively Determined (AD) pay for power dispatcher employees in order to better recruit and retain qualified and experienced dispatchers. The AD dispatcher pay will give Southeastern the flexibility to offer competitive pay already authorized for the other Power Marketing Administrations (Bonneville, Southwestern, and Western Area Power Administrations) and is comparable to Wage Board authorities granted to the Corps of Engineers for dispatcher employees.

Program Direction Funding (\$K)

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Program Direction Summary

Southeastern Power Administration

Salaries and Benefits	4,800	4,800	4,800	0
Travel	100	105	100	-5
Support Services	40	5	3	-2
Other Related Expenses	1,439	1,590	1,694	104
Total, Program Direction	6,379	6,500	6,597	97
Federal FTS	44	44	44	0

Support Services and Other Related Expenses

Support Services				
Management and Professional Support Services	40	5	3	-2
Total, Support Services	40	5	3	-2

Other Related Expenses

Training	10	20	20	0
Communications, Utilities, Misc.	193	177	202	25
Equipment	43	81	68	-13
Maintenance Agreements	96	175	171	-4
Rent to GSA	345	352	352	0
Rent to Others	0	0	0	0
Tuition	5	10	47	37
Contract Services	399	400	456	56
Audit of Financial Statements	240	246	251	5
Supplies and Materials	68	77	71	-6
Working Capital Fund	37	47	48	1
Printing and Reproduction	3	5	8	3
Total, Other Related Expenses	1,439	1,590	1,694	104

**Program Direction
(\$K)**

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$6,500	\$6,597	+\$97
Salaries and Benefits \$4,800	\$4,800	\$0
The funding supports Federal salaries and benefits for 44 FTEs who market Federal hydropower, promote energy efficiency and renewable energy, administrative support, and workloads in cyber-security and operational reliability. These estimates are derived from the current year budgeted salaries, plus cost-of-living adjustments, promotions, within-grade increases, overtime, DOE-cascading performance awards, and retirement payouts for unused leave.	Continue funding support for Federal salaries and benefits for 44 FTEs.	Continue funding support for Federal salaries and benefits.
Travel \$105	\$100	-\$5
Funding supports transportation and per diem expenses incurred for preference customer meetings, relocation expenses for new FTEs, contract negotiations, rate forums, Congressional hearings, site visits, and operations meetings with industry organizations.	Continued funding supports ongoing activities.	Decrease due to continued greater use of conference calls, webinar sessions, internet training, and video conferencing.
Support Services \$5	\$3	-\$2
Funding supports preference customers' efforts in support of the Energy Policy Act of 2005.	Continue funding for co-sponsored training support for municipal and cooperative utilities.	Decrease reflects reduced customer participation in program funding.
Other Related Expenses \$1,590	\$1,694	+\$104
Funding provides administrative support for office, rent, communications, maintenance, contract services, supplies, materials, equipment and support for cyber and physical security, training expenses for power operator certification, acquisition of renewable energy certificates, support for installation of electronic hardware and software for the operations center and provides maintenance to integrate real-time data from the control area and provides the data to other transmission operators and NERC.	Continue funding support for Southeastern Power Administration's headquarters office.	Increase reflects required hardware and software updates along with training, tuition, and communications costs. Costs are based on the historical usage and actual cost of similar items as well as inflationary increases.

**Additional Tables
Revenue and Receipts (\$K)**

	FY 2018 Actuals	FY 2019 Estimate	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Gross Revenues	291,734	299,444	304,526	305,629	314,469	316,086	317,783
Net Billing (Credited as an Offsetting Receipt)	-13,818	-13,824	-14,704	-14,874	-15,053	-15,240	-15,437
Total Cash Receipts	277,916	285,620	289,822	290,755	299,416	300,846	302,346
Use of Offsetting Collections to fund PPW	-49,168	-55,000	-65,715	-66,917	-68,281	-69,710	-71,211
Use of Offsetting Collections to fund Annual Expenses	-6379	-6,500	-6,597	-6,739	-6,882	-6,921	-6,926
Total Receipts, net use of Offsetting Collections	222,369	224,120	217,510	217,099	224,253	224,215	224,209
Cumberland Rehabilitation	-55,398	-28,000	-25,000	-25,000	-25,000	-25,000	-25,000
GA-AL-SC Rehabilitation	-70	-15,000	-10,000	-10,000	-15,000	-15,000	-15,000
Kerr-Philpott Rehabilitation	-2,444	-5,000	-4,000	-3,000	-5,000	-5,000	-5,000
Jim Woodruff	0	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Accts Rec Yearly Difference	-12	0	0	0	0	0	0
Total Proprietary Receipts	164,445	175,120	177,510	178,099	178,253	178,215	178,209
Percent of Sales to Preference Customers	99%	99%	99%	99%	99%	99%	99%
Energy Sales and Power Marketed (megawatt-hours)	6,959,061	5,587,740	5,587,740	5,587,740	5,587,740	5,587,740	5,587,740

Alternative Financing

2018

	Transmission	Purchase Power	Offsetting Collections	Net Billing	Appropriated Funds
Jim Woodruff System	343	1,348	-1,095	-596	0
Kerr-Philpott System	6,393	769	-7,162	0	0
GA-AL-SC System	16,656	26,796	-40,832	-2,620	0
Cumberland System	10,681	0	-79	-10,602	0
	34,073	28,913	-49,168	-13,818	0

2019

	Transmission	Purchase Power	Offsetting Collections	Net Billing	Appropriated Funds
Jim Woodruff System	230	2,600	-2,130	-700	0
Kerr-Philpott System	5,649	0	-5,649	0	0
GA-AL-SC System	21,506	29,180	-47,138	-3,548	0
Cumberland System	9,659	0	-83	-9,576	0
	37,044	31,780	-55,000	-13,824	0

2020

	Transmission	Purchase Power	Offsetting Collections	Net Billing	Appropriated Funds
Jim Woodruff System	230	2,600	-2,130	-700	0
Kerr-Philpott System	9,147	0	-9,147	0	0
GA-AL-SC System	25,031	32,729	-54,355	-3,402	0
Cumberland System	10,685	0	-83	-10,602	0
	45,093	35,329	-65,715	-14,704	0

Power Marketed, Wheeled, or Exchanged by Project

Project	State	Plants	Installed Capacity (KW)	FY 2018 Estimated Power (GWH)	FY 2019 Estimated Power (GWH)	FY 2020 Estimated Power (GWH)
<u>Kerr-Philpott System</u>				293	293	293
John H. Kerr	VA-NC	1	291,000			
Philpott	VA	1	15,000			
<u>Georgia-Alabama-South Carolina System</u>				2,508	2,508	2,508
Allatoona	GA	1	82,000			
Buford	GA	1	127,000			
Carters	GA	1	600,000			
J. Strom Thurmond	GA-SC	1	364,000			
Walter F. George	GA-AL	1	160,000			
Hartwell	GA-SC	1	424,000			
R. F. Henry	AL	1	82,000			
Millers Ferry	AL	1	90,000			
West Point	GA-AL	1	87,000			
Richard B. Russell	GA-SC	1	656,000			
<u>Jim Woodruff Project</u>	FL-GA	1	43,500	148	148	148
<u>Cumberland System</u>				2,481	2,481	2,481
Barkley	KY	1	130,000			
Center Hill	TN	1	135,000			
Cheatham	TN	1	36,000			
Cordell Hull	TN	1	99,900			
Dale Hollow	TN	1	54,000			
Old Hickory	TN	1	103,752			
J. Percy Priest	TN	1	28,000			
Wolf Creek	TN	1	270,000			
Laurel	TN	1	61,000			
Total Power Marketed		22	3,939,152	5,430	5,430	5,430

System Statistics

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
<u>Generating Capacity:</u>			
Nameplate Capacity (KW)	3,939,152	3,939,152	3,939,152
Peak Capacity (KW) ^a	4,330,000	4,330,000	4,330,000
<u>Generating Stations</u>			
Generating Projects (Number)	22	22	22
<u>Available Energy</u>			
Energy from Stream-flow (MWH)	6,404,304	4,685,000	4,685,000
Energy generated from Pumping (MWH)	476,229	745,100	745,100
Energy Purchased for Replacement (MWH)	78,528	157,640	157,640
Total, Energy available for marketing ^b (MWH)	6,959,061	5,587,740	5,587,740

^a Southeastern markets capacity based on nameplate plus an overload factor. NERC requires that Southeastern keep a portion of the capacity in reserve for emergency purposes and to cover losses.

^b Gross amount. Transmission losses are deducted from this amount to estimate the amount of energy marketed.

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Southeastern Power Admin. - Operation & Maint.			
Southeastern Power Administration			
Purchase Power and Wheeling			
Purchase Power and Wheeling	66,070	68,824	80,419
Program Direction			
Program Direction	6,379	6,500	6,597
Total, Southeastern Power Administration	72,449	75,324	87,016
Total, Southeastern Power Admin. - Operation & Maint.	72,449	75,324	87,016

Southwestern Power Administration

Southwestern Power Administration

**Southwestern Power Administration
Proposed Appropriation Language**

For expenses necessary for operation and maintenance of power transmission facilities and for marketing electric power and energy, for construction and acquisition of transmission lines, substations and appurtenant facilities, and for administrative expenses, including official reception and representation expenses in an amount not to exceed \$1,500 in carrying out section 5 of the Flood Control Act of 1944 (16 U.S.C. 825s), as applied to the Southwestern Power Administration, [\$45,802,000] \$47,775,000 to remain available until expended: Provided, That notwithstanding 31 U.S.C. 3302 and section 5 of the Flood Control Act of 1944 (16 U.S.C. 825s), up to [\$35,402,000] \$37,375,000 collected by the Southwestern Power Administration from the sale of power and related services shall be credited to this account as discretionary offsetting collections, to remain available until expended, for the sole purpose of funding the annual expenses of the Southwestern Power Administration: Provided further, That the sum herein appropriated for annual expenses shall be reduced as collections are received during the fiscal year so as to result in a final fiscal year [2019] 2020 appropriation estimated at not more than \$10,400,000: Provided further, That, notwithstanding 31 U.S.C. 3302, up to [\$50,000,000] \$83,000,000 collected by the Southwestern Power Administration pursuant to the Flood Control Act of 1944 to recover purchase power and wheeling expenses shall be credited to this account as offsetting collections, to remain available until expended for the sole purpose of making purchase power and wheeling expenditures: Provided further, That for purposes of this appropriation, annual expenses means expenditures that are generally recovered in the same year that they are incurred (excluding purchase power and wheeling expenses).

Explanation of Changes

No changes.

Public Law Authorizations

Southwestern Power Administration:

- P.L. 78-534, Section 5, Flood Control Act of 1944
- P.L. 95-91, Section 302, DOE Organization Act of 1977
- P.L. 100-71, Supplemental Appropriations Act, 1987
- P.L. 101-101, Title III, Continuing Fund (amended 1989)
- P.L. 102-486, Section 721, Energy Policy Act of 1992
- P.L. 108-447, Appropriations Act, FY 2005
- P.L. 111-85, Appropriations Act, FY 2010

Southwestern Power Administration

	(\$K)		
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
Gross	112,947	126,876	156,863
Offsets	-101,547	-116,476	-146,463
Net BA	11,400	10,400	10,400

Overview

Southwestern Power Administration's (Southwestern) mission is to market and reliably deliver Federal hydroelectric power, with preference to public bodies and cooperatives. This is accomplished by maximizing the use of Federal assets to repay the Federal investment, participating with other water resource users in an effort to balance diverse interests with power needs within broad parameters set by the U.S. Army Corps of Engineers (Corps), and implementing public policy.

Southwestern markets and delivers power at wholesale rates to 78 municipal utilities, 21 rural electric cooperatives, and 3 government entities in the six states of Arkansas, Kansas, Louisiana, Missouri, Oklahoma, and Texas. In turn, these customers distribute that power to approximately 10 million end users in the six-state area. To integrate the operation of the Federal hydroelectric generating plants and to transmit power from 24 multi-purpose Corps dams to customers, Southwestern operates and maintains 1,380 miles of high-voltage transmission lines, 26 substations/switchyards, and 51 microwave and very high frequency (VHF) radio sites. Southwestern is headquartered in Tulsa, Oklahoma, and has maintenance facilities in Gore, Oklahoma; Jonesboro, Arkansas; and Springfield, Missouri. In addition, around-the-clock power scheduling and dispatching are conducted by staff in Southwestern's Springfield Operations Center.

Southwestern participates in the Southwest Power Pool (SPP) Regional Transmission Organization (RTO), which reinforces Southwestern's role as part of the Nation's interconnected generation and transmission system. In participation with the SPP RTO, Southwestern works on regional and interregional transmission policy initiatives in response to the evolution of the electric utility industry. Furthermore, with the integration of a large investor owned electric utility into the Midcontinent Independent System Operator (MISO) RTO, Southwestern coordinates its varied utility activities in conjunction with a broader group of stakeholders. As the demand for the transmission of power increases across regional and interregional footprints, maintaining and improving the Nation's energy infrastructure through improvements, replacements, interconnections, and coordination with the RTOs in Southwestern's marketing area has become more critical than ever. Southwestern assures the efficient and reliable delivery of Federal hydropower, thus fulfilling energy security for the present as well as for future generations.

Southwestern's marketing services and delivery capability provide for recovery of all annual operating costs, including the Corps' hydropower related costs, and for repayment of taxpayer investment in all assets and facilities that support the Federal hydropower program. Hydroelectric power is a domestic energy source that helps reduce American dependence on foreign energy supplies and provides American jobs. Southwestern markets an average of 5,570 gigawatt-hours of clean renewable hydroelectric energy annually.

Southwestern will use the following strategies to fulfill its mission:

- Market and deliver, at the lowest possible cost, all available Federal hydropower generated at the Corps multipurpose projects and work with the Corps, States, cooperatives, and municipalities to meet its statutory requirements while balancing the interests of other water users.
- Maintain infrastructure and modernize systems to increase the reliability, efficiency, and use of Federal assets. This will be accomplished using appropriations; Federal power receipts; and alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances) wherein Southwestern may accept work or services in lieu of payment.¹

¹ Southwestern's authority to use net billing and bill crediting is inherent in the authority provided by the Flood Control Act of 1944 and has been affirmed by the Comptroller General. Honorable Secretary of the Interior B-125127 (February 14, 1956).

- Conduct annual power repayment studies to ensure power rates are sufficient to repay all annual operating costs and the Federal investment with interest.
- Meet Southwestern's 1200-hour peaking power contractual obligations with necessary purchase power and wheeling using Federal power receipts; alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances); and the Continuing Fund as necessary in periods of below-average hydropower generation.
- Operate the transmission system efficiently to support the Nation's integrated power grid and engage in transmission policy initiatives within the RTOs in Southwestern's marketing area to respond effectively to the evolution of the electric utility industry.
- Meet requirements for Southwestern's compliance with the latest North American Electric Reliability Corporation (NERC) standards.
- Bolster Southwestern's cyber and physical security postures using best-available technologies and in cooperation with DOE and industry partners to protect the Federal transmission system and the Nation's power grid.

External factors that present potential impacts to the overall achievement of the programs' strategic goals include weather, natural disasters, NERC reliability standards, industry deregulation, physical and cybersecurity, changing electric industry organizational structure, interconnections, open access, the uncertainty of sustainable funding resources, competing uses' demand for the limited water resource, and other unforeseen requirements. More specifically:

- The bulk of Southwestern's transmission infrastructure is approximately 60 years old and requires ongoing maintenance and replacement while concurrently balancing changing and increasing demands for availability.
- Industry efforts to improve the reliability of the Nation's power grid are placing more requirements on Southwestern's workforce to implement mandatory reliability standards.
- Southwestern continues to emphasize security, both cyber and physical, as an agency priority. Ongoing assessments, realigning vacant positions, investments in the cyber and physical security programs, and infrastructure protection improvements enable Southwestern to continue to provide a safe and reliable product.
- Southwestern competes with the rest of the electric utility industry to attract and retain the quality workforce needed to provide a reliable power supply and transmission service as Southwestern's workforce retires.
- Southwestern is increasingly challenged by more complex transmission policy developments including intricate energy and capacity markets, transmission planning processes, and technical rate structures; the deployment of new technologies such as renewables and distributed generation; and heightening emissions and environmental restrictions.
- The Corps water resources projects from which Southwestern markets the hydropower are all multi-purpose. As the demand for water for other purposes increases, energy generation and operating capacity of the hydropower units can be impacted by loss of water storage and availability as well as required operational changes.

Highlights of the FY 2020 Budget Request

Southwestern requests a net appropriation of \$10.4 million for FY 2020. Southwestern's appropriation consists of four subprograms: Operations and Maintenance, Construction, Purchase Power and Wheeling, and Program Direction. Southwestern utilizes a variety of financing methods including appropriations, discretionary offsetting collections, alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances).

Priority is placed on maintenance, upgrades, physical and cybersecurity, compliance, and cost containment.

Consistent with the FY 2018 and FY 2019 Budget Requests, the FY 2020 Budget Request includes the proposal that the Federal government be authorized to sell the transmission assets of Southwestern. The FY 2020 Budget Request also includes a proposal to change Southwestern's statutory rate structure requirement from cost recovery to a market-based structure.

**Southwestern Power Administration
Funding by Congressional Control (\$K)**

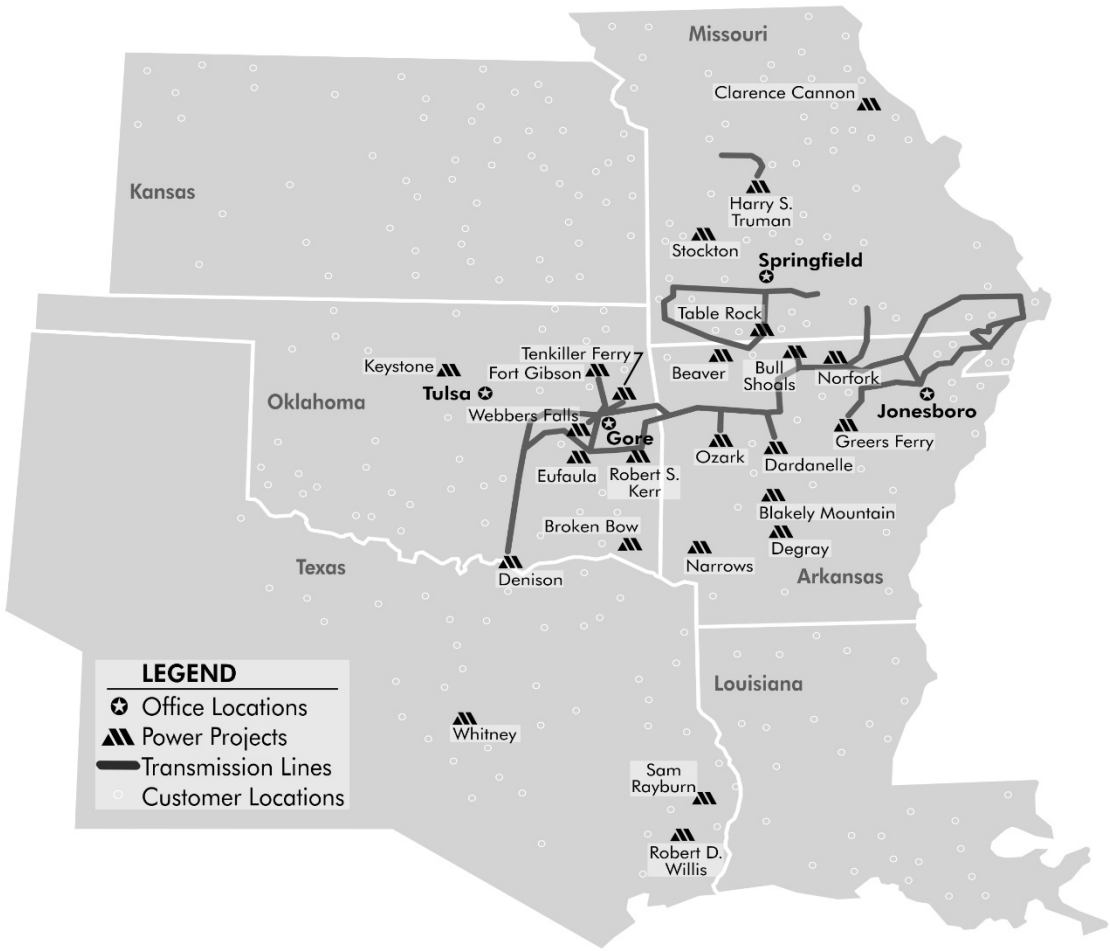
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Operation and Maintenance				
Operations and Maintenance (O&M)	16,680	17,006	13,639	-3,367
Construction (CN)	14,932	16,875	15,067	-1,808
Purchase Power and Wheeling (PPW)	50,000	60,000	93,000	+33,000
Program Direction (PD)	31,335	32,995	35,157	+2,162
Subtotal, Operation and Maintenance	112,947	126,876	156,863	+29,987
Offsetting Collections, PD (annual expenses)	-16,035	-29,695	-31,467	-1,772
Use of Prior Year Balances, PD (annual expenses)	-12,000	0	0	0
Offsetting Collections, O&M (annual expenses)	-2,853	-5,707	-5,908	-201
Use of Prior Year Balances, O&M (annual expenses)	-2,200	0	0	0
Offsetting Collections, PPW	-40,000	-50,000	-83,000	-33,000
Alternative Financing, O&M	-9,042	-8,894	-6,018	+2,876
Alternative Financing, CN	-9,417	-12,180	-10,070	+2,110
Alternative Financing, PPW	-10,000	-10,000	-10,000	0
Total, Operation and Maintenance	11,400	10,400	10,400	0
Federal FTEs	194	194	194	0

**Operation and Maintenance
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

<p>Operations and Maintenance: The decrease in the operations and maintenance subprogram reflects a one-time request for the acquisition or construction of a new facility in FY 2019, not needed in FY 2020.</p>	-3,367
<p>Construction: The decrease in the construction subprogram reflects rebuilding fewer miles of transmission line.</p>	-1,808
<p>Purchase Power and Wheeling: The increase in system support reflects anticipated needs based on projected market prices. In recent years, Southwestern has relied upon its Purchase Power and Wheeling (PPW) spending authority from offsetting collections to fund its Purchased Power needs and effectuate its PPW risk mitigation strategy. Southwestern is requesting a limitation to collect for PPW at the “worst case scenario” level; it has not and does not anticipate collecting and expending up to the limit unless and until a severe water condition occurs in its six-state region.</p>	+33,000
<p>Program Direction: The increase in the program direction subprogram reflects aggressive recruiting to fill several technical hard to fill positions, back-filling retirees, and filling succession planning positions for knowledge transfer. Increases in travel reflect transmission policy related efforts, water resource activities, and field maintenance crew travel. Also, increase in support services for projected contractual cost of living adjustments.</p>	+2,162
Total, Southwestern, Operation and Maintenance	+29,987

Service Area Map



**Operations and Maintenance
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Operations and Maintenance (O&M)				
Power Marketing	200	4,200	200	-4,000
Operations	5,235	7,893	8,217	+324
Maintenance	9,553	3,088	3,834	+746
Capitalized Moveable Equipment	1,692	1,825	1,388	-437
Subtotal, Operations and Maintenance	16,680	17,006	13,639	-3,367
Offsetting Collections (annual expenses)	-2,853	-5,707	-5,908	-201
Use of Prior Year Balances, (annual expenses)	-2,200	0	0	0
Alternative Financing	-9,042	-8,894	-6,018	+2,876
Total, Operations and Maintenance	2,585	2,405	1,713	-692

Southwestern Power Administration Operations and Maintenance

Description

The activities of the Operations and Maintenance (O&M) subprogram are critical components in maintaining the reliability of the Federal power system, which is part of the Nation's interconnected generation and transmission system. By marketing and delivering hydroelectric energy, Southwestern makes a meaningful contribution of clean, safe, reliable, affordable, and secure renewable hydroelectric energy to our Nation. The Energy Policy Act (EPACT) and the Department of Energy (DOE) and Administration's policies emphasize its significant contribution to the Nation's past, current, and future energy supply; and identify Southwestern's important role in meeting electricity demand by supplying hydroelectric energy to its customers. These laws and policies emphasize the need to repair, maintain, and improve generation facilities to ensure safety, security, and reliability of the Nation's energy infrastructure.

Southwestern's planned O&M projects are subject to change due to unanticipated equipment failure, customer needs, and weather conditions. The realities of maintaining a complex interconnected electric power system periodically require unforeseen reprioritizations of planned projects. All projects share the commonality of maintaining, repairing, and improving the aging infrastructure to ensure the reliability of the Federal power system. Southwestern will continue to maintain infrastructure and modernize systems to increase the reliability, efficiency, and use of Federal assets. This will be accomplished using appropriations; offsetting collections; and alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances) wherein Southwestern may accept work or services in lieu of payment.²

The budget request includes a proposal to authorize the Federal government to sell the transmission assets of Southwestern. Until such time as this proposal is enacted, Southwestern will continue its plans for operating, maintaining, and replacing equipment.

Southwestern will continue to strengthen cyber and physical security postures using strong and proven technologies that are part of the Continuous Diagnostics and Mitigation (CDM) program. The CDM program provides capabilities and tools to identify cybersecurity risks on an ongoing basis, prioritize these risks based on potential impacts, and enable cybersecurity personnel to mitigate the most significant problems first. In addition to CDM, Southwestern continues to look for other technologies that can be leveraged to ensure compliance with the Federal Information Security Management Act (FISMA) and North American Energy Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) Standards to protect the Federal transmission system and the Nation's power grid.

² Southwestern's authority to use net billing and bill crediting is inherent in the authority provided by the Flood Control Act of 1944 and has been affirmed by the Comptroller General. Honorable Secretary of the Interior B-125127 (February 14, 1956).

Power Marketing

The Power Marketing activity funds technical and economic studies to support Southwestern's transmission planning, water resources management, and communication functions. Technical and economic studies provide data to analyze and evaluate the impacts of proposed operational changes and decision-making based on cost-benefit analysis. Funding is also required for Southwestern's coordination with the RTOs and to provide regional power restoration assistance to other non-hydropower generation sources during electric power grid emergencies. The National Electric Transmission Congestion Study identified constraints in the Nation's interconnected electrical grid which could impede power flows. Studies to identify any constraints on Southwestern's system will continue to be conducted. These studies show how the marketing and delivery of power is operationally impacted. The funding level for this activity is derived from Southwestern's engineering plan, negotiated architect/engineering contracts, and the number of studies required per year.

Operations

The Operations activity funds communication functions associated with the dispatch and delivery of power; environmental, safety, and health activities; and other transmission activity costs such as physical security, cybersecurity, and day-to-day power dispatch functions. The Operations activity includes three subactivities:

Communications

This subactivity funds telemetering improvements, technical support to protect cyber infrastructure, an e-tagging system that electronically schedules power for customers, load forecasting, digital test equipment, the radio frequency spectrum fee, and supplies and materials. The telemetering improvements include replacement of obsolete power and energy accounting equipment and modification of existing remote terminal units that improve the reliability of the power system, specifically in the areas of monitoring and control. Funding is required for upgrades that enable Southwestern to meet the goals of the EFACT and NERC by replacing aging infrastructure while assuring reliability and continuing to coordinate with the RTOs in its marketing area. The funding level for communications maintenance is derived from maintenance history, the age of equipment, expected life span, annual diagnostic maintenance testing, and historical pricing information.

Environmental, Safety, and Health

This subactivity funds environmental activities including waste disposal and clean-up of oil and polychlorinated biphenyl contaminants from old circuit breakers and transformers, grounding and drainage, cultural resource reviews, and environmental assessments for threatened and endangered species such as the American Burying Beetle, various endangered bats, the Leopard Darter, and Interior Least Tern. Additionally, Southwestern may have environmental activities it performs as a Consulting Agency or participating agency resulting from a Biological Opinion or Biological Assessment, or as a participant on an interagency committee or working group. This subactivity also funds property transfers, wetland assessments, environmental library access, Toxic Substance Control Act and Resource Conservation Recovery Act compliance, contractor services, and requirements of the Environmental Protection Program as identified in DOE Order 450.1. The Safety and Health Program activities require funding for aviation safety, industrial hygiene, medical examinations, medical officer, wellness program, safety equipment, and first aid equipment and supplies.

Other Transmission

This subactivity funds physical security, field utility costs, and day-to-day power expenses of the dispatch center and the Alternate Control Center.

Maintenance

The Maintenance activity funds routine repair, maintenance, and improvement of Southwestern's substations/switchyards and high-voltage transmission lines and ensures delivery of reliable, efficient, and clean power to its customers. Southwestern's initial facilities, which were built approximately 60 years ago, are constantly evaluated. The funding level is based on analysis derived from age of equipment, risk of failure, life-cycle of equipment, and field crew evaluation. Internal and external factors include obsolescence of technology and unavailability of replacement parts. This budget request reflects Southwestern's assessment of the funding required to ensure continued reliability of the Federal power system and to fulfill the NERC operational criteria. By replacing aging equipment and removing constraints that impede power flows, Southwestern ensures the provision of a reliable Federal transmission system. The maintenance activity includes two subactivities:

Substation Maintenance

This subactivity funds power circuit breakers, disconnect switches, instrument transformers, protective relays and related equipment, computer aided drafting and design, revenue meters, vehicle maintenance, fuel, and other equipment to reliably perform general maintenance projects. Southwestern maintains the Federal power system in compliance with the regional electric reliability council and NERC requirements. The funding level for this subactivity is derived from an internal maintenance information system, which includes age and condition of the existing equipment.

Transmission Line Maintenance

This subactivity funds the purchase and maintenance of wood and steel structures, crossarms and braces, right-of-way (ROW) clearing, herbicide application, aerial patrol of the transmission system to identify maintenance needs, routine vehicle repair and maintenance, tractors, equipment, and fuel. The number of steel or wood poles and crossarms and high-voltage insulators replaced is derived from internal maintenance information system criteria. Emphasis has been placed on ROW clearing since NERC identified improper/insufficient ROW clearing as a major factor in potential blackouts. The funding level is appropriate for the number of structures and components to be replaced and the miles of ROW to be cleared as set forth by Southwestern's maintenance plan for meeting the goals of the EPACT and NERC to maintain a reliable transmission system.

Capitalized Moveable Equipment

This activity funds the replacement of vehicles, tractor-trailers, and heavy equipment used for the maintenance and repair of the transmission system and facilities. These vehicles and equipment have exceeded their useful lives and require high levels of maintenance. The vehicle cost estimates are derived from General Services Administration (GSA) pricing schedules.

Operations and Maintenance

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Operations and Maintenance \$17,006,000	\$13,639,000	-\$3,367,000
Power Marketing \$4,200,000	\$200,000	-\$4,000,000
<ul style="list-style-type: none"> The Power Marketing activity funds the technical and economic studies to support transmission planning and the purchase or construction of a facility to reduce future costs by \$21M over 30 years and eliminate unnecessary overhead expenses of approximately \$1M annually, which equates to a 0.5 percent downward pressure on the power rates charged to customers. 	<ul style="list-style-type: none"> The Power Marketing activity funds the technical and economic studies to support transmission planning. 	<ul style="list-style-type: none"> The decrease reflects no additional funding requested for the purchase or construction of a facility.
Operations \$7,893,000	\$8,217,000	+\$324,000
<i>Communications (\$6,384,000)</i>	<i>Communications (\$6,573,000)</i>	<i>Communications (+\$189,000)</i>
<ul style="list-style-type: none"> This subactivity funds telemetering improvements, technical support to protect cyber infrastructure, SCADA/EMS system maintenance, load forecasting, and digital testing equipment. 	<ul style="list-style-type: none"> This subactivity funds telemetering improvements, technical support to protect cyber infrastructure, SCADA/EMS system maintenance, load forecasting, and digital testing equipment. 	<ul style="list-style-type: none"> The increase reflects mobile radio system replacement, hardware and software in support of information technology.
<i>Environmental, Safety, and Health (\$798,000)</i>	<i>Environmental, Safety, and Health (\$903,000)</i>	<i>Environmental, Safety, and Health (+\$105,000)</i>
<ul style="list-style-type: none"> The subactivity funds environmental, safety, and health services. 	<ul style="list-style-type: none"> The subactivity funds environmental, safety, and health services. 	<ul style="list-style-type: none"> The increase reflects a physical security upgrade for FY 2020.
<i>Other Transmission (\$711,000)</i>	<i>Other Transmission (\$741,000)</i>	<i>Other Transmission (+\$30,000)</i>
<ul style="list-style-type: none"> The subactivity funds physical security, field utility costs, and day to day expenses of the dispatch center. 	<ul style="list-style-type: none"> The subactivity funds physical security, field utility costs, and day to day expenses of the dispatch center. 	<ul style="list-style-type: none"> The increase reflects an increase in security enhancements and additional cost of operating the new alternate control center

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Maintenance \$3,088,000	\$3,834,000	+\$746,000
<i>Substation (\$2,044,000)</i> <ul style="list-style-type: none"> This subactivity funds all equipment, parts, and materials for the operation of high voltage substations. 	<i>Substation (\$2,298,000)</i> <ul style="list-style-type: none"> This subactivity funds all equipment, parts, and materials for the operation of high voltage substations. 	<i>Substation (+\$254,000)</i> <ul style="list-style-type: none"> The increase reflects substation grounding and drainage improvements.
<i>Transmission Line Maintenance (\$1,044,000)</i> <ul style="list-style-type: none"> This subactivity funds all equipment, parts, and materials for the operation of the high voltage transmission system. 	<i>Transmission Line Maintenance (\$1,536,000)</i> <ul style="list-style-type: none"> This subactivity funds all equipment, parts, and materials for the operation of the high voltage transmission system. 	<i>Transmission Line Maintenance (+\$492,000)</i> <ul style="list-style-type: none"> The increase reflects implementation of a vegetation management contract.
Capitalized Moveable Equipment \$1,825,000	\$1,388,000	-\$437,000
<ul style="list-style-type: none"> This activity funds the replacement of vehicles, tractor-trailers, and heavy equipment used for the maintenance and repair of the transmission system and facilities. 	<ul style="list-style-type: none"> This activity funds the replacement of vehicles, tractor-trailers, and heavy equipment used for the maintenance and repair of the transmission system and facilities. 	<ul style="list-style-type: none"> The decrease reflects a reduction in heavy equipment and utility trucks being replaced.

**Construction
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Construction				
Transmission System				
Substation Upgrades	2,209	1,896	1,933	+37
Communication Upgrades	4,837	4,579	4,412	-167
Transmission Upgrades	7,886	10,400	8,722	-1,678
Subtotal, Construction	14,932	16,875	15,067	-1,808
Alternative Financing	-9,417	-12,180	-10,070	+2,110
Total, Construction	5,515	4,695	4,997	+302

Southwestern Power Administration Construction

Description

The activities of the Construction subprogram enable Southwestern to market and deliver Federal hydropower in the most reliable, safe, efficient, and cost-effective manner to meet the operational criteria required by the North American Electric Reliability Corporation while avoiding transmission infrastructure deterioration. Southwestern's planned construction projects are subject to change based on unanticipated equipment failure, customer needs, and weather conditions. The realities of maintaining a complex interconnected power system include unforeseen priority projects which arise periodically, causing a reprioritization of planned projects. All projects share the commonality of replacing aging infrastructure necessary to maintain the reliability of the Federal power system.

Southwestern will continue to maintain infrastructure and modernize systems to increase the reliability, efficiency, and use of Federal assets. This will be accomplished using appropriations and alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances).³

The budget request includes a proposal to authorize the Federal government to sell the transmission assets of Southwestern. Until such time as this proposal is enacted, Southwestern will continue current plans for construction, maintenance, and equipment upgrades.

Transmission System

This activity funds current construction projects that require expansion of, or additions to, existing facilities. Southwestern ensures system reliability by replacing aging equipment and removing constraints that limit power flows. The projects outlined below address Southwestern's efforts to reduce the risk of extended service outages, avoid more costly replacements in the future, and support the increased transmission system usage. The funding level for this activity is derived from internal and external management decisions and field crew observations. System age, risk of equipment failure, life-cycles, and obsolescence of technology and unavailability of spare parts, budget constraints, cost, and demand for more capacity are also considered in these budgeting decisions. These variables are assessed and incorporated into Southwestern's ten-year construction plan. The transmission activity includes three subactivities:

Substation Upgrades

This subactivity funds the construction and upgrade of the substations and the components necessary to provide improved system reliability and reduce future maintenance and equipment costs. Southwestern owns and operates 26 substation/switching stations. Many of these facilities were designed and constructed over 60 years ago. The equipment which will be replaced or upgraded includes power transformers, circuit breakers, and control equipment, as well as the structural components necessary to sustain reliable power delivery and support a stable, flexible interconnected power grid.

Communication Upgrades

This subactivity funds all communication equipment planned to provide improved system reliability and reduce future maintenance and equipment costs. This subactivity also provides funding for microwave radios and microwave tower additions, replacements, and modifications that will increase the reliability of communications with generating plants and substations. The communication system provides for the transfer of voice and data traffic to allow monitoring and control of power system generation and transmission assets.

³ Southwestern's authority to use net billing and bill crediting is inherent in the authority provided by the Flood Control Act of 1944 and has been affirmed by the Comptroller General. Honorable Secretary of the Interior B-125127 (February 14, 1956).

Transmission Upgrades

This subactivity funds transmission system upgrades. Much of the conductor, optical ground wire (OPGW), and static wire on Southwestern's transmission lines has reached the end of its service life. With this assumed service life, approximately 20 to 30 miles of transmission line, including the conductor, OPGW, static wire, and structures, will need to be replaced each year. As Southwestern replaces the conductor, Southwestern will use the opportunity to increase line capacity where practical to accommodate increased loads in the region.

Spectrum Relocation

The Commercial Spectrum Enhancement Act of 2004 (CSEA, Title II of P.L. 108-494) created the Spectrum Relocation Fund (SRF) to streamline the relocation of Federal systems from existing spectrum bands and accommodate commercial use by facilitating reimbursement of relocation costs to affected agencies. Southwestern has received \$42.8 million in spectrum relocation funds, as approved by the Office of Management and Budget, and as reported to the Congress. Southwestern has completed 94 percent of the tower installation project and anticipates completing construction and obtaining comparable capability by the fall of 2019. These mandatory funds will remain available until expended, and Southwestern will return any amounts received in excess of actual relocation costs to the SRF. Spectrum relocation activities were funded from spectrum auction proceeds; thus, no funding is requested in this subactivity.

Construction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Construction \$16,875,000	\$15,067,000	-\$1,808,000
Transmission System \$16,875,000	\$15,067,000	-\$1,808,000
<i>Substation Upgrades (\$1,896,000)</i> <ul style="list-style-type: none"> Springfield Transformer #1 replacement project consists of replacing an autotransformer that threatens system reliability due to exceeding its life expectancy of 35 years. Due to its age, this autotransformer is difficult to repair due to scarcity of parts and overloading issues. 	<i>Substation Upgrades (\$1,933,000)</i> <ul style="list-style-type: none"> Funding is requested for Power Circuit Breakers at Clarksville; Disconnect Switches at New Madrid and Weleetka; Grounding and Drainage Projects at Malden and Piggott; and Instrument Transformers at various locations. 	<i>Substation Upgrades (+\$37,000)</i> <ul style="list-style-type: none"> The increase is due to different substation upgrades at different locations than the previous year.
<i>Communication Upgrades (\$4,579,000)</i> <ul style="list-style-type: none"> This subactivity funds all communication equipment, fiber optic, and microwave systems additions and replacements. 	<i>Communication Upgrades (\$4,412,000)</i> <ul style="list-style-type: none"> This subactivity funds all communication equipment additions and replacements. Projects include microwave equipment between Nixa, Selmore, and Hercules. Also, Microwave Tower Replacement at White Oak. 	<i>Communication Upgrades (-\$167,000)</i> <p>The decrease is due to different communication upgrades at different locations than the previous year.</p>
<i>Transmission Upgrades (\$10,400,000)</i> <ul style="list-style-type: none"> Rebuild Van Buren-Liberty, 12.2 miles and rebuild Akins-Liberty, 8.6 miles due to age, condition and electrical loading of the conductor. 	<i>Transmission Upgrades (\$8,722,000)</i> <ul style="list-style-type: none"> Rebuild portions of Line 3001, 15.1 miles due to age, condition and electrical loading of the conductor. 	<i>Transmission Upgrades (-\$1,678,000)</i> <ul style="list-style-type: none"> The decrease in the construction subprogram reflects rebuilding a reduced number of miles of transmission line.

**Purchase Power and Wheeling
Funding (\$K)**

Purchase Power and Wheeling

System Support

Other Contractual Services

Subtotal, Purchase Power and Wheeling

Offsetting Collections (PPW)

Alternative Financing

Total, Purchase Power and Wheeling

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
46,500	56,500	89,500	+33,000
3,500	3,500	3,500	0
50,000	60,000	93,000	+33,000
-40,000	-50,000	-83,000	-33,000
-10,000	-10,000	-10,000	0
0	0	0	0

Southwestern Power Administration Purchase Power and Wheeling

Description

The Purchase Power and Wheeling (PPW) subprogram provides for the purchase of energy to meet peaking power contractual obligations and the delivery of Federal power. Except for contractual arrangements pertaining to a few electrically-isolated hydropower projects, Southwestern's power sales contracts provide for 1200-hours of peaking power per year delivered from its interconnected system of hydropower projects. At times, due to below average water conditions or hydropower unit outages, Southwestern must purchase power when the hydropower projects cannot produce enough to fulfill its 1200-hour contract obligations. Blending purchased power with the Federal hydropower provides a reliable product while ensuring contract fulfillment occurs.

Southwestern assesses its purchase power needs based on hydrologic conditions and anticipated hydropower unit outages. Hydrologic conditions can vary widely and change rapidly, such that purchase power needs are assessed at least seasonally and can change daily. Unit outages for major rehab and replacement work are known years in advance so that purchase power needs can be planned; however, forced outages or delays in units returning to service can cause sudden changes to anticipated purchase power needs. Power purchases are typically made through contractual arrangements but may also be made on the spot market when conditions are more severe than anticipated or otherwise unexpected. Delivery of purchase power to Southwestern's system is made via the SPP RTO or Southwestern's own transmission system.

Southwestern's budget request for the PPW subprogram reflects the maximum anticipated need to ensure adequate funding to fulfill its 1,200-hour peaking power contractual obligations taking into account volatile market prices, unknown forced generation outages, and all but the most severe hydrological conditions. Southwestern will continue to use offsetting collections and alternative financing arrangements, which include net billing, bill crediting, and/or reimbursable authority (customer advances), to fund this subprogram. When hydropower generation falls significantly below normal due to severe drought conditions or major outages, Southwestern will utilize the Continuing Fund for emergency PPW expenses.

Southwestern has implemented a PPW risk mitigation strategy to ensure continuous operations during periods of significant drought. The strategy was developed consistent with existing authorities, and with the participation and support of Southwestern power customers. Under this approach, Southwestern retains receipts from the recovery of purchase power and wheeling expenses within the 'up to' amount specified by Congress. The receipts retained are available until expended and are available only for PPW expenses. As of the end of FY 2018, Southwestern's PPW reserve balance was \$69 million. Customers will provide other power resources and/or purchases for the remainder of their firm loads.

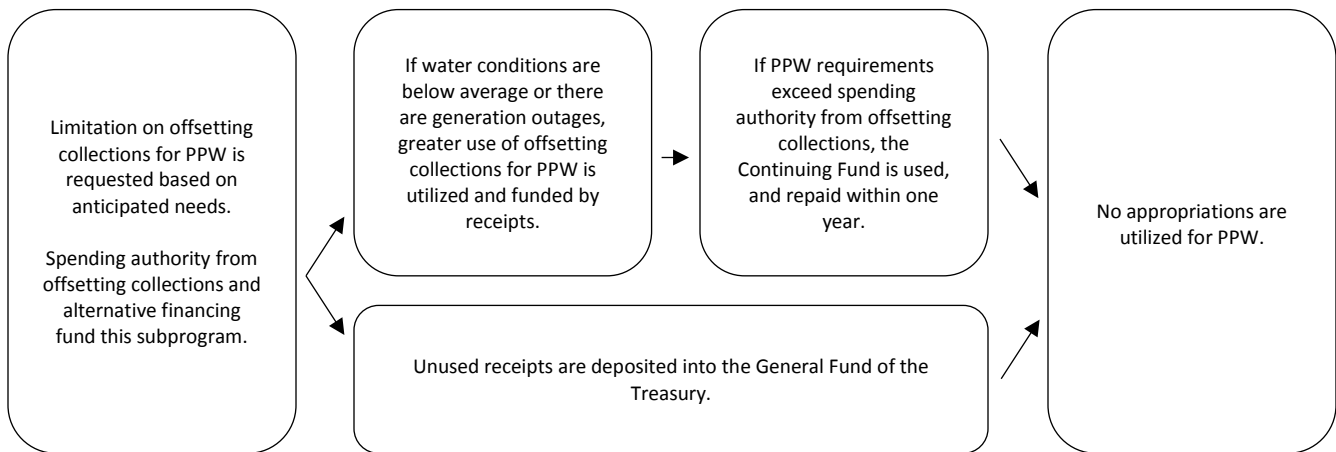
The activities of the PPW subprogram provide for the purchase of power that helps fulfill limited peaking power contractual obligations, thereby ensuring the marketability of the Federal hydropower resource and repayment of the Federal investment. This subprogram also provides for wheeling services that deliver Federal power to optimize the operation of the hydropower facilities marketed by Southwestern. This subprogram enhances the reliability of the electrical transmission grid. PPW includes two activities:

System Support

This activity funds Southwestern’s purchase power requirements needed to fulfill all 1200-hour contractual peaking power obligations with customers. System support requirements depend on the conditions of the interconnected system of hydropower projects which is affected by weather, power market prices (which can be volatile), and limited availability of energy banks. In prior years, inadequate funding for PPW and hydrological fluctuations required multiple requests to access the Continuing Fund to ensure sufficient funding was available to fulfill Southwestern’s 1200-hour peaking power contractual obligations. In FY 2001, Southwestern requested, and Congress enacted, authority to use Federal power receipts that recover purchase power and wheeling expenses (offsetting collections) to fund its PPW program (up to a specified limit). The use of this authority will be largely dependent upon the hydrological conditions realized during the fiscal year. Under average conditions, less than half of the limit requested will be collected and used. Since the rates Southwestern charges its customers are based on full cost recovery, Southwestern has a built-in incentive to minimize expenditures for purchase power. This authority ensures greater flexibility when Southwestern experiences low water conditions, hydropower unit outages, and/or volatile power market prices, and will decrease dependence on the Continuing Fund under all but the most severe hydrological conditions.

Other Contractual Services

This activity funds other contractual services that provide for wheeling associated with the purchase of transmission service to meet limited peaking power obligations and for the integration of projects for the delivery of Federal power. The funding level is derived from contractual wheeling requirements. The FY 2020 funding request reflects the projected cost for wheeling services based on contractual pricing and delivery terms.



Purchase Power and Wheeling

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Purchase Power and Wheeling \$60,000,000	\$93,000,000	\$33,000,000
<i>System Support \$56,500,000</i>	<i>\$89,500,000</i>	<i>\$33,000,000</i>
<ul style="list-style-type: none"> • This activity funds purchase power requirement needed to fulfill all 1200-hour contractual peaking power obligations with customers. 	<ul style="list-style-type: none"> • This activity funds purchase power requirement needed to fulfill all 1200-hour contractual peaking power obligations with customers. 	<ul style="list-style-type: none"> • The increase in system support reflects maximum anticipated needs based on projected market prices and hydrologic conditions.
<i>Other Contractual Services \$3,500,000</i>	<i>\$3,500,000</i>	<i>+\$0</i>
<ul style="list-style-type: none"> • Contractual services for wheeling associated with the purchase of transmission service. 	<ul style="list-style-type: none"> • Contractual services for wheeling associated with the purchase of transmission service. 	<ul style="list-style-type: none"> • Funding request remains the same.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Southwestern Power Administration				
Salaries and Benefits	22,688	23,311	25,157	+1,846
Travel	1,356	1,372	1,561	+189
Support Services	3,591	3,867	3,983	+116
Other Related Expenses	3,700	4,445	4,456	+11
Subtotal, Southwestern Power Administration	31,335	32,995	35,157	+2,162
Offsetting Collections (annual expenses)	-16,035	-29,695	-31,467	-1,772
Use of Prior Year Balances, PD (annual expenses)	-12,000	0	0	0
Total, Program Direction	3,300	3,300	3,690	+390
Federal FTEs	194	194	194	0
Support Services				
Management Support				
Reports and Analyses management and General Administrative Support	3,591	3,867	3,983	+116
Total Management Support	3,591	3,867	3,983	+116
Total, Support Services	3,591	3,867	3,983	+116
Other Related Expenses				
Rent to Others	840	882	889	+7
Communication, Utilities, Misc.	255	390	1,000	+610
Printing and Reproduction	110	115	76	-39
Other Services	660	1,085	719	-366
Training	260	285	185	-100
Power Marketing Liaison	97	178	140	-38
Financial Audit	528	545	400	-145
Supplies and Materials	250	250	150	-100
Equipment	475	465	450	-15
Working Capital Fund	225	250	447	+197
Total, Other Related Expenses	3,700	4,445	4,456	+11

Program Direction

Overview

Southwestern's Program Direction subprogram ensures continued reliability of the Federal power system by utilizing Federal staffing resources and associated funds required to provide overall direction and execution of Southwestern's Operation and Maintenance Program.

The Program Direction subprogram supports DOE's and Southwestern's missions by providing compensation and all related expenses for its workforce, including those employees that operate and maintain Southwestern's high-voltage interconnected transmission system and associated facilities; those that plan, design, and supervise the construction of replacements, upgrades, and additions (capital investments) to the transmission facilities; those that market the power and energy produced to repay annual expenses and capital investment; those that perform cyber and physical security roles; and those that administratively support these functions.

Southwestern will use available programs and develop new strategies to hire and train the next generation of engineers, cyber and physical security specialists, power system dispatchers, high voltage electricians, and linemen. These initiatives will address the shortage of these valuable resources because of retirement trends, and the ever-expanding demands on the electric utility industry, such as compliance with NERC and FISMA standards.

Southwestern trains all employees on a continuing basis in occupational safety and health regulations, policies, and procedures to keep the safety culture strong. Accidents are always reviewed to ensure lessons are learned and proper work protocol is in place.

Program Direction is mainly funded from offsetting collections. Other funding utilized for Program Direction is appropriations and if necessary alternative financing arrangements.

Highlights of the FY 2020 Budget Request

The FY 2020 Budget Request's funding level for salaries is derived from the current year budgeted salaries, projected cost-of-living adjustments, promotions, and within-grade increases. The funding level for benefits is derived from a percentage of budgeted salaries.

Program Direction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$32,995,000	\$35,157,000	+\$2,162,000
<i>Salaries and Benefits \$23,311,000</i>	<i>\$25,157,000</i>	<i>+\$1,846,000</i>
<ul style="list-style-type: none"> The FY 2019 level supports 194 Federal employees: 54 percent of the employees are GS; salaries of the remaining 46 percent (craft workers and power system dispatchers) are determined through union negotiations and wage surveys. This activity also includes overtime, awards, relocation, workers' compensation, recruitment bonuses, retention pay, and advanced in-hire rates. By the end of FY 2019, approximately 22 percent of Southwestern's staff will be eligible for optional retirement. Southwestern will continue to invest in its employees, emphasizing strong development programs, completing skills gap analyses, and pursuing aggressive recruitment and retention efforts. 	<ul style="list-style-type: none"> The FY 2020 level supports 194 Federal employees: 54 percent of the employees are GS; salaries of the remaining 46 percent (craft workers and power system dispatchers) are determined through union negotiations and wage surveys. This activity also includes overtime, awards, relocation, workers' compensation, recruitment bonuses, retention pay, and advanced in-hire rates. By the end of FY 2020, approximately 24 percent of Southwestern's staff will be eligible for optional retirement. Southwestern will continue to invest in its employees, emphasizing strong development programs, completing skills gap analyses, and pursuing aggressive recruitment and retention efforts. 	<ul style="list-style-type: none"> The increase in Salaries and Benefits reflects aggressive recruiting to fill several technical hard to fill positions, back-filling retirees, and filling succession planning positions for knowledge transfer.
<i>Travel \$1,372,000</i>	<i>\$1,561,000</i>	<i>+\$189,000</i>
<ul style="list-style-type: none"> This activity funds all related travel and per diem expenses for mission-related travel to maintain the integrity and reliability of Southwestern's geographically dispersed power system. The funding level for this activity is primarily derived from the daily requirement of the field maintenance personnel to maintain 1,380 miles of transmission lines, 26 substations/switchyards, 51 microwave/radio sites, communication equipment, and the Supervisory Control and Data Acquisition network. Travel for the performance of general and administrative functions is also included. 	<ul style="list-style-type: none"> This activity funds all related travel and per diem expenses for mission-related travel to maintain the integrity and reliability of Southwestern's geographically dispersed power system. The funding level for this activity is primarily derived from the daily requirement of the field maintenance personnel to maintain 1,380 miles of transmission lines, 26 substations/switchyards, 51 microwave/radio sites, communication equipment, and the Supervisory Control and Data Acquisition network. Travel for the performance of general and administrative functions is also included. 	<ul style="list-style-type: none"> The increase in travel reflects transmission policy related efforts, water resource activities, and field maintenance crew travel.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p><i>Support Services \$3,867,000</i></p> <ul style="list-style-type: none"> This activity funds contracted management support services including information technology, E-government, and administrative/records management support. The funding level for this activity is derived from the most recent negotiated contract for support services essential to achieve Southwestern’s mission. 	<p><i>\$3,983,000</i></p> <ul style="list-style-type: none"> This activity funds contracted management support services including information technology, E-Government, and administrative/records management support. The funding level for this activity is derived from the most recent negotiated contract for support services essential to achieve Southwestern’s mission. 	<p><i>+\$116,000</i></p> <ul style="list-style-type: none"> Increase reflects contractual cost-of-living increase.
<p><i>Other Related Expenses \$4,445,000</i></p> <ul style="list-style-type: none"> This activity funds rental space, facility security, the financial audit, services of the Power Marketing Liaison Office, the working capital fund, technology refresh in the areas of personal computers, hardware and software, printing and reproduction, and training and tuition fees in support of workforce planning and required training to meet the NERC emergency operations requirement. Rental space costs assume the GSA inflation factor. Other costs are based on the historical usage and actual cost of similar items. 	<p><i>\$4,456,000</i></p> <ul style="list-style-type: none"> This activity funds rental space, facility security, the financial audit, services of the Power Marketing Liaison Office, the Human Resources Shared Service Center (HRSSC), the working capital fund, technology refresh in the areas of personal computers, hardware and software, printing and reproduction, and training and tuition fees in support of workforce planning and required training to meet the NERC emergency operations requirement. Rental space costs assume the GSA inflation factor. Other costs are based on the historical usage and actual cost of similar items. 	<p><i>+\$11,000</i></p> <ul style="list-style-type: none"> The increase reflects the costs of the Working Capital Fund, Legal Support, the HRSSC, and Information Technology service agreements.

**Southwestern Power Administration
Revenues and Receipts**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Gross Revenues							
Sale and Transmission of Electric Energy	186,305	228,610	268,336	268,336	268,336	268,336	268,336
Total, Gross Revenues ⁴	186,305	228,610	268,336	268,336	268,336	268,336	268,336
Alternative Financing Credited as an Offsetting Receipt, Net Billing/Bill Crediting	-121,141	-122,459	-123,597	-120,616	-117,421	-117,580	-116,561
Offsetting Collections, Southwestern Annual Expenses (Net Zero)	-18,888 ⁵	-35,402	-37,375	-37,019	-37,882	-38,359	-39 087
Offsetting Collections, Purchase Power and Wheeling ('up to' ceiling) ⁶	-40,000	-50,000	-83,000	-83,000	-83,000	-83,000	-83,000
Total Proprietary Receipts	6,276	20,749	24,364	27,701	30,033	29,397	29,688
Percent of Sales to Preference Customers	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Energy Sales from Power Marketed (billions of kilowatt hours)	5.4	5.4	5.4	5.4	5.4	5.4	5.4

⁴ Southwestern has the ability to adjust its revenues to ensure full recovery of purchase power expenses, by making limited adjustments as allowed for within its current rates and/or through the annual power repayment studies and rates change process if a more substantial adjustment is needed.

⁵ FY 2018 annual expenses were less than previous and estimated future years resulting from the use of prior year balances to offset the request.

⁶ FY 2018 amount is actual. Line identifies purchase power and wheeling limitation to collect 'up to' amount requested in the budget. Limit requested (when matched with PPW receipts) could potentially fund a drought for one year or replenish unobligated balances after a drought has occurred. This will also allow funding to be collected in case the drought persists for more than a year.

Southwestern Power Administration
Estimate of Offsetting Collections for Reimbursable Work and Work for Others⁷

(Dollars in Thousands)

	FY 2018	FY 2019	FY 2020
Offsetting Collections for Reimbursable Work ⁸			
Alternative Financing			
Operations and Maintenance	9,042	8,894	6,018
Construction	9,417	12,180	10,070
Purchase Power and Wheeling (PPW)	10,000	10,000	10,000
Subtotal, Alternative Financing	28,459	31,074	26,088
Offsetting Collections not anticipated for obligation in budget year	0	0	0
Subtotal, Offsetting Collections for Reimbursable Work	28,459	31,074	26,088
Offsetting Collections for Reimbursable Work-for-Others ⁹	8,541	19,926	24,912
Total, Offsetting Collections for Reimbursable	37,000	51,000	51,000

⁷Southwestern received permanent non-Federal reimbursable authority pursuant to 16 USC 825s-4. Table is shown for transparency purposes.

⁸Southwestern relies significantly on alternative financing arrangements with customers to finance much of its direct mission work on a reimbursable basis.

⁹ Southwestern utilizes various forms of Federal and non-Federal reimbursable agreements. Work-for-Others agreements include interconnection requests, system upgrades for reliability, and relocation of structures for State and Federal highways.

**Southwestern Power Administration
System Statistics**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Generating Capacity (kilowatts)							
Installed Capacity	2,193,500	2,193,500	2,193,500	2,193,500	2,193,500	2,193,500	2,193,500
Marketed Capacity	2,052,500	2,052,500	2,052,500	2,052,500	2,052,500	2,052,500	2,052,500
Generating Stations							
Generating Projects							
(Number)	24	24	24	24	24	24	24
Substations/Switchyards							
(Number)	26	26	26	26	26	26	26
Substations/Switchyards							
(kVA Capacity)	1,026,900	1,026,900	1,026,900	1,026,900	1,026,900	1,026,900	1,026,900
Available Energy¹⁰ (Megawatt-hours)							
Energy Generated	4,063,765	4,991,900	5,202,200	5,136,400	5,144,300	5,144,300	5,144,300
Energy Received	240,428	237,900	220,200	227,200	228,300	228,300	228,300
Total, Energy Available for Marketing	4,304,193	5,229,800	5,422,400	5,363,600	5,372,600	5,372,600	5,372,600
Transmission Lines (Circuit-Miles)							
161-KV	1,117	1,117	1,117	1,117	1,117	1,117	1,117
138-KV	164	164	164	164	164	164	164
69-KV	99	99	99	99	99	99	99
Total, Transmission Lines	1,380	1,380	1,380	1,380	1,380	1,380	1,380

¹⁰ Available Energy: actual data is gross; estimated data comes from Southwestern's 2018 power repayment studies.

Power Marketed, Wheeled, or Exchanged by Project

	State	Number of Plants	Installed Capacity (kW)	Marketed Capacity (kW)	FY 2018 Actual Energy (GWh)	FY 2019 Estimated Energy (GWh)	FY 2020 Estimated Energy (GWh)	FY 2021 Estimated Energy (GWh)	FY 2022 Estimated Energy (GWh)	FY 2023 Estimated Energy (GWh)	FY 2024 Estimated Energy (GWh)
Power Marketed											
Interconnected											
	System										
	Missouri	4	470,000	721,347	1,462	1,786	1,851	1,831	1,836	1,836	1,836
	Arkansas	9	1,037,050	395,248	801	978	1,015	1,004	1,005	1,005	1,005
	Oklahoma	7	514,100	420,860	853	1,041	1,081	1,069	1,070	1,070	1,070
	Texas	2	113,000	179,829	425	518	538	532	533	533	533
	Louisiana	0	0	112,802	289	352	366	362	362	362	362
	Kansas	0	0	163,064	331	403	419	414	415	415	415
	Subtotals	22	2,134,150	1,993,150	4,161	5,078	5,270	5,212	5,221	5,221	5,221
Isolated:											
Robert D. Willis Project											
Sam Rayburn Project											
	50% to Texas	2	59,350	29,675	62.4	76	76	76	76	76	76
	50% to Louisiana	0	0	29,675	62.4	76	76	76	76	76	76
	Subtotals	2	59,350	59,350	125	152	152	152	152	152	152
	Total, Power Marketed¹¹	24	2,193,500	2,052,500	4,286	5,230	5,422	5,364	5,373	5,373	5,373
Power Wheeled/Exchanged											
	Wheeled (MW)				777	687	675	678	681	681	681
	Exchanged (GWh)				0	0	0	0	0	0	0

¹¹ Total, Power Marketed: actual energy data is the energy delivered and therefore net of losses and other non-marketed energy; estimated data comes from Southwestern’s 2018 power repayment studies.

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Southwestern Power Admin. - Operation & Maint.	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Southwestern Power Administration			
Systems Operation and Maintenance			
Systems Operation and Maintenance	16,680	17,006	13,639
Purchase Power and Wheeling			
Purchase Power and Wheeling	50,000	60,000	93,000
SWPA Construction			
Construction	14,932	16,875	15,067
Program Direction			
Program Direction	31,335	32,995	35,157
Total, Southwestern Power Administration	112,947	126,876	156,863
Total, Southwestern Power Admin. - Operation & Maint.	112,947	126,876	156,863

Western Area Power Administration

**Western Area Power
Administration**

**Construction, Rehabilitation, Operation and Maintenance
Western Area Power Administration
Proposed Appropriation Language**

For carrying out the functions authorized by title III, section 302(a)(1)(E) of the Act of August 4, 1977 (42 U.S.C. 7152), and other related activities including conservation and renewable resources programs as authorized, [\$265,142,000] \$262,959,000, including official reception and representation expenses in an amount not to exceed \$1,500, to remain available until expended, of which [\$265,142,000] \$262,959,000 shall be derived from the Department of the Interior Reclamation Fund: Provided, That notwithstanding 31 U.S.C. 3302, section 5 of the Flood Control Act of 1944 (16 U.S.C. 825s), and section 1 of the Interior Department Appropriation Act, 1939 (43 U.S.C. 392a), up to [\$175,770,000] \$173,587,000 collected by the Western Area Power Administration from the sale of power and related services shall be credited to this account as discretionary offsetting collections, to remain available until expended, for the sole purpose of funding the annual expenses of the Western Area Power Administration: Provided further, That the sum herein appropriated for annual expenses shall be reduced as collections are received during the fiscal year so as to result in a final fiscal year [2019] 2020 appropriation estimated at not more than \$89,372,000 of which \$89,372,000 is derived from the Reclamation Fund: Provided further, That notwithstanding 31 U.S.C. 3302, up to [\$225,442,000] \$258,881,000 collected by the Western Area Power Administration pursuant to the Flood Control Act of 1944 and the Reclamation Project Act of 1939 to recover purchase power and wheeling expenses shall be credited to this account as offsetting collections, to remain available until expended for the sole purpose of making purchase power and wheeling expenditures: Provided further, That for purposes of this appropriation, annual expenses means expenditures that are generally recovered in the same year that they are incurred (excluding purchase power and wheeling expenses). *Provided further, That of the unobligated balances from prior year appropriations available under this heading, \$176,000 is hereby permanently cancelled. (Energy and Water Development and Related Agencies Appropriations Act, 2019.)*

Explanation of Changes

The appropriation language includes rescission of approximately \$176,000 remaining available from the completed Basic Substation Environmental Remediation Project.

Public Law Authorizations

P.L. 57-161, "The Reclamation Act of 1902"
P.L. 78-534, "Flood Control Act of 1944"
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 66-389, "Sundry Civil Appropriations Act" (1922)
P.L. 76-260, "Reclamation Project Act of 1939"
P.L. 80-790, "Emergency Fund Act of 1948"
P.L. 102-575, "Reclamation Projects Authorization and Adjustment Act of 1992"
"Economy Act" of 1932, as amended (41 stat. 613)
"Interior Department Appropriation Act of 1928"
(44 Stat. 957)
P.L. 70-642, "Boulder Canyon Project Act" (1928)
P.L. 75-756, "Boulder Canyon Project Adjustment Act" (1940)
P.L. 98-381, "Hoover Power Plant Act of 1984"
P.L. 75-529, "The Fort Peck Project Act of 1938"
P.L. 84-484, "The Colorado River Storage Project Act of 1956"
P.L. 90-537, "The Colorado River Basin Project Act of 1968"
The Act of June 18, 1954 (68 Stat. 255)
P.L. No 111-5, "American Recovery and Reinvestment Act of 2009"

**Falcon and Amistad Operating and Maintenance Fund
Proposed Appropriation Language**

For operation, maintenance, and emergency costs for the hydroelectric facilities at the Falcon and Amistad Dams, [\$1,568,000] \$3,160,000, to remain available until expended, and to be derived from the Falcon and Amistad Operating and Maintenance Fund of the Western Area Power Administration, as provided in section 2 of the Act of June 18, 1954 (68 Stat. 255): Provided, That notwithstanding the provisions of that Act and of 31 U.S.C. 3302, up to [\$1,340,000] \$2,932,000 collected by the Western Area Power Administration from the sale of power and related services from the Falcon and Amistad Dams shall be credited to this account as discretionary offsetting collections, to remain available until expended for the sole purpose of funding the annual expenses of the hydroelectric facilities of these Dams and associated Western Area Power Administration activities: Provided further, That the sum herein appropriated for annual expenses shall be reduced as collections are received during the fiscal year so as to result in a final fiscal year [2019] 2020 appropriation estimated at not more than \$228,000: Provided further, That for purposes of this appropriation, annual expenses means expenditures that are generally recovered in the same year that they are incurred: Provided further, That for fiscal year [2019] 2020, the Administrator of the Western Area Power Administration may accept up to [\$372,000] \$1,187,000 in funds contributed by United States power customers of the Falcon and Amistad Dams for deposit into the Falcon and Amistad Operating and Maintenance Fund, and such funds shall be available for the purpose for which contributed in like manner as if said sums had been specifically appropriated for such purpose: Provided further, That any such funds shall be available without further appropriation and without fiscal year limitation for use by the Commissioner of the United States Section of the International Boundary and Water Commission for the sole purpose of operating, maintaining, repairing, rehabilitating, replacing, or upgrading the hydroelectric facilities at these Dams in accordance with agreements reached between the Administrator, Commissioner, and the power customers. (Energy and Water Development and Related Agencies Appropriations Act, 2019.)

Explanation of Changes

There is no change in the appropriation language.

Public Law Authorizations

P.L. 103-236, "Foreign Relations Authorization Act, Fiscal Years 1994 and 1995"
The Act of June 18, 1954 (68 Stat. 255)

Western Area Power Administration

	(\$K)		
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
Gross	1,079,379	1,102,514	1,189,137
Offsets	-1,008,779	-1,035,914	-1,121,113
Net BA	70,600	66,600	68,024

Overview

Western Area Power Administration (WAPA) continues to support the Department of Energy (DOE)'s priorities for a resilient, reliable and secure North American electricity system.

WAPA's mission is to market and reliably deliver cost-based Federal hydroelectric power. WAPA markets power in 15 central and western states from Federally-owned power plants operated primarily by the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation and the Department of State's International Boundary and Water Commission. WAPA operates and maintains a high-voltage, integrated transmission system, including approximately 17,000 circuit-miles of high-voltage transmission lines, more than 300 substations/switchyards and associated power system controls, and communication and electrical facilities.

WAPA serves a diverse group of nearly 700 wholesale customers, including more than two dozen military installations, DOE National labs, municipalities, cooperatives, public utility and irrigation districts, Federal and state agencies and Native American tribes. In turn, WAPA's customers provide service to millions of retail consumers.

WAPA's base program is funded through three appropriation accounts: 1) the Construction, Rehabilitation, Operation and Maintenance Account (CROM); 2) Falcon and Amistad Operating and Maintenance Fund; and 3) Colorado River Basins Power Marketing Fund (CRBPMF). Within these three accounts, there are seven subprograms; four in the CROM Account, one in the Falcon and Amistad Operating and Maintenance Fund and two in CRBPMF.

Highlights and Major Changes in the FY 2020 Budget Request

There are no major programmatic changes in the FY 2020 request. Consistent with the FY 2018 and FY 2019 budget requests, the FY 2020 budget request includes a proposal to authorize the Federal government to sell the transmission assets of WAPA and a proposal to repeal the \$3.25 billion borrowing authority managed by WAPA's Transmission Infrastructure Program (TIP). The FY 2020 budget request again proposes to change WAPA's statutory rate structure requirement from cost recovery to a market based structure that takes into consideration rates charged by comparable utilities and could result in faster recoupment of the taxpayer investment.

**Western Area Power Administration
Funding by Congressional Control (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Construction, Rehabilitation, Operation and Maintenance (CROM)				
Operation and Maintenance	72,407	77,056	72,176	-4,880
Construction and Rehabilitation	52,272	32,632	45,887	+13,255
Purchase Power and Wheeling	498,072	486,396	547,650	+61,254
Program Direction	235,722	238,483	250,091	+11,608
Subtotal, CROM Program	858,473	834,567	915,804	+81,237
Alternative Financing				
Operation and Maintenance	-5,068	-7,758	-6,600	+1,158
Construction and Rehabilitation	-40,500	-27,077	-39,922	-12,845
Purchase Power and Wheeling	-289,072	-260,954	-288,769	-27,815
Program Direction	-38,398	-39,136	-44,719	-5,583
Subtotal, Alternative Financing	-373,038	-334,925	-380,010	-45,085
Offsetting Collections from Colorado River Dam Fund				
Operation and Maintenance	-1,580	-1,455	-1,415	+40
Program Direction	-7,726	-7,603	-7,539	+64
Subtotal, Offsetting Collections from Colorado River Dam Fund	-9,306	-9,058	-8,954	+104
Offsetting Collections, annual Operation and Maintenance and Program Direction				
Operation and Maintenance	-13,854	-25,009	-24,445	+564
Program Direction	-116,050	-150,761	-149,142	+1,619
Subtotal, Offsetting Collections, annual Operation and Maintenance and Program Direction	-129,904	-175,770	-173,587	+2,183
Offsetting Collections, Purchase Power and Wheeling	-209,000	-225,442	-258,881	-33,439
Use of Prior Year Balances				
Annual Operation and Maintenance	-12,305	0	-1,000	-1,000
Annual Program Direction	-31,548	0	-4,000	-4,000
Subtotal, Use of Prior Year Balances	-43,853	0	-5,000	-5,000
Subtotal, CROM	93,372	89,372	89,372	0
Rescission of Prior Year Balances			-176	-176
Total, CROM	93,372	89,372	89,196	-176
Federal FTEs	1,166	1,210	1,210	0

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Falcon and Amistad Operating and Maintenance Fund	5,048	4,440	5,647	+1,207
Offsetting Collections, annual Operation and Maintenance	-3,948	-1,340	-2,932	-1,592
Use of Prior Year Balances		-2,500	-1,300	+1,200
Alternative Financing	-872	-372	-1,187	-815
Total, Falcon and Amistad	228	228	228	0
Federal FTEs	0	0	0	0
Colorado River Basins Power Marketing Fund (CRBPMF)	185,396	220,337	220,244	-93
Offsetting Collections	-208,396	-243,337	-241,644	+1693
Total, CRBPMF	-23,000	-23,000	-21,400	+1,600
Federal FTEs	273	293	296	+3
Transmission Infrastructure Program Fund (TIP)	30,462	43,170	47,442	+4,272
Advance Funding	-5,550	-4,500	-4,300	+200
Offsetting Collections	-24,912	-38,670	-43,142	-4,472
Total TIP	0	0	0	0
Federal FTEs	7	18	15	-3
Total, Western Area Power Administration	70,600	66,600	68,024	1,424
Federal FTEs	1,446	1,521	1,521	0

**Construction, Rehabilitation, Operation and Maintenance
Western Area Power Administration**

	(\$K)		
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
Gross	858,473	834,567	915,804
Offsets	-765,101	-745,195	-826,432
Subtotal	93,372	89,372	89,372
Rescission of prior year balances			-176
Net BA	93,372	89,372	89,196

Overview

WAPA markets and delivers reliable, cost-based Federal hydroelectric power and related services. WAPA’s marketing efforts and delivery capability provide for recovery of annual operational costs, including the generating agencies’ hydropower related costs, and repayment of taxpayer investment in the Federal hydropower program. WAPA repays the Federal investment for which it is responsible within the timeframes established by law and regulations.

WAPA’s Construction, Rehabilitation, Operation and Maintenance Account (CROM) is comprised of four subprograms:

- Operation and Maintenance
- Construction and Rehabilitation
- Purchase Power and Wheeling
- Program Direction

WAPA’s subprograms are funded using a variety of financing methods including appropriations, alternative financing (primarily customer advances), and use of receipt authorities.

Highlights of the FY 2020 Budget Request

There are no major programmatic changes in the FY 2020 request. Consistent with the FY 2018 and FY 2019 budget requests, the FY 2020 budget request includes a proposal to authorize the Federal government to sell the transmission assets of WAPA. The FY 2020 budget request again proposes to change WAPA’s statutory rate structure requirement from cost recovery to a market based structure that takes into consideration rates charged by comparable utilities and could result in faster recoupment of the taxpayer investment.

**Operation and Maintenance
Funding (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Operation and Maintenance

Regular Operation and Maintenance	33,291	34,715	33,923	-792
Replacements and Additions	39,116	42,341	38,253	-4,088
Total, Operation and Maintenance	72,407	77,056	72,176	-4,880
Alternative Financing	-5,068	-7,758	-6,600	+1,158
Use of Receipts from Colorado River Dam Fund	-1,580	-1,455	-1,415	+40
Offsetting Collections	-13,854	-25,009	-24,445	+564
Use of Prior Year Balances	-12,305	0	-1,000	-1,000
Total, Operation and Maintenance (Budget Authority)	39,600	42,834	38,716	-4,118

Construction, Rehabilitation, Operation and Maintenance Operation and Maintenance

Description

The Operation and Maintenance (O&M) subprogram provides the supplies, materials and equipment necessary for WAPA to continue to deliver on its mission of providing reliable, resilient domestic energy to 40 million Americans across its 15 state footprint.

Regular Operation and Maintenance

Supplies and materials necessary to respond to routine and emergency situations across WAPA's 17,000 miles of high-voltage interconnected transmission system will be purchased. This includes miscellaneous equipment and software used for power billing, transmission planning, e-tagging, and energy scheduling, as well as supplies and materials such as wood poles (individual pole replacement only; excludes whole line replacements), instrument transformers, meters, relays, etc. Additionally, cyber and physical security audits and monitoring as well as grid operations and monitoring are provided through this activity, which is funded primarily through offsetting collections and alternative customer financing.

Replacements and Additions

WAPA's planned replacements and additions activity is based on cyber and physical security audits, assessments of condition and criticality of equipment, maintenance and frequency of problems on individual items of equipment, availability of replacement parts, safety of the public and WAPA's personnel, environmental concerns and an orderly work plan. Cost estimates are based on an analysis of system operation and maintenance requirements and concerns, customer-coordinated work plans, actual costs of recent similar projects, and bottom-up budgeting techniques. Planned activity is detailed by category below.

Cyber and Physical Security

Investments in the hardening of the transmission grid against increasing foreign and domestic threats include firewalls, cybersecurity upgrades, encryptors for operations offices; security equipment such as perimeter intrusion detection devices, card readers and associated software, security cameras and recording devices at various sites throughout WAPA's service area. These investments in cyber, physical security, and grid technology improvements rely primarily on appropriated funds.

Electrical Equipment

Electrical equipment, such as circuit breakers, transformers, relays, batteries and chargers, reactors, meters, buses, surge arresters, capacitor banks and disconnect switches, will replace obsolete equipment at facilities throughout WAPA's 15-state area. Test equipment used by maintenance crews, such as metering and relaying test sets, pentameters, Ohm testers, oil dielectric testers, battery load testers, and specialized communication and environmental control test equipment is also included. Also included in this request is funding for WAPA's wood pole replacement program. This is a continuing program to replace aging wood transmission line structures, line hardware, and repair damaged conductors and static wires. Many of WAPA's wood transmission line structures were built in the 1950's and 1960's, with the facilities reaching ages in excess of recommended lifespan. Due to age, woodpecker damage, vibratory fatigue, and general deterioration, the system requires constant maintenance upgrades and repairs in order to eliminate the weak links and improve the reliability to our customers.

Communications Equipment

Key to system reliability, replacement of aged or obsolete remote terminal units (RTU), telephone systems, microwave and mobile radio systems with new generation digital radio and fiber optic systems continues. Manufacturers are discontinuing support of obsolete time domain multiplexing (TDM) digital technology equipment in favor of newer packet/internet protocol (IP) based technology as the industry transitions to packet-based networks. WAPA continues with its migration plans to incorporate packet technologies as the current TDM based equipment reaches its end-of-life. Manufacturers have discontinued support of the digital mobile radio equipment WAPA is operating due to obsolescence; this equipment is being replaced with new digital mobile radio technology equipment now and will continue for the next several years. WAPA's communication systems are currently comprised of approximately 20 percent fiber optics, 70 percent fixed radio,

and 10 percent mobile radio. WAPA currently has 1,193 radio frequency authorizations in the fixed radio bands, all of which are digital. This funding will not be used to replace equipment impacted by the Spectrum Relocation initiative.

In addition, WAPA will continue to upgrade its existing supervisory control and data acquisition (SCADA) systems which control WAPA's electric power system. These hardware and software upgrades improve grid reliability by allowing the main SCADA computer to communicate with RTUs in over 300 substations across WAPA's territory, thus allowing the power system dispatcher to operate a device in any of these substations to rapidly make changes in response to electric power industry requirements or system emergencies.

Spectrum Relocation Equipment

The Commercial Spectrum Enhancement Act (CSEA, Title II of P.L. 108-494) of 2004, created the Spectrum Relocation Fund (SRF) to streamline the relocation of Federal systems from specific radio spectrum bands. These spectrum bands will accommodate commercial users and the SRF will facilitate reimbursement to affected agencies for relocation costs. The Federal Communications Commission has allocated this spectrum for Advanced Wireless Services. Funds have been made available to agencies from the crediting of auction receipts to the SRF during FY 2007 and system relocation efforts are underway. WAPA received \$108.2 million for this effort. This amount includes WAPA's estimated relocation costs, as approved by the Office of Management and Budget, and as reported to the Congress by the Department of Commerce in December 2005. Since receipt of these funds, WAPA has completed all design work including radio path analysis, tower load analysis, communication building upgrades and replacements, acquiring radio frequency authorizations, and all communication equipment purchases. Final communication equipment installation is occurring and is scheduled to be completed on or before the end of FY 2019. WAPA anticipates returning approximately \$16 million received in excess of actual relocation costs to the SRF. No appropriations are being requested for this activity.

Capitalized Movable Equipment

The majority of these funds will be used to purchase and lease the fleet of standard and specialized vehicles required for WAPA's O&M activities. Although WAPA prefers to lease its vehicles from GSA, GSA cannot always provide the necessary specialized vehicles, especially in the Upper Great Plains Region and the Desert Southwest Region, where they must be equipped for extreme weather and terrain conditions. In these instances, WAPA is forced to purchase its specialized vehicles. All sedans, vans, SUVs, and light trucks are leased from GSA. WAPA uses over 800 vehicles, of which 62 percent are leased from GSA. WAPA replaces government-owned vehicles according to the Federal Management Regulations guidelines, the same guidelines used by GSA. Other capitalized movable equipment in this estimate includes substation test equipment, brush chipper, map board replacement; information technology equipment such as server and router replacements, LAN upgrades, network equipment replacements, storage upgrades, upgrades to WAPA's power system simulator equipment for training purposes, auto-CAD workstation replacements, and helicopter equipment replacements that add value to the helicopter or extend the service life, such as engine, rotor blades, avionics, airframe, and other major components.

Operation and Maintenance

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Operation and Maintenance \$77,056,000	\$72,176,000	-\$4,880,000
<i>Regular O&M (\$34,715,000)</i> The continuing maintenance of WAPA's transmission system at or above industry standards supports DOE and WAPA missions by minimizing sudden failure, unplanned outages, and possible regional power system disruptions. The request is based on projected work plans for activities funded from this account. Estimates are based on historical data of actual supplies needed to operate and maintain the transmission system and recent procurement of similar items. This request also includes approximately \$153,000 for appropriated O&M annual expenses that are required to fund WAPA's Salinity and Levee non-reimbursable power systems. The request includes approximately \$1,455,000 for activities in the Boulder Canyon Project, funded directly through receipts from the Colorado River Dam.	<i>Regular O&M (\$33,923,000)</i> The continuing maintenance of WAPA's transmission system at or above industry standards supports DOE and WAPA missions by minimizing sudden failure, unplanned outages, and possible regional power system disruptions. The request is based on projected work plans for activities funded from this account. Estimates are based on historical data of actual supplies needed to operate and maintain the transmission system and recent procurement of similar items. This request also includes approximately \$123,000 for appropriated O&M annual expenses that are required to fund WAPA's Salinity and Levee non-reimbursable power systems. The request includes approximately \$1,415,000 for activities in the Boulder Canyon Project, funded through receipts from the Colorado River Dam.	<i>Regular O&M (-\$792,000)</i> The slight decrease in regular O&M is due to lower anticipated maintenance of communication, transmission line and substation equipment.
<i>Replacements and Additions (\$42,341,000)</i> Replacement needs are based on age, reliability, and safety of equipment, customer-coordinated review, cost analysis of rebuild versus replacement, availability of replacement parts, and obsolescence of diagnostic maintenance tools. Estimates are determined using actual costs of similar items.	<i>Replacements and Additions (\$38,253,000)</i> Replacement needs are based on age, reliability, and safety of equipment, customer-coordinated review, cost analysis of rebuild versus replacement, availability of replacement parts, and obsolescence of diagnostic maintenance tools. Estimates are determined using actual costs of similar items.	<i>Replacements and Additions (-\$4,088,000)</i> The decrease in Replacement and Additions follows WAPA's maintenance schedule and is primarily attributable to the timing of the replacement of moveable capital equipment relative to its lifecycle.

**Construction and Rehabilitation
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Construction and Rehabilitation				
Transmission Lines and Terminal Facilities	30,512	20,091	27,599	+7,508
Substations	16,911	8,725	14,825	+6,100
Other	4,849	3,816	3,463	-353
Subtotal, Construction and Rehabilitation	52,272	32,632	45,887	+13,255
Alternative Financing	-40,500	-27,077	-39,922	-12,845
Total, Construction and Rehabilitation	11,772	5,555	5,965	+410

Construction, Rehabilitation, Operation and Maintenance Construction and Rehabilitation

Description

The Construction and Rehabilitation (C&R) subprogram supports WAPA's mission to deliver reliable, clean Federal hydroelectric power by emphasizing the replacement, upgrade, and modernization of the electrical system infrastructure to bring continued reliability, improved connectivity, and increased resilience, flexibility and capability to the power grid.

Financing of the FY 2020 C&R budget, planned at \$45.9 million, will continue to rely heavily on voluntary stakeholder participation in alternative methods for capital financing. Approximately 87 percent of the program funding, or \$39.9 million, will be required from stakeholders, requiring significant partnering efforts.

WAPA has initiated a formalized asset management program to capture data uniformly and systematically on condition, consequences of failure data, and other relevant asset information. The improvements to WAPA's current asset management practices include stronger, more objective data driven evidence, risk-informed priority and decision making, and greater transparency to stakeholders in the allocation of limited resources.

The request incorporates the most current information to identify and schedule necessary C&R projects. WAPA assigns priority to those situations that pose the highest risk to compliance, system reliability, and economic impact to WAPA and its customers, while meeting the mandates for open access to our transmission system. When conditions change, WAPA shifts funding as necessary to ensure the highest program priorities continue to be met to maintain the reliability and integrity of WAPA's power transmission system.

All replacement and rehabilitation plans are coordinated with stakeholders to help establish the timing and scope of work at specific substations. When upgrades or additional capacity are required, WAPA actively pursues partnering with neighboring utilities to jointly finance activities, resulting in cost savings and increased efficiencies for participants.

Unless otherwise provided by law, all C&R costs are recovered from ratepayers with interest over the useful life of the asset providing a revenue stream to the U.S. Treasury. In rare cases, where a C&R project is abandoned, costs are still recovered, but may be expensed.

The FY 2020 budget request continues to include a proposal to authorize the Federal government to sell the transmission assets of WAPA. Until such time as this proposal is enacted, WAPA will continue its plans for construction, maintenance, and equipment upgrades.

Transmission Lines and Terminal Facilities

WAPA's 17,000 circuit-mile transmission infrastructure was primarily constructed in the 1940s through 1960s. Thousands of miles of transmission line already exceed their design life. For FY 2020, there is continued focus on replacement and upgrade of deteriorating and inadequate infrastructure across WAPA's service area using alternative financing, with continued emphasis on deteriorating transmission lines in the Parker-Davis systems in Arizona. In addition, activities are underway to address voltage support problems in the Colorado front-range, impacts of growing loads in the Pick-Sloan Missouri Basin service territory, and reliability or compliance concerns in northern California.

Substations

WAPA owns and operates more than 300 substations across its 15-state service territory. Many of these facilities were designed and constructed more than 50 years ago. As substation equipment (such as power transformers, circuit breakers, and control equipment) ages, maintenance costs increase, replacement parts become unavailable, risk of outages increase, and system reliability declines. The normal service life for power transformers and circuit breakers is 40 years and 35 years, respectively. This activity funds the construction, replacement, or upgrade of the substations and its components necessary to sustain reliable power delivery and support a stable, flexible interconnected power grid.

Other

The Other category includes C&R activities not otherwise included in the Substations or Transmission Lines and Terminal Facilities categories. These include communication system equipment and other miscellaneous projects covering items like construction or major rehabilitation of maintenance facilities, access roads, and facility decommissioning and removal costs.

Construction and Rehabilitation

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Construction and Rehabilitation \$32,632,000	\$45,887,000	+\$13,255,000
<i>Transmission and Terminal Facilities (\$20,091,000)</i>	<i>Transmission and Terminal Facilities (\$27,599,000)</i>	<i>Transmission and Terminal Facilities (+\$7,508,000)</i>
<ul style="list-style-type: none"> • Continue rehabilitation and construction required on WAPA’s transmission lines and terminal facilities to cost-effectively market and deliver clean renewable Federal hydropower and promote a strong record of reliability and safety. • Address additional system reliability risk and operational problems. • Appropriations (\$2,234,000) provide for the following projects in FY 2019: <ul style="list-style-type: none"> ○ Dome Tap – Gila (AZ) 161-kV T-line rebuild of a deteriorating 7.6-mile segment to increase reliability, improve safety, and reduce maintenance costs ○ Gila-Wellton Mohawk Interstate 8 Crossings (AZ) rebuild of 13-mile segment to comply with NERC standards, improve safety at interstate crossings, improve life span of the transmission line, and reduce maintenance costs ○ Kofa-Dome Tap (AZ) 161-kV rebuild of a 7.3-mile segment to comply with NERC standards and improve the engineered life span of the transmission line ○ Gila-Knob (AZ) 161-kV transmission line re-route of 2-mile segment in advance of neighboring utility 500-kV transmission line build ○ Lovell-Yellowtail (MT) rebuild of 15-miles of two 115-kV transmission lines and 	<ul style="list-style-type: none"> • Continue rehabilitation and construction required on WAPA’s transmission lines and terminal facilities to cost-effectively market and deliver clean renewable Federal hydropower and promote a strong record of reliability and safety. • Address additional system reliability risk and operational problems. • Appropriations (\$5,021,000) are requested for the following projects in FY 2020: <ul style="list-style-type: none"> ○ Dome Tap-Gila (AZ) 161-kV T-line rebuild of a deteriorating 7.6-mile segment to increase reliability, improve safety, and reduce maintenance costs ○ Kofa-Dome Tap (AZ) 161-kV rebuild of a 7.3-mile segment to comply with NERC standards and improve the engineered life span of the transmission line • Alternative financing (\$22,578,000) sought for the following projects: <ul style="list-style-type: none"> ○ Bouse-Kofa (AZ) rebuild of a 44.3 miles of 161-kV transmission line to comply with NERC standards, increase reliability and reduce maintenance costs ○ Groton South-Ordway (SD) 115-kV reconductoring on an aging 15-mile transmission line to increase reliability and reduce maintenance costs ○ Lovell-Yellowtail (MT) rebuild of 15-miles of two 115-kV transmission lines and 	<ul style="list-style-type: none"> • The increase in transmission line work reflects a continued focus on upgrading and replacing aging and inadequate infrastructure to improve reliability and safety and reduce maintenance costs.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>deteriorating structures to increase reliability and reduce maintenance costs</p> <ul style="list-style-type: none"> ○ Snowy Range-Laramie (WY) construction of a new 1.5-mile 115-kV double circuit transmission line to mitigate low voltage to comply with FERC and NERC standards ○ Groton South-Ordway (SD) 115-kV reconductoring on an aging 15-mile transmission line to increase reliability and reduce maintenance costs ● Alternative financing (\$17,857,000) provide for the following projects in FY 2019: <ul style="list-style-type: none"> ○ Estes-Flatiron (CO) transmission line rebuild to improve reliability and accessibility of the deteriorating 17-mile transmission line serving the city of Estes Park, CO ○ Cottonwood-Olinda (CA) substation rating upgrade of relays on two transmission lines to match new conductor and increase transfer capacity and eliminate potential NERC standard violation ○ Keswick-Airport and Airport-Cottonwood (CA) 230-kV transmission line reconductoring to increase transfer capacity and improve maintenance flexibility on 20.15-miles of existing single circuit line ○ Headgate Rock-Parker (CA and AZ) 116-kV double circuit rebuild and relocation of 16-miles of deteriorating transmission line and structures to improve reliability of service, improve safety, and reduce maintenance costs 	<p>deteriorating structures to increase reliability and reduce maintenance costs</p> <ul style="list-style-type: none"> ○ Headgate Rock-Parker (CA and AZ) 116-kV double circuit rebuild and relocation of 16-miles of deteriorating transmission line and structures to improve reliability of service, improve safety, and reduce maintenance costs 	

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p><i>Substations (\$8,725,000)</i></p> <ul style="list-style-type: none"> • Continue construction, modification, and rehabilitation of WAPA’s substations to ensure power system reliability and stability. • Address additional system reliability risk and operational problems. • Appropriations (\$3,296,000) provide for the following projects in FY 2019: <ul style="list-style-type: none"> ○ Devil’s Lake Substation (ND) transformer replacement due to age (60+ years) and deteriorating conditions which could result in catastrophic failure, reliability, and customer outages ○ Gila Substation (AZ) 69-kV yard rebuild to improve reliability and safety of deteriorating facilities, and reduce rising maintenance costs and outage risk impacting the Parker-Davis, Salinity Control Project, and Colorado River Front Work and Levee system ○ Watertown Unit substations (SD) replacement of two aging (40+ years) unit substations to provide reliable station service power for critical operation and maintenance facilities ○ Fargo Substation (ND) control panel replacement for 115-kV and lower voltage equipment to improve reliability and maintenance ○ Sioux City 2 Substation (IA) transformer replacement is needed due to deteriorating conditions creating an environmental hazard and will provide for increased reliability and load growth • Alternative financing (\$5,429,000) sought for the following projects in FY 2019: 	<p><i>Substations (\$14,825,000)</i></p> <ul style="list-style-type: none"> • Continue construction, modification, and rehabilitation of WAPA’s substations to ensure power system reliability and stability. • Address additional system reliability risk and operational problems. • Appropriations (\$210,000) requested for the following projects in FY 2020: <ul style="list-style-type: none"> ○ Watertown Unit substations (SD) replacement of two aging (40+ years) unit substations to provide reliable station service power for critical operation and maintenance facilities • Alternative financing (\$14,615,000) sought for the following projects in FY 2020: <ul style="list-style-type: none"> ○ Carr Substation (CA) motor operated disconnect switch replacements to improve system reliability and mitigate risk of customer outages ○ Devil’s Lake Substation (ND) transformer replacement due to age (60+ years) and deteriorating conditions which could result in catastrophic failure, reliability, and customer outages ○ Elverta Substation (CA) station service transformer installation to improve system reliability and mitigate risk of customer outages ○ Grand Forks Substation (ND) replacement of all 230, 115, 69, and 12.47-kV control panels for improved reliability, and construction of a new control building to house the control panels and comply with current safety regulations ○ Gregory Substation (SD) expansion and equipment replacement including breakers, transformer, disconnect switches, instrument transformers and relay to mitigate the risk of catastrophic failure and customer outages 	<p><i>Substations (+\$6,100,000)</i></p> <ul style="list-style-type: none"> • The increase in substation work reflects a continued focus on replacing aging and deteriorating equipment and facilities to provide for system reliability, increased capacity, and anticipated future needs.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> ○ Martin Substation (SD) 115-kV oil breakers, control panels, and relay replacements to increase reliability ○ Keswick, Airport, and Cottonwood substations (CA) rating upgrades to improve capacity and operational and maintenance flexibility ○ Folsom Substation (CA) transformer installation to eliminate a single point of failure and provide operation and maintenance flexibility ○ Maurine Substation (SD) aging (40+ years) transformer replacement to ensure reliability and mitigate risk of catastrophic failure ○ Grand Forks Substation (ND) replacement of all 230, 115, 69, and 12.47-kV control panels for improved reliability, and construction of a new control building to house the control panels and comply with current safety regulations ○ Mount Vernon Substation (SD) transformer and oil breaker replacement due to age and deteriorating conditions which could result in reliability and outage conditions as well as environmental impacts ○ Fargo Substation (ND) control panel replacement for 115-kV and lower voltage equipment to increase reliability and reduce maintenance costs 	<ul style="list-style-type: none"> ○ Jamestown Substation (ND) aging (60+ years) transformer replacement to increase reliability and mitigate risk of catastrophic failure ○ Maurine Substation (SD) aging (40+ years) transformer replacement to ensure reliability and mitigate risk of catastrophic failure ○ Pole Creek Tap (WY) installation of line circuit breakers and line relays to sectionalize the Archer-Stegall 115-kV transmission line and to increase reliability and reduce maintenance costs ○ Roseville Substation (CA) replacement of 230-kV voltage transformers to improve system reliability and mitigate risk of customer outages ○ Sioux City 2 Substation (IA) transformer replacement is needed due to deteriorating conditions creating an environmental hazard and will provide for increased reliability 	

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p><i>Other (\$3,816,000)</i></p> <ul style="list-style-type: none"> • Appropriations (\$25,000) provide for the following projects in FY 2019: <ul style="list-style-type: none"> ○ Crossman Peak microwave facility to increase reliability of service on the WAPA microwave backbone from Phoenix to the Hoover substation in AZ • Alternative financing (\$3,791,000) sought for the following projects in FY 2019: <ul style="list-style-type: none"> ○ Replacement of existing overhead ground wire with optical fiber ground wire for continued system improvements for the Pick-Sloan Missouri Basin Program ○ Substation service upgrades at eight substations in CA to mitigate safety hazards and increase reliability ○ Replace Sioux Falls (SD) maintenance building (+60 years old) with new building for crew, shop, vehicles, and equipment/materials storage ○ Bismarck maintenance facility (ND) addition of a 60' x 100' cold storage building to house critical vehicles and equipment required for maintenance activities ○ Rapid City Substation (SD) maintenance building replacement (+40 years old) will accommodate crew quarters, shop areas, house vehicles, and provide equipment storage and enable WAPA to be more efficient in maintenance and response to emergencies 	<p><i>Other (\$3,463,000)</i></p> <ul style="list-style-type: none"> • Appropriations (\$734,000) requested for the following projects in FY 2020: <ul style="list-style-type: none"> ○ Substation service upgrades at eight substations in CA to mitigate safety hazards and increase reliability • Alternative financing (\$2,729,000) sought for the following projects in FY 2020: <ul style="list-style-type: none"> ○ Renovate Fargo (ND) line crew building to modernize the data, communication and electrical systems and improve the efficiency of the heating and cooling systems ○ Replace Sioux Falls (SD) maintenance building (+60 years old) with new building for crew, shop, vehicles, and equipment/materials storage 	<p><i>Other (-\$353,000)</i></p> <ul style="list-style-type: none"> • The decrease is attributed to ongoing communications projects coming to a close where the investment has already been made.

**Purchase Power and Wheeling
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Purchase Power and Wheeling				
Central Valley	288,882	299,752	307,649	+7,897
Pick-Sloan Missouri Basin and other Programs	209,190	186,644	240,001	+53,357
Subtotal, Purchase Power and Wheeling	498,072	486,396	547,650	+61,254
Alternative Financing Needed	-289,072	-260,954	-288,769	-27,815
Offsetting Collections	-209,000	-225,442	-258,881	-33,439
Total, Purchase Power and Wheeling (New Budget Authority)	0	0	0	0

Construction, Rehabilitation, Operation & Maintenance Purchase Power and Wheeling

Description

The Purchase Power and Wheeling subprogram continues to support WAPA's marketing efforts and delivery capability which spans a 1.3 million square mile area serving a diverse group of several hundred wholesale customers, including municipalities, cooperatives, public utility and irrigation districts, Federal and state agencies and Native American tribes. No appropriated budget authority is necessary.

For a historical perspective, WAPAs Purchase Power and Wheeling subprogram is highly variable; it is affected by reservoir storage levels, annual and long-term drought conditions, downstream flow concerns due to icing, flooding, environmental, health and safety, recreation, irrigation and navigation requirements. To illustrate the extent of the variability, WAPA Purchase Power and Wheeling costs during FY 2008, an adverse water year, were nearly \$600 million; whereas in FY 2016, a much improved water year, costs were half that at just over \$300 million. Year-to-year changes can be extensive, and during long-term drought scenarios, the increased purchase power requirements can last several years. Year-to-year variation during the most recent five-year period from FY 2013 through FY 2017 was as high as 55 percent, with an overall average variation of 13 percent. The FY 2020 budget request reflects potentially adverse hydro generation conditions. WAPA can provide for more current assessment of conditions, following the calendar year 2019 winter snowpack and spring thaw seasons.

WAPA has implemented a Purchase Power and Wheeling risk mitigation strategy to ensure continuous operations during periods of significant drought. The strategy was developed consistent with existing authorities, and with the participation and support of WAPA power customers. Under this approach, WAPA retains receipts from the recovery of purchase power and wheeling expenses within the 'up to' amount specified by Congress. The receipts retained are available until expended, and are available only for purchase power and wheeling expenses. As of the end of FY 2018, WAPA's PPW reserve balance was \$282 million.

Central Valley Project

WAPA continues to deliver on its contractual power commitments to customers under the Central Valley Project's Post 2004 Marketing Plan. The budget request assumes current full load service customers will continue to choose service from WAPA through "Custom Product" contractual agreements. WAPA also purchases power to support variable resource customers on a pass-thru basis. If project net generation is not sufficient, WAPA may also purchase to support project use load, First Preference Customer load, and sub-control area reserve requirements. As part of the Order 741, FERC promulgated guidance requiring RTO/ISOs to take physical title/ownership to the energy bought/sold in their respective markets, making it necessary for WAPA to acknowledge that customers receive the financial, and not the physical benefit of their Federal power allocations. In order to provide service in the state, WAPA is voluntarily participating in the California greenhouse gas cap-and-trade program which became effective January 1, 2013.

Pick-Sloan Missouri Basin and Other Programs

The budget request continues to support long-term firm power commitments to customers of the eastern and western divisions of the Pick-Sloan Missouri Basin Program, the Fryingpan-Arkansas Project, and the Parker-Davis Project commensurate with the levels of average firm hydroelectric energy marketed by WAPA. The request also provides transmission support for the Pacific Northwest-Southwest Intertie Project. The total program estimates shown are based primarily on market pricing of short term firm energy, negotiated transmission rates, and WAPA and generating agency's forecasts.

Purchase Power and Wheeling

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Central Valley Project		
<p><i>Program Requirements (\$299,752,000)</i></p> <ul style="list-style-type: none"> The Purchase Power and Wheeling subprogram supports WAPA’s power marketing effort by providing for power purchases to firm the variable hydropower resource and securing transmission services as necessary to meet its contractual power delivery obligations. 	<p><i>Program Requirements (\$307,649,000)</i></p> <ul style="list-style-type: none"> The Purchase Power and Wheeling subprogram continues to support WAPA’s power marketing effort by providing for power purchases to firm the variable hydropower resource and securing transmission services as necessary to meet its contractual power delivery. 	<p><i>Program Requirements (+\$7,897,000)</i></p> <ul style="list-style-type: none"> Increase is attributed to anticipated purchase needs based on hydro generation estimates to meet contractual needs. Amounts are for offsetting collection authority and alternative financing; no direct appropriations are requested for this activity.
<p><i>Alternative Financing (-\$160,152,000)</i></p> <ul style="list-style-type: none"> Contractual arrangements made with customers provide opportunities for alternative financing of the purchase power requirements. Alternative financing methods include net billing, bill crediting, energy exchanges, and direct customer funding. 	<p><i>Alternative Financing (-\$167,831,000)</i></p> <ul style="list-style-type: none"> Contractual arrangements made with customers provide opportunities for alternative financing of the purchase power requirements. Alternative financing methods include net billing, bill crediting, energy exchanges, and direct customer funding. 	<p><i>Alternative Financing (-\$7,679,000)</i></p> <ul style="list-style-type: none"> Decrease is attributed to participation in markets. Amounts are for alternative financing. No direct appropriations are requested for this activity.
Pick-Sloan Missouri Basin		
<p><i>Program Requirements (\$186,644,000)</i></p> <ul style="list-style-type: none"> The Purchase Power and Wheeling subprogram continues to support WAPA’s power marketing effort by providing for power purchases to firm the variable hydropower resource and securing transmission services as necessary to meet its contractual power delivery obligations. 	<p><i>Program Requirements (\$240,001,000)</i></p> <ul style="list-style-type: none"> The Purchase Power and Wheeling subprogram continues to support WAPA’s power marketing effort by providing for power purchases to firm the variable hydropower resource and securing transmission services as necessary to meet its contractual power delivery. 	<p><i>Program Requirements (+\$53,357,000)</i></p> <ul style="list-style-type: none"> Increase is attributed to anticipated purchase needs based on hydro generation estimates to meet contractual needs. Amounts are for offsetting collection authority and alternative financing; no direct appropriations are requested for this activity.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p><i>Alternative Financing (-\$100,802,000)</i></p> <ul style="list-style-type: none"> Alternative financing methods negotiated with customers provide an offset to the total program receipt financing requirement. Alternative financing methods include net billing, bill crediting, energy exchanges, and direct customer funding. 	<p><i>Alternative Financing (-\$120,938,000)</i></p> <ul style="list-style-type: none"> Contractual arrangements made with customers provide opportunities for alternative financing of the purchase power requirements. Alternative financing methods include net billing, bill crediting, energy exchanges, and direct customer funding. 	<p><i>Alternative Financing (-\$20,136,000)</i></p> <ul style="list-style-type: none"> Decrease is attributed to participation in markets. Amounts are for alternative financing. No direct appropriations are requested for this activity

Program Direction

Overview

WAPA's Program Direction subprogram provides compensation and all related expenses for its workforce, including those employees that operate and maintain WAPA's high-voltage interconnected transmission system and associated facilities; those that plan, design, and supervise the construction of replacements, upgrades and additions (capital investments) to the transmission facilities; those that market the power and energy produced to repay annual expenses and capital investment; and those that administratively support these functions.

The Program Direction subprogram supports DOE's and WAPA's mission of operating and maintaining a resilient and secure energy grid by attaining and developing a critical highly skilled workforce of engineers, dispatchers, linemen, power system operators, and high voltage electricians. The Program Direction subprogram also includes the administrative staff, including those positions that monitor, detect and deter physical and cyber-attacks on WAPA's infrastructure, which support the technical functions, in addition to strengthening our workforce planning for hard to fill specialized skilled positions and potential increase in retirement rates.

WAPA trains its employees on a continuing basis in occupational safety and health regulations, policies and procedures, and conducts safety meetings at employee, supervisory and management levels to keep the safety culture strong. Accidents are reviewed to ensure lessons are learned and proper work protocol is in place.

In consultation with its customers, WAPA reviews required replacements and upgrades to its existing infrastructure to sustain reliable power delivery to its customers and to contain annual maintenance expenses. The timing and scope of these replacements and upgrades are critical to assure that WAPA's facilities do not become the "weak link" in the interconnected system. WAPA pursues opportunities to join with neighboring utilities to jointly finance activities, which avoid redundant facilities and result in realized cost savings and/or increased efficiencies for all participants.

Highlights of the FY 2020 Budget Request

The FY 2020 request provides for the continuation of WAPA's CROM account activities related to Program Direction at the level necessary to meet mission requirements. FY 2020 CROM FTEs remains level at the FY 2019 request.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction				
Salaries and Benefits	163,600	161,966	169,663	+7,697
Travel	10,516	10,573	11,540	+967
Support Services	27,563	31,786	33,417	+1,631
Other Related Expenses	34,043	34,158	35,471	+1,313
Total, Program Direction	235,722	238,483	250,091	+11,608
Use of Alternative Financing	-38,398	-39,136	-44,719	-5,583
Use of Receipts from Colorado River Dam Fund	-7,726	-7,603	-7,539	+64
Offsetting Collections, Other Expenses	-116,050	-150,761	-149,142	+1,619
Use of Prior Year Balances	-31,548	0	-4,000	-4,000
Total, Program Direction	42,000	40,983	44,691	+3,708
Federal FTEs	1,222	1,210	1,210	0
Support Services				
Technical Support				
Economic and Environmental Analysis	7,686	8,052	9,687	+1,635
Total, Technical Support	7,686	8,052	9,687	+1,635
Management Support				
Automated Data Processing	9,233	14,222	13,508	-714
Training and Education	1,964	1,910	3,338	+1,428
Reports and Analysis	8,680	7,602	6,884	-718
Management and General Administrative Support				
Total Management Support	19,877	23,734	23,730	-4
Total, Support Services	27,563	31,786	33,417	+1,631

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Other Related Expenses				
Rent to GSA	1,757	2,139	2,571	+432
Communication, Utilities, Misc.	5,754	5,921	5,576	-345
Printing and Reproduction	143	116	117	+1
Other Services	12,572	11,369	12,755	+1,386
Training	18	11	12	+1
Purchases from Gov. Accounts	949	1,045	1,285	+240
Operation and Maintenance of Equipment	4,301	5,575	5,926	+351
Supplies and Materials	3,186	2,612	2,260	-352
Equipment	3,080	2,995	2,335	-660
Working Capital Fund	2,283	2,375	2,634	+259
Total, Other Related Expenses	34,043	34,158	35,471	+1,313

Program Direction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$238,483,000	\$250,091,000	+\$11,608,000
Salaries and Benefits \$161,966,000	Salaries and Benefits \$169,663,000	Salaries and Benefits +\$7,697,000
Salary and benefits provide for Federal employees who construct and replace, operate and maintain and secure, on a continuing basis, WAPA's high-voltage interconnected transmission system. Salary and benefits funds those FTEs assigned to this account, including those salaries determined through negotiations.	Salary and benefits funding is for Federal employees who construct and replace, operate and maintain and secure, on a continuing basis, WAPA's high-voltage interconnected transmission system.	The salary and benefits reflect inflationary factors; OPM pay increase for engineers and journeymen negotiated salaries.
Travel \$10,573,000	Travel \$11,540,000	Travel +\$967,000
This activity funds all travel and related expenses associated with WAPA's mission-related operation and maintenance activities, and those functions that support them.	Request funds all travel and related expenses associated with WAPA's mission-related operation and maintenance activities, and those functions that support them.	The increase supports mission related operation and maintenance travel, and increased travel for cross-functional collaboration among various internal and external programs.
Support Services \$31,786,000	Support Services \$33,417,000	Support Services +\$1,631,000
Support Services funded in this category include information technology, job related training and education, engineering, miscellaneous advisory and reporting services, and general administrative support.	Request funds information technology, job related training and education, engineering, miscellaneous advisory and reporting services, and general administrative support services.	Increase is driven by technical support for operations and maintenance activities, concerted effort on employee development programs along with inflationary factors. Increase is partially offset by decrease in miscellaneous and general administrative service support.
Other Related Expenses \$34,158,000	Other Related Expenses \$35,471,000	Other Related Expenses +\$1,313,000
Other related expenses include rental space, utilities, supplies and materials, telecommunications, computers, printing and reproduction, training tuition, and DOE's Working Capital Fund distribution. Rental space costs assume the General Services	Request funds rental space, utilities, supplies and materials, telecommunications, computers, printing and reproduction, training tuition, and DOE's Working Capital Fund distribution.	The increase is primarily attributable to other services for physical security, vegetation management, and asset management support. GSA rental space also increased, as does the distribution of DOE's Working Capital Fund and operation and maintenance of equipment. Slight offsetting

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Administration's (GSA) inflation factor. Other costs are based on historical usage and actual cost of similar items.		decreases occur in communication and utilities; supplies and materials; and equipment.

Falcon and Amistad Operating and Maintenance Fund

	(\$K)		
	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
Gross	5,048	4,440	5,647
Offsets	-4,820	-4,212	-5,419
Net BA	228	228	228

Overview

The Falcon and Amistad Operating and Maintenance fund (Maintenance Fund) was established in the Treasury of the United States as directed by the Foreign Relations Authorization Act, FYs 1994 and 1995. The Maintenance Fund is administered by WAPA's Administrator for use by the Commissioner of the U. S. Section of the International Boundary and Water Commission (IBWC) to defray administrative, O&M, replacement, and emergency costs for the hydroelectric facilities at the Falcon and Amistad Dams. IBWC owns and operates the U.S. portion of the projects, and Federal staff funded under this program continues to be allocated to the U.S. Section of IBWC by the Department of State. The Falcon and Amistad project supports WAPA's program goals by providing power to rural electric cooperatives through WAPA. With the exception of monies received from the Government of Mexico, all revenues collected from the sale of electric power generated at the Falcon and Amistad Dams are credited to the Maintenance Fund. Monies received from the Government of Mexico are credited to the General Fund of the U.S. Treasury. Revenues collected in excess of operating expenses are used to repay, with interest, the cost of replacements and original investments. Full funding will support 24-hour/day operation and maintenance of the two power plants to ensure response to ever-changing water conditions, customer demand, and continual coordination with operating personnel of the Government of Mexico.

Highlights of the FY 2020 Budget Request

In FY 2020, WAPA's request has been formulated to meet its power marketing and contractual power delivery obligations with continued high marks for reliability. Revenues collected from customers to recover the costs of the Federal Power Program will be sufficient to provide for FY 2020 planned expenses for the facilities operated by the IBWC. Also included in FY 2020 is the continuation of WAPA's request to allow for U.S. Customer(s) of the Falcon and Amistad Dams to contribute funds for use by the IBWC in fulfilling their duties in accordance with agreements between WAPA, IBWC, and the power customers. This will allow work to be accomplished using customer advances/alternative financing, a funding mechanism used throughout WAPA under the Contributed Funds Act, 43 USC 395. The customer contributed funds are planned to predominantly assist in capitalized replacement projects.

In response to the Explanatory Statement accompanying the Energy and Water Development and Related Agencies Appropriations Act, 2018, WAPA, the IBWC, and the stakeholder have collaboratively developed and submitted a work plan to the Appropriations committees to address immediate and future infrastructure needs for the Falcon and Amistad hydroelectric facilities. As part of the work plan implementation, WAPA will continue to work closely with IBWC and the stakeholder(s) to review progress and plan for future infrastructure needs.

**Falcon and Amistad Operating and Maintenance Fund
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Western Area Power Administration Falcon and Amistad Operating and Maintenance Fund	5,048	4,440	5,647	+1,207
Subtotal, Falcon and Amistad Operating and Maintenance Fund	5,048	4,440	5,647	+1,207
Offsetting Collections	-3,948	-1,340	-2,932	-1,592
Use of Prior Year Balances		-2,500	-1,300	+1,200
Alternative Financing	-872	-372	-1,187	-815
Total, Falcon and Amistad Operating and Maintenance Fund	228	228	228	0

Falcon and Amistad Operating and Maintenance Fund

Description

The Falcon and Amistad Project consists of two international dams located on the Rio Grande River between Texas and Mexico. The United States and Mexico operate separate power plants on each side of the Rio Grande River. The Operating and Maintenance Fund was established in the Treasury of the United States and is administered by WAPA's Administrator for use by the Commissioner of the U.S. Section of the IBWC to defray administrative, O&M, replacement, and emergency costs for the hydroelectric facilities at the Falcon and Amistad Dams.

IBWC

O&M

Activities include salaries and benefits for the approximately 40 positions of the U.S. Section of the IBWC who operate and maintain the two power plants on a 24-hour/day basis, planned maintenance activities, required safety services, and emergency response to flood operations and/or equipment failure. O&M includes inspection and service of the HVAC and air compressor system, fire suppression systems, elevators, self-contained breathing apparatus, recharge and hydro-testing of fire extinguishers, calibration of test equipment, rebuild of electric motors, and repair of obsolete equipment when replacement parts are no longer available. Travel, training, communications, utilities, printing, and office supplies and materials for the IBWC employees and technical advisors is also funded by the O&M activity. The request includes essential training for employees to comply with standards of the Interagency Commission on Dam Safety, Occupational and Health Administration, and the National Dam Safety Act.

Capital Investment

WAPA, the IBWC, and the stakeholder have collaboratively developed a rehabilitation work plan to address immediate and future infrastructure needs for the hydroelectric facilities. Future infrastructure needs will be appropriately planned and categorized by all parties through regularly scheduled progress reviews.

WAPA

Marketing, Contract, Repayment Studies

This activity funds power marketing, administration of power contracts, and preparation of rate and repayment studies. Based on accurate studies, staff ensures power revenues are set at an appropriate level to recover annual expenses and meet repayment schedules.

Falcon and Amistad Operating and Maintenance Fund

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Falcon and Amistad Operating and Maintenance Fund \$4,440,000	\$5,647,000	+\$1,207,000
<i>IBWC O&M (\$3,810,000)</i> This activity funds the salaries and benefits for those employees assigned to the U.S. Section of the IBWC who operate and maintain the two power plants, equipment inspections and maintenance services, and travel, training, communications, utilities, printing, and office supplies/materials for the IBWC employees and technical advisors.	<i>IBWC O&M (\$4,177,000)</i> This activity funds the salaries and benefits for those employees assigned to the U.S. Section of the IBWC who operate and maintain the two power plants, equipment inspections and maintenance services, and travel, training, communications, utilities, printing, and office supplies/materials for the IBWC employees and technical advisors.	<i>IBWC O&M (+\$367,000)</i> The increase is attributed to consultation services on NERC compliance at both plants, and inspection/repair of penstock intake gate at Falcon.
<i>IBWC Capital Investment (\$600,000)</i> This activity funds capital investment activities at the Falcon and Amistad hydroelectric facilities.	<i>IBWC Capital Investment (\$1,415,000)</i> This activity funds capital investment activities at the Falcon and Amistad hydroelectric facilities.	<i>IBWC Capital Investment (+\$815,000)</i> The increase is attributed to retrofit of the overhead crane at Falcon, and corrosion repair in turbine pits and replacement of transfer switches and wicket gate seals at Amistad.
<i>WAPA Marketing, Contracts, Repayment (\$30,000)</i> This activity funds power marketing, administration of power contracts, and preparation of rate and repayment studies.	<i>WAPA Marketing, Contracts, Repayment (\$55,000)</i> This activity funds power marketing, administration of power contracts, and preparation of rate and repayment studies.	<i>WAPA Marketing, Contracts, Repayment (+\$25,000)</i> The increase is attributed to the new PRS software utilized by WAPA for power repayment and rates systems.

**Colorado River Basins Power Marketing Fund
(\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
Gross	185,396	220,337	220,244
Offsets	-208,396	-243,337	-241,644
Net BA	-23,000	-23,000	-21,400

Overview

WAPA operates and maintains the transmission system for the projects funded in this account to ensure an adequate supply of reliable electric power in a clean and environmentally safe, cost-effective manner. The Colorado River Basins Power Marketing Fund Program (CRBPMF) is comprised of the Colorado River Storage Project, including the Dolores and Seedskadee and Olmsted Projects; and the Fort Peck Project. WAPA is responsible for construction, maintenance, and operation of facilities for transmitting and marketing the electrical energy generated in these power systems.

Highlights of the FY 2020 Budget Request

In FY 2020, WAPA's request has been formulated to meet its power marketing and contractual power delivery obligations with continued high marks for reliability. Revenues collected from customers to recover the costs of the Federal Power Program will be sufficient to provide for WAPA's FY 2020 planned expenses for the power systems in the CRBPMF.

**Colorado River Basins Power Marketing Fund
Funding (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Colorado River Basins Power Marketing Fund

Equipment, Contracts and Related Expenses

Supplies, Materials and Services	21,300	18,489	18,356	-133
Purchase Power Costs	93,715	109,062	98,172	-10,890
Capitalized Equipment	8,040	24,838	31,104	+6,266
Interest/Transfers	4,000	5,000	5,500	+500
Total, Equipment, Contracts and Related Expenses	127,055	157,389	153,132	-4,257
Program Direction	58,341	62,948	67,112	+4,164
Total, Operating Expenses from new authority	185,396	220,337	220,244	-93
Offsetting Collections Realized	-208,396	-243,337	-241,644	+1,693
Total, Obligational Authority	-23,000	-23,000	-21,400	+1,600

Colorado River Basins Power Marketing Fund Equipment, Contracts and Related Expenses

Description

WAPA's equipment, contracts and related expenses are necessary to operate and maintain this activity. Revenues from the sale of electric energy, capacity and transmission services replenish the fund and are available for expenditure for operation, maintenance, power billing and collection, program direction, purchase power and wheeling, interest, emergencies, and other power marketing expenses.

Supplies, Materials and Services

This activity funds the procurement of supplies, materials, and services necessary to respond to routine and emergency situations in the transmission system, and the continuation of reimbursements to the U.S. Army Corps of Engineers for operation and maintenance of the Fort Peck Power Plant. Estimates are based on recent actual costs for supplies needed to maintain transmission system reliability.

Purchase Power Costs

This activity funds the procurement of electrical power, transmission capacity and wheeling services on the open market. The request anticipates the results of continued low-steady-flow tests conducted at Glen Canyon Dam, as required by the Glen Canyon Dam Environmental Impact Statement Record of Decision. Additionally, the request includes obligation authority to accommodate replacement power purchases for customers served by the Colorado River Storage Project. The replacement power purchases, a provision of the Salt Lake City Area Integrated Projects electric power contracts, are made at the request of power customers at times when WAPA lacks sufficient generation to meet its full contract commitment. The funds for the replacement power purchases are advanced by the requesting customers prior to the purchase.

Capitalized Equipment

This activity funds the procurement of capitalized equipment including circuit breakers, transformers, relays, switches, transmission line equipment, microwave, SCADA, and other communication and control equipment to assure reliable service to WAPA's customers. Replacement and upgrade of aged power system components are crucial to system reliability and transmission services.

Transmission line estimates include the purchase of poles, crossarms, conductors, fusion splicers, line switches, overhead ground wire and hardware for the continued transmission line rebuilds. This estimate includes line rebuilds with the anticipated completion of 10 miles a year.

Planned substation estimates include upgrades, replacement of breakers and circuit switches, and replacement of transformers, test equipment, as well as other aged equipment at various substations. WAPA cyclically replaces older electro-mechanical relays with microprocessor relays. The microprocessor relays assist in finding faults faster in order to more efficiently restore service to customers. Other miscellaneous items required for substation replacements include surge arrestors, batteries and chargers, and monitoring equipment.

Planned movable capitalized property estimates include replacements of special purpose trucks, replacement of generators to maintain the reliability and backup power to the communications system, and replacement of outdated test and recording equipment. Other estimates include the replacement of test equipment used to troubleshoot the new digital microwave radio system. Ongoing replacement is also planned for aging information technology support systems and routers. Other requests include funding for other minor enhancements that provide for the ease of maintenance, protection of equipment and materials, and environmental compliance.

Interest/Transfers

This activity funds interest payments to the U.S. Treasury. Estimates are based on Power Repayment Studies for the Projects funded in this account.

Colorado River Basins Power Marketing Fund

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Equipment, Contracts and Related Expenses \$157,389,000	\$153,132,000	-\$4,257,000
<i>Supplies, Materials & Services (\$18,489,000)</i> This activity funds the procurement of supplies, materials, and services necessary to respond to routine and emergency situations in the transmission system, and the continuation of reimbursements to the U.S. Army Corps of Engineers for operation and maintenance of the Fort Peck Power Plant.	<i>Supplies, Materials & Services (\$18,356,000)</i> This activity funds the procurement of supplies, materials, and services necessary to respond to routine and emergency situations in the transmission system, and the continuation of reimbursements to the U.S. Army Corps of Engineers for operation and maintenance of the Fort Peck Power Plant.	<i>Supplies, Materials & Services (-\$133,000)</i> The decrease is primarily driven by reduction in services offset with increases in Federal Agency and DOE Agency services.
<i>Purchase Power Costs (\$109,062,000)</i> This activity funds the procurement of electrical power, transmission capacity and wheeling services on the open market. Purchase power cost estimates are based on 24-month study factors including water cycle, snow pack and market rates.	<i>Purchase Power Costs (\$98,172,000)</i> This activity funds the procurement of electrical power, transmission capacity and wheeling services on the open market. Purchase power cost estimates are based on 24-month study factors including water cycle, snow pack and market rates.	<i>Purchase Power Costs (-\$10,890,000)</i> The decrease is primarily attributed to purchase power costs along with a minimal offset in the increase of wheeling expenses.
<i>Capitalized Equipment (\$24,838,000)</i> This activity funds the procurement of capitalized equipment including circuit breakers, transformers, relays, switches, transmission line equipment, microwave, SCADA, and other communication and control equipment to assure reliable service to WAPA's customers.	<i>Capitalized Equipment (\$31,104,000)</i> This activity funds the procurement of capitalized equipment including circuit breakers, transformers, relays, switches, transmission line equipment, microwave, SCADA, and other communication and control equipment to assure reliable service to WAPA's customers.	<i>Capitalized Equipment (+\$6,266,000)</i> The increase is primarily attributable to scheduled replacements for capitalized communication, transmission line, and substation equipment of the Fort Peck Power Plant.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p><i>Interest/Transfers (\$5,000,000)</i> This activity funds interest payments to the U.S. Treasury. Estimates are based on Power Repayment Studies for the Projects funded in this account.</p>	<p><i>Interest/Transfers (\$5,500,000)</i> This activity funds interest payments to the U.S. Treasury. Estimates are based on Power Repayment Studies for the Projects funded in this account.</p>	<p><i>Interest/Transfers (+\$500,000)</i> The increase in interest/transfers is due to the ongoing annual debt service payments made on capital repayments as calculated in the Power Repayment Study.</p>

**Colorado River Basins Power Marketing Fund
Program Direction**

Overview

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Colorado River Basins Power Marketing Fund. WAPA trains its employees on a continuing basis in occupational safety and health regulations, policies and procedures, and conducts safety meetings at employee, supervisory and management levels to keep the safety culture strong. Accidents are reviewed to ensure lessons are learned and proper work protocol is in place.

Highlights of the FY 2020 Budget Request

The FY 2020 request provides for the continuation of WAPA's revolving fund activities related to Program Direction at the level necessary to meet mission requirements. The increase of 3 FTEs is primarily for planned capital investments. This is mostly attributed to replacement and additions for substations. These positions are critical to WAPA's mission activities.

Colorado River Basins Power Marketing Fund

Program Direction

Funding (\$K)

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction				
Salaries and Benefits	41,543	44,278	46,963	+2,685
Travel	3,093	3,276	3,268	-8
Support Services	5,941	6,981	7,678	+697
Other Related Expenses	7,764	8,413	9,203	+790
Total, Program Direction	58,341	62,948	67,112	+4,164
Federal FTEs	280	293	296	+3
Support Services				
Technical Support				
Engineering and Technical Services	1,075	2,388	1,448	-940
Total, Technical Support	1,075	2,388	1,448	-940
Management Support				
Automated Data Processing	2,138	1,964	3,304	+1,340
Training and Education	471	915	970	+55
Reports and Analyses Management and General	2,257	1,714	1,956	+242
Administrative Support				
Total, Management Support	4,866	4,593	6,230	+1,637
Total, Support Services	5,941	6,981	7,678	+697
Other Related Expenses				
Rent to GSA	474	536	723	+187
Communication, Utilities, Misc.	1,514	1,710	1,468	-242
Printing and Reproduction	28	30	24	-6
Other Services	2,240	2,247	3,067	+820
Training	27	15	13	-2
Purchases from Gov. Accounts	243	261	237	-24

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Operation and Maintenance of Equipment	1,077	1,484	1,653	+169
Supplies and Materials	798	695	631	-64
Equipment	771	797	652	-145
Working Capital Fund	592	638	735	+97
Total, Other Related Expenses	7,764	8,413	9,203	+790

**Colorado River Basins Power Marketing
Fund Program Direction**

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$62,948,000	\$67,112,000	+\$4,164,000
Salaries and Benefits \$44,278,000	Salaries and Benefits \$46,963,000	Salaries and Benefits +\$2,685,000
Salary and benefits supports a FY 2019 request level of 293 FTE. This includes General Schedule employees, as well as those salaries determined through negotiations. This activity provides for Federal employees who operate and maintain the Program's high-voltage integrated transmission system and associated facilities; plan, design, and supervise the replacement (capital investments) to the transmission facilities; and market the power and energy produced to repay annual expenses and capital investment.	Salary and benefits supports a FY 2020 request level of 296 FTE. This includes General Schedule employees, as well as those salaries determined through negotiations. This activity provides for Federal employees who operate and maintain the Program's high-voltage integrated transmission system and associated facilities; plan, design, and supervise the replacement (capital investments) to the transmission facilities; and market the power and energy produced to repay annual expenses and capital investment.	The increase in salaries and benefits supports the FTE charged to this account. The salary and benefits reflect inflationary factors; OPM pay increase for engineers and journeymen negotiated salaries. The FTE increase (+3) supports planned capital investments for a total request level of 296 FTE. This is mostly attributed to replacement and additions for substations.
Travel \$3,276,000	Travel \$3,268,000	Travel -\$8,000
This activity funds personnel travel and per diem expenses for essential mission-related activities, including the maintenance of transmission facilities. The request includes estimates for the rent/lease of GSA vehicles and other transportation.	This activity funds personnel travel and per diem expenses for essential mission-related activities, including the maintenance of transmission facilities. The request includes estimates for the rent/lease of GSA vehicles and other transportation.	The decrease in travel reflects continued effort to use technological capabilities to decrease travel requirements with slight offset for inflationary factors.
Support Services \$6,981,000	Support Services \$7,678,000	Support Services +\$697,000
Support services funded in this category include automated data processing support, warehousing, computer-aided drafting/engineering, job related training and education, and general administrative support.	Support services funded in this category include information technology support, warehousing, computer-aided drafting/engineering, job related training and education, and general administrative support.	The increase is primarily driven by planned Automated Data Processing necessary to support IT Systems & Applications, SCADA support, Facility Management & Maintenance and Environment & Lands support.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>Other Related Expenses \$8,413,000</p> <p>Other related expenses include, but are not limited to, DOE’s working capital fund distribution, space, utilities and miscellaneous charges, printing and reproduction, training tuition, maintenance of office equipment, supplies and materials, telecommunications, and office equipment to include computers.</p>	<p>Other Related Expenses \$9,203,000</p> <p>Other related expenses include, but are not limited to, DOE’s working capital fund distribution, space, utilities and miscellaneous charges, printing and reproduction, training tuition, maintenance of office equipment, supplies and materials, telecommunications, and office equipment to include computers.</p>	<p>Other Related Services +\$790,000</p> <p>The increase to this activity is primarily driven by contractual services, GSA rent, operations and maintenance of information technology equipment. These increases are partially offset by decreases to communications and utilities and supplies and materials. Other increases are primarily inflationary.</p>

Transmission Infrastructure Program

(\$K)		
FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
0	0	0

Overview

WAPA established the Transmission Infrastructure Program (TIP) and Office to implement Title III, Section 301 of the Hoover Power Plant Act of 1984 as amended by the American Recovery and Reinvestment Act of 2009 (Recovery Act), which provided WAPA borrowing authority of up to \$3.25 billion for the purposes of: (1) constructing, financing, facilitating, planning, operating, maintaining, or studying construction of new or upgraded electric power transmission lines and related facilities with at least one terminus within the area served by WAPA; and (2) delivering or facilitating the delivery of power generated by renewable energy resources constructed or reasonably expected to be constructed after the Recovery Act's date of enactment.

TIP is expected to be an administratively self-sustaining program that relies on funding arrangements with project developers. When developers seek technical assistance, WAPA collects funds from the project developers to support development of eligible projects and to cover the overhead and administrative costs of the program. Reimbursable or Advance Funding Agreements with project developers are required prior to initiating efforts to evaluate the technical and financial merits of a potential project to ensure the full cost of services delivered are paid by project beneficiaries. For projects that are approved for use of WAPA's borrowing authority, the authority to cover the full amount of the loan is apportioned at the outset and cash is borrowed periodically from the Departments of Treasury (Treasury) as needed. The debt is repaid according to the financial agreement terms and conditions of each project.

As mandated, the TIP program is completely separate and distinct from WAPA's power marketing program.

TIP has two projects currently using the borrowing authority for a total of \$116 million in loan authority obligated.

All administrative costs for TIP are offset by advanced financing and collections. WAPA is not requesting any new annual appropriated funds for TIP.

Highlights and Major Changes in the FY 2020 Budget Request

Consistent with the FY 2018 and FY 2019 budget requests, the FY 2020 budget request includes a proposal to repeal the \$3.25 billion borrowing authority managed by WAPA's Transmission Infrastructure Program (TIP). This proposal to repeal the borrowing authority managed by the TIP program is in concert with the proposal in the FY 2020 Budget Request to eliminate DOE loan programs in accordance with Administration priorities. Pending repeal, WAPA anticipates ongoing use of new borrowing authority as new projects are approved as well as collaborations with Departmental programs as appropriate. Construction and project debt estimates are based on preliminary information provided by the Project Sponsors/Proponents.

Note: Values for TIP are based on early stages of project development, forecasts of current projects, estimates of future project development, and departmental collaboration, which are subject to change. While based on knowledge and experience to date, these estimates are to be regarded as non-binding representations that are determined by Project Sponsors/Proponents.

**Transmission Infrastructure Program
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Mandatory, Direct Budget Authority				
New Borrowing Authority	1,185,000	1,025,000	550,000	-475,000
Use of Collections from Projects	4,100	4,470	4,800	+330
Collections from Projects	-4,100	-4,470	-4,800	-330
Total Mandatory	1,185,000	1,025,000	550,000	-475,000
Repayment of Borrowing Authority	-375,000	-350,000	-25,000	+325,000
Federal FTEs (Mandatory)	0	0	0	0
Discretionary, Reimbursable Budget Authority				
Program Direction	30,462	43,170	47,442	+4,272
Advance Funding	-5,550	-4,500	-4,300	+200
Offsetting Collections	-24,912	-38,670	-43,142	-4,472
Total Discretionary	0	0	0	0
Federal FTEs (Discretionary)	19	18	15	-3
Total, Transmission Infrastructure Program				
Total, Federal FTEs	19	18	15	-3

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Direct Budget Authority \$1,025,000,000	\$550,000,000	-\$475,000,000
New Borrowing Authority \$1,025,000,000	\$550,000,000	-\$475,000,000
Estimated new projects approved for use of WAPA's borrowing authority.	Estimated new projects approved for use of WAPA's borrowing authority.	The decrease is due to lower estimates provided by Project Sponsors/Proponents.
Collections from Projects \$4,470,000	\$4,800,000	+\$330,000
Collections in this category are from excess capacity offtake from borrowing authority funded projects.	Collections in this category are from excess capacity offtake from borrowing authority funded projects.	TIP estimates collecting \$4.8 million in excess capacity from the ED5 energized line in FY 2020. These collections will all be obligated and used for costs associated with operating and maintaining those lines generating the capacity.
Repayment of Borrowing Authority -\$350,000,000	-\$25,000,000	+\$325,000,000
This activity represents repayments to Treasury from projects for principal.	This activity represents repayments to Treasury from projects for principal.	Amounts are for repayment of cash drawn for current projects according to the terms of each projects' lending agreement as they are anticipated to move into long term financing.

Transmission Infrastructure Program Program Direction

Overview

WAPA's TIP Program Direction subprogram provides compensation and all related expenses for its workforce, including those employees that are directly assigned to the program as project management, technical experts, finance and administration; those that provide expertise in land acquisition, engineering and environmental compliance; those that provide legal counsel; and those that administratively support these functions.

All TIP program direction costs are expected to be offset by customers over time, either through advanced funding agreements or offsetting collections. Advanced funding is provided to TIP from project applicants who use TIP's expertise in the development of their project. The advanced funding agreements fund federal and/or contract staff working on the development of a specific project. Other sources of funds include the overhead rate applied to each active project; service charges; interest rate differentials; and the advance collection of Project Proposal and Business Plan Proposal evaluation expenses. These collections offset the costs of administering the TIP program and provide a risk mitigation reserve.

The Program Direction subprogram supports DOE and WAPA missions, specifically in facilitating delivery of renewable energy resources to market.

Highlights of the FY 2020 Budget Request

In FY 2020 the TIP office will continue to recover programmatic expenses, and maintain a risk mitigation reserve.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Transmission Infrastructure Program Office				
Salaries and Benefits	2,447	2,315	2,065	-250
Travel	90	120	106	-14
Support Services	1,411	1,997	2,166	+169
Other Related Expenses	26,514	38,738	43,105	+4,367
Subtotal, Program Direction	30,462	43,170	47,442	+4,272
Use of Offsetting Collections	-30,462	-43,170	-47,442	-4,272
Total, Program Direction	0	0	0	0
Federal FTEs (Mandatory Direct)	0	0	0	0
Federal FTEs (Discretionary Reimbursable)	19	18	15	-3
Federal FTEs (Total TIP)	19	18	15	-3
Technical Support				
Projects	1,250	1,809	1,982	+173
Total, Technical Support	1,250	1,809	1,982	+173
Management Support				
Financial Modeling	36	42	41	-1
Legal Policy and Review	125	146	143	-3
Total Management Support	161	188	184	-4
Total, Support Services	1,411	1,997	2,166	+169
Other Related Expenses				
Communications; utilities; miscellaneous charges	340	172	223	+51
Services from Non- Federal Sources	10	42	41	-1
Services from Loan Programs Office	3,839	3,221	2,209	-1,012
Supplies and materials	5	5	5	0
Interest Payments	22,320	35,298	40,627	+5,329
Total, Other Related Expenses	26,514	38,738	43,105	+4,367

Program Direction

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$43,170,000	\$47,442,000	+4,272,000
Salaries and Benefits \$2,315,000	\$2,065,000	-\$250,000
Salary and benefits provide for Federal employees that are directly assigned to the TIP program as project management, technical experts, finance and administration; those that provide expertise in land acquisition, engineering and environmental compliance; those that provide legal counsel; and those that administratively support these functions. FTE assigned to this account charge TIP's mandatory as well as discretionary funding accounts.	Salary and benefits provide for Federal employees that are directly assigned to the TIP program as project management, technical experts, finance and administration; those that provide expertise in land acquisition, engineering and environmental compliance; those that provide legal counsel; and those that administratively support these functions. FTE assigned to this account charge TIP's mandatory as well as discretionary funding accounts.	The decrease of salaries and benefits is due to the slight reduction of direct and indirect support provided to this account to include the proportionate FTE. This decrease is slightly offset by inflationary factors.
Travel \$120,000	\$106,000	-\$14,000
Planned essential travel supports TIP's mission related activities. TIP supports efficient spending initiatives and is cognizant of travel costs associated with general program operations. TIP focuses on using alternative means to conduct meetings and training sessions where appropriate.	Planned essential travel supports TIP's mission related activities. TIP supports efficient spending initiatives and is cognizant of travel costs associated with general program operations. TIP focuses on using alternative means to conduct meetings and training sessions where appropriate.	The decrease in travel reflects TIP's continued effort to use technological capabilities to decrease travel requirements and also capturing a slight offset for inflationary factors.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>Support Services \$1,997,000</p> <p>Support services funded in this category include technical support costs directly associated with TIP projects; to include Environmental, Lands, Engineering, and Project Management activities. Also within this category are costs to cover legal and financial support activities to include financial modeling, outside legal counsel for contract review, policy issues and legislative concerns.</p>	<p>\$2,166,000</p> <p>Support services funded in this category include technical support costs directly associated with TIP projects; to include Environmental, Lands, Engineering, and Project Management activities. Also within this category are costs to cover legal and financial support activities to include financial modeling, outside legal counsel for contract review, policy issues and legislative concerns.</p>	<p>+\$169,000</p> <p>The increase in support services is due to the estimated need for technical support associated with project management and stage of development of projects, and based on revised estimates to work scope demands with a slight offset of management support in financial modeling and legal policy and review.</p>
<p>Other Related Expenses \$38,738,000</p> <p>Other related expenses include communications, utilities, training, depreciation, WAPA overhead rates, supplies and materials, Loan Program Office (LPO) services, and interest loan payments.</p>	<p>\$43,105,000</p> <p>Other related expenses include communications, utilities, training, depreciation, WAPA overhead rates, supplies and materials, Loan Program Office (LPO) services, and interest loan payments.</p>	<p>+\$4,367,000</p> <p>The increase is due to anticipated loan interest payments and interest rate adjustment with offset in Services from Loan Program Office.</p>

Estimate of Gross Revenues ¹

(Dollars in Thousands)

	FY 2018 ²	FY 2019	FY 2020
Boulder Canyon Project	78,656	85,651	90,809
Central Valley Project	231,731	419,925	405,087
Falcon-Amistad Project	5,973	6,441	6,436
Fryingpan-Arkansas Project	-235	5,914	6,001
Pacific Northwest-Southwest Intertie Project	40,912	38,509	38,509
Parker-Davis Project	73,562	68,448	68,664
Pick-Sloan Missouri Basin Program	629,315	543,698	537,588
Provo River Project	397	252	252
Washoe Project	374	483	483
Salt Lake City Area Integrated Projects	224,967	210,494	210,589
Other	155,081	0	0
Total, Gross Revenues	1,440,733	1,379,815	1,364,418

¹ Amounts for FY 2019 and FY 2020 are based on the FY 2017 Final Power Repayment Studies (PRS).

² FY 2018 amounts are actuals from the preliminary annual financial reports. For Central Valley Project, FY 2018 amounts reported exclude contractual pass-through purchase power arrangements which are included in the PRS estimates. The 'Other' FY 2018 amounts shown represent WAPA activities reported in the financials that are not reimbursable through the power and transmission rate-setting process, and are not forecasted through the PRS.

Estimate of Proprietary Receipts

(Dollars in Thousands)

	FY 2018 Actual	FY 2019	FY 2020
Mandatory Receipts			
Falcon Amistad Maintenance Fund	37	2,000	2,000
Sale and Transmission of Electric Power, Falcon and Amistad Dams	2,000	0	0
Sale of Power and Other Utilities Not Otherwise Classified	37,357	30,000	30,000
Sale of Power–WAPA–Reclamation Fund	265,519	172,528	165,778
Total, Mandatory Receipts	304,913	204,528	197,778
Discretionary Receipts			
Offsetting Collections from the Recovery of Power Related Expenses – WAPA CROM	209,000	225,442	258,881
Less Purchase Power and Wheeling Expenses	-209,000	-225,442	-258,881
Subtotal, WAPA CROM Recovery of Power Related Expenses	0	0	0
Offsetting Collections from the Recovery of Annual Expenses – WAPA CROM	129,904	175,770	173,587
Less Operating and Maintenance expenses	-13,854	-25,009	-24,445
Less Program Direction Expenses	-116,050	-150,761	-149,142
Subtotal, WAPA CROM Recovery of Annual Expenses	0	0	0
Offsetting Collections from the recovery of power related expenses – Falcon and Amistad	3,948	1,340	2,932
Less Operating and Maintenance expenses	-3,948	-1,340	-2,932
Subtotal, Falcon and Amistad Recovery of Power Related Expenses	0	0	0
Total, Discretionary Receipts	0	0	0
Total, Proprietary Receipts	304,913	204,528	197,778

**Western Area Power Administration
Estimate of Offsetting Collections for Reimbursable Work and Work for Others**

(Dollars in Thousands)

	FY 2018	FY 2019	FY 2020
Construction, Rehabilitation, Operation and Maintenance (CROM)			
Offsetting Collections for Reimbursable Work ¹			
Alternative Financing			
Operations and Maintenance	0	7,758	6,600
Construction and Rehabilitation	40,500	27,077	39,922
Purchase Power and Wheeling (PPW)	289,072	260,954	288,769
Program Direction	8,056	39,136	44,719
Subtotal, Alternative Financing	337,628	334,925	380,010
Offsetting Collections not anticipated for obligation in budget year	67,437	35,002	122,357
Less PPW net billing, bill crediting, energy exchange	-275,371	-248,985	-256,321
Offsetting collections from Colorado River Dam Fund	9,306	9,058	8,954
Subtotal, Offsetting Collections for Reimbursable Work	139,000	130,000	255,000
Offsetting Collections for Reimbursable Work-for-Others ²	504,000	469,000	490,000
Total, Offsetting Collections for Reimbursable	643,000	599,000	745,000

¹ WAPA relies significantly on alternative financing arrangements with customers to finance much of its direct mission work on a reimbursable basis.

² WAPA has partnering arrangements with many power customers and Federal agencies to perform electrical systems operations, maintenance, construction, purchase power, and transmission services on a reimbursable basis. WAPA's reimbursable authority and partnerships were demonstrated following the severe hurricane damage in the U.S. Virgin Islands and Puerto Rico. WAPA responded to help restore the energy infrastructure and access to power in the U.S. Virgin Islands and supported the U.S. Army Corps of Engineers' emergency power restoration efforts in Puerto Rico. WAPA also supported responses to natural disasters in Hawaii (volcanic eruption), Guam (typhoon), and California (wild fires).

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

Western Area Power Admin. Const.,Rehab.,O&M	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Western Area Power Administration			
Systems Operation and Maintenance			
Systems Operation and Maintenance	288,111	300,295	330,422
Program Direction			
Program Direction	197,324	199,347	205,372
Total, Western Area Power Administration	485,435	499,642	535,794
Total, Western Area Power Admin. Const.,Rehab.,O&M	485,435	499,642	535,794

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

Falcon & Amistad - Operating & Maintenance Fund	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Western Area Power Administration Falcon & Amistad Operating and Maintenance Fund Falcon & Amistad - Operating and Maintenance	4,176	4,068	4,460
Total, Western Area Power Administration	4,176	4,068	4,460
Total, Falcon & Amistad - Operating & Maintenance Fund	4,176	4,068	4,460

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
 (\$K)

Colorado River Basins Power Marketing Fund	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Western Area Power Administration Equipment, Contracts and Other Related Expenses Colorado River Storage Project	127,055	157,389	153,132
Program Direction Program Direction	58,341	62,948	67,112
Total, Western Area Power Administration	185,396	220,337	220,244
Total, Colorado River Basins Power Marketing Fund	185,396	220,337	220,244

Bonneville Power Administration

Bonneville Power Administration

**Bonneville Power Administration (Bonneville, BPA)
Proposed Appropriations Language**

Expenditures from the Bonneville Power Administration Fund, established pursuant to Public Law 93-454, are approved for *the Steigerwald Floodplain Restoration Project and, in addition, for official* reception and representation expenses in an amount not to exceed \$5,000: *Provided*, that during fiscal year [2019] 2020, no new direct loan obligations may be made.

Explanation of Changes

Language is included to allow expenditures from the Bonneville Power Administration Fund for the Steigerwald Floodplain Restoration Project.

The proposed appropriations language restricts new direct loans in FY 2020 as in FY 2019. This bill language is drafted consistent with the Credit Reform Act of 1990.

Please Note - The FY 2020 Bonneville Power Administration Congressional Budget submission includes FY 2019 budget estimates.

Bonneville operates under a business-type budget under the Government Corporation Control Act, 31 U.S.C 9101-10 and on the basis of the self-financing authority provided by the Federal Columbia River Transmission System Act of 1974 (Transmission Act) (Public Law 93-454). Bonneville has authority to borrow from the U.S. Treasury under the Transmission Act, the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act) (Public Law 96-501) for acquisition of energy conservation and renewable energy resources, investment in fish facilities, and other purposes, the American Recovery and Reinvestment Act of 2009 (Public Law 111-5), and other legislation. Authority to borrow from the U.S. Treasury is available to Bonneville on a permanent, revolving basis. The principal amount of U.S. Treasury borrowing outstanding at any time may not exceed \$7.70 billion.¹ Bonneville finances its approximate \$4.4 billion annual cost of operations and investments primarily using power and transmission revenues, and proceeds of borrowing from the U.S. Treasury.

This budget has been prepared in accordance with the Statutory Pay-As-You-Go Act (PAYGO) of 2010. Under PAYGO, all Bonneville budget estimates are treated as mandatory and are not subject to the discretionary caps included in the Budget Control Act of 2011. These estimates support activities that are separate from discretionary activities and accounts. Thus, any changes to Bonneville estimates cannot be used to affect any other budget categories, which have their own dollar caps. Because Bonneville's obligations are and will be incurred under pre-existing legislative authority, Bonneville is not subject to a "pay-as-you-go" test regarding its revision of current-law funding estimates.

¹ The outstanding principal amount of bonds issued by Bonneville to the U.S. Treasury can be found in tables BP-4A – 4D in the Additional Tables section.

Bonneville Power Administration

Funding Profile by Subprogram ^{1/}

(Accrued Expenditures in Thousands of Dollars)

	Fiscal Year			
	2018 Actuals	2019 Original ^{1/2}	2019 Revised ^{1/2}	2020 Proposed
Capital Investment Obligations				
Associated Project Costs ^{3/}	199,438	264,735	264,735	238,000
Fish & Wildlife	30,669	44,000	44,000	47,266
Subtotal, Power Services	230,107	308,735	308,735	285,266
Transmission Services	253,494	489,066	489,066	479,172
Capital Equipment & Bond Premium	14,566	28,860	26,860	22,099
Total, Capital Obligations ^{3/}	498,167	826,661	824,661	786,537
Expensed and Other Obligations				
Expensed	3,205,885	3,140,939	3,136,029	2,867,867
Projects Funded in Advance	156,849	41,125	41,125	85,886
Total, Obligations	3,860,901	4,008,724	4,001,815	3,740,290
Capital Transfers (cash)	569,325	408,637	408,637	407,536
Bonneville Total	4,430,226	4,417,361	4,410,452	4,147,826
Bonneville Net Outlays	245,000	23,061	16,690	(166,596)
Full-time Equivalent (FTEs) ^{4/}	2,793	3,000	3,000	3,000

Public Law Authorizations include:

Bonneville Project Act of 1937, Public Law No. 75-329

Federal Columbia River Transmission System Act of 1974, Public Law No. 93-454

Regional Preference Act of 1964, Public Law No. 88-552

Flood Control Act of 1944, Public Law No. 78-543

Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act), Public Law No. 96-501

Outyear Funding Profile by Subprogram ^{1/}

(Accrued Expenditures in Thousands of Dollars)

	Fiscal Year			
	2021	2022	2023	2024
Capital Investment Obligations				
Associated Project Costs ^{3/}	256,000	281,000	300,000	306,000
Fish & Wildlife	47,266	43,000	43,000	40,000
Subtotal, Power Services	303,266	324,000	343,000	346,000
Transmission Services	481,725	475,383	514,510	532,878
Capital Equipment & Bond Premium	22,131	22,295	22,267	21,146
Total, Capital Obligations ^{3/}	807,122	821,677	879,777	900,024
Expensed and Other Obligations				
Expensed	3,091,644	3,214,129	3,327,246	3,400,958
Projects Funded in Advance	66,170	60,452	39,843	39,819
Total, Obligations	3,964,937	4,096,258	4,246,866	4,340,801
Capital Transfers (cash)	456,893	425,663	388,345	399,897
Bonneville Total	4,421,830	4,521,921	4,635,211	4,740,698
Bonneville Net Outlays	14,767	102,806	208,023	253,982
Full-time Equivalents (FTEs) ^{4/}	3,000	3,000	3,000	3,000

These notes are an integral part of this table.

- ^{1/} This budget has been prepared in accordance with PAYGO. Under PAYGO all Bonneville budget estimates are treated as mandatory and are not subject to the discretionary caps included in the Budget Control Act of 2011. These estimates support activities that are separate from discretionary activities and accounts. Thus, any changes to Bonneville estimates cannot be used to affect any other budget categories which have their own dollar caps. Because Bonneville's obligations are and will be incurred under pre-existing legislative authority, Bonneville is not subject to a "pay-as-you-go" test regarding its revision of current-law funding estimates.
- ^{2/} Original estimates reflect Bonneville's FY 2019 Congressional Budget Submission. Revised estimates, consistent with Bonneville's annual near-term funding review process, provide notification to the Administration and Congress of updated capital and expense funding levels for FY 2019. The BPA estimates in this budget are consistent with 2018 initial IPR output numbers. Please see <https://www.bpa.gov/Finance/FinancialPublicProcesses/IPR/Pages/IPR-2018.aspx> for further information.
- ^{3/} Includes infrastructure investments to address the long-term electric power related needs of the Northwest and significant changes affecting Bonneville's power and transmission markets.
- ^{4/} As of September 30, 2018 DOE HR staff has reported FY 2018 BPA's FTE usage at 2,793.

Additional Notes

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

Cumulative advance amortization payments as of the end of FY 2018 are \$5,503 million.

Refer to 16 USC Chapters 12B, 12G, 12H, and Bonneville's other organic laws, including P.L. 100-371, Title III, Sec. 300, 102 Stat. 869, July 19, 1988, regarding Bonneville's ability to obligate funds.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Net Outlay estimates are based on current cost savings to date and anticipated cash management goals. They are expected to follow anticipated management decisions throughout the rate period that, along with actual market conditions, will impact revenues and expenses. Actual Net Outlays are volatile and are reported in Report on Budget Execution and Budgetary Resources (SF-133). Actual Net Outlays could differ from estimates due to changing market conditions, streamflow variability, continuing restructuring of the electric industry, and other reasons.

Revenues, included in the Net Outlay formulation, are calculated consistent with cash management goals and assume a combination of adjustments. Assumed adjustments include the use of a combination of tools, including upcoming rate adjustment mechanisms, a net revenue risk adjustment, debt service refinancing strategies and/or short-term financial tools to manage net revenues and cash. Some of these potential tools will reduce costs rather than generate revenue, causing the same Net Outlay result. Adjustments for depreciation and 4(h)(10)(C) credits of the Northwest Power Act are also assumed.

FY 2018 Net Outlays are based on Bonneville's FY 2018 audited financial actuals. FY 2019 Net Outlays are calculated using Bonneville's revenue forecast from the BP-18 rate case. FYs 2020 to 2024 Net Outlays are based on 2018 Initial IPR assumptions and standard inflation factors.

FTE outyear data are estimates and may change. Bonneville is facing a dynamic and changing transmission marketplace and operations while, at the same time, many of its employees are eligible to retire in the near future. It is important that Bonneville continue to attract and retain skilled individuals to meet the growing demands of a competitive and rapidly changing industry. Accordingly, FTE estimates may need to be adjusted in the future.

Amounts in tables and schedules may not add to totals due to rounding.

Major Outyear Considerations

Bonneville's outyear estimates reflect ongoing efforts to achieve its long-term mission and strategic direction. The outyear estimates are developed with consideration and support of Bonneville's multi-year performance targets that lay out the course for achieving Bonneville's long-term objectives. Outyear capital investment levels support Bonneville's infrastructure program, hydro efficiency program, and its fish and wildlife mitigation projects.

Bonneville continues to incorporate the various aspects of the Energy Policy Act of 2005 related to its business, in particular the energy supply, conservation, and new energy technologies for the future that are highlighted in the legislation.

Overview and Accomplishments

Bonneville provides electric power, transmission, and energy efficiency throughout the Pacific Northwest. Bonneville serves a 300,000 square mile area including Oregon, Washington, Idaho, western Montana, and small parts of eastern Montana, California, Nevada, Utah, and Wyoming with a population of about 13.3 million people. Bonneville markets the electric power produced from 31 federal hydro projects in the Pacific Northwest owned by the U.S. Army Corps of Engineers (Corps) and the U.S. Department of Interior, Bureau of Reclamation (Reclamation)—the hydro projects are known as Associated Projects. Bonneville also markets power acquired from non-federal generating resources, including the power from a nuclear power plant, Columbia Generating Station (CGS). Bonneville uses the power from non-federal and federal projects primarily to meet the needs of its customer utilities. Bonneville currently maintains and operates 15,238 circuit miles of transmission lines, 260 substations, and associated power system control and communications facilities over which this electric power is delivered. Bonneville has capital and similar leases for certain transmission facilities. Bonneville also supports the protection and enhancement of fish and wildlife, and promotes conservation and energy efficiency, as part of its efforts to preserve and balance the economic and environmental benefits of the Federal Columbia River Power System (FCRPS).

The organization of Bonneville's FY 2020 Budget reflects Bonneville's business services basis for utility enterprise activities. Bonneville's two major areas of activity on a consolidated budget and accounting basis are Power Services (PS) and Transmission Services (TS) and include their related administrative costs. Power Services activities include line items for Fish and Wildlife, Energy Efficiency, Residential Exchange Program (REP), Associated Projects Operations & Maintenance (O&M) Costs, and Northwest Power and Conservation Council (Planning Council or Council). Transmission Services activities include line items for engineering, operations, and maintenance for Bonneville's electric transmission system.

The mission of Bonneville is to create and deliver the best value for its customers and constituents as it acts in concert with others to assure the Pacific Northwest has the following: (1) an adequate, efficient, economical, and reliable power supply; (2) an open access transmission system that is adequate for integrating and transmitting power from federal and non-federal generating units, providing service to Bonneville's customers, providing interregional interconnections, and maintaining electrical reliability and stability; and (3) mitigation of the impacts on fish and wildlife from the federally owned hydroelectric projects from which BPA markets power. Bonneville is legally obligated under current law to provide cost-based rates and public and regional preference in its marketing of power. Bonneville establishes rates as low as possible consistent with sound business principles and sufficient to ensure the full recovery of all of its costs, including timely repayment of the federal investment in the system. Bonneville's vision is to advance a Northwest power and transmission system that is a national leader in providing high reliability, low rates consistent with sound business principles, responsible environmental stewardship, and accountability to the region, all through a commercially successful business. Bonneville pursues this vision consistent with its four core values of safety, trustworthy stewardship of the FCRPS, collaborative relationships, and operational excellence.

Current Financial Status

Bonneville is striving to enhance its competitive, cost-effective delivery of utility products and services and the continued delivery of the public benefits of its operations, while ensuring it continues to make its scheduled payments to the U.S. Treasury on time and in full. Bonneville recently published a Strategic and Financial plan for 2018-2023. The Strategic Plan has four goals: 1. Strengthen financial health, 2. Modernize assets and system operations, 3. Provide competitive power products and services, and 4. Meet transmission customer needs efficiently and responsively. Acting on these goals will put Bonneville on a path to become more competitive and responsive to customer needs, modernize our assets and operations to leverage and enable industry change, and deliver on our public responsibilities through a commercially successful business. This set of strategic goals is the central reference point for everything we will be doing at Bonneville over the next five years. Our business units and asset managers will develop operating plans and asset strategies to execute on these goals. Individual performance contracts and performance incentives will align with these goals as well.

Through rate-setting and attentive cost management efforts, Bonneville has maintained adequate financial reserves levels to assure full recovery of its costs and financial stability while meeting its overall responsibilities to the Pacific Northwest and U.S. taxpayers.

The Final Record of Decision for the FYs 2018-2019 rate case was issued on July 26, 2017. The rates were confirmed and approved by FERC on a final basis on March 19, 2018. The rates went into effect beginning October 1, 2017.

Preserving and Enhancing the FCRPS

The FCRPS is one of the nation's largest nearly carbon-free energy sources, and preserving and enhancing the value of the FCRPS for the future continues to be a major Bonneville focus. Bonneville's ongoing prioritization and execution of capital investment in transmission and FCRPS generation assets is the foundation for delivering clean, low cost power to support the communities and economies of the region well into the future.

Bonneville plays a key role in advancing energy efficiency across the region consistent with its statutes, including developing and promoting related technologies, and exploring demand-side management opportunities. Bonneville is making disciplined technology innovation investments and looking to apply new operational and market mechanisms that enhance the reliability, efficiency, and flexibility of system operations.

In addition to these efforts, Bonneville is committed to the quality of the Northwest's natural resources. Bonneville funds one of the largest fish and wildlife programs in the nation and continues to be a national leader on environmental protection and compliance.

Together, all of these efforts contribute to sustaining and advancing the region's resilience.

Program Performance

To validate and verify program performance, Bonneville conducts various internal and external reviews and audits. Bonneville conducts extensive reviews with regional stakeholders of both capital and expense programs. In addition, Bonneville's programmatic activities are subject to review by Congress, the U.S. Government Accountability Office (GAO), the DOE's Inspector General, and other governmental entities. Bonneville's financial statements are audited annually by an independent external auditor. Bonneville has received unqualified audit opinions since the mid-1980s and no material weaknesses have been identified in controls over financial reporting.

Legislative History

The Bonneville Project Act of 1937 provides the original statutory foundation for Bonneville's power marketing responsibilities and authorities. In 1974, passage of the Federal Columbia River Transmission System Act (Transmission Act) applied provisions of the Government Corporation Control Act (31 U.S.C. §§ 9101-9110) to Bonneville. The Transmission Act provides Bonneville with "self-financing" authority, establishes the Bonneville Fund (a permanent, indefinite appropriation) allowing Bonneville to use its revenues from electric power and transmission ratepayers to fund all programs without further appropriation, and first authorizing Bonneville to sell bonds to the U.S. Treasury.

In 1980, enactment of the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act) expanded Bonneville's authorities, obligations, and responsibilities. The purpose of the act includes the following: to encourage electric energy conservation to meet regional electric power loads placed on Bonneville; to develop renewable energy resources within the Pacific Northwest; to assure the Northwest an adequate, efficient, economical, and reliable power supply; to promote regional participation and planning; and to protect, mitigate, and enhance the fish and wildlife of the Columbia River and its tributaries. The Northwest Power Act also established the statutory framework for Bonneville's administrative rate-setting process and established judicial review of Bonneville's final decisions in the U.S. Court of Appeals for the Ninth Circuit.

As of the end of FY 2018, Bonneville has revolving U.S. Treasury borrowing authority of \$7.7 billion of which approximately \$2.2 billion remains available to be drawn.

The Columbia River Treaty

The U.S. Government reached consensus on a high level position for negotiations of the post-2024 future of the Columbia River Treaty in June 2015, and received authorization to negotiate with Canada on the Columbia River Treaty in October 2016. Government Affairs Canada notified the United States State Department in December 2017 of Canada's mandate to negotiate the Columbia River Treaty with the United States. Negotiations began in spring 2018 and U.S. and Canadian officials completed a third round of negotiations on the Columbia River Treaty in Portland on October 17-18. Both the U.S. Department of State and Canadian negotiators discussed shared objectives and exchanged information on flood risk

management, hydropower and ecosystem considerations. The next negotiation took place on Dec. 12-13 in Vancouver, British Columbia and another town hall meeting is also being planned for early 2019.

Judicial and Regulatory Activity

The Energy Policy Act of 2005 authorized the Federal Energy Regulatory Commission (FERC) to approve and enforce mandatory electric reliability standards with which users, owners, and operators of the bulk power system, including Bonneville, are required to comply. These standards became enforceable on June 18, 2007, and compliance is monitored by the North American Electric Regulatory Corporation (NERC) and the regional reliability organizations.

Fish and Wildlife Program Overview

Bonneville is committed to funding its share of the region's efforts to protect and mitigate Columbia River Basin fish and wildlife. To the extent possible, Bonneville is integrating actions to protect species listed for protection under the Endangered Species Act (ESA) in response to the FCRPS Biological Opinions (BiOps), including the National Oceanic and Atmospheric Administration (NOAA) Fisheries Willamette River BiOp and the United States Fish and Wildlife Service's (USFWS) 2006 Libby Dam BiOp, with projects implemented consistent with the Council's Fish and Wildlife Program (Program). The Program, BiOps, and long-term agreements include prioritized strategies for mitigation actions to meet Bonneville's environmental compliance responsibilities under the ESA, Northwest Power Act, and other laws.

Included with the budget schedules section of this document is the current tabulation of Bonneville's fish and wildlife costs from FY 2007 through FY 2018.

Infrastructure Investments

Bonneville is reviewing infrastructure investments in the Pacific Northwest to meet transmission capacity and reliability needs and continues to support a competitive wholesale market in the Western Interconnection, which encompasses 14 western states, two Canadian provinces, and one Mexican state.

Bonneville has completed three major transmission lines since 2011 (i) the McNary-John Day line—completed in FY 2012 — adding 79 miles, (ii) the Big Eddy-Knight 500kV transmission line and substation project resumed construction in 2014 and was energized in November 2015, adding 28 miles, and (iii) the Central Ferry-Lower Monumental 500kV Reinforcement which began construction in May 2014 and was also energized in November 2015, adding 38 miles. Bonneville also completed the modernization of the Celilo Converter Station at the northern end of the 846-mile Pacific Direct Current Intertie. The station was energized in January 2016. Additionally, 265 miles of direct current line were upgraded to match the capacity of the station upgrade.

In FY 2012, Bonneville signed two agreements to participate with two investor-owned utilities in the environmental work and permitting for another transmission project, the proposed Boardman-to-Hemingway 500kV line. Participation in this preliminary review keeps Bonneville's options open for serving its six southeast Idaho preference customers following the expiration of legacy transmission service agreements. Bonneville has not made a decision to co-develop or purchase capacity in this project. On January 17, 2014, Public Law 113-76 was enacted, which provided Bonneville with expenditure authority approval to construct or participate in the construction of a transmission line to southeast Idaho, should Bonneville decide to continue pursuing that service arrangement.

On May 18, 2017, Bonneville announced its decision to not build the I-5 Corridor Reinforcement Project. Bonneville continues to work with constituents and stakeholders to study more cost effective options to mitigate the current limitations along this path. Public meetings began in July 2017 to address alternatives to building. Cumulative capitalized costs associated with this project of \$130.0 million were reclassified in fiscal year 2017 from Construction work in progress to a Regulatory asset on the Combined Balance Sheets, as these costs are expected to be recovered through future rates.

Bonneville is also continuing to evaluate additional transmission investments and non-wires solutions across the Pacific Northwest to improve reliability and support both load and renewable generation needs.

Bonneville has experienced significant growth within its balancing area in installed variable renewable generation, primarily in the form of wind generation. Since 2001, installed wind generation connected to Bonneville's transmission system has grown from 115 MWs to 5,081 MWs through September 2018. Of the 5,081 MW of connected wind, 2,764 MW is currently

in Bonneville's Balancing Authority Area (BAA). This substantial increase in variable renewable generation has resulted in additional uncertainties in the balance between load and generation required for maintaining a reliable grid. Wind is a non-dispatchable source of energy, meaning it cannot be relied upon for capacity. As a result, Bonneville has implemented and continues to study operational tools for integrating this variable generation more cost effectively and reliably. Further complicating matters, 846 MW of the wind energy currently in Bonneville's BAA is requesting to join different BAA's. Although this removes variable generation from Bonneville's BAA, these projects are still physically connected to Bonneville's system and continue to impact the daily operations of Bonneville. Off-setting the wind leaving Bonneville's BAA is the possibility that a large amount of utility scale solar photo-voltaic (PV) projects are being added to Bonneville's queue. Bonneville is currently studying approximately 4,000 MW of solar interconnection requests and new requests are coming in at an average rate of two per month. Solar, like wind, is a variable generation source, but its characteristics are different than wind. Bonneville will need to learn and adapt to this new generation type.

Bonneville is considering approaches, in addition to or in lieu of the use of its U.S. Treasury borrowing authority, to sustain funding for its infrastructure investment requirements. These approaches include financial reserves financing some amount of transmission investments, or seeking, when feasible, third party financing sources. See the BP-5 Potential Third Party Financing Transparency table in the budget schedules section of this document. This FY 2020 Budget assumes \$15 million of annual financial reserves financing in FYs 2018-2019 for transmission infrastructure capital, which is included in this budget under Projects Funded In Advance.

Consistent with the FY 2018 and FY 2019 Budget Requests, the FY 2020 Budget Request maintains the proposal that the Federal government be authorized to sell the transmission assets of Bonneville.

Radio Spectrum Communications

Bonneville's wireless communication system is used to operate and control critical national transmission grid infrastructure in a reliable, secure, and safe manner. Bonneville's communication systems are designed to meet strict reliability/availability objectives required by NERC and Western Electricity Coordinating Council (WECC) standards. Concerning proper spectrum stewardship, Bonneville designs highly efficient radio systems that use minimal radio frequency (RF) channel bandwidths to meet critical mission needs. However, in certain circumstances, efficiently designed spectrum radio systems will require broad RF channels and/or lower state RF modulation schemes to meet existing and future requirements in order to meet operational and reliability/availability objectives.

In order to meet Bonneville's mission/operational requirements, RF communication equipment approved for system use goes through a rigorous evaluation and testing process. RF spectrum efficiency factors are considered during the evaluation/testing period. RF terminal equipment approved for use is normally purchased directly from vendors and is not typically supplied through a Request for Proposal process.

Bonneville's operational telecommunications and other capital equipment and systems are acquired using Bonneville's self-financing and procurement authorities. The Bonneville budget includes a system-wide electric reliability performance indicator, consistent with NERC rules, to track and evaluate performance.

Bonneville may share temporarily-available spare capacity on its RF communication system with other government agencies (both Federal and State), and with other electric utilities in the region whose power systems interconnect with Bonneville. Non-critical administrative traffic is typically supported by commercial carrier enterprises. However, to meet the North American Electric Reliability Corporation/ Western Electricity Coordinating Council (NERC/WECC) electrical bulk transmission requirements, Bonneville exclusively operates highly critical transmission control traffic over its private telecommunication system as Bonneville has no control over the reliability/availability of the commercial enterprise or on how quickly critical operational control circuits are restored to active service during an interruption.

For high capacity communication system applications, Bonneville considers and operates non-spectrum dependent alternatives such as fiber optic cable infrastructure systems.

During FY 2014, Bonneville began upgrading the Very High Frequency (VHF) land mobile system and installing a number of digital Synchronous Optical Network (SONET) rings typically consisting of fiber segments in combination with point-to-point microwave hops operating in the 4 GHz and 7/8 GHz bands. These various telecommunication systems operate within

Bonneville's approximate 300,000 square mile utility responsibility service territory (Oregon, Washington, Idaho, western Montana) with the majority of the RF infrastructure located in low population-rural areas.

The FCRPS hydroelectric projects, owned by the Corps and Reclamation, also utilize federal radio spectrum to preserve very high operational telecommunications and power system reliability.

In FY 2014, Bonneville completed work costing approximately \$40 million, funded through the Spectrum Relocation Fund, to relocate its operational telecommunication systems from the 1710-55 MHz radio spectrum bands to alternative federal radio spectrum bands, part of the AWS-1 Federal Spectrum Relocation. In accordance with Federal law, Bonneville plans to return the approximately \$8.2 million of excess funds to the U.S. Treasury, via the Spectrum Relocation Fund, as soon as the National Telecommunications and Information Administration (NTIA) officially notifies the Federal Communications Commission (FCC) that the DOE relocation effort is complete.

Bonneville began participating in a new spectrum relocation effort in FY 2015. The NTIA has approved and, in July 2014, web-posted federal agency relocation plans, including the Bonneville relocation plan. The FCC held an auction of this spectrum on November 13, 2014. Bonneville received an additional \$5.2 million from the Spectrum Relocation Fund on July 29, 2015 to fully pay for this new relocation effort, including, as in the prior relocation, the purchase and installation of new digital radio equipment. Bonneville received obligational authority to proceed with this relocation effort by apportionment on July 24, 2015.

Bonneville has worked to complete its move off of 1755-80 MHz in two stages. First, Bonneville moved off of the old federal frequencies and "retuned" to new alternate federal frequencies in the band segment of 1780-1850 MHz which is above the highest frequency that is involved in the auction. Three hops federal frequency moves/retuning were completed as of June 7, 2017. One remaining path, Happy Camp to Hilltop in northern California near the Oregon California Border, is being moved/retuned. As of July 31, 2018, Bonneville is off of the AWS-3 radio frequencies. The new radios, using new federal radio frequencies, have been installed, have been fully tested and are now being used. The old radios have been turned off. Bonneville has met the July 31, 2018 commitment date that we promised the NTIA. Bonneville still has additional work remaining to finish the construction related to the AWS-3 relocations. Bonneville will use the SRF relocation funds for about another two years. Second, Bonneville will complete its move of these four microwave hops to 7GHz-8GHz. This will take additional time because two of four hops require building construction to complete the work. AWS-3 funds will need to be retained by Bonneville for over five years after Bonneville first received AWS-3 funds, at least through FY 2020, to complete construction of two communications buildings. Bonneville will assure that "comparable capability" has been achieved for these four AWS-3 relocated Bonneville operational telecommunication hops.

Financial Mechanisms

Bonneville's program is treated as mandatory and nondiscretionary. Bonneville is "self-financed" with its own revenues and does not rely on annual appropriations from Congress. Under the Transmission Act, Bonneville funds the expense portion of its budget and repays the federal investment with revenues from electric power and transmission sales. Bonneville's revenues fluctuate for a variety of reasons, including in response to variations in market prices for fuels and stream flow in the Columbia River System due to variations in weather conditions and fish mitigation needs. Through FY 2018, Bonneville has returned approximately \$34.7 billion to the U.S. Treasury, of which about \$3.7 billion was for payment of FCRPS operation and maintenance (O&M) and other costs, \$16.0 billion for interest, and \$15.0 billion for amortization of appropriations and bonds.

In the FY 2020 Budget, the term Bonneville "bonds" refers to the debt instruments under which Bonneville receives advances of funds from the U.S. Treasury. This reference is consistent with section 13(a) of the Transmission Act, which defines "bonds" as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

In May 2018, debt instruments issued by non-federal entities but secured by payment and other financial commitments provided by Bonneville maintained their credit ratings as follows: Moody's at Aa1 with a stable outlook, Fitch at AA with a negative outlook, and Standard & Poor's at AA- with a stable outlook.

Bonneville and the U.S. Treasury have a comprehensive banking arrangement that covers Bonneville's short- and long-term federal borrowings. This provides Bonneville with the ability to borrow from the U.S. Treasury to finance capital

investments and, on a short-term basis, to cover Northwest Power Act-related operating expenses. This latter ability provides Bonneville with much needed liquidity to help manage within-year cash flow needs and mitigate risk. Access to this use of U.S. Treasury borrowing authority has been incorporated into and relied upon in Bonneville's rate-setting process.

Bonneville undertook a Power Prepayment Program in FY 2013 under which all Bonneville preference customers had an opportunity to submit formal offers to provide lump-sum payments to Bonneville as prepayments of a portion of their power purchases through September 30, 2028, the termination date of the Long-Term Regional Dialogue Power Sales Contracts. Bonneville accepted power prepayments from four preference customers, as described below.

Upon Bonneville's receipt of the agreed-to, lump-sum prepayments, the selected preference customers became entitled to future portions of their electricity from Bonneville without further payment. The power prepayments are and will be recognized in the customers' future power bills from Bonneville as fixed, equal monthly prepayment credits. In effect, the amount of electricity that is prepaid may vary by month, depending on Bonneville's power rates and rate schedules that apply to electricity purchases by the prepaying customers in the related month. Because this is structured as a variable amount prepayment and not as a fixed-price/fixed-amount type of prepayment, Bonneville maintains flexibility to establish rates for the electric power that is prepaid.

As a result of the FY 2013 Prepayment solicitation, Bonneville received \$340 million in prepayments, which Bonneville is using to fund needed FCRPS investments. The aggregate prepayment credits are set at \$2.55 million per month through FY 2028.

Depending on a variety of factors it is possible that Bonneville may seek to implement later phases of the Power Prepayment Program in connection with future FCRPS hydroelectric investment needs.

U.S. Treasury Payments and Budget Overview

Bonneville's FY 2018 payment to the U.S. Treasury was \$862 million. This was the 35th consecutive year that Bonneville made its scheduled payments to the U.S. Treasury on time and in full. The payment included \$569 million in principal, which included \$275 million in early retirement of higher interest rate U.S. Treasury debt, \$226 million for interest, \$27 million in irrigation assistance payments, and \$40 million in pension and post-retirement benefits. Total credits associated with fish mitigation and recovery that are applied toward Bonneville's U.S. Treasury payment were about \$70.2 million for FY 2018. These credits are established and applied under section 4(h)(10)(C) of the Northwest Power Act. The FYs 2019 and 2020 U.S. Treasury payments are currently estimated at \$776 million and \$702 million, respectively. The FY 2019 and 2020 4(h)(10)(C) credits are estimated to be \$92 million and \$90 million, respectively.

Estimates of interest and amortization levels for outyear U.S. Treasury payments are included in the FY 2018-2019 final transmission and power rates. Bond and Appropriations Interest will continue to be revised based on upcoming capital investments and debt management actions. These estimates may change due to revised capital investment plans and actual U.S. Treasury borrowing. In recent years, Bonneville has made amortization payments in excess of those scheduled in its FERC-approved rate filings resulting in a balance of advance repayment. The cumulative balance of advance amortization payments as of the end of FY 2018 was about \$5,503 million.

Bonneville has direct funding arrangements to fund the power-related portion of O&M and capital investments at the Corps and Reclamation facilities as well as the O&M costs of the U.S. Fish and Wildlife Service Lower Snake River Compensation Plan facilities. Direct funded Associated Projects capital costs, which had been funded exclusively through appropriations to the Corps and Reclamation prior to the initiation of direct funding, are now funded primarily from the proceeds of bonds issued by Bonneville to the U.S. Treasury. Certain power prepayments have also been a source of funds for direct funding. Bonneville's aggregate direct funding provided for capital and O&M was \$643 million in FY 2018.

Starting in FY 2014, Bonneville and Energy Northwest, the Washington state joint operating agency that owns and operates the Columbia Generating Station nuclear plant, have been working together to implement a new phase of integrated debt management for their combined total debt portfolios. The debt service of these portfolios is borne by Bonneville and recovered from Bonneville ratepayers through Bonneville's rates. Energy Northwest-related debt, as refinanced under this

effort, is called Regional Cooperation Debt. Bonneville currently has Energy Northwest Board approval for these types of transactions through FY 2020.

In FY 2018, BPA proposed an extension of the Regional Cooperation Debt program. This would extend the program through 2030 and involve up to \$3.5 billion of tax-exempt debt. This extension would be similar to the current Regional Cooperation Debt program in many ways but the proceeds could be used to prepay federal bonds or directly used for capital investments. The Energy Northwest Board approved this proposal on September 27, 2018.

An important component of Regional Cooperation Debt is the issuance of new bonds by Energy Northwest to refund outstanding bonds shortly before their maturities when substantial principal repayments are due. An equal amount of higher interest rate Federal debt will be repaid instead. The net effect of refunding Regional Cooperation Debt and prepaying higher interest rate federal obligations is that the weighted-average interest rate of Bonneville's overall debt portfolio has been and will be reduced. In addition, Bonneville's aggregate principal balance of debt outstanding (federal and non-federal) does not and will not increase by virtue of the Regional Cooperation Debt program.

Energy Northwest accelerated site restoration efforts for the Energy Northwest Nuclear Projects 1 and 4 in the summer of 2015 and these efforts continue.

This FY 2020 Budget proposes estimated accrued expenditures of \$2,868 million for operating expenses, \$86 million for Projects Funded in Advance (PFIA), \$787 million for capital investments, and \$408 million for capital transfers in FY 2020.

The estimated spending levels in this budget are still subject to change to accommodate competitive dynamics in the region's energy markets, debt management strategies, continuing changes in the electric industry, and other factors.

Budget Estimates and Planning

This FY 2020 Budget includes capital and expense estimates based on initial spending proposals from Bonneville's 2018 initial Integrated Program Review (IPR). FY 2018 costs are based on Bonneville's FY 2018 audited financial statements. Consistent with the FY 2018 and FY 2019 Budget Requests, the FY 2020 Budget Request maintains the proposal that the Federal government be authorized to sell the transmission assets of Bonneville. The FY 2020 budget request also re-proposes to change BPA's statutory rate structure requirements from cost recovery to a market based structure that takes into consideration rates charged by comparable utilities and which could allow for faster recoupment of the taxpayer investment.

Capital investment levels reflect Bonneville's capital asset management process and external factors such as changes affecting the West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region and national energy security goals.

Bonneville utilizes a structured capital project selection process requiring submission of a standardized business case for review. Each business case consists of a description of the project, a clear statement of objectives, description and mitigation of risks, and a rigorous analysis of project costs and benefits including a status quo assumption and preferred alternatives. In addition, both annual and end-of-project targets are set for each project covering cost, scope, and schedule. Progress reports on these targets are provided to Bonneville's senior executives at least quarterly.

The FYs 2019-2024 revenue estimates in this budget, included in the Net Outlay formulation, are calculated consistent with cash management goals. The revenue estimates reflect assumed adjustments, which include the use of a combination of tools, including upcoming rate adjustment mechanisms, reduced cost estimates, a net revenue risk adjustment, debt management strategies, and/or short-term financial tools to manage net revenues and cash. The revenue estimates also include depreciation and U.S. Treasury repayment credit assumptions. These U.S. Treasury repayment credits offset, among other things, Bonneville's fish and wildlife program costs allocable to the non-power project purposes of the FCRPS, as provided under section 4(h)(10)(C) of the Northwest Power Act.

Overview of Detailed Justifications

In Bonneville's Detailed Justification Summaries, accrued expenditure is the basis of presenting Bonneville's program funding levels in the power and transmission rate making processes and the basis upon which Bonneville managers control

their resources to provide products and services. Accrued expenditures relate period costs to period performance. Traditional budget obligation requirements for Bonneville's budget are assumed on the Program and Financing Summary Schedule prepared in accordance with Office of Management & Budget Circular A-11.

The organization of Bonneville's FY 2020 Budget and these performance summaries reflect Bonneville's business services basis for utility enterprise activities. Bonneville's major areas of activity on a consolidated budget and accounting basis include power and transmission, with administrative costs included. Power Services includes line items for Fish and Wildlife, Energy Efficiency, Residential Exchange Program, Associated Projects O&M Costs, and the Council. Environmental activities are shown in the relevant Power Services and Transmission Services sections, as are reimbursable costs. Bonneville's interest expense, pension and post-retirement benefits, and capital transfers to the U.S. Treasury are shown by program.

The first section of performance summaries, Capital Investments, includes accrued expenditures for investments in electric utility and general plant associated with the FCRPS generation and transmission services, fish and wildlife, and capital equipment. These capital investments are estimated to require budget obligations and expected use of \$787 million in bonds to be issued and sold to the U.S. Treasury in FY 2020.

The near-term forecast of capital funding levels has undergone an extensive internal review as a result of Bonneville's development of asset management plans. These plans encompass project cost management initiatives, capital investment assessments, and categorization of capital projects to be funded based on risk and other factors. Consistent with Bonneville's near-term asset planning process and Bonneville's standard operating budget process, this FY 2020 Budget includes updated capital investment levels for FY 2019. Utilizing this review process helps Bonneville in its efforts as a participant in wholesale energy markets. Bonneville will continue to work with the Corps and Reclamation to optimize the mix of projects.

The second section of Bonneville's performance summaries, entitled Annual Operating Expenses, includes accrued expenditures for services and program activities financed by power sales revenues, transmission sales revenues, and projects funded in advance. For FY 2020, budget expense obligations are estimated at \$2,868 million. The total program requirements of all Bonneville programs include estimated budget obligations of \$4,148 million in FY 2020.

Evidence and Analysis in the Budget

Bonneville has undertaken several initiatives and processes to determine appropriate budget expenditures.

Bonneville's Integrated Program Review (IPR) process allows interested parties to see all relevant FCRPS expense and capital spending level estimates in the same forum. In addition, Bonneville's IPR process allows interested parties to review and comment on Bonneville's Strategic Asset Management Plans (SAMPs) and 10-year capital forecasts. The IPR occurs every two years, or just prior to each rate case, and provide participants with an opportunity to review and comment on Bonneville's program level estimates prior to spending levels being set for inclusion in rate cases. The 2016 IPR process concluded in the fall of 2016. Bonneville completed a second, targeted IPR (IPR2) process in early 2017 and used that information in preparing Bonneville's final rate proposal for FYs 2018-2019. BPA concluded the 2018 IPR in summer 2018, focusing on FYs 2020-2021.

Bonneville is focused on institutionalizing operational excellence – continuous improvement that produces more efficient and effective ways to deliver on Bonneville's mission and vision. In FY 2015, Bonneville re-focused its continuous improvement efforts to concentrate on seven Key Strategic Initiatives (KSIs). In FY 2017 the Business Transformation Office (BTO) was implemented in order to ensure that Bonneville's transformational initiatives, including the KSIs, are executed in the most efficient manner, from a time, cost and resource perspective. Additionally, the BTO will ensure KSI initiatives are aligned to Bonneville's strategy and operating environment and are focused on delivering the value as required by our customers. The BTO will mature foundational capabilities such as portfolio, project, business process management, and organizational change management. The BTO is establishing an Enterprise Architecture capability with the responsibility for developing a disciplined approach to modeling and aligning the organization's business capabilities, processes, information, technology, and resources to business models that support Bonneville's value chain and value system. Enterprise Architecture will bring together business and Information Technology to deliver quality and cost effective solutions for transformational initiatives.

Educational Activities

Bonneville is a supporter of science, technology, engineering, and math (collectively known as “STEM”) education programs. These programs provide support and encouragement to middle and high school students to study the sciences in school and to pursue careers in these fields. Working with Bonneville employees as volunteer ambassadors, the Bonneville education program provides value-added presentations, curricula, and activities to K-12 schools that enhance the learning experience for students and teachers, and extend awareness of the value of the region’s hydroelectric system to future generations. As a regional leader in STEM education, Bonneville also proudly supports and organizes an award-winning Science Bowl. Bonneville also sponsors Science Fair competitions for students in Washington State, as well as a First Robotics tournament championship.

**Power Services - Capital
Funding Schedule by Activity**

Funding (\$K)

Power Services – Capital

Associated Project Costs

Fish & Wildlife

Total, Power Services – Capital

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
			\$	%
199,438	264,735	238,000	-26,735	-10.1%
30,669	44,000	47,266	+3,266	+7.4%
230,107	308,735	285,266	-23,469	-7.6%

Outyears (\$K)

Power Services – Capital

Associated Project Costs

Fish & Wildlife

Total, Power Services - Capital

FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
238,000	256,000	281,000	300,000	306,000
47,266	47,266	43,000	43,000	40,000
285,266	303,266	324,000	343,000	346,000

Program Overview

Associated Project Costs provide for direct funding of additions, improvements, and replacements of existing Reclamation and Corps hydroelectric projects in the Pacific Northwest. The FCRPS hydro projects produce electric power that is marketed by Bonneville.

Maintaining the availability and increasing the efficiency of the FCRPS is critical to ensuring that the region has an adequate, efficient, economic, and reliable power supply. The FCRPS represents about 80 percent of Bonneville's firm power supply and includes 31 operating federal hydroelectric projects with over 200 generating units. These projects have an average age of about 50 years, with some that exceed 60 years of age. Through direct funding and the cooperation of the Corps and Reclamation, Bonneville uses its U.S. Treasury borrowing authority and other sources to make investments needed to restore generation availability and improve efficiency, reducing demand on Corps and Reclamation appropriations for power-related investments.

Since the beginning of direct funding in FY 1997, Bonneville, along with its joint operating partners, the Corps of Engineers and the Bureau of Reclamation, has improved system performance. In 1999, at the direction of Congress, Bonneville issued a report that it soon began to implement called the "Asset Management Strategy for the FCRPS." In this report, Bonneville concluded that it needed to invest nearly \$1 billion, in aggregate, in the hydroelectric projects over the ensuing 12 to 15 years. Supplementary analyses and experience with the system have revealed additional and ongoing investment needs.

These planned investments, included in the FY 2020 Budget estimates, will maintain the generation performance of the FCRPS. Moving forward with the cost-effective opportunities to expand the generation and to preserve and enhance the capability of the FCRPS is a smart, economic, and environmentally beneficial decision when compared to purchasing power from the market to serve growing Pacific Northwest electricity needs.

Fish and wildlife capital costs incurred by Bonneville are directed at activities that mitigate Columbia River Basin fish and wildlife resources. Bonneville uses capital to fund projects designed to increase juvenile and adult fish passage through the Columbia River system, to increase fish production and survival through construction of hatchery, acclimation and fish monitoring facilities, and to increase wildlife and resident fish populations through land acquisitions and habitat enhancement. These capital projects support both Northwest Power Act and ESA priorities and are integrated with the Program in order to efficiently meet Bonneville's responsibilities under the Northwest Power Act and other statutes to mitigate federal hydrosystem impacts to Columbia River Basin fish and wildlife.

Bonneville implements projects consistent with the Pacific Northwest Electric Power Planning Council's (Council) Columbia Basin Fish and Wildlife Program and the purposes of the Northwest Power Act. Under the Northwest Power Act, the Council must develop a Program that protects, mitigates, and enhances Columbia River Basin fish and wildlife affected by the federal and non-federal hydroelectric projects in the basin while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply. The Program, the FCRPS BiOp, other BiOps, and Bonneville's long-term agreements include prioritized strategies for mitigation actions and projects to meet Bonneville's responsibilities under the Northwest Power Act, the ESA, the Federal Clean Water Act, and other laws. When issues arise that potentially trigger the *in lieu* provision of the Northwest Power Act, which prohibits Bonneville from funding mitigation that other entities are authorized or required to undertake, Bonneville works with the Council and the regional fish and wildlife managers, customers, and tribes, as appropriate, to ensure ratepayers fund only appropriate mitigation.

Most projects recommended by the Council also undergo independent scientific review as directed by the 1996 Energy and Water Appropriations Act, which added section 4(h)(10)(D) to the Northwest Power Act. As a result, the Council appoints an Independent Scientific Review Panel (ISRP) "to review a sufficient number of projects" proposed to be funded through Bonneville's annual fish and wildlife budget "to adequately ensure that the list of prioritized projects recommended is consistent with the Program." The Northwest Power Act further states that "in making its recommendations to Bonneville, the Planning Council shall consider the impact of ocean conditions on fish and wildlife populations; and shall determine whether the projects employ cost effective measures to achieve program objectives." Today, most mitigation projects funded by Bonneville receive ISRP review as part of the Council recommendation process. The Council uses a multi-year project review cycle during which the ISRP reviews categories of projects grouped together.

To comply with the ESA, Bonneville funds capital investment actions to avoid jeopardizing listed species. Guidance for those actions is found in the most recent BiOp issued by NOAA in 2008, as supplemented in 2010 and 2014, and the USFWS BiOp in 2006/2010.

- In February 2006, USFWS issued a BiOp for Libby Dam on the Kootenai River for white sturgeon and bull trout. A subsequent Settlement Agreement between USFWS and the Center for Biological Diversity was memorialized by modifying the BiOp in 2008. Additional consultation is occurring as part of the larger USFWS bull trout consultation.
 - In 2010 USFWS designated critical habitat for bull trout (following USFWS's issuance in 2000 of a BiOp for FCRPS impacts on bull trout). The Action Agencies (Corps, Reclamation, and Bonneville) are preparing a biological assessment covering FCRPS operational effects on bull trout and designated bull trout critical habitat.
 - In May 2008, NOAA issued an FCRPS BiOp for 13 listed species of salmon and steelhead, supplemented in a 2010 Supplemental BiOp that incorporated the Action Agencies' Adaptive Management Implementation Plan, and further supplemented in a 2014 Supplemental BiOp. On January 17, 2014, NOAA released its 2014 Supplemental BiOp. In May 2016, the Federal District Court for the District of Oregon invalidated the BiOp on numerous grounds and found that the Corps and Reclamation violated the National Environmental Policy Act (NEPA) when they issued decision documents to implement the BiOp. The court ordered NOAA to complete a new BiOp by December 31, 2018, and ordered the Corps and Reclamation to complete a NEPA process in 2021. In an order issued April 3, 2017, the court ordered additional spill beginning in 2018 and continuing through the BiOp remand period; this order was upheld by the Ninth Circuit Court of Appeals on April 2, 2018. The Action Agencies are now in consultations with NOAA on a new BiOp.
- In July 2008, USFWS and NOAA issued Willamette River BiOps to address impacts from 13 federal dams on salmon, steelhead, Oregon chub, and bull trout. Implementation of a BiOp measure related to hatchery fish in the McKenzie River was the subject of litigation in Federal District Court. The Action Agencies are currently engaged in discussions with NOAA related to BiOp implementation for downstream passage and for hatchery consultations.

Under these collective BiOps, the Action Agencies have committed to implement hydro, habitat, hatchery, and other actions throughout the Columbia River Basin to address impacts stemming from the operation of the federal hydro-electric dams on ESA-listed fish, and to ensure that operations of the federal dams do not jeopardize the continued existence of the ESA listed species or adversely modify their designated critical habitat.

The Action Agencies also signed the 2008 Columbia Basin Fish Accords (Fish Accords or Accords) with five Northwest Tribes and the states of Idaho and Montana. In 2009, an agreement was signed with the state of Washington and federal agencies (the state of Washington Estuary agreement). And in 2012, the Action Agencies signed an agreement with the Kalispel Tribe of Indians covering Albeni Falls Dam and FCRPS operations. Wildlife settlement agreements have been signed with the states of Oregon and Idaho to help complete mitigation for the flooding and inundation caused by the construction of FCRPS dams operating in those states. These Fish Accords and settlements complement the BiOps and provide firm commitments to prioritize mitigation actions and secure funding over the life of the agreements.

In October 2018, Bonneville and its federal partners Corps and Reclamation signed extension agreements with current Accords partners, namely certain states and tribes, to extend the Columbia Basin Fish Accords. The existing agreements expired September 30, 2018, and were extended from October 2018 until September 30, 2022, at the latest. The extension agreements commit nearly \$450 million for fish and wildlife protection and mitigation, which is likely to result in future expenses or regulatory assets. No amounts relating to the extension agreements were recognized in the fiscal year 2018 financial statements, as they were executed subsequent to the fiscal year end.

As noted above, BiOps, Fish Accords, and wildlife settlement commitments are integrated along with other projects and implemented through the Program under the Northwest Power Act. They provide the basis for the Bonneville Fish and Wildlife Program's planned capital investment.

Accomplishments

- The BP-18 rates were confirmed and approved by FERC on a final basis on March 19, 2018.

- Enhanced more than 700 stream miles by improving channel complexity, reconnecting floodplains, and improving fish passage
- Restored in-stream flow 53 cubic feet per second, and secured more than 500,000 acre-feet of water over the life of the projects
- Met key milestones for four major, new innovative fish hatcheries under the Columbia Basin Fish Accords
- Completed transformer improvements at Bonneville Dam Powerhouse 2
- Completed digital governor upgrades at Dworshak Dam
- Completed installation of circuit breakers at the Keys Pump Generating Plant
- Completed powerhouse roof replacements at Libby and Cougar dams
- Completed unit 3 generator repair at The John Day Dam
- Completed replacement of tailrace gantry crane at The Dalles Dam

Explanation of Changes

Bonneville’s budget includes \$285.3 million in FY 2020 for Power Services capital, which is a 7.6 percent decrease from the FY 2019 forecasted level. The FY 2020 level reflects additional cost management efforts while continuing to align with Bonneville’s strategic asset management plans which focus on the need for investment in the hydroelectric system assets and investments necessary to implement the BiOps, Fish Accords, and other Columbia Basin Fish and Wildlife activities.

The FY 2020 budget decreases the levels for Associated Projects (-\$26.7 million) and increases the level for Fish & Wildlife (+\$3.3 million), relative to FY 2019.

Strategic Management

Bonneville provides electric power while supporting the achievement of its vital responsibilities for fish and wildlife, energy efficiency, renewable resources, and low-cost power in the Pacific Northwest region. Bonneville will continue to implement the following strategies to serve the region:

1. Bonneville coordinates its power operational activities with the Corps, Reclamation, NERC, regional electric reliability councils, its customers, and other stakeholders to provide the most efficient use of federal assets.
2. Ongoing work with the Corps and Reclamation is focused on improving the reliability of the FCRPS, increasing its generation efficiency, and optimizing hydro facility operation.
3. Bonneville is committed to funding efforts to protect listed fish and wildlife species in the Columbia Basin under the ESA and working closely with the Council, regional fisheries managers, and other federal agencies to prioritize and manage projects to mitigate fish and wildlife affected by the FCRPS.
4. Bonneville’s utility customers have been, and continue to be, a critical part of Bonneville’s collaborative efforts to promote and foster the efficient use of energy.
5. Bonneville has assisted with a DOE Wind Power crosscutting initiative to strengthen energy security.

The following external factors present the most significant risk and impact to overall achievement of the strategies listed above:

1. Continually changing regional economic and institutional conditions;
2. Competitive dynamics; and
3. Ongoing changes in the electric industry.

Associated Projects

Overview

Bonneville will work with both the Corps and Reclamation to reach mutual agreement on budgeting and scheduling capital improvement projects that are cost-effective and provide system or site-specific enhancements, increase system reliability, or provide generation efficiencies.

The work is focused on improving the reliability of the FCRPS and on increasing its generation efficiency or capacity through turbine runner replacements, optimizing hydro facility operation, and new unit construction. Also, limited investments may be made in joint-use facilities that are beneficial to both the FCRPS operations and to other Corps and Reclamation project purposes.

Corps of Engineers Projects

(\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
166,668	122,298	123,071

Bonneville Dam:

- FY 2018. Continue generator step up (GSU) transformer instrumentation and powerhouse 2 roof replacement. Continue main unit breaker and station service reconfiguration, and tailrace gantry crane rehabilitation. Begin powerhouse 2 tailrace gantry crane rehabilitation and generator cooler replacements.
- FY 2019. Complete powerhouse 2 roof replacement. Continue GSU transformer instrumentation, main unit breaker and station service reconfiguration, and tailrace gantry crane rehabilitation. Begin generator fire protection projects and trash racks replacement.
- FY 2020. Complete GSU transformer instrumentation. Continue main unit breaker and station service reconfiguration, tailrace gantry crane rehabilitation, generator fire protection projects and trash racks replacement.

John Day Dam:

- FY 2018. Completed draft tube bulkhead refurbishment. Continued 500kV disconnect replacement, station service transformer replacement, Heating, Ventilating, Air Conditioning (HVAC) system upgrade, emergency gantry crane replacement and SQ board replacement.
- FY 2019. Complete station service transformer replacements and 500kV disconnect replacement. Continue HVAC system upgrade, emergency gantry crane replacement and SQ board replacement. Begin powerhouse roof replacement and trash rack crane replacement.
- FY 2020. Complete emergency gantry crane replacement. Continue HVAC system upgrade, emergency gantry crane replacement, SQ board replacement, powerhouse roof replacement and trash rack crane replacement. Begin control room fire protection upgrades.

The Dalles Dam:

- FY 2018. Continued transformer replacements, fish unit breaker replacement, SR panel replacement, and emergency gantry crane rehabilitation.
- FY 2019. Complete SR panel replacement. Continue transformer replacements, fish unit breaker replacement, and emergency gantry crane rehabilitation. Begin control room modernization and fish units runner replacement and generator rewinds.
- FY 2020. Continue transformer replacements, fish unit breaker replacement, emergency gantry crane rehabilitation, control room modernization and fish runner replacements and generator rewinds.

Willamette Plants:

- FY 2018. Completed Hills Creek spillway gate rehabilitation, and digital governor replacements at Cougar. Continued Foster Bridge crane rehabilitation, Detroit spillway gate rehabilitation, Generic Data Acquisition and Control System (GDACS) and turbine platform installations at all Willamette Valley plants, electrical reliability upgrades and turbine

rehabilitation at Foster, and powerhouse roof replacement at Cougar Dam. Began intake gantry crane replacement at Big Cliff.

- FY 2019. Complete Foster bridge crane rehabilitation and turbine platform installations in the Willamette Valley. Continue Detroit spillway gate rehabilitation, GDACS installation across the Willamette Valley, intake gantry crane replacement at Big Cliff, electrical reliability upgrades and turbine and generator rehabilitation at Foster, and powerhouse roof replacement at Cougar. Begin fire detection, HVAC and life safety improvements at Dexter.
- FY 2020. Complete GDACS installation across the Willamette Valley, Detroit spillway gate rehabilitation, and Big Cliff intake gantry crane replacement. Continue electrical reliability upgrades and turbine and generator rehabilitation at Foster, powerhouse roof replacement at Cougar, and fire detection, HVAC and life safety improvements at Dexter. Begin Dexter intake gantry crane.

Albeni Falls Dam:

- FY 2018. Continue station service switchgear replacement and spillway gate modifications. Continue design for transformer replacement.
- FY 2019. Complete station service switchgear replacement and spillway gate modifications. Begin installation of main unit transformers.
- FY 2020. Continue installation of main unit transformers.

Libby Dam:

- FY 2018. Complete powerhouse DC emergency lighting system installation. Continue system control console replacement. Begin hydropower critical spares warehouse. Begin intake gantry crane replacement.
- FY 2019. Complete system control console replacement and hydropower critical spares warehouse. Continue intake gantry crane replacement.
- FY 2020. Complete intake gantry crane replacement.

Chief Joseph Dam:

- FY 2018. Complete DC and preferred AC upgrade. Continue intake and tailrace gantry crane replacement. Begin system control console boards replacement.
- FY 2019. Complete intake and tailrace gantry crane replacement. Begin powerhouse HVAC upgrade and upgrades for station service units.
- FY 2020. Continue upgrades for station service units and powerhouse HVAC upgrade. Begin powerbus replacement.

Dworshak Dam

- FY 2018. Completed unit 3 stator and cooler replacement. Continued exciter replacement and tailrace crane rehabilitation.
- FY 2019. Complete exciter replacement. Continue tailrace crane rehabilitation.
- FY 2020. Complete tailrace crane rehabilitation. Begin life safety fire alarm system upgrades.

McNary Dam

- FY 2018. Completed powerhouse bridge crane skew control. Continued 4160-480V station service rehabilitation, turbine design and replacement, drainage system oil water separator and main unit cooling water strainers replacement. Begin spillway gates rehabilitation.
- FY 2019. Complete 4160-480V station service rehabilitation, main unit water strainers replacement, and drainage system oil water separator. Continue spillway gate rehabilitation and turbine design and replacement. Purchase 230kV transformer. Begin exciters upgrade, levee drainage pump station upgrades and station service units rehabilitation.
- FY 2020. Continue exciters upgrade, levee drainage pump station upgrades, turbine design and replacement, drainage system oil water separator, spillway gate rehabilitation, and station service units rehabilitation. Begin governor mechanical system rehabilitation, powerhouse control system upgrade, and intake gantry crane replacement.

Ice Harbor Dam

- FY 2018. Continued units 1-3 turbine runner replacements, stator winding replacements, main unit surface air cooler upgrades, and station service transformer replacements. Began 115kV disconnect upgrade and drainage system oil water separator installation.
- FY 2019. Complete drainage system oil water separator installation, stator winding replacements, 115kV disconnect upgrade and main unit surface air cooler upgrades. Continue Units 1-3 turbine runner replacements.
- FY 2020. Complete station service transformer replacements. Continue units 1-3 turbine runner replacements. Begin intake gantry crane controls upgrade and fish ladder entrance weir gates and hoists replacement.

Little Goose Dam

- FY 2018. Completed bridge crane rehabilitation. Continue station service transformers replacement and drainage and unwatering pump replacement.
- FY 2019. Complete station service transformers replacement. Continue drainage and unwatering pump replacement. Begin DC system and LV switchgear upgrade and headgate repair pit upgrade.
- FY 2020. Complete headgate repair pit upgrade, drainage and unwatering pump replacement and drainage system oil water separator installation. Continue DC system and LV switchgear upgrade.

Lower Granite Dam

- FY 2018. Completed bridge crane rehabilitation. Continued digital governor upgrade. Began isophase bus and housing upgrade, drainage system oil water separator and DC system and LV switchgear upgrade.
- FY 2019. Complete isophase bus and housing upgrade, digital governor upgrade and drainage system oil water separator. Continue DC system and LV switchgear upgrade.
- FY 2020. Complete DC system and LV switchgear upgrade.

Lower Monumental Dam

- FY 2018. Completed breaker replacements. Continued digital governor replacements, drainage system oil water separator installation, and drainage and unwatering pump replacements. Began DC system and LV switchgear upgrades.
- FY 2019. Complete digital governor replacements, drainage system oil water separator installation and drainage and unwatering pump replacements. Continue DC system and LV switchgear upgrades.
- FY 2020. Continue DC and LV switchgear upgrades. Begin headgate repair pit upgrades.

Bureau of Reclamation Projects

(\$K)

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
32,770	142,437	114,929

Grand Coulee Dam

- FY 2018. Continued firehouse construction, Supervisory Control and Data Acquisition (SCADA) replacement, Units G11-G18 transformer replacements and G22-24 wear ring replacements, left and right powerhouse bridge crane replacements, and compressed air system upgrades. Began G1-G18 penstock stoplogs and crane control upgrades, G21-G24 transformers replacement, and roof replacement in the Third Powerplant.
- FY 2019. Complete compressed air system upgrades. Continue SCADA replacement, Units G11-G18 transformer replacements, G22-24 wear ring replacements, left and right powerhouse bridge crane replacements, G1-G18 penstock stoplogs, crane control upgrades, G21-G24 transformers replacement and roof replacement in the Third Powerplant.
- FY 2020. Complete SCADA replacement, Third Powerplant roof replacement and G1-G18 penstock stoplogs. Continue Units G11-G18 transformer replacements, G22-G24 wear ring replacements, left and right powerhouse bridge crane replacements and crane control upgrades, G21-G24 transformers replacement and roof replacement in the Third Powerplant. Begin G1-G18 transformers replacement.

Keys Pump Generating Plant

- FY 2018. Continued P5 and P6 impeller and core replacement and rewinds. Continued P1-P6 exciters, relays and unit controls and PG7-12 governors, exciters, relays and unit controls. Continued phase reversal switch replacement.
- FY 2019. Continue P5 and P6 impeller and core replacement and rewinds. Continue P1-P6 exciters, relays and unit controls and PG7-12 governors, exciters, relays and unit controls. Continue phase reversal switch replacement. Begin KP10B transformer replacement.
- FY 2020. Complete P5 and P6 impeller and core replacement and rewinds, and phase reversal switch replacement. Continue P1-P6 exciters, relays and unit controls, KP10B transformer replacement and PG7-12 governors, exciters, relays and unit controls. Begin crane controls upgrade.

Hungry Horse Dam

- FY 2018. Continued powerplant crane controls, SCADA replacement, control room panel revisions, and main unit transformer fire protection system replacement.
- FY 2019. Complete SCADA replacement and control room panel revisions. Continue powerplant crane controls, main unit transformer fire protection system replacement.
- FY 2020. Continue powerplant crane controls, main unit transformer fire protection system replacement. Begin static exciters and governors replacement.

Chandler Dam

- FY 2018. No planned capital projects.
- FY 2019. No planned capital projects.
- FY 2020. No planned capital projects.

Palisades Dam

- FY 2018. Completed turbine runner replacement. Continued microwave system backbone modernization, and arc flash mitigation.
- FY 2019. Complete arc flash mitigation and microwave system backbone modernization.
- FY 2020. Complete switchyard modernization.

Green Springs Dam

- FY 2018. Continued excitation system replacement.
- FY 2019. Continue excitation system replacement.
- FY 2020. Complete excitation system replacement.

Black Canyon Dam

- FY 2018. Began switchyard replacement, trash rack system, and Units 1 and 2 upgrades.
- FY 2019. Continue switchyard replacement, trash rake system, and Units 1 and 2 upgrades.
- FY 2020. Continue switchyard replacement, trash rake system, and Units 1 and 2 upgrades.

Anderson Ranch Dam

- FY 2018. No planned capital projects.
- FY 2019. No planned capital projects.
- FY 2020. No planned capital projects.

Roza Dam

- FY 2018. Continued switchyard rehabilitation and breaker upgrade.
- FY 2019. Continue switchyard rehabilitation and breaker upgrade.
- FY 2020. Complete switchyard rehabilitation and breaker upgrade.

Minidoka Dam

- FY 2018. Completed Units 8 and 9 governor replacements. Continued switchyard modernization, arc flash mitigation, and microwave system backbone modernization.
- FY 2019. Complete arc flash mitigation and switchyard modernization projects. Continue microwave system backbone modernization.
- FY 2020. Complete microwave system backbone modernization.

**Fish & Wildlife
(\$K)**

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
30,669	44,000	47,266

Overview

Bonneville continues to develop budgets for the suite of fish and wildlife mitigation projects originally adopted in FY 2007 based on recommendations from the Council. Bonneville reaffirmed and expanded many project-specific commitments in subsequent agreements and processes, including BiOps and Fish Accords, and since then, virtually all these projects received independent science review through the Council and its project review processes. Bonneville’s funding decisions embrace many of the management objectives and priorities in the Program and continue to integrate ESA compliance as described in the NOAA Fisheries’ and USFWS’s FCRPS BiOps. Coordination continues among Bonneville, Council, federal resource management agencies, states, tribes, and others to support the projects that satisfy Bonneville’s mitigation responsibilities.

Bonneville intends to continue implementing the kinds of capital projects listed below. These projects are based upon the best available science and are regionally important in that they provide high priority mitigation and protection actions for fish and wildlife populations affected by the construction and operation of the FCRPS dams. Projects and facilities listed below deliver direct on-the-ground benefits to both ESA listed and non-listed fish and wildlife throughout the Columbia River Basin and have been evaluated and coordinated with the Council, state, federal and tribal fish and wildlife resource managers, local governments, watershed and environmental groups, and other interested parties. Specifically, as capital construction projects, hatchery facilities typically go through the Council’s three-step process, which includes development of a Master Plan, environmental compliance, ESA consultation, value engineering analysis, and review by the Independent Science Review Panel.

The three types of fish and wildlife projects that Bonneville capitalizes are as follows:

- 1) Fish passage structures – Structures funded with capital that enhance fish access to habitat in the Columbia River Basin include but not limited to wells, ladders, screens, pumping, culverts, diversion (irrigation) consolidation, piping to reduce water loss, irrigation efficiencies (drip irrigation), lining of ditches (seepage reduction), removal of objects impeding fish passage or pushup dams, and construction-related habitat restoration.
- 2) Hatchery facility construction – Projects and activities relating to the construction, improvement, and replacement of fish hatcheries, including related satellite facilities (acclimation ponds and collection weirs). This may also include construction-related habitat restoration.
- 3) Land acquisition and stewardship – Land acquisition projects protect, enhance, and maintain instream wetland and riparian habitat and provide credit to Bonneville, such as acres for wildlife or instream miles for resident fish, to fulfill the legal obligation of Bonneville to mitigate the impacts from construction and operation of the FCRPS.

Fish supplementation, production, and related hatchery facilities that may require capital funds in FY 2020 include the following:

Requesting Expenditure Authority for the following project:

- Steigerwald Project: The Steigerwald Floodplain Restoration Project is a collaborative project that will reconfigure the Port of Camas-Washougal’s existing Columbia River levee system to reduce flood risk, reconnect 960 acres of Columbia River floodplain, and increase ecological function at the Steigerwald Lake National Wildlife Refuge. Specifically, the project will construct 1.6 miles of setback levee; completely remove 2.2 miles of existing levee; provide unobstructed access to floodplain and tributary habitats for salmonids and lamprey; and greatly reduce flood risk to the Port’s Industrial Park and City of Washougal’s wastewater treatment plant, which serves 15,000 residents. The lower Columbia Estuary Partnership is leading the project, which would provide seven survival benefit units (approximately 15% of the Action Agencies’ total goal in the estuary). Partners include the Port, USFWS, Washington State Department of Transportation, City of Washougal, and several private landowners. Capital construction is scheduled to begin in FY 2020 and will last three years.

The Consolidated Appropriations Act, 2016 (Public Law 114-113) provided Expenditure Authority for the following projects:

- Shoshone Paiute Trout Hatchery: The Shoshone Paiute Tribes of the Duck Valley Reservation propose that Bonneville fund the purchase or construction of a trout hatchery. The Tribes would own and operate the hatchery to produce trout for stocking in reservoirs located on the Duck Valley Reservation. Bonneville would fund the capital expenditure to meet contemporary aquaculture standards and achieve fish production goals. The Tribes believe they can reduce federal reservoir stocking costs—some of which Bonneville pays now on an annual basis.

- Spokane Tribal Hatchery: The Spokane Tribal Hatchery, funded by Bonneville in 1989 as partial mitigation for the impacts of the FCRPS, is owned and operated by the Spokane Tribe of Indians. The facility spawns, incubates, and rears Kokanee salmon and rainbow trout near Wellpinit, WA. In June 2015, the Tribe and Bonneville signed a 20-year agreement renewing commitments to operate and maintain the facility. The renewed agreement also plans to upgrade aging infrastructure, including ground water pumps and rearing containers. Contracting for this work began in FY 2017.

- Snake River Sockeye Weirs: Bonneville funds efforts implemented by the Idaho Department of Fish and Game and the Shoshone Bannock Tribes to rebuild Snake River sockeye throughout their historic range. The combination of substantially increased numbers of returning adults as well as the completion of the Springfield Sockeye Hatchery in 2013 and its associated increased production has created the need for Bonneville to potentially fund the construction, operation, and maintenance of weirs to further sockeye management objectives.

The FY 2014 Omnibus Appropriations Act (Public Law No. 113-76) provided Expenditure Authority for the following projects:

- John Day Reprogramming and Construction: This project is being proposed by the Columbia River Inter-Tribal Fish Commission (CRITFC) under the Accords to work on the balance between upriver and down river salmon hatchery production mitigating for John Day and The Dalles Dams. Final reprogramming facilities and locations are still being analyzed by the Tribes, the Corps, and Bonneville. The project area encompasses the mainstream Columbia River from the base of McNary Dam downstream to The Dalles Dam. Capital dollars for this project will integrate with the Corps funds constructing additions to new or existing FCRPS hatchery facilities to accommodate the reprogramming of hatchery fish.

- Columbia River Basin White Sturgeon Hatchery: This project, proposed by the CRITFC under the Accords, will mitigate for white sturgeon population declines due to consistent poor recruitment upstream of Bonneville Dam. Expected production at a new or existing facility will be 15,000 - 20,000 yearling white sturgeons per year. The final project may include broodstock collection and holding, rearing wild-spawned juveniles, and acclimating juveniles prior to release. The site of the existing Marion Drain sturgeon facilities operated by Yakama Nation has been proposed as a location, near Toppenish, Washington. The project team is working on additional analyses to respond to Council comments and to begin the environmental review process.

- Kelt Reconditioning and Reproductive Success Evaluation Research: CRITFC, under the Accords, is proposing a facility to recondition female steelhead (kelts) after they have spawned. The fish will be held and fed until they have rematured and then be released into the Snake River where they will contribute to the spawning run. The capital portion of the project is expected to be constructed in the Snake River Basin, potentially at Lower Granite Dam. As specified in the 2008 FCRPS BiOp and Supplemental FCRPS BiOps issued in 2010 and 2014, Bonneville will implement the kelt reconditioning plan to improve the productivity of Snake River basin B-run steelhead populations that are listed for protection under the ESA. NOAA's analysis of Prospective Actions indicates that a combination of transportation, kelt reconditioning, and in-stream passage improvements (e.g., spill-flow modifications) could increase kelt returns enough to increase the number of returning Snake River B-run steelhead spawners to Lower Granite Dam by a target of six percent. The Master Plan for the facility is currently in step 2 of 3 in the amended, shortened Council 3 step process.

Ongoing Projects (Expenditure Authority previously received):

- Crystal Springs Hatchery Facilities: This proposed project is for facilities for rearing and out-planting resident and anadromous fish in central and southern Idaho. The facility would be located near the American Falls Reservoir in Idaho. It may produce Yellowstone cutthroat, a resident fish, and anadromous fish including Snake River spring chinook salmon, Snake River steelhead, and Snake River sockeye. The facility is expected to produce up to one million chinook smolts annually. The facility is sponsored by the Shoshone-Bannock Tribes under their Accord, who are expected to operate and manage the facility once it is complete. Crystal Springs' Environmental Impact Statement (EIS) and Record of Decision (ROD) have been "paused" pending the resolution of water quality issues. Final results won't be known until summer 2019, at which point a decision will be made to move forward (or not) with EIS/ROD.

- Redfish Lake Sockeye Salmon program: The Snake River sockeye salmon, an Evolutionarily Significant Unit (ESU), was listed under the Endangered Species Act in 1991 (56 FR 58619). The Snake River Sockeye Salmon Captive Broodstock Program has supported the survival of endangered Snake River sockeye salmon. The program has been able to help successfully conserve the genetic resources of the founding population and began producing fish for rebuilding the naturally spawning population in Redfish Lake. The program uses state of the art hatchery facilities and fish husbandry protocols, genetic support, and monitoring and evaluation to continue rebuilding numbers of fish. Currently, the program retains replicate, captive broodstock within multiple facilities (Eagle Fish Hatchery located in Idaho state and Burley Creek Fish Hatchery and Manchester Research Station, both located in Washington state). Eggs produced from these locations are transferred to other facilities (Springfield Fish Hatchery and Burley Creek Fish Hatchery) for release programs. The project continues to expand by increasing the capacity of existing facilities and also by acquiring a new facility under the Idaho Fish Accord. The newly constructed Springfield Fish Hatchery located in Idaho produces additional smolts as called for in the NOAA Fisheries FCRPS BiOp. The expanded smolt releases have already resulted in an increase in the abundance and productivity of the naturally-spawning population. This strategy will greatly increase the likelihood of higher adult returns. Additional expansions include improvements at the Redfish Lake Creek trap and Sawtooth Fish Hatchery weir to hold/trap an increased number of adults to support increased smolt production from Springfield Fish Hatchery. The biological goals are to increase the number of adults spawning naturally in the Sawtooth Valley and transition the captive broodstock to a conventional hatchery production program that uses anadromous adults as broodstock.

- Klickitat Production Expansion: In 2008, the Klickitat River Master Plan was submitted by the Yakama Nation, reviewed by the Independent Science Review Panel, recommended with comments by the Council and approved by Bonneville. The plan's original goals were to protect and increase naturally producing populations of spring chinook and steelhead, localize brood collection of harvest stocks (fall chinook and coho), while protecting the biological integrity and the genetic diversity of indigenous fish stocks in the sub-basin. In 2009, a component of the Master Plan was implemented. Upgrades to Lyle Falls Fishway and Castile Falls Fishway were completed and a new bridge was constructed at Klickitat Hatchery. In July 2009, a new Klickitat Hatchery Complex EIS was initiated to examine options for the development and operation of new production and supplementation facilities, acclimation alternatives and additional upgrades to the existing hatchery facility. The Yakama Nation issued a revised Master Plan, July 2012, providing updates to their fish management plans. Bonneville put the NEPA process on hold while the Yakama Nation refined its proposal in response to site and budgetary limitations and comments on the draft EIS. Since that time, the National Marine Fisheries Service (NMFS) has completed their Mitchell Act EIS and BiOp, helping inform funding authority responsibilities in the subbasin. A new scope of work has been negotiated with the Yakama Nation and a revised Master Plan was submitted to Council in fall 2017, targeting design and construction activities to the expansion of the current spring chinook program only, from 600,000 to 800,000 smolt converting to a wild brood collection program along with general water supply and water abatement upgrades. Bonneville is finalizing plans to cancel the past NEPA process and initiate a new EIS process. Construction will occur after Bonneville issues a ROD and after NMFS, Bonneville and the Yakama Nation sign a three way funding agreement establishing expectations for operations and maintenance funding within the subbasin.

- Hood River Production Facility: This project has been ongoing since the early 1990s. It currently produces 150,000 spring chinook salmon smolts and 50,000 winter steelhead smolts annually. The Powerdale Dam Fish Trap formerly provided the foundation for many of the activities associated with implementation of the Hood River Production Program. These include monitoring escapement, collecting life history characteristics, and broodstock acquisition. PacifiCorps' demolition of its

Powerdale Dam and the associated fish trapping facility in 2010 necessitated the development of alternative adult broodstock trapping sites. One permanent fish trap on the West Fork of the Hood River was completed in 2013, and a temporary trapping site is operational on the East Fork Hood River. A permanent trap site on the East Fork is currently being evaluated. The Hood River Production Program has four primary goals: 1) re-establish naturally sustaining runs of spring chinook in the Hood River; 2) re-build naturally sustaining runs of winter steelhead in the Hood River; 3) maintain genetic characteristics of Hood River fish populations; and 4) provide fish for sustainable harvest by both sport and tribal fishers.

- Mid-Columbia Coho Restoration: This Yakama Accord project's vision is to re-establish naturally reproducing coho salmon populations in the Wenatchee River and Methow River sub-basins at biologically sustainable levels which provide significant harvest in most years. This program will construct a facility on the Wenatchee River for holding and spawning broodstock, incubating eggs, and rearing juveniles. Additional semi-natural ponds will also be constructed in the Wenatchee and Methow sub-basins for acclimating smolts prior to their release. The phased approach, including associated facilities, incorporates development of a mid-Columbia hatchery broodstock, local adaptation to tributaries in the Wenatchee and Methow Basins, and habitat restoration that will benefit coho as well as ESA-listed spring chinook, steelhead, and bull trout. Major facility construction is expected to occur over the FYs 2017-2020 timeframe.

- Walla Walla Hatchery: The Walla Walla Hatchery is proposed by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under their Accord. The Tribes would own and operate the hatchery, which will produce up to 500,000 spring chinook smolts annually for release into the Walla Walla River. A 30 percent design was completed in June 2015, however due to budget overruns, the project has been on hold. A draft EIS was completed in September 2016. Design and construction have been successfully rebid; the construction phase of Walla Walla Hatchery will not commence until spring or fall 2019, depending on data collection and analysis requirements by the state water authority. The facility will hold, spawn, incubate and rear spring chinook on the South Fork Walla Walla River near Milton-Freewater, Oregon.

- Yakima Coho Facility: This hatchery is proposed by the Confederated Tribes and Bands of the Yakama Nation under the Yakama Nation Accord, and is presented in the Yakima River Subbasin Summer and Fall Run Chinook and Coho Salmon Hatchery Master Plan. The Yakama Nation would own and operate the hatchery which will produce up to 700,000 coho smolts using broodstock collected at Roza and Sunnyside dams. Bonneville holds the design and construction contract on behalf of the Yakama Nation and will transfer ownership after construction is complete. Construction ground-breaking was August 22, 2018 with an estimated schedule for substantial completion by October 2019.

Potential non-construction capital Wildlife and Resident Fish Habitat Acquisitions (including Conservation Easements) eligible for capitalization are:

- Albeni Falls Wildlife Mitigation
- Willamette Wildlife Habitat Acquisitions
- Libby and Hungry Horse Reservoirs Resident Fish Acquisitions
- Southern Idaho Habitat Acquisitions

Activities and Explanation of Changes (\$K)

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Power Services – Capital \$308,735	\$285,266	-\$23,469/-7.6%
Associated Projects \$264,735	\$238,000	-\$26,735/-10.1%
Milestones ¹ :	Milestones:	
<ul style="list-style-type: none"> • Complete compressed air system upgrades at Grand Coulee. • Complete SCADA replacement at Hungry Horse. • Complete arc flash mitigation at Minidoka. • Complete exciter replacement at Green Springs. • Complete station service switchgear replacement at Albeni Falls. 	<ul style="list-style-type: none"> • Complete GSU transformer instrumentation at Bonneville Dam. • Complete emergency gantry crane replacement at John Day Dam. • Complete GDACS installation across the Willamette Valley, Detroit spillway gate rehabilitation, and Big Cliff intake gantry crane replacement at Willamette Plants. • Complete intake gantry crane replacement at Libby Dam. • Complete upgrades for station service units and powerhouse HVAC upgrade at Chief Joseph Dam. • Complete tailrace crane rehabilitation at Dworshak Dam. • Complete station service transformer replacements at Ice Harbor Dam. • Complete DC system and LV switchgear upgrade at Lower Granite Dam. • Complete SCADA replacement, Third Powerplant roof replacement and G1-G18 penstock stoplogs at Grand Coulee Dam. • Complete P5 and P6 impeller and core replacement and rewinds, and phase reversal switch replacement at Keys Pump Generating Plant. 	<ul style="list-style-type: none"> • The decrease reflects a reshaping of funding needs for investment in the hydroelectric system assets.

¹ FY 2019 milestones have been updated from the FY 2019 Congressional submission due to updated forecasts.

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Fish & Wildlife \$44,000 Milestones: <ul style="list-style-type: none"> Continue implementation of the Program, BiOps and Fish Accords. 	\$47,266 Milestones: <ul style="list-style-type: none"> Continue implementation of the Program, BiOps and Fish Accords. 	+\$3,266/+7.4% <ul style="list-style-type: none"> Small increase but will continue long-term, planned effort to reshape funding necessary to implement the BiOps, Fish Accords, Columbia River Basin Fish and Wildlife activities.

**Transmission Services – Capital
Funding Schedule by Activity
Funding (\$K)**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
Transmission Services – Capital					
Main Grid	10,652	39,968	2,759	-\$37,209	-93.1%
Area & Customer Services	35,505	47,871	81,796	+33,925	+70.9%
Upgrades & Additions	29,251	71,708	56,696	-\$15,012	-20.9%
System Replacements	178,086	329,519	337,920	+8,401	+2.5%
Projects Funded in Advance	156,849	41,125	85,886	+44,761	+108.8%
Total, Transmission Services - Capital	410,343	530,191	565,057	+34,867	+6.6%

Outyears (\$K)

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Transmission Services - Capital					
Main Grid	2,759	27,365	25,313	33,808	45,944
Area & Customer Services	81,796	91,867	74,912	69,733	56,442
Upgrades & Additions	56,696	50,024	69,295	105,036	121,705
System Replacements	337,920	312,470	305,862	305,933	308,787
Projects Funded in Advance	85,886	66,170	60,452	39,843	39,819
Total, Transmission Services - Capital	565,057	547,896	535,834	554,353	572,697

Transmission Services – Capital

Overview

Transmission Services (TS) is responsible for about 75 percent of the Pacific Northwest’s high-voltage transmission. TS provides funding for all additions and upgrades (Expansion Investments), and replacements (Sustain Investments) to the Bonneville transmission system, resulting in reliable service to Northwest generators and transmission customers. The Bonneville transmission system also facilitates the sale and exchange of power to and from the region. The TS Capital Program is structured with a balanced focus on Expansion and Sustain investments.

In addition to replacing aging and obsolete equipment, TS continues to make significant infrastructure improvements and additions to the system to assure reliable transmission in the Northwest. These improvements and additions will help the Bonneville transmission system continue to comply with national reliability standards and remove constraints that limit economic trade or the ability to maintain the system. Some of the proposed TS projects may be funded through Bonneville lease-purchase agreements. The lease-purchases obligate Bonneville to make expenditures to acquire the use of the related facilities and are identified on an as needed basis. Bonneville may also make related expenditures to facilitate lease-purchase opportunities. Consistent with the FY 2018 and FY 2019 Budget Requests, the FY 2020 Budget Request maintains the proposal that the Federal government be authorized to sell the transmission assets of Bonneville.

Expansion Investments

Expansion investments continue to make significant infrastructure improvements and additions to the Bonneville transmission system to assure reliable transmission operations in the Northwest and fall into two categories:

- Internally driven Expansion requests, which are derived from system engineering studies, technology innovation research, system operations and maintenance functions, and system event analysis.
- Externally driven Expansion Investment requests, which are derived from governmental initiatives and regulations, consumer demand, and the integration of customer load service and generation needs.

These investments are categorized into:

1. Main Grid – System investments affecting the major interties or internal paths and flowgates that transfer bulk power across the system.
2. Area & Customer Service – System investments related to geographical load service areas.
3. Upgrades & Additions – Upgrades are system investments that replace existing assets to increase capacity, reliability, or functionality and Additions are net new assets added to the system.
4. Projects Funded in Advance – System investments that are requested, and funded in advance, by customers.

Congressionally-approved Production Tax Credits (PTC) for renewable energy enacted in 2005 was extended through 2016. The PTC begins to phase out after 2018. The incentives created by these credits, along with Renewable Portfolio Standards (RPS) mandates implemented by the states of Oregon, Washington, and California, have spurred a large number of renewable interconnection requests to the Bonneville transmission grid. As of July 2018, Bonneville has interconnected a total of 5,336 MW of renewable qualified generation. Bonneville has more than 10,000 MW in additional renewable (wind, solar, biomass, geothermal, etc.) interconnection requests still remaining in the study queue. Solar interconnection requests are currently making up the majority of the new requests in Bonneville’s queue. The current projections are possibly 9,000 MW of renewable generation interconnected by 2025. Much of the remaining generation demand is the result of the Renewable Portfolio Standards enacted by Oregon and Washington that require utilities to acquire more than 8,000 MW of renewable energy in the Northwest by 2025. Exports to California are limited now by California laws and are expected to remain at 2,000 MW to 2,500 MW during the same period. Also in the interconnection queue is approximately 1,500 MW of natural gas fired generation. Efficiency improvements to the FCRPS hydro units that qualify as renewable are also proposed between 2018 and 2024.

In June 2008, Bonneville’s first Network Open Season (NOS) received 153 requests from 28 customers for 6,410 MW of new service, about three-fourths for wind energy integration. Bonneville subsequently offered 1,782 MW of new transmission service on its existing system. Bonneville identified four new Main Grid capital projects from the 2008 NOS: (1) McNary-John Day 500 kV transmission line (part of West of McNary Reinforcements Group 1); (2) Big Eddy-Knight 500 kV transmission line and substation (part of West of McNary Reinforcements Group 2); (3) Central Ferry- Lower Monumental 500 kV Reinforcement (formerly Little Goose Area Reinforcement); and (4) I-5 Corridor 500 kV Reinforcement. Construction of the McNary-John Day 500 kV transmission line is complete. Bonneville has completed construction of the Big Eddy-Knight

project and the Central Ferry-Lower Monumental 500 kV Reinforcement project is complete. On May 18, 2017, Bonneville announced its decision to not build the I-5 Corridor Reinforcement Project. Bonneville continues to work with constituents and stakeholders to study more cost effective options to mitigate the current limitations along this path. Public meetings began in July 2017 to address alternatives to building.

Bonneville's 2009, 2010, 2013, and 2016 study processes for new Transmission Service Requests (TSR) total 11,027 MW, including 5,240 MW of wind project interconnection and 240 MW of solar project interconnection. The 2010 study process identified the Montana to Washington project, for which environmental review was begun, however, the requests to support this project have been subsequently withdrawn and so all work on the project was terminated. The 2016 study process re-identified the Montana to Washington and Garrison to Ashe projects to move new wind generation in Montana to the Northwest. The 2013 study process identified upgrades to the Monroe-Novelly Hill 230-kV transmission line which were re-identified for additional new requests in the 2016 study process. The 2016 study process also identified network upgrades in Central Oregon, Walla Walla, Washington and across the Raver-Paul flowgate. Efforts are currently underway to evaluate the financial impacts and move forward with required agreements and processes within the TSR Study and Expansion Process (TSEP).

Sustain Investments

Sustain investments are made to maintain the health of the existing infrastructure to assure reliable transmission in the Northwest. These replacements enable continued compliance with national reliability standards, replace aging and obsolete equipment, and remove constraints that limit economic trade or the ability to maintain the transmission system.

In 2009, TS began implementing best practice frameworks that provide a standardized structure and approach to Asset Management. As a result, TS's Asset Management Strategies, derived from the Agency's Strategic Plan, drive Bonneville's Asset Plans, which determine its capital and expense investment priorities. Sustain investments are forecasted, prioritized within asset programs, and optimized across the asset base for asset planning and approval. Bonneville now bundles both sustain and expand capital projects in an effort to improve execution and to lower risks and costs. TS's capital program does remain somewhat fluid and subject to changes as the complexity of the transmission system produces unexpected needs resulting from equipment failure, climate/weather incidents, changes in performance and/or operation of connected systems, outage schedules and conflicts, updated regulations, customer interconnection requests, etc. For these and other reasons, specificity with Sustain investments in the transmission system is somewhat limited.

The TS Sustain Program Asset Programs include:

1. Steel Lines – Transmission lines with steel structures including footings, insulators assemblies, vibration dampers, grounding systems, conductor, ground wire.
2. Wood Lines – Transmission lines with wood structures including cross arm systems, insulator assemblies, vibration dampers, grounding systems, conductor, ground wire.
3. Rights-of-Way – Real property including land parcels, easements, use right, access roads.
4. AC Substations – Substations managing AC current including transformers, reactors, shunt capacitors, power circuit breakers, circuit switchers, series capacitors, disconnect switches.
5. Power System Controls and System Telecommunications – Control and communication equipment including SCADA, transfer trips, fiber, communications, SONET, Telephone, RAS.
6. System Protection and Control – Control equipment including relays, Control Houses, meters.
7. DC Substations – Celilo DC converter station, Static VAR Compensators, DC control systems.
8. Control Centers – Various control equipment and software.
9. Tools and Equipment Acquisition Program (TEAP) –Tools, equipment, fleet.
10. Facilities – Non-electric facilities including warehouses, operational structures, hangar, and maintenance centers.

Notwithstanding that the capital program for TS is subject to change, Bonneville has identified several general areas where capital investments will occur.

Bonneville will continue to fund fiber optic communications facilities needed to meet Bonneville's projected operational needs. To the extent that these investments create temporary periods of excess fiber optic capacity, such dark fiber capacity can be made available to telecommunications providers and to non-profits to meet public benefit internet access needs for rural areas and other needs in Bonneville's service area. Bonneville's investments in fiber optics, including the

role of the private sector in building fiber optic networks, is consistent with the “Fiber Optic Cable Plan” submitted to Congress on May 24, 2000, accompanying the FY 2000 Energy and Water Development Appropriations Act. In accordance with this plan, when possible, Bonneville will establish partnerships with fiber optic facility and service providers to meet its needs.

In December 2004, Congress passed and the President signed the Commercial Spectrum Enhancement Act (CSEA, Title II of P.L. 108-494), creating the Spectrum Relocation Fund (SRF) to streamline the relocation of federal systems from certain spectrum bands to accommodate commercial use by facilitating reimbursement to affected agencies of relocation costs. The Federal Communications Commission has auctioned licenses for reallocated federal spectrum, which will facilitate the provision of Advanced Wireless Services to consumers. Funds were made available to agencies in FY 2007 for relocation of communications systems operating on the affected spectrum. These funds are mandatory and will remain available until expended, and agencies will return to the SRF any amounts received in excess of actual relocation costs. The estimated Bonneville cost of this relocation was \$48.7 million. The project was completed in November 2013 with a cost of approximately \$40 million and the operational system performance was being observed during FY 2014 and early FY 2015 to determine that it has achieved comparable capability as defined under the CSEA. Bonneville determined in December 2014 that comparable capability had been achieved.

Bonneville began participating in a new spectrum relocation effort in FY 2015. The NTIA has approved and, in July 2014, web-posted federal agency relocation plans, including the Bonneville relocation plan. The FCC held an auction of this spectrum on November 13, 2014. Bonneville received an additional \$5.2 million from the Spectrum Relocation Fund on July 29, 2015, to fully pay for this new relocation effort, including, as in the prior relocation, the purchase and installation of new digital radio equipment.

As part of the Homeland Security Presidential Directives, Bonneville has completed a physical security assessment of all critical facilities and is implementing security enhancements at these facilities. These security enhancements increase controlled access to Bonneville’s facilities and provide video surveillance and monitoring capabilities.

Accomplishments

- The BP-18 rates were confirmed and approved by FERC on a final basis on March 19, 2018.
- Integrated 5,336 MW of renewable energy through July 2018 on Bonneville’s transmission system.
- Completed construction of the Alvey Substation Reactors.
- Completed construction of the McNary Substation 500/230 kV Bank Addition.
- Completed construction of the Bell-Boundary #DC SONET Ring Upgrade.
- Completed the rebuilding of the Midway-Grandview and Midway-Moxee 115kv Lines.

Explanation of Changes

Bonneville’s budget includes \$565.1 million in FY 2020 for TS Capital which is a 6.6 percent increase from the FY 2019 forecasted level. The FY 2020 budget decreases the levels for Main Grid (-\$37.2 million) and Upgrades & Additions (-\$15 million). The budget increases levels for Area & Customer Services (+\$33.9 million), System Replacements (+\$8.4 million), and PFIA (+\$44.8 million).

Strategic Asset Management

Transmission Services provides transmission and energy services while integrating renewable resources across the Pacific Northwest. This effort is coordinated throughout Bonneville in conjunction with the newly developed Strategic Asset Management Plan (SAMP). TS continues to implement integrated detailed Asset Plans to serve the region:

1. To improve system adequacy, reliability, and availability, Bonneville has embarked on major transmission infrastructure projects. The identified projects reinforce the transmission system and help meet the region’s future power needs. These projects address multiple challenges, such as integration of renewable energy, the need to relieve a number of congested transmission paths, the challenge to keep up with growing energy demands, and the need to meet changing regulatory and customer requirements.
2. Open access policy in support of competitive markets for load and generation.

3. The replacement of aging assets is vital to the reliability of the existing transmission system. To that end, TS has developed specific long-term strategies for the following asset categories:
 - a. Substations AC
 - b. Power System Control/System Telecommunications
 - c. Wood Lines
 - d. Steel Lines
 - e. Rights of Way (ROW), (Land Rights, Access Roads, and Vegetation Management)
 - f. System Protection and Control
 - g. Control Centers
 - h. Non-Electric Facilities

The following external factors present the strongest impact to overall achievement of the program's strategic goal:

- Continually changing economic and institutional conditions
- Competitive dynamics
- Ongoing changes in the electric industry
- Siting issues

Main Grid (\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
10,652	39,968	2,759

Overview

Bonneville’s strategic objectives for Main Grid projects are to assure compliance with the NERC and Western Electricity Coordinating Council (WECC) reliability criteria, provide voltage support, provide a reliable transmission system for open access, and provide for relief of transmission system congestion. During this budgeting period, projects are planned that will provide transmission reinforcement and voltage support to major load areas that are primarily west of the Cascade Mountains.

Continued investments in Main Grid assets include:

Monroe Line Re-termination

- FY 2018. Continue construction.
- FY 2019. Continue construction.
- FY 2020. Complete construction.

Schultz-Wautoma 500KV Series Capacitors

- FY 2018. Begin design.
- FY 2019. Begin construction.
- FY 2020. Continue construction

Continue Planning Studies to: (all years)

- Identify infrastructure additions.
- Identify projects driven by NERC and WECC reliability criteria.
- Identify system reactive needs to mitigate unacceptable low or high voltage problems and other system additions.
- Relieve transmission system congestion and integrate new generation facilities.

**Area & Customer Service
(\$K)**

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
35,505	47,871	81,796

Overview

Bonneville’s strategic objective for Area and Customer Service projects is to assure that Bonneville meets reliability standards and contractual obligations to its load service areas.

Continued investments in Area & Customer Service assets include:

Hooper Springs Substation

- This project will now be constructed and owned by Lower Valley Energy.

Midway-Grandview 115 kV Line upgrade

- FY 2018. Completed construction.

Puget Sound Area Northern Intertie (PSANI)

- FY 2018. Continue construction.
- FY 2019. Continue construction.
- FY 2020. Complete construction.

Alvey Substation Reactors

- FY 2018. Completed construction.

McNary Substation 500/230 kV Bank Addition

- FY 2018. Completed construction.

Paul Substation 500 kV Shunt Reactor Addition

- FY 2018. Completed construction.

Big Eddy Breaker Additions

- FY 2019. Begin design.
- FY 2020. Begin construction.

Drummond 115kV Breaker Additions

- FY 2018. Completed construction.

Midway –Ashe Double Circuit 230kV Line

- FY 2018. Complete scoping.
- FY 2019. Begin design.
- FY 2020. Begin construction.

Carlton Substation Upgrade

- FY 2018. Complete scoping.
- FY 2019. Begin design.
- FY 2020. Begin construction.

Conkelley Substation Retirement

- FY 2018. Complete scoping.
- FY 2019. Complete design.
- FY 2020. Begin construction.

Continuous Activities (all years)

Continue preliminary engineering and design for miscellaneous facilities required to meet contractual obligations and maintain reliable service for Bonneville's service area.

**Upgrades & Additions
(\$K)**

FY 2018 actual	FY 2019 Estimate	FY 2020 Estimate
29,251	71,708	56,696

Overview

Bonneville’s strategic objectives for Upgrades and Additions are to replace older 60 Hz (Hertz) communications and controls with newer technology including fiber optics in order to maintain or enhance the capabilities of the transmission system; to implement special remedial action control schemes to accommodate new generation and mitigate immediate operational and market constrained paths; and to support communications and remedial action schemes, among other proposals.

During this budget period, Bonneville will complete design, material acquisition, construction, and activation of several fiber optics facilities to provide bandwidth capacity and high-speed data transfers to eventually replace microwave analog radios, which are technologically obsolete and nearing the end of their useful life. Temporarily, in some areas, excess dark fiber capacity is being offered for a term to telecommunications providers or to public entities such as public utilities, schools, libraries, and hospitals, providing them access to high-speed telecommunication services as a public benefit.

Continued investments in Upgrades & Additions assets include:

VHF Radio System Upgrade

- FY 2018. Continue construction.
- FY 2019. Continue construction.
- FY 2020. Continue construction.

Synchrophasor Project

- FY 2018. Completed construction.

Bell-Boundary #DC SONET Ring Upgrade

- FY 2018. Continue construction.
- FY 2019. Complete construction.

Operational Megabit Ethernet (OMET) System

- FY 2018. Continue construction.
- FY 2019. Continue construction.
- FY 2020. Continue construction.

500 kV Spares at Wind Integration Substations

- FY 2018. Continue construction.
- FY 2019. Complete construction.

Continuous Activities (all years)

- Upgrading two miles of fiber between Bonneville Power House and Bonneville Control House.
- Planning, design, material acquisition, and construction of special remedial action control schemes required for interconnecting new generation projects and mitigating immediate constrained paths.
- Planning, design, material acquisition, and construction of various system additions and upgrades necessary to maintain a reliable system for Bonneville’s service area.
- Construction of secondary fiber related projects and digital radio system upgrades to improve the operational telecommunication system.
- Material procurement and construction to upgrade the main fiber optic backbone system (#KC and #NC systems).

**System Replacements
(\$K)**

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
178,086	329,519	337,920

Overview

Bonneville’s strategic objectives for the Sustain Program are to replace high-risk, obsolete, and maintenance-intensive facilities and equipment and to reduce the chance of equipment failure by: (1) replacing high voltage transformers and power circuit breakers which are at or near the end of their useful life; (2) replacing risky, outdated and obsolete control and communications equipment and systems, including mandated replacements due to legislation; and (3) replacing all other existing high-risk equipment and facilities affecting the safety and reliability of the transmission system. Transmission Services uses a total economic cost model to determine priorities for replacement.

Continued investments in System Replacements assets include:

Continuous Activity (all years)

Non-Electric Replacements

- Continue non-electric replacements as necessary.
- Continue the design, material acquisition, and construction for the Access Road program capital component and the Land Rights program capital component in support of the Lines and ROW Programs.
- Continue design and construction of capital improvements for identified existing facilities.
- Continue replacement of tools, equipment, and vehicle fleet.

Electric Replacements

- Continue replacement of system protection and control equipment and other substation and line facilities as needed to maintain reliability using Reliability Centered Maintenance criteria. Such replacements include relays, annunciators, oscillographs, metering, and various types of communication related equipment replacing and migrating analog to digital technology and SCADA equipment.
- Begin design and replacement of the Keeler and Maple Valley SVC units. Completion scheduled for FY2020.
- Continue replacement of under-rated and high maintenance substation equipment.
- Continue replacing insulators and refurbishing foundations on 500 kV Lines.
- Continue replacement of older generations of digital equipment that is obsolete.
- Continue replacing critical, operational tools and business systems at the Dittmer and Munro Control Centers.
- Continue replacing deteriorating wood pole transmission line structures, spacer dampers, and insulators.

**Projects Funded in Advance
(\$K)**

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
156,849	41,125	85,886

Overview

This category includes those facilities and/or equipment where Bonneville retains control or ownership but which are funded or financed by a third party or with reserves, either in total or in part.

Continued investments in PFIA assets include:

Umatilla Electrical Cooperative - Phase 2

- FY 2018. Complete design and begin construction.
- FY 2019. Complete construction.

Summit Ridge Wind Project

- FY 2018. Complete design and begin construction.
- FY 2019. Continue construction.
- FY 2020. Continue construction.

Bakeoven Wind Project

- FY 2018. Complete design and begin construction.
- FY 2019. Continue construction.
- FY 2020. Complete construction.

Quenett Creek Load Service Project

- FY 2018. Begin construction.
- FY 2019. Complete construction.

PacifiCorps' Ponderosa Project Vitesse

- FY 2018. Complete design and begin construction.
- FY 2019. Continue construction.
- FY 2020. Complete construction.

Midway-Ashe Line Project

- FY 2018. Complete scoping.
- FY 2019. Complete design.
- FY 2020. Begin construction.

Avangrid Montague 1 Wind Project

- FY 2018. Complete design and begin construction.
- FY 2019. Continue construction.
- FY 2020. Complete construction.

Invenergy's Heppner Wind Project

- FY 2019. Begin design.
- FY 2020. Begin construction.

Morrow Solar Project

- FY 2019. Complete design and begin construction.
- FY 2020. Continue construction.

Willow Creek Fiber Addition Project

- FY 2018. Begin design.
- FY 2019. Complete design and begin construction.
- FY 2020. Complete construction.

2 Morrow Energy LLC's Ella 3 Wind Project

- FY 2019. Begin design.
- FY 2020. Begin construction.

Whistling Ridge 230 kV Ring Bus Project

- FY 2020. Begin design.

Continuous Activity (all years)

- Continue to integrate various new generation and line/load projects into Bonneville transmission grid based on requests placed and processed in accordance with transmission tariff.
- Continue planning studies to identify system impacts and needs regarding proposed new generation projects.
- Engineer and begin construction of several large wind generation interconnection substations.

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Transmission Services – Capital \$530,191	\$565,057	+\$34,867/+6.6%
Main Grid \$39,968	\$2,759	-\$37,209/-93.1%
Milestones:	Milestones:	
<ul style="list-style-type: none"> • Continue construction of Monroe 500 kV Line Re-termination #2. 	<ul style="list-style-type: none"> • Complete construction of Monroe 500 kV Line Re-termination #2. 	<ul style="list-style-type: none"> • The decrease is due to decreased construction planned for FY 2020.
<ul style="list-style-type: none"> • Begin construction of Schultz-Wautoma 500Kv Series Capacitors 	<ul style="list-style-type: none"> • Continue construction of Schultz-Wautoma 500Kv Series Capacitors. 	
Area & Customer Service \$47,871	\$81,796	+\$33,925/+70.9%
Milestones:	Milestones:	
<ul style="list-style-type: none"> • Begin design of the Carlton Substation Upgrade. 	<ul style="list-style-type: none"> • Begin construction of Carlton Substation Upgrade. 	<ul style="list-style-type: none"> • The increase reflects increased construction planned for FY 2020.
<ul style="list-style-type: none"> • Complete design of the Midway-Ashe double circuit 230KV line. 	<ul style="list-style-type: none"> • Begin construction of Midway- Ashe Double Circuit 230kv line. 	
<ul style="list-style-type: none"> • Continue construction of the PSANI project. 	<ul style="list-style-type: none"> • Complete construction of the PSANI project. 	
<ul style="list-style-type: none"> • Complete design of the Conkelley Upgrade 	<ul style="list-style-type: none"> • Begin construction of Conkelley Upgrade. 	

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Upgrades & Additions \$71,708 Milestones: <ul style="list-style-type: none"> Complete construction of 500kV spares at wind integration substations. 	\$56,696 Milestones: <ul style="list-style-type: none"> Continue construction of VHF Radio System Upgrade. 	-\$15,012/-20.9% <ul style="list-style-type: none"> The decrease reflects the movement of spare transformers for wind projects between years.
Systems Replacements \$329,519 Milestones: <ul style="list-style-type: none"> Continue design and construction of capital improvements for identified existing facilities. Continue non-electric replacements as necessary. Continue replacement of system protection and control equipment and other substation and line facilities as needed to maintain reliability using Reliability Centered Maintenance criteria. Begin design and construction of Keeler-Maple Valley SVC Upgrade 	\$337,920 Milestones: <ul style="list-style-type: none"> Continue design and construction of capital improvements for identified existing facilities. Continue non-electric replacements as necessary. Continue replacement of system protection and control equipment and other substation and line facilities as needed to maintain reliability using Reliability Centered Maintenance criteria. Complete construction of Keeler-Maple Valley Upgrade. 	+\$8,401/+2.5% <ul style="list-style-type: none"> The increase reflects increased construction planned for FY 2020.
Projects Funded in Advanced \$41,125	\$85,886	+\$44,761/+108.8%

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
<p>Milestone:</p> <ul style="list-style-type: none"> • Continue to integrate new generation as requested. • Continue planning studies on needs and impacts of proposed new generation. • Continue construction of Bakeoven Series Capacitors • Complete construction of Quenett Creek Project. • Continue construction of PacifiCorps' Project Vitesse. • Continue construction of Avangrid Montague 1 project • Begin design of Invenergy's Heppner Wind Project • Complete design and begin construction of Morrow Solar Project. 	<p>Milestones:</p> <ul style="list-style-type: none"> • Continue to integrate new generation as requested. • Continue planning studies on needs and impacts of proposed new generation. • Complete construction of Bakeoven Series Capacitors • Complete construction of PacifiCorps' Project Vitesse. • Complete construction of Avangrid Montague 1 project • Begin construction of Invenergy's Heppner Wind Project • Complete construction of Morrow Solar Project. 	<ul style="list-style-type: none"> • The Projects Funded In Advance (PFIA) funding increases in FY 2020 over FY 2019 are due to several multi-year projects scheduled to be designed in FY 2019 (10- 15% of project cost) with material purchases, equipment purchases, and construction occurring in FY 2020.

**Capital Information Technology & Equipment/Capitalized Bond Premium
Funding Schedule by Activity
Funding (\$K)**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
Capital Information Technology (IT) & Equipment/Capitalized Bond Premium					
Capital IT & Equipment	14,566	26,860	22,099	-4,761	-17.7%
Capitalized Bond Premium	0	0	0	0	0.0%
Total, Capital IT & Equipment/Capitalized Bond Premium	14,566	26,860	22,099	-4,761	-17.7%

Outyears (\$K)

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Capital Information Technology (IT) & Equipment/Capitalized Bond Premium					
Capital IT & Equipment	22,099	22,131	22,295	22,267	21,146
Capitalized Bond Premium	0	0	0	0	0
Total, Capital IT & Equipment/Capitalized Bond Premium	22,099	22,131	22,295	22,267	21,146

Capital Information Technology & Equipment/Capitalized Bond Premium

Overview

Capital Information Technology (IT) provides for the acquisition of general and some dedicated special purpose capital information technologies, and acquisition of special-use capital and IT equipment in support of Bonneville's strategic objectives. This category also includes Bonneville's on-going efforts to facilitate delivery of a highly resilient organization able to anticipate, withstand, and effectively respond to disruptive events affecting it and its partners in the Northwest region. The four main areas of resiliency focus continue to include asset management, emergency management, crisis management, and continuity of operations.

Bonneville continues to move its IT infrastructure to a more efficient architecture. This FY 2020 Budget supports this effort. IT continues to eliminate redundancies in tools and applications, establish an agency-wide IT architecture with standardized IT purchasing criteria, standardize software licensing processes and minimize agency liabilities through stronger contracts, apply continuous improvement practices to IT project management, and implement an agency IT portfolio cost management strategy. The IT estimates in this FY 2020 Budget under Capital IT and Equipment include all IT functions within the agency except TS grid operations. See the Capital Program – TS section of this budget for additional discussion of grid operations-related IT requirements acquisitions.

Capital equipment provides for the acquisition of general and some dedicated special purchases of capital office furniture and equipment.

Bonneville can incur a bond premium when it repays a U.S. Treasury bond before the due date. When bonds are refinanced and premiums are incurred, the bond premiums can be capitalized. Historically, Bonneville generally has chosen to finance capitalized bond premiums with bonds issued to the U.S. Treasury, as envisioned by the Transmission Act.

Capital Information Technology & Equipment
(\$K)

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
14,566	26,860	22,099

Overview

This category includes enhancements to Bonneville’s information technology processes to provide cost effective efficiencies for secure, timely, and accurate information. Investments will enable continued enhancements to Bonneville’s enterprise systems that are designed to link key information systems throughout Bonneville and improve business processes. Current efforts include continued functional process improvements in areas not included in the initial development phase. Other investments include acquisition of capital office furniture and equipment, capital automated data processing (ADP) based administrative telecommunications equipment, ADP equipment (hardware), and support of capital software development for certain Bonneville programs.

Continued investments in Capital IT & Equipment assets include:

Continuous Activity (all years)

Capital system developments in support of:

- Corporate IT Projects
- IT Infrastructure Projects
- Power IT Projects
- Transmission Services IT Projects (excluding grid operations)

Capitalized Bond Premium
(\$K)

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
0	0	0

Overview

Continue to assess financial market and when cost-effective, refinance available bonds as prudent.

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Capital Information Technology & Equipment/Capitalized Bond Premium \$26,860	\$22,099	-\$4,761/-17.7%
Capital Information Technology & Equipment \$26,860 Milestones: Capital system developments in support of: <ul style="list-style-type: none"> • Corporate IT Projects • IT Infrastructure Projects • Power IT Projects • Transmission Services IT Projects 	\$22,099 Milestones: Capital system developments in support of: <ul style="list-style-type: none"> • Corporate IT Projects • IT Infrastructure Projects • Power IT Projects • Transmission Services IT Projects 	-\$4,761/-17.7% <ul style="list-style-type: none"> • The decrease reflects a reshaping of funding needs for investment in the IT system assets.
Capitalized Bond Premium \$0	\$0	\$0/0.0%

**Power Services – Operating Expense
Funding Schedule by Activity
Funding (\$K)**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
Power Services - Operating Expenses					
Production	912,166	1,098,201	961,002	-137,198	-14.3%
Associated Projects Costs	449,323	475,160	476,646	+1,486	+0.3%
Fish & Wildlife	247,263	276,083	275,719	-364	-0.1%
Residential Exchange Program	241,464	318,350	257,122	-61,228	-23.8%
NW Power & Conservation Council	10,969	11,914	11,789	-125	-1.1%
Energy Efficiency & Renewable Resources	162,833	165,152	158,053	-7,099	-4.5%
Total, Power Services - Operating Expenses	2,024,018	2,344,860	2,140,331	-204,528	-9.6%

Outyears (\$K)

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Power Services - Operating Expenses					
Production	961,002	1,161,821	1,202,773	1,267,819	1,281,217
Associated Projects Costs	476,646	474,660	485,187	495,973	506,929
Fish & Wildlife	275,719	276,147	282,139	288,289	294,547
Residential Exchange Program	257,122	255,399	261,069	266,891	272,816
NW Power & Conservation Council	11,789	12,004	12,270	12,544	12,823
Energy Efficiency & Renewable Resources	158,053	156,513	159,987	163,555	167,186
Total, Power Services - Operating Expenses	2,140,331	2,336,544	2,403,425	2,495,071	2,535,518

Power Services – Operating Expense

Overview

Production includes certain Bonneville non-federal debt service (including Energy Northwest debt service), O&M costs for power system generation resources (including a large nuclear plant, business operations, and short- and long-term power purchases³), electric utility marketing of power, and oversight of the FCRPS hydroelectric projects and CGS. Bonneville develops products and services to meet the needs of Bonneville’s customers and stakeholders and acquires power as needed.

In FY 2018, Bonneville completed a long-term Resource Program. The purpose of the program is to assess Bonneville’s need for power and reserves and develop an acquisition strategy to meet those needs. In the event that Bonneville does acquire output from a resource on a long-term basis, Bonneville will modify its budget to reflect the acquisition.

Associated Projects Costs represents funding for operation and maintenance costs for the FCRPS hydroelectric projects, minor additions, improvements and replacements, and costs of the Corps and the Reclamation hydroelectric projects in the Pacific Northwest, which serve many purposes. All agencies emphasize efficient power production from existing facilities and improvement of the performance and availability of power generating units. Bonneville pays additional financing costs of the FCRPS facilities through its Interest Expense and Capital Transfer budget programs. Bonneville provides funding for the operations and maintenance costs that are part of the USFWS’s Lower Snake River Compensation Plan (LSRCP) hatcheries. Bonneville is responsible for annual payments to the Confederated Tribes of the Colville Reservation for their contribution to the production of hydropower by the Grand Coulee Dam in accordance with the Settlement Agreement between the United States and the Colville Tribes (April 1994).

Bonneville’s Fish and Wildlife Program provides for extensive protection, mitigation, and enhancement of Columbia River Basin fish and wildlife adversely affected by the development and operation of the FCRPS. Bonneville satisfies its fish and wildlife responsibilities by funding projects and activities designed to be consistent with the Program under the Northwest Power Act. Through the Program, Bonneville also implements measures to aid in the protection of fish and wildlife in the Columbia River and its tributaries, both listed as threatened or endangered as well as unlisted, under the ESA (see ESA discussion in the Power Services – Capital Overview section).

Bonneville’s mitigation expenditures will focus on activities that benefit Columbia River Basin fish and wildlife resources, following priorities established through ESA consultations, agreements with resource managers, and the Program, including actions that:

- increase survival of ESA-listed and non-listed fish at FCRPS dams and reservoirs;
- increase survival of ESA-listed and non-listed fish throughout their life cycle by protecting and enhancing important habitat areas;
- protect and enhance important wildlife habitat;
- use hatcheries to contribute to conservation and recovery of ESA-listed and non-listed fish;
- provide offsite mitigation projects and habitat, passage, and other improvements that address factors limiting improvements of target species; and
- support a focused and well-coordinated research, monitoring, and evaluation program.

The Energy and Water Development Appropriations Act of 1996 added section 4(h)(10)(D) to the Northwest Power Act, directing the Council to appoint an ISRP “to review a sufficient number of projects” proposed to be funded through Bonneville’s annual fish and wildlife budget “to adequately ensure that the list of prioritized projects recommended is consistent with the Program.” The Northwest Power Act further states that “in making its recommendations to Bonneville, the Council shall consider the impact of ocean conditions on fish and wildlife populations and shall determine whether the projects employ cost effective measures to achieve program objectives.” Today, most mitigation projects funded by

³ Including expenses associated with the use of power financial instruments to hedge Bonneville's exposure to market price risk and certain index sales contract provisions as permitted by Bonneville's internal power transacting risk management guidance.

Bonneville receive ISRP review as part of the Council recommendation process. The Council has shifted to a multi-year project review cycle during which the ISRP reviews categories of projects grouped together.

The Council's major activities include the periodic preparation of a Northwest Conservation and Electric Power Plan (a 20-year electric energy demand and resources forecast and conservation program – known as the Power Plan) and the Fish and Wildlife Program. The Northwest Power Act directs that expenses of the Council, subject to certain limits based on forecasted Bonneville power sales, shall be included in Bonneville's annual budget to Congress. The cost of funding the Council is recovered through Bonneville's power rates.

Bonneville's Energy Efficiency program promotes the efficient use of energy in the Pacific Northwest and acquires conservation resources. Such actions will: 1) meet energy efficiency targets; 2) achieve a least cost resource mix; 3) lessen the cost impacts of power purchases; 4) avoid the costs of ramping programs and infrastructure up and down; 5) extend the value of the FCRPS to customers; and 6) build the region's resource portfolio with energy efficiency. Bonneville is also exploring how best to integrate demand-side management, distributed generation, and other leading edge technologies into its generation and transmission planning processes.

Bonneville's Energy Efficiency program offers several ways for customer utilities to participate in energy efficiency. Program components include: (1) standard offer efficiency measures and custom projects, which result in customer proposals to conserve energy through such programs as residential weatherization; commercial lighting; heating, ventilation, and air conditioning (HVAC); industrial processes and lighting; and irrigated agriculture; (2) third-party delivery programs, such as Simple Steps Smart Savings, Energy Smart Industrial, and the Green Motors programs; and (3) programs to help regional federal installations reduce energy use, including federal hatcheries and irrigation districts, and to support the Corps of Engineers and Bureau of Reclamation in their efforts to reduce energy use; (4) efficiency achieved independently through the market or through codes and standards, i.e. Momentum Savings; and (5) market transformation through the Northwest Energy Efficiency Alliance (NEEA).

Bonneville's Energy Efficiency budgets reflect BPA's commitment to acquire energy efficiency supportive of the Northwest Power and Conservation Planning Council's 7th Power Plan, which forecasts regional electricity demand and resource strategies for the next 20 years. The 7th Power Plan's preferred resource strategy calls for the region to acquire 1,400 aMW of energy efficiency between 2016 and 2021. Bonneville is pursuing a plan to achieve a portion of that goal (581 aMW). Bonneville recently updated its Resource Program to complement the Council's plan, isolating BPA's specific electricity demand obligations and potential resource strategies. Incorporating findings from Bonneville's Resource Program will optimize BPA's energy efficiency acquisitions but may reduce savings achievement by up to 5%.

In meeting its energy efficiency goals, Bonneville may employ resource acquisition agreements, as authorized by Northwest Power Act section 6, and customer self-funded conservation as well as research, evaluation, contract support, NEEA support, and emerging technology development.

The Residential Exchange Program (REP) was created by the Northwest Power Act to extend the benefits of low-cost federal power to the residential and small farm loads of Pacific Northwest electric utilities that have high average system costs. These benefits are passed directly to the consumers. Currently, the region's six investor-owned utilities (IOUs) and two of the region's consumer-owned utilities are actively participating in the REP. Payments under the REP are made to individual IOUs based on the difference between Bonneville's utility-specific Priority Firm (PF) Exchange rates and each utility's average system cost (ASC), times a utility's residential and small farm loads. ASCs are determined in accordance with the 2008 Average System Cost Methodology (ASCM). Participating utility ASCs are established in a public process that occurs prior to and during Bonneville's power rate cases. Bonneville's utility-specific PF Exchange rates are determined each rate period. As described below, Bonneville and regional parties reached a settlement of the REP in 2011 under which the total amount of REP benefits available to the IOUs was established through 2028. Payments to the IOUs are made monthly based on historical invoiced exchange loads and the terms of the settlement.

Over the past decade, and prior to the settlement, regional parties filed multiple lawsuits challenging Bonneville's implementation of the REP. These lawsuits were consolidated into four cases that were stayed before the U.S. Court of

Appeals for the Ninth Circuit. On July 26, 2011, Bonneville adopted a regionally supported settlement, referred to as the 2012 REP Settlement. Under the settlement, the region's six IOUs will receive about \$4.1 billion in REP payments over the 17-year term of the settlement, beginning at \$182.1 million in FY 2012, and increasing to \$286.1 million in FY 2028. In addition to this settlement, Bonneville has reached related REP settlements with two consumer-owned utilities. A single challenge to the 2012 REP Settlement was dismissed by the U.S. Court of Appeals for the Ninth Circuit in October of 2013.

Explanation of Changes

Bonneville's budget includes \$2,140.3 million in FY 2020 for Power Services operating expenses, which is a reduction of 8.7 percent over the FY 2019 forecasted level.

The FY 2020 budget increases the level for Associated Projects Costs (+\$1.5 million) and decreases the Residential Exchange (-\$61.2 million), Planning Council (-\$0.1 million), Energy Efficiency & Renewable Resources (-\$7.1 million), Production (-\$137.2 million), and Fish & Wildlife (-\$0.4 million).

Production (\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
912,166	1,098,201	961,002

Overview

Power Purchases: Includes power purchased to cover power supply obligations as well as balancing loads with generation from the hydro system. These purchases can be made in the form of long-term purchases to meet supply obligations based on long-term planning requirements or they can be made within the year due to the monthly shape of the loads and the monthly shape of the hydroelectric generation. Also, purchases can be made within the month and within the day to fill shortages due to fluctuations in the hydro system and load.

Power Scheduling/Marketing: Schedule and market (buy/sell) electric energy with Bonneville customers and the Pacific Northwest's interconnected utilities. Scheduling includes Power Services' implementation of physical and memo power schedules and associated transmission schedules, implementation of Electronic Tagging (ETag) in accordance with NERC and in accordance with FERC, and implementation of electronic scheduling.

Columbia Generating Station (CGS): Bonneville has acquired full lifetime project capability of CGS. CGS is on a 24-month fuel and outage cycle. Maintenance and refueling outage occurred in the spring of 2017 and will again in FY 2019.

Continued investments in Production include:

Continuous Activity (all years)

- Provide oversight of all power supply contracts and related projects from which Bonneville purchases generation capability to ensure that all Bonneville approval rights are protected; coordinate, communicate, and administer agreements, issues, and programs between Bonneville and the project owners.
- Provide wind resource integration services for wind generation.
- Power Purchases.
- Power Scheduling/Marketing.
- Provide oversight of all contracts signed to date. Pursue cost-effective means to mitigate capacity demands associated with interconnecting large amounts of wind into the Bonneville system.
- Pursue acquisition of additional cost-effective generation to meet load growth.
- Provide oversight on the wind resource integration services currently purchased by public power customers and offer additional renewable resource shaping services to such customers using wind generation to serve their load.

Associated Projects
(\$K)

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
449,323	475,160	476,646

Overview

Support FCRPS project costs and work to strengthen interagency and regional relationships to improve project performance, supporting functions, and to better understand project resource requirements and costs. This helps to maintain FCRPS reliability and system performance, as well as to attain Bonneville’s strategic business objectives.

Continued investments in Associated Projects include:

Continuous Activity (all years)

Bureau of Reclamation:

- Continue direct funding Reclamation O&M power activities.

Corps of Engineers:

- Continue direct funding Corps O&M power activities.

**Fish & Wildlife
(\$K)**

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
247,263	276,083	275,719

Overview

Bonneville implements a mature fish and wildlife mitigation program based on recommendations made by the region’s fish and wildlife management agencies and tribes to the Council. Several recent Council reviews have made additional fish and wildlife project recommendations to Bonneville. Bonneville, in coordination with the Council, reviews new and on-going projects for consistency with the Program and purposes of the Northwest Power Act. Bonneville reviews and resets project-specific funding commitments annually, including projects under the FCRPS BiOps and other agreements. Bonneville informs its funding decisions with the management objectives and priorities in the Program (including ISRP reviews) and the Accords as it integrates their implementation with actions necessary to fulfill ESA responsibilities. Regular coordination on implementation priorities continues among Bonneville, the Council, federal resource management agencies, states, Tribes, and others.

Continued investments in Fish & Wildlife include:

Continuous Activity (all years)

- Anadromous Fish: Continue implementing both ongoing and new projects that support ESA-listed species and other measures called for under the 2008 FCRPS BiOp and Supplemental FCRPS BiOps issued in 2010 and 2014, the Fish Accords, the Washington Estuary Agreement, the Kalispel Agreement, and the Willamette and Southern Idaho agreements and 2018 Accord extensions. Prioritize projects that address the factors that contribute most to mitigation success and that fulfill Bonneville’s responsibility for mitigating the impacts from the FCRPS. Implement and develop activities that protect and enhance tributary and estuary habitat, improve mainstream habitat, reduce potentially harmful hatchery practices on ESA-listed populations, and contribute to sustainable fisheries.
- Resident Fish: Implement activities to mitigate the impacts of the FCRPS on lamprey, sturgeon, and bull trout and promote the reproduction and recruitment of Kootenai River white sturgeon. These activities have been selected in response to the USFWS’s 2000 bull trout and 2006 Libby BiOp, the Program, and the Fish Accords.
- Mitigation using resident fish to offset anadromous fish losses (substitution): mitigate for reservoir power operation impacts to resident fish and wildlife by seeking projects that benefit both simultaneously. Those resident fish habitat acquisition projects that meet Bonneville’s Capitalization Policy will be funded under the capital portion of Bonneville’s Fish and Wildlife budget and credited for both fish and wildlife where appropriate.
- Wildlife: Use existing Bonneville policies to continue the current effort to mitigate wildlife in a manner consistent with the Program and fulfill commitments in wildlife agreements such as the Kalispel Agreement, Willamette Wildlife Agreement, and Southern Idaho Wildlife Agreement. Those wildlife projects that meet Bonneville’s Capitalization Policy will be funded under the capital portion of Bonneville’s Fish and Wildlife budget and credited against both wildlife and fish obligations according to Bonneville’s crediting policy and applicable mitigation contracts.

Residential Exchange, Northwest Power and Conservation Council, and Energy Efficiency & Renewable Resources
(\$K)

FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
415,266	495,416	426,964

Overview

Residential Exchange Program (REP)

- Includes forecasted REP benefits based on the 2012 REP Settlement.

Northwest Power and Conservation Council

- Continue support of the Council activities, as directed under the Northwest Power Act, including regional power plan development and maintenance and fish and wildlife program activities.

Energy Efficiency Resources

- Conservation Purchases: Provide programmatic savings reimbursements and energy efficiency incentives to Bonneville customers to purchase conservation savings. This includes performance payments and Energy Smart Reserved Power payments for federal installations and fish hatcheries and irrigation districts.
- Conservation Infrastructure: All support for programs and operations, including third-party program implementation, contract support, market research (Momentum Savings research), evaluation, and emerging technology research.
- Market Transformation: Support for NEEA's market transformation initiatives. NEEA identifies barriers and opportunities to increase the market adoption of efficiency by leveraging its regional partnerships.

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Power Services - Operating Expense \$2,344,860	\$2,140,331	-\$204,529/-9.6%
Production \$1,098,201	\$961,002	-\$137,198/-14.3%
Milestones: <ul style="list-style-type: none"> Continue to provide oversight of all signed contracts. Continue to provide wind resource integration services for customer wind generation. 	Milestones: <ul style="list-style-type: none"> Continue to provide oversight of all signed contracts. Continue to provide wind resource integration services for customer wind generation. 	<ul style="list-style-type: none"> The decrease is primarily due to lower CGS and support costs.
Associated Project Costs \$475,160	\$476,646	+\$1,486/+0.3%
Milestones: <ul style="list-style-type: none"> Continue direct funding of Corps and Reclamation O&M power activities. 	Milestones: <ul style="list-style-type: none"> Continue direct funding of Corps and Reclamation O&M power activities. 	<ul style="list-style-type: none"> The small increase reflects changes to security, biological opinion requirements, non-routine extraordinary maintenance, WECC/NERC compliance activities, and improvements, replacements, and minor additions at the projects.
Fish & Wildlife Costs \$276,083	\$275,719	-\$364/-0.1%
Milestones: <ul style="list-style-type: none"> Continue implementing both ongoing and new projects that support ESA-listed species and other measures called for under the 2008, 2010, and 2014 FCRPS BiOps, the Fish Accords, the Washington Estuary Agreement, the Kalispel Agreement, the Southern Idaho Agreement, and the Willamette Agreement, and 2018 Accord extensions. 	Milestones: <ul style="list-style-type: none"> Continue implementing both ongoing and new projects that support ESA-listed species and other measures called for under the 2008, 2010, and 2014 FCRPS BiOps, the Fish Accords, the Washington Estuary Agreement, the Kalispel Agreement, the Willamette Agreement, and the Southern Idaho Agreement, and 2018 Accord extensions. 	<ul style="list-style-type: none"> No material change in funding. The costs reflect funding associated with the Biological Opinions, Fish Accord commitments, and Northwest Power Act activities.
Residential Exchange Program \$318,350	\$257,122	-\$61,228/-23.8%
Milestones: <ul style="list-style-type: none"> Continue to provide REP benefits. 	Milestones: <ul style="list-style-type: none"> Continue to provide REP benefits. 	<ul style="list-style-type: none"> The decrease reflects the lower scheduled in the amount of REP payments payable to the IOUs prescribed by the Residential Exchange Settlement.
NW Power & Conservation Council \$11,914	\$11,789	-\$125/-1.1%

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
<p>Milestones:</p> <ul style="list-style-type: none"> Continue support of the Council activities, as directed under the Northwest Power Act, including regional power plan development and maintenance, and fish and wildlife program activities. 	<p>Milestones:</p> <ul style="list-style-type: none"> Continue support of the Council activities, as directed under the Northwest Power Act, including regional power plan development and maintenance, and fish and wildlife program activities. 	<ul style="list-style-type: none"> The decrease reflects our cost cutting effort while continuing emphasis on the NW Power and Conservation Council.
<p>Energy Efficiency & Renewable Resources \$165,152</p> <p>Milestones:</p> <ul style="list-style-type: none"> Continue close-out of the legacy conservation resource acquisition contracts, which support Bonneville’s contractual obligation to serve customer loads. Continue to support utility incentive programs. Continue to support regional energy efficiency programs. Continue supporting energy efficiency at direct serve federal agencies. 	<p>\$158,053</p> <p>Milestones:</p> <ul style="list-style-type: none"> Continue close-out of the legacy conservation resource acquisition contracts, which support Bonneville’s contractual obligation to serve customer loads. Continue to support utility incentive programs. Continue to support regional energy efficiency programs. Continue supporting energy efficiency at direct serve federal agencies. 	<p>-\$7,099/-4.5%</p> <ul style="list-style-type: none"> The decrease reflects our cost cutting effort while continuing emphasis on the energy efficiency program consistent with the Power Plan.

**Transmission Services – Operating Expense
Funding Schedule by Activity
Funding (\$K)**

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
Transmission Services - Operating Expense					
Engineering	72,076	96,886	74,075	-22,811	-23.5%
Operations	189,922	200,837	205,697	+4,860	+2.4%
Maintenance	200,538	215,121	212,379	-2,742	-1.3%
Total, Transmission Services - Operating Expense	462,536	512,844	492,151	-20,693	-4.2%

Outyears (\$K)

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Transmission Services - Operating Expense					
Engineering	74,075	80,131	81,663	83,233	84,828
Operations	205,697	200,383	203,170	206,010	208,889
Maintenance	212,379	213,573	217,072	220,648	224,279
Total, Transmission Services - Operating Expense	492,151	494,087	501,905	509,891	517,996

Transmission Services – Operating Expense

Overview

This activity provides for the transmission system services of engineering, operations, and maintenance for Bonneville's electric transmission system, and the associated power system control and communication facilities. Primary goals of this program are: 1) maintain the safety and reliability of the transmission system; 2) increase the focus on meeting customers' needs; 3) optimize the transmission system; 4) provide open and non-discriminatory transmission access; and 5) improve Bonneville's cost effectiveness. Consistent with the FY 2018 and FY 2019 Budget Requests, the FY 2020 Budget Request maintains the proposal that the Federal government be authorized to sell the transmission assets of Bonneville.

Explanation of Changes

Bonneville's budget includes \$492.1 million in FY 2020 for TS operating expense which is a 4 percent decrease over the FY 2019 forecasted level. The decrease still reflects continuing operation and maintenance of Bonneville's transmission assets.

The FY 2020 budget decreases the levels for Engineering (-\$22.8 million) and Maintenance (-\$2.7 million) and increases the level for Operations (+\$4.9 million).

Engineering (\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
72,076	96,886	74,075

Overview

Continue efforts to identify best methods for improving system reliability and maintenance practices, and continue cost reduction efforts by identifying opportunities for low-cost reinforcement and voltage support of the existing transmission system.

Continued investments in Engineering include:

Continuous Activity (all years)

- **Research and Development (R&D):** Conduct research focused on technologies related to business challenges Bonneville faces including reliability, energy efficiency, and integration of renewable energy resources. Technologies of interest are identified in Bonneville's Technology Roadmaps. A portfolio of research is selected every year through Bonneville's Portfolio Decision Framework.
- **System Development Planning and Analysis:** Continue providing technical support and asset planning to deploy the Asset Management approach to sustain existing assets and expand the system to meet Agency objectives.
- **Technical Support:** Provide technical support activities, such as transmission system planning and studies to optimize portions of the system. Provide support for non-wires solutions studies and pilot projects.
- **Capital-to-Expense Adjustments:** Conduct annual analysis of Bonneville's outstanding capital work orders to assess whether they should be expensed. As obsolete inventory is identified and disposed of, it is expensed.
- **Regulatory Fees:** WECC dues and loop flow payments, Department of Commerce/National Telecommunications and Information Administration licensing costs for radio frequencies, DOE Radio Spectrum staff and contractor support, and NERC Critical Infrastructure Protection (CIP) compliance program costs. Includes membership in ColumbiaGrid, a transmission planning organization in the region.
- **Reimbursable Transactions:** Enter into written agreements with federal and non-federal entities that have work or services to be performed by Bonneville staff at the expense of the benefiting entities. The projects must be beneficial, under agreed upon criteria, to Bonneville operations and to the federal or non-federal entity involved or otherwise be aligned with or supportive of Bonneville's strategic objectives. Additionally, these activities generally contribute to more efficient or reliable construction of the federal transmission system or otherwise enhance electric service to the region.
- **Leased and Other Costs:** Includes leases, lease purchases, and other costs of financing transmission, delivery, and voltage support facilities when such arrangements are operationally feasible and cost effective to deliver power. Leases and lease purchases enable Bonneville to continue to invest in infrastructure to support a safe and reliable system for the transmission of power. Other costs included are the accrued interest costs associated with Large Generator Interconnection Agreements (LGIA).

Operations (\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
189,922	200,837	205,697

Overview

Substation Operations: Perform operations functions necessary to provide electric service to customers and to protect the federal investment in electric equipment and other facilities. Includes equipment adjustments, switching lines and equipment during emergencies or maintenance, isolating damaged equipment, restoring service to customers, inspecting equipment, and reading meters.

Power System Dispatching and Supporting Functions: Perform central dispatching, control, and monitoring of the electric operation of the federal transmission system. Also includes load, frequency, and voltage control of federal generating plants, and coordinating long- and short-term outages of system equipment. In addition, provides technical engineering support of dispatching function and provides all technical and systems support for Dittmer Control Center (DCC) and Munro Control Center (MCC).

Marketing and Sales: Provide management and direction of transmission rates, and provide business strategy in marketing of transmission and ancillary products and services of Transmission Services. Involve customers and constituents in the process of product and rate development. Maintain accurate and complete historical records of current and past legacy transmission agreements. Provide guidance for current and future transmission contract negotiations. Provide financial analysis of market strategies. Monitor and report on the financial health of Transmission Services. Support cost management by effective reporting and analysis of current expenditures. Ensure official budget submittals reflect current management financial strategies and adequately fund transmission programs.

Transmission Scheduling: Provide non-discriminatory, open access to the Bonneville transmission system consistent with Bonneville's Open Access Transmission Tariff (OATT). Schedule transmission capacity to eligible Bonneville customers, which include customers acquiring services under Use of Facilities (UFT), Formula Power Transmission (FPT), Integration of Resources (IR), and Part II or Part III of the OATT. Manage the reservations and scheduling of all transmission services associated with the OATT. Update practices, policies, and commercial systems to accommodate a large diversity of resources, including wind.

Continuous Activity (all years):

- Continue to operate within parameters of NERC and WECC.
- Continue support of increased compliance activities related to the reliability of the transmission system, including cyber security.
- Continue developing facilities, policies, procedures, and implementing systems to support integrating the diversity of resources into the transmission grid.
- Continue preparation for increased complexity of transmission scheduling, power system operations, and dispatching, including congestion management and outage scheduling.
- Continue developing the Dittmer Scheduling Center and Munro Scheduling Center facilities to support continuous real time scheduling operations from both facilities.
- Continue developing a long-term approach to optimize transmission availability through streamlined, cost-effective, and sustainable processes.
- Continue to address succession planning issues across key functions.
- Continue development and implementation of business systems and tools.

Maintenance (\$K)		
FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate
200,538	215,121	212,379

Overview

In all aspects of maintenance, Bonneville is continuing the use of Reliability Centered Maintenance (RCM) practices. The use of RCM practices is focused on improving system reliability, increasing availability, and meeting new and existing compliance regulations at lowest lifecycle costs. In addition Bonneville is deploying Asset Management to optimize maintain/replace decision making. Maintenance costs are expected to increase as Bonneville addresses the aging transmission system, meeting reliability standards, including vegetation management, and environmental constraints associated with construction, enhancement, and maintenance of the system. The Bonneville transmission system encompasses 15,238 circuit miles on over 11,860 right-of-way miles (many of these miles are through rugged, inaccessible terrain).

Continued investments in Maintenance include:

Continuous Activity (all years)

- Continue to improve performance to meet System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) targets.
- Continue refining processes and procedures for monitoring and tracking compliance activities related to the reliability of the transmission system.
- Continue to improve system availability performance through new maintenance procedures and work practices.
- Continue to develop and implement work practices and procedures for implementation of a new specialty crew using bare-hand live line practices for maintenance of high-voltage transmission lines.
- Continue increased emphasis on replacement of line hardware (life extension programs for insulators, connectors, dampers, and fiber optic cable hardware).
- Continue to prepare for the impact of an expected high attrition rate among Bonneville’s aging workforce by recruiting apprentices and replacements for critical minimum crew size workload positions.
- Increase outage-scheduling planning and coordination to increase customer satisfaction and system availability.
- Maintain vegetation management levels to ensure system reliability.
- Continue access road work to provide reliable access to facilities and ensure environmental compliance.
- Continue improving environmental stewardship.

Transmission Line Maintenance: Maintain and repair 15,238 circuit miles of high voltage transmission lines, of which over 4,734 circuit miles are 500 kV transmission extra-high voltage (EHV). Maintenance of EHV lines is two and one-half times more labor-intensive than maintenance of lower transmission voltages, although more efficient in transmission of power. This responsibility includes maintaining transmission rights-of-way to ensure system reliability, safety, and environmental compliance. Adopt work practices that improve system availability, reliability, and compliance.

Right-of-Way Maintenance: Maintain over 11,860 of Bonneville’s right-of-way miles. This responsibility includes vegetation management, danger tree management, and access road maintenance to ensure system reliability, safety, and environmental compliance. Adopt procedures and processes that improve system availability, reliability, environmental compliance, and reliability compliance. Continue to deploy new technologies such as LiDAR (Light Detection and Ranging) to reliably and cost-effectively manage vegetation.

Substation Maintenance: Maintain and repair the transmission system power equipment located in Bonneville’s 260 substations. Work includes inspections, diagnostic testing, and predictive and condition-based maintenance.

System Protection Maintenance: Maintain relaying metering and remedial action scheme equipment used to control and protect the electrical transmission system and to meter energy transfers for the purpose of revenue billing. Additionally,

field-engineering services provide technical advice and assure the correct operation of power system relaying and special control systems used to support interregional energy transmission capabilities.

Power System Control Maintenance: Test, repair, and provide field engineering support of Bonneville's highly complex equipment, communications, and control systems, including seven major microwave systems, fiber optic systems, and other critical communications and control equipment that support the power system.

Non-Electric Plant Maintenance: Maintain and manage Bonneville's non-electric facilities. Includes site, building, and building utility maintenance; custodial services; station utility; and other maintenance service activities, as well as facilities asset management on Bonneville-owned or Bonneville-leased non-electric facilities.

Maintenance Standards and Engineering: Establish, monitor, and update system maintenance standards, policies, and procedures, and review and update long-range plans for maintenance of the electric power transmission system.

Activities, Milestones, and Explanation of Changes (\$K)

FY 2019 Estimate	FY 2020 Estimate	Explanation of Changes FY 2020 Estimate vs FY 2019 Estimate
Transmission Services - Operating Expense \$512,844	\$492,151	-\$20,693/-4.2%
Engineering \$96,886 Milestones: <ul style="list-style-type: none"> Continue efforts to identify best methods for improving system reliability and maintenance practices. Continue cost reduction efforts by identifying opportunities for low-cost reinforcement and voltage support of the existing transmission system. 	\$74,075 Milestones: <ul style="list-style-type: none"> Continue efforts to identify best methods for improving system reliability and maintenance practices. Continue cost reduction efforts by identifying opportunities for low-cost reinforcement and voltage support of the existing transmission system. 	-22,811/-23.5% <ul style="list-style-type: none"> The decrease reflects our cost tightening effort and emphasis on system reliability standards compliance and research and development.
Operations \$200,837 Milestones: <ul style="list-style-type: none"> Continue to operate within parameters of NERC and WECC. Continue support of increased compliance activities related to the reliability of the transmission system including cyber security. 	\$205,697 Milestones: <ul style="list-style-type: none"> Continue to operate within parameters of NERC and WECC. Continue support of increased compliance activities related to the reliability of the transmission system including cyber security. 	+\$4,860/+2.4% <ul style="list-style-type: none"> The increase reflects continued emphasis on reliability compliance activities, resource integration activities, key strategic initiative, security, and control center systems support.
Maintenance \$215,121 Milestones: <ul style="list-style-type: none"> Continue to improve performance to meet System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) targets. 	\$212,379 Milestones: <ul style="list-style-type: none"> Continue to improve performance to meet System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) targets. 	-\$2,742/-1.3% <ul style="list-style-type: none"> The decrease reflects implementation of facilities asset management plans, continued implementation of live-line crew, NERC/WECC compliance activities related to land rights and vegetation management, continuing maintenance program activities, including system protection, right-of-way, line maintenance, and performance improvements.

Interest, Pension, and Post-retirement Benefits
Operating Expense
Funding Schedule by Activity
Funding (\$K)

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
Interest, Pension, and Post-retirement Benefits					
BPA Bond Interest (Net)	161,755	161,411	136,903	-24,508	-15.2%
BPA Appropriation Interest	532	1,518	0	-1,518	-100.0%
Corps of Engineers Appropriation Interest	62,902	76,472	51,611	-24,861	-32.5%
Lower Snake River Comp Plan Interest	157	206	122	-84	-40.8%
Bureau of Reclamation Appropriation Interest	2,016	6,009	1,150	-4,859	-80.9%
Bond Premiums Paid/Discounts (not capitalized)	(2,000)	556	6,584	6,028	1084.8%
Subtotal, Interest – Operating Expense	225,362	246,172	196,370	-49,802	-20.2%
Additional Pension, and Post-retirement Benefits	39,969	31,152	38,015	6,862	22.0%
Total, Interest, Pension, and Post-retirement Benefits	266,531	277,324	234,385	-42,941	-15.5%

Outyears (\$K)

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Interest, Pension, and Post-retirement Benefits					
BPA Bond Interest (Net)	136,903	157,177	207,369	226,639	249,514
BPA Appropriation Interest	0	0	0	0	0
Corps of Engineers Appropriation Interest	51,611	50,508	52,192	52,445	53,797
Lower Snake River Comp Plan Interest	122	122	122	122	122
Bureau of Reclamation Appropriation Interest	1,150	1,150	1,150	1,150	1,150
Bond Premiums Paid/Discounts (not capitalized)	6,584	11,932	6,951	0	0
Subtotal, Interest – Operating Expense	196,370	220,889	267,784	280,356	304,583
Additional Pension, and Post-retirement Benefits	38,015	40,124	41,015	41,929	42,860
Total, Interest, Pension, and Post-retirement Benefits	234,385	261,013	308,799	322,285	347,443

Interest, Pension and Post-retirement Benefits Operating Expense

Overview

Interest expense provides for interest due on bonds issued to the U.S. Treasury and appropriations repayment responsibilities. The appropriation repayments relate to capital investment in FCRPS hydroelectric generating and transmission facilities of Bonneville, and the Corps and Reclamation. Investments were financed by Congressional appropriations and Bonneville borrowings from the U.S. Treasury. Bonneville repays these amounts through revenue raised in its power sales and transmission services revenues.

Since initially receiving U.S. Treasury borrowing authority in 1974 under the Transmission Act, all of Bonneville's U.S. Treasury borrowing has been at market rates. As of October 1, 1996, all of Bonneville's repayment obligations on FCRPS appropriated investment (Corps and Reclamation FCRPS investment and Bonneville investment financed with appropriations prior to the Transmission Act that were unpaid as of September 30, 1996) were restructured and assigned new current-market interest rates. The Bonneville Appropriations Refinancing Act of 1996 (Refinancing Act) called for re-setting (reducing) the unpaid principal of FCRPS appropriations and reassigning (increasing) interest rates. New principal amounts were established as of the beginning of FY 1997 at the present value of the principal and annual interest payments Bonneville would make to the U.S. Treasury for these obligations in the absence of the legislation, plus \$100.0 million. The new principal amounts were assigned prevailing market interest rates as of October 1, 1996. Bonneville's outstanding appropriations repayment obligations at the end of FY 1996 were \$6.6 billion with a weighted average interest rate of 3.4 percent. The refinancing reduced the principal amount to \$4.1 billion with a weighted average interest rate of 7.1 percent. Implementation of the refinancing took place in 1997 after audited actual financial data were available. Pursuant to the legislation, Bonneville submitted its calculations and interest rate assignments implementing the Refinancing Act to the U.S. Treasury for its review and approval. The U.S. Treasury approved the implementation calculations in July 1997. The Refinancing Act also calls for all future FCRPS appropriations to be assigned prevailing U.S. Treasury yield curve interest rates. Bonneville's outstanding appropriations may be prepaid prior to their stated maturities.

Interest estimates are a function of costs of U.S. Treasury borrowing to Bonneville, repayment status of outstanding FCRPS investments, and projected additions to FCRPS plant in service. These estimates may change over time depending on forecasted market conditions. The interest cost estimates include the impact of Bonneville's appropriation refinancing legislation.

Federal employees associated with the operation of the FCRPS participate in either the Civil Service Retirement System or the Federal Employees Retirement System. Employees may also participate in the Federal Employees Health and Benefit Program and the Federal Employee Group Life Insurance Program. All such postretirement systems and programs are sponsored by the Office of Personnel Management; therefore, Bonneville does not record any accumulated plan assets or liabilities related to the administration of such programs. Since 1997, Bonneville has made additional annual contributions to the General Fund of the U.S. Treasury (receipt account 892889) related to the Federal post-retirement benefit programs provided to employees associated with the operation of the FCRPS.

**Capital Transfers
Funding Schedule by Activity
Funding (\$K)**

Capital Transfers

	FY 2018 Actual	FY 2019 Estimate	FY 2020 Estimate	FY 2020 vs FY 2019	
				\$	%
BPA Bond Amortization ¹	287,000	370,213	351,940	-18,273	-4.9%
Reclamation Appropriation Amortization	17,000	14,236	0	-14,236	-100.0%
BPA Appropriation Amortization	7,000	21,053	0	-21,053	-100.0%
Corps Appropriation Amortization	258,000	3,135	55,596	52,461	1673.3%
Lower Snake River Comp Plan Amortization	325	0	0	0	0.0%
Total, Capital Transfers	569,325	408,637	407,536	-1,101	-0.3%

Outyears (\$K)

Capital Transfers

	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
BPA Bond Amortization ¹	351,940	456,893	425,663	388,345	399,897
Reclamation Appropriation Amortization	0	0	0	0	0
BPA Appropriation Amortization	0	0	0	0	0
Corps Appropriation Amortization	55,596	0	0	0	0
Lower Snake River Comp Plan Amortization	0	0	0	0	0
Total, Capital Transfers	407,536	456,893	425,663	388,345	399,897

Overview

This activity conveys funds to the U.S. Treasury for repayment of certain FCRPS costs not included in the Associated Project Costs budget. Since capital transfers are cash transactions, they are not considered budget obligations.

¹ Bonneville "Bond(s)" in this FY 2020 Budget refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13(a) of the Transmission Act (P.L. 93-454), which defines Bonneville bonds as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

Additional Tables

**BONNEVILLE POWER ADMINISTRATION
TOTAL OBLIGATIONS/OUTLAYS**

Current Services
(in millions of dollars)

	2018		2019		2020		2021	2022	2023	2024
	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Oblig.	Oblig.	Oblig.
BP-1 SUMMARY ^{1/3/}										
1 Residential Exchange Program	241	241	318	318	257	257	255	261	267	273
2 Power Services ^{2/}	1,814	1,814	1,574	1,574	1,439	1,439	1,636	1,688	1,764	1,788
3 Transmission Services	716	716	1,002	1,002	971	971	976	977	1,024	1,051
4 Conservation & Energy Efficiency	163	163	165	165	158	158	157	160	164	167
5 Fish & Wildlife	278	278	320	320	323	323	323	325	331	335
6 Interest/ Pension ^{4/}	266	266	277	277	234	234	261	309	322	347
7 Associated Project Cost - Capital	199	199	265	265	238	238	256	281	300	306
8 Capital Equipment	15	15	27	27	22	22	22	22	22	21
9 Planning Council	11	11	12	12	12	12	12	12	13	13
10 Projects Funded in Advance	157	157	41	41	86	86	66	60	40	40
11 Capitalized Bond Premiums	0	0	0	0	0	0	0	0	0	0
12 TOTAL OBLIGATIONS/ OUTLAYS^{3/}	3,861	3,861	4,002	4,002	3,740	3,740	3,965	4,096	4,247	4,341

REVENUES AND REIMBURSEMENTS

Current Services
(in millions of dollars)

BP-1 SUMMARY	FISCAL YEAR									
	2018		2019		2020		2021	2022	2023	2024
	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Oblig.	Oblig.	Oblig.
13 Revenues ^{5/}	3,497	3,497	3,944	3,944	3,821	3,821	3,884	3,933	3,999	4,047
14 Project Funded in Advance	157	157	41	41	86	86	66	60	40	40
15 TOTAL	3,654	3,654	3,985	3,985	3,907	3,907	3,950	3,993	4,039	4,087
16 BUDGET AUTHORITY (NET) ^{6/}	181		416		379		350	396	491	500
17 OUTLAYS (NET) ^{6/7/8}		245		17		(167)	15	103	208	254

These notes are an integral part of this table.

^{1/} This FY 2020 budget includes capital and expense estimates based on initial spending proposals from Bonneville's 2018 IPR process.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

- ^{2/} Power Services doesn't include Fish & Wildlife, Residential Exchange Program, Planning Council, Conservation & Energy Efficiency and Associated Project Costs which have been shown separately for display purposes.
- ^{3/} This budget has been prepared in accordance with PAYGO. Under PAYGO all Bonneville budget estimates are treated as mandatory and are not subject to the discretionary caps included in the Budget Control Act of 2011. These estimates support activities that are separate from discretionary activities and accounts. Thus, any changes to Bonneville estimates cannot be used to affect any other budget categories which have their own dollar caps. Because Bonneville's obligations are and will be incurred under pre-existing legislative authority, Bonneville is not subject to a "pay-as-you-go" test regarding its revision of current-law funding estimates.
- ^{4/} See Interest Expense, Pension and Post-retirement Benefits and Capital Transfers section of this budget for a complete discussion of these cost estimates.
- ^{5/} Revenues, included in the Net Outlay formulation, are calculated consistent with cash management goals and assume a combination of adjustments. Assumed adjustments include the use of a combination of tools, including upcoming rate adjustment mechanisms, a net revenue risk adjustment, debt service refinancing strategies and/or short-term financial tools to manage net revenues and cash. Some of these potential tools will reduce costs rather than generate revenue, causing the same Net Outlay result. Adjustments for depreciation and 4(h)(10)(C) credits of the Northwest Power Act are also assumed.
- ^{6/} Bonneville received \$48.7 million of additional budget authority in FY 2007 to accommodate the work necessary to relocate the radio spectrum consistent with the Commercial Spectrum Enhancement Act (P.L. 108-494). In accordance with Federal law, Bonneville plans to return the forecasted unused balance of approximately \$8.2 million to the U.S. Treasury as soon as the National Telecommunications Information Administration notifies the Federal Communications Commission that the DOE relocation effort is complete.
- ^{7/} Net Outlay estimates are based on current cost savings to date and anticipated cash management goals. They are expected to follow anticipated management decisions throughout the rate period that, along with actual market conditions, will impact revenues and expenses. Actual Net Outlays are volatile and are reported in Report on Budget Execution and Budgetary Resources (SF-133). Actual Net Outlays could differ from estimates due to changing market conditions, streamflow variability, continuing restructuring of the electric industry, and other reasons.
- ^{8/} FY 2018 Net Outlays are based on Bonneville's FY 2018 audited financial actuals. FY 2019 Net Outlays are calculated using Bonneville's revenue forecast from the BP-18 rate case. FYs 2020 to 2024 Net Outlays are based on 2018 Initial IPR assumptions and standard inflation factors.

EXPENSED OBLIGATIONS/OUTLAYS ^{1,4/}
Current Services
(in millions of dollars)
FISCAL YEAR

BP-2	2018		2019		2020		2021	2022	2023	2024
	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Oblig.	Oblig.	Oblig.
1 Residential Exchange Program	241	241	318	318	257	257	255	261	267	273
2 Power Services ^{2/}	1,814	1,814	1,574	1,574	1,439	1,439	1,636	1,688	1,764	1,788
3 Transmission Services	463	463	513	513	492	492	494	502	510	518
4 Conservation & Energy Efficiency	163	163	165	165	158	158	157	160	164	167
5 Fish & Wildlife	247	247	276	276	276	276	276	282	288	295
6 Interest/ Pension ^{3/}	266	266	277	277	234	234	261	309	322	347
7 Planning Council	11	11	12	12	12	12	12	12	13	13
8 TOTAL EXPENSE	3,206	3,206	3,136	3,136	2,868	2,868	3,092	3,214	3,327	3,401
9 Projects Funded in Advance	157	157	41	41	86	86	66	60	40	40

CAPITAL OBLIGATIONS/OUTLAYS ^{1/}

Current Services
(in millions of dollars)

BP-2 continued

10 Transmission Services
11 Associated Project Cost
12 Fish & Wildlife
13 Capital Equipment
14 Capitalized Bond Premiums
15 **TOTAL CAPITAL INVESTMENTS**
16 **TREASURY BORROWING AUTHORITY TO**
17 **FINANCE CAPITAL OBLIGATIONS ^{4/}**

2018		2019		2020		2021	2022	2023	2024
Oblig.	Outlays	Oblig.	Outlays	Oblig.	Outlays	Oblig.	Oblig.	Oblig.	Oblig.
253	253	489	489	479	479	482	475	515	533
199	199	265	265	238	238	256	281	300	306
31	31	44	44	47	47	47	43	43	40
15	15	27	27	22	22	22	22	22	21
0	0	0	0	0	0	0	0	0	0
498	498	825	825	787	787	807	822	880	900
498		825		787		807	822	880	900

These notes are an integral part of this table.

^{1/} This FY 2020 budget includes capital and expense estimates based on initial spending proposals from Bonneville's 2018 IPR process.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

^{2/} Power Services doesn't include Fish & Wildlife, Residential Exchange Program, Planning Council, Conservation & Energy Efficiency and Associated Project Costs which have been shown separately for display purposes.

^{3/} See Interest Expense, Pension and Post-retirement Benefits and Capital Transfers section of this budget for a complete discussion of these cost estimates.

^{4/} This budget has been prepared in accordance with PAYGO. Under PAYGO all Bonneville budget estimates are treated as mandatory and are not subject to the discretionary caps included in the Budget Control Act of 2011. These estimates support activities that are separate from discretionary activities and accounts. Thus, any changes to Bonneville estimates cannot be used to affect any other budget categories which have their own dollar caps. Because Bonneville's obligations are and will be incurred under pre-existing legislative authority, Bonneville is not subject to a "pay-as-you-go" test regarding its revision of current-law funding estimates.

CURRENT SERVICES
(in millions of dollars)

CAPITAL TRANSFERS

	FISCAL YEAR						
	2018	2019	2020	2021	2022	2023	2024
	Pymts	Pymts	Pymts	Pymts	Pymts	Pymts	Pymts
Amortization:							
18 BPA Bonds	287	370	352	457	426	388	400
19 Reclamation Appropriations	17	14	0	0	0	0	0
20 BPA Appropriations	7	21	0	0	0	0	0
21 Corps Appropriations	258	3	56	0	0	0	0
22 Lower Snake River Comp Plan Amortization	0	0	0	0	0	0	0
23 TOTAL CAPITAL TRANSFERS	569	409	408	457	426	388	400
24 FULL-TIME EQUIVALENT (FTE)	2,793	3,000	3,000	3,000	3,000	3,000	3,000

PROGRAM & FINANCING SUMMARY

Current Services

(in millions of dollars)

Identification Code: 89-4045-0-3-271

	est.						
	2018	2019	2020	2021	2022	2023	2024
Program by activities:							
Operating expenses:							
0.01 Power Services	1,365	1,098	961	1,162	1,203	1,268	1,281
0.02 Residential Exchange Program	241	318	257	255	261	267	273
Associated Project Costs:							
0.05 Bureau of Reclamation	153	163	165	163	166	170	174
0.06 Corps of Engineers	245	256	256	256	261	267	273
0.07 Colville Settlement	20	23	23	23	23	24	24
0.19 U.S. Fish & Wildlife Service	31	33	33	33	34	35	36
0.20 Planning Council	11	12	12	12	12	13	13
0.21 Fish & Wildlife	247	276	276	276	282	288	295
0.23 Transmission Services	463	513	492	494	502	510	518
0.24 Conservation & Energy Efficiency	163	165	158	157	160	164	167
0.25 Interest	226	246	196	221	268	280	305
0.26 Pension and Health Benefits ^{1/}	40	31	38	40	41	42	43
0.91 Total operating expenses ^{2/}	3,206	3,135	2,867	3,092	3,214	3,327	3,401
Capital investment:							
1.01 Power Services	199	265	238	256	281	300	306
1.02 Transmission Services	253	489	479	482	475	515	533
1.04 Fish & Wildlife	31	44	47	47	43	43	40
1.05 Capital Equipment	15	27	22	22	22	22	21
1.06 Capitalized Bond Premiums	0	0	0	0	0	0	0
1.07 Total Capital Investment ^{3/}	498	825	787	807	822	880	900
2.01 Projects Funded in Advance	157	41	86	66	60	40	40
10.00 Total obligations ^{4/}	3,861	4,001	3,739	3,965	4,096	4,247	4,341

These notes are an integral part of this table.

^{1/} See Interest Expense, Pension and Post-retirement Benefits and Capital Transfers section of this budget for a complete discussion of these cost estimates.

^{2/} Assumes expense obligations, not accrued expenses.

Power Services doesn't include Fish & Wildlife, Residential Exchange Program, Planning Council, Conservation & Energy Efficiency and Associated Project Costs which have been shown separately for display purposes.

Bonneville makes an accounting adjustment to the production services component of FY 2018 Bonneville's audited actual obligations. This past year adjustment relates primarily to long-term obligation requirements consistent with Bonneville's FY 2018 Combined Schedules of Budgetary Resources and the GTAS FY 2018 Treasury reports for Bonneville.

^{3/} Assumes capital obligations, not capital expenditures.

^{4/} This FY 2020 budget includes capital and expense estimates based on initial spending proposals from Bonneville's 2018 IPR process.

For purposes of this table, this FY 2020 budget reflects, for FY 2018, forecasted third party financing expense only for PFIA.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Refer to 16 USC Chapters 12B, 12G, 12H, and Bonneville's other organic laws, including P.L. 100-371, Title III, Sec. 300, 102 Stat. 869, July 19, 1988, regarding Bonneville's ability to obligate funds.

Program and Financing (continued)
 Current Services
 (in millions of dollars)
 est.

	2018	2019	2020	2021	2022	2023	2024
Financing:							
1000 Unobligated balance available, start of year. ^{5/}	13	12	10	0	0	0	0
1050 Unobligated balance available, end of year. ^{5/}	12	10	8	0	0	0	0
1900 Budget authority (gross)	3,859	4,401	4,286	4,300	4,389	4,530	4,587
Budget Authority:							
1400 Permanent Authority: Authority to borrow from Treasury (indefinite) ^{6/}	809	825	787	807	822	880	900
1800 Spending authority from off-setting collections	3,654	3,985	3,907	3,950	3,993	4,039	4,087
1825 Portion applied to debt reduction	(287)	(409)	(408)	(457)	(426)	(388)	(400)
1850 Spending authority from offsetting collections (adjusted)	446	3,576	3,499	3,493	3,568	3,650	3,687
900 Total obligations	3,861	4,002	3,740	3,965	4,096	4,247	4,341
4110 Outlays (gross)	3,861	4,002	3,740	3,965	4,096	4,247	4,341
Adjustments to budget authority and outlays:							
Deductions for offsetting collections:							
4120 Federal funds	(63)	(90)	(90)	(90)	(90)	(90)	(90)
4121 Interest on Federal Securities	(5)						
4123 Non-Federal sources	(3,586)	(3,895)	(3,817)	(3,860)	(3,903)	(3,949)	(3,997)
4130 Total, offsetting collections	(3,654)	(3,985)	(3,907)	(3,950)	(3,993)	(4,039)	(4,087)
4160 Budget authority (net)	181	416	379	350	396	491	500
4170 Outlays (net) ^{7/8/}	245	17	(167)	15	103	208	254

These notes are an integral part of this table.

^{5/} Reflects estimated cost for radio spectrum fund.

^{6/} The Permanent Authority: Authority to borrow (indefinite) from the U.S. Treasury amounts reflect both Bonneville's capital program financing needs and either the use of, or creation of, deferred borrowing. Deferred borrowing is created when, as a cash and debt management decision, Bonneville uses cash from revenues to liquidate capital obligations in lieu of borrowing at that time from the U.S. Treasury. This temporary use of cash on hand instead of borrowed funds creates the ability in future years to borrow money, when fiscally prudent. The FY 1989 Energy and Water Development Appropriations Act (P.L. 100-371 Of 7/19/88) confirmed that Bonneville has authority to incur obligations in excess of U.S. Treasury borrowing authority and cash in the BPA fund. Total includes BPA's self-financing activities and funds for Radio Spectrum Relocation. In addition, BPA has negotiated with the U.S. Treasury access to a \$750 million short term note.

^{7/} Net Outlay estimates are based on current cost savings to date and anticipated cash management goals. They are expected to follow anticipated management decisions throughout the rate period that, along with actual market conditions, will impact revenues and expenses. Actual Net Outlays are volatile and are reported in Report on Budget Execution and Budgetary Resources (SF-133). Actual Net Outlays could differ from estimates due to changing market conditions, streamflow variability, continuing restructuring of the electric industry, and other reasons.

Revenues, included in the Net Outlay formulation, are calculated consistent with cash management goals and assume a combination of adjustments. Assumed adjustments include the use of a combination of tools, including upcoming rate adjustment mechanisms, a net revenue risk adjustment, debt service refinancing strategies and/or short-term financial tools to manage net revenues and cash. Some of these potential tools will reduce costs rather than generate revenue, causing the same Net Outlay result. Adjustments for depreciation and 4(h)(10)(C) credits of the Northwest Power Act are also assumed.

This budget has been prepared in accordance with PAYGO. Under PAYGO all Bonneville budget estimates are treated as mandatory and are not subject to the discretionary caps included in the Budget Control Act of 2011. These estimates support activities that are separate from discretionary activities and accounts. Thus, any changes to Bonneville estimates cannot be used to affect any other budget categories which have their own dollar caps.

Because Bonneville's obligations are and will be incurred under pre-existing legislative authority, Bonneville is not subject to a "pay-as-you-go" test regarding its revision of current-law funding estimates.

^{8/} FY 2018 Net Outlays are based on Bonneville's FY 2018 audited financial actuals. FY 2019 Net Outlays are calculated using Bonneville's revenue forecast from the BP-18 rate case. FYs 2020 to 2024 Net Outlays are based on 2018 Initial IPR assumptions and standard inflation factors.

**BONNEVILLE POWER ADMINISTRATION
BPA STATUS of U.S. TREASURY BORROWING
CURRENT SERVICES**

BP-4A

	Fiscal Year							
	2018				2019			
	Net Capital		Net Capital		Net Capital		Net Capital	
	Net Capital Obs	Subject to BA	Net Capital Expend.	Bonds Out-Standing	Net Capital Obs	Subject to BA	Net Capital Expend.	Bonds Out-Standing
Start-of-Year: Total	4,094	3,552	4,993	5,009	4,305	3,763	5,204	5,531
Plus: Annual Increase								
Cum.-Annual Treasury Borrowing	498	498	498	809	825	825	825	825
Treasury Borrowing (Cash)								
Less:								
BPA Bond Amortization	287	287	287	287	370	370	370	370
Net Increase/(Decrease):	211	211	211	522	454	454	454	454
Cum.-End-of-Year: Total	4,305	3,763	5,204	5,531	4,760	4,218	5,659	5,985
Total Remaining Treasury Borrowing Amount				2,169				1,715
Total Legislated Treasury Borrowing Amount				7,700				7,700

These notes are an integral part of this table.

In any given year, Bonneville may issue lower principal amount of bonds to the U.S. Treasury than forecast depending on net revenues, borrowing costs, and other cash management factors. In such cases, Bonneville accumulates a deferred borrowing balance that it accesses as necessary in the future.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

In this FY 2020 budget, Bonneville "bond(s)" refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13 (a) of the Transmission Act, which defines Bonneville bonds as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

As in the past, Bonneville may pursue future restructuring of total debt as opportunities arise.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Bonneville reserve financing of \$15 million annually is assumed as part of TS capital-PFIA for FYs 2018-2019.

Cumulative advance amortization payments as of the end of FY 2018 are \$5,503 million.

Total includes BPA's self-financing activities and funds for Radio Spectrum Relocation. In addition, BPA has negotiated with the U.S. Treasury access to a \$750 million short term note.

BONNEVILLE POWER ADMINISTRATION
BPA STATUS of U.S. TREASURY BORROWING
CURRENT SERVICES
(in millions of dollars)

BP-4B

	2020				2021			
	Net Capital		Net Capital	Bonds Out-	Net Capital		Net Capital	Bonds Out-
	Obs	Subject to BA			Obs	Subject to BA		
Start-of-Year: Total	4,760	4,218	5,659	5,985	5,194	4,652	6,093	6,420
Plus: Annual Increase								
Cum.-Annual Treasury Borrowing	787	787	787	787	807	807	807	807
Treasury Borrowing (Cash)								
Less:								
Total BPA Bond Amortization	352	352	352	352	457	457	457	457
Net Increase/(Decrease):								
Total	435	435	435	435	350	350	350	350
Cum.-End-of-Year: Total	5,194	4,652	6,093	6,420	5,544	5,002	6,443	6,770
Total Remaining Treasury Borrowing Amount				1,280				930
Total Legislated Treasury Borrowing Amount				7,700				7,700

These notes are an integral part of this table.

In any given year, Bonneville may issue lower principal amount of bonds to the U.S. Treasury than forecast depending on net revenues, borrowing costs, and other cash management factors. In such cases, Bonneville accumulates a deferred borrowing balance that it accesses as necessary in the future.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

In this FY 2020 budget, Bonneville "bond(s)" refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13 (a) of the Transmission Act, which defines Bonneville bonds as all bonds, notes, and other evidences of indebtednesses issued and sold by Bonneville to the U.S. Treasury.

As in the past, Bonneville may pursue future restructuring of total debt as opportunities arise.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Bonneville reserve financing of \$15 million annually is assumed as part of TS capital-PFIA for FYs 2018-2019.

Cumulative advance amortization payments as of the end of FY 2018 are \$5,503 million.

Total includes BPA's self-financing activities and funds for Radio Spectrum Relocation. In addition, BPA has negotiated with the U.S. Treasury access to a \$750 million short term note.

BONNEVILLE POWER ADMINISTRATION
BPA STATUS of U.S. TREASURY BORROWING
CURRENT SERVICES
(in millions of dollars)

BP-4C

Fiscal Year

	2022				2023			
	Net Capital		Net Bonds		Net Capital		Net Bonds	
	Net Capital	Obs Subject	Net Capital	Bonds Out-	Net Capital	Obs Subject	Net Capital	Bonds Out-
	Obs	to BA	Expend.	Standing	Obs	to BA	Expend.	Standing
Start-of-Year: Total	5,544	5,002	6,443	6,770	5,940	5,398	6,839	7,166
Plus: Annual Increase								
Cum.-Annual Treasury Borrowing	822	822	822	822	880	880	880	880
Treasury Borrowing (Cash)								
Less:								
Total BPA Bond Amortization	426	426	426	426	388	388	388	388
Net Increase/(Decrease):								
Total	396	396	396	396	491	491	491	491
Cum.-End-of-Year: Total	5,940	5,398	6,839	7,166	6,432	5,890	7,331	7,658
Total Remaining Treasury Borrowing Amount				534				42
Total Legislated Treasury Borrowing Amount				7,700				7,700

These notes are an integral part of this table.

In any given year, Bonneville may issue lower principal amount of bonds to the U.S. Treasury than forecast depending on net revenues, borrowing costs, and other cash management factors. In such cases, Bonneville accumulates a deferred borrowing balance that it accesses as necessary in the future.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

In this FY 2020 budget, Bonneville "bond(s)" refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13 (a) of the Transmission Act, which defines Bonneville bonds as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

As in the past, Bonneville may pursue future restructuring of total debt as opportunities arise.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Bonneville reserve financing of \$15 million annually is assumed as part of TS capital-PFIA for FYs 2018-2019.

Cumulative advance amortization payments as of the end of FY 2018 are \$5,503 million.

Total includes BPA's self-financing activities and funds for Radio Spectrum Relocation. In addition, BPA has negotiated with the U.S. Treasury access to a \$750 million short term note.

**BONNEVILLE POWER ADMINISTRATION
BPA STATUS of U.S. TREASURY BORROWING
CURRENT SERVICES**

(in millions of dollars)

BP-4D

	Fiscal Year			
	2024			
	Net Capital		Net Capital Expend.	Bonds Out- Standing
	Net Capital Obs	Obs Subject to BA		
Start-of-Year: Total	6,432	5,890	7,331	7,658
Plus: Annual Increase				
Cum.-Annual Treasury Borrowing	900	900	900	900
Treasury Borrowing (Cash)				
Less:				
Total BPA Bond Amortization	400	400	400	400
Net Increase/(Decrease):				
Total	500	500	500	500
Cum.-End-of-Year: Total	6,932	6,390	7,831	8,158
Total Remaining Treasury Borrowing Amount				(458)
Total Legislated Treasury Borrowing Amount				7,700

These notes are an integral part of this table.

In any given year, Bonneville may issue lower principal amount of bonds to the U.S. Treasury than forecast depending on net revenues, borrowing costs, and other cash management factors. In such cases, Bonneville accumulates a deferred borrowing balance that it accesses as necessary in the future.

Capital funding levels reflect external factors such as the significant changes affecting West Coast power and transmission markets, along with planned infrastructure investments designed to address the long-term needs of the region.

In this FY 2020 budget, Bonneville "bond(s)" refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13 (a) of the Transmission Act, which defines Bonneville bonds as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

As in the past, Bonneville may pursue future restructuring of total debt as opportunities arise.

Budget estimates included in this budget are subject to change due to rapidly changing economic and institutional conditions in the evolving electric utility industry.

Bonneville reserve financing of \$15 million annually is assumed as part of TS capital-PFIA for FYs 2018-2019.

Cumulative advance amortization payments as of the end of FY 2018 are \$5,503 million.

Total includes BPA's self-financing activities and funds for Radio Spectrum Relocation. In addition, BPA has negotiated with the U.S. Treasury access to a \$750 million short term note.

**BONNEVILLE POWER ADMINISTRATION
POTENTIAL THIRD PARTY FINANCING TRANSPARENCY**

(in millions of dollars)

BP-5

		Fiscal Year						
		2018	2019	2020	2021	2022	2023	2024
Transmission Services - Capital	Main Grid	11	40	3	27	25	34	46
	Area & Customer Services	36	48	82	92	75	70	56
	Upgrades & Additions	29	72	57	50	69	105	122
	System Replacements	178	330	338	312	306	306	309
	Projects Funded in Advance	157	41	86	66	60	40	40
	Total, Transmission Services - Capital	410	530	565	548	536	554	573

Associated Project Costs - Capital

	Requirement	Fiscal Year						
		2018	2019	2020	2021	2022	2023	2024
		Associated Project Costs	199	265	238	256	281	300	306
Projects Funded in Advance ^{1/}	0	0	0	0	0	0	0	
Total, Associated Project Costs - Capital	199	265	238	256	281	300	306	

Federal and Non-Federal Funding

	Source	Fiscal Year						
		2018	2019	2020	2021	2022	2023	2024
Projects Funded in Advance		157	41	86	66	60	40	40
U.S. Treasury Borrowing Authority		453	754	717	738	756	815	839

Scenario

	Scenario	Fiscal Year						
		2018	2019	2020	2021	2022	2023	2024
		Projects Funded in Advance ^{1/}	0	0	0	0	0	0
Third Party Financing		150	122	120	120	119	129	133
Alternate Treasury Borrowing Authority		NA	632	597	617	638	686	706

These notes are an integral part of this table.

1/ In this instance, Projects Funded in Advance represents prepayment of Power customers' bills reimbursed by future credits and third party non-federal financing for Conservation initiatives.

The table above shows both the potential use of U.S. Treasury borrowing authority for transmission capital projects based on this FY 2020 budget and the use adjusted for potential third-party financing to fund appropriate capital expenditures when feasible in lieu of U.S. Treasury borrowing. Estimates included in this FY 2020 budget are uncertain and may change due to revised capital investment plans, changing economic conditions, and an evolving financial market environment. The estimates of third-party financing included in the table show a reduction in the use of U.S. Treasury borrowing and do not reflect the actual notional third party financing commitment Bonneville may enter into in that particular year. The difference of reduction in use of U.S. Treasury borrowing and the actual notional third party financing commitment is primarily due to the difference in the timing of financing transactions between U.S. Treasury and third-party financing for capital projects with multi-year construction schedules.

Bonneville's Third Party Financing for Transmission Services consists primarily of lease-purchase agreements, which are capitalized obligations that enable Bonneville to acquire the use of transmission facilities over time. Bonneville also undertakes the construction and installation of facilities from funds that customers advance to Bonneville for construction of BPA-owned facilities that assist the customers in obtaining necessary transmission service from Bonneville. These customers receive monetary payment credits in bills for transmission services from Bonneville up to the amount of funds advanced to Bonneville, plus interest.

Bonneville's historical Third Party Financing amounts may vary over time due to re-assignment of certain lease-purchase agreements to Treasury Financing.

Bonneville Status of U.S. Treasury Borrowing with Potential Third Party Financing & PFIA Scenario

With the potential use of third party financing assumed in the scenario above, Bonneville's total remaining U.S. Treasury Borrowing Amount would be extended to the following amounts. See BP-4 BPA Status of Treasury Borrowing- Current Services.

	Fiscal Year						
	2018	2019	2020	2021	2022	2023	2024
Start-of-Year: Total Bonds Outstanding	5,009	5,531	5,863	6,178	6,408	6,685	7,048
Plus:							
U.S. Treasury Borrowing (Cash)	809	825	787	807	822	880	900
Less:							
Potential Third Party Financing & PFIA	150	122	120	120	119	129	133
BPA Bond Amortization	287	370	352	457	426	388	400
Net Increase/(Decrease) Bonds Outstanding:	522	332	315	230	277	363	367
Cum.-End-of-Year: Total	5,531	5,863	6,178	6,408	6,685	7,048	7,415
Total Remaining U.S. Treasury Borrowing Amount	2,169	1,837	1,522	1,292	1,015	652	285
Total Legislated U.S. Treasury Borrowing Amount	7,700	7,700	7,700	7,700	7,700	7,700	7,700

U.S. TREASURY PAYMENTS

(in millions of dollars)

	FISCAL YEAR						
	2018	2019	2020	2021	2022	2023	2024
A. INTEREST ON BONDS & APPROPRIATIONS							
Bonneville Bond Interest							
1 Bonneville Bond Interest (net)	130	161	137	157	207	227	250
2 AFUDC ^{1/}	31	33	35	34	35	33	31
Appropriations Interest							
3 Bonneville	1	2	0	0	0	0	0
4 Corps of Engineers ^{2/}	63	76	52	51	52	52	54
5 Lower Snake River Comp. Plan	0	0	0	0	0	0	0
6 Bureau of Reclamation ^{3/}	2	6	1	1	1	1	1
7 Bond Premiums paid/Discounts (not capitalized)	-2	1	7	12	7	0	0
8 Total Bond and Approp. Interest	226	279	232	255	302	313	336
B. ASSOCIATED PROJECT COST							
9 Bureau of Reclamation Irrigation Assistance	27	57	24	15	16	13	15
10 Bureau of Rec. O & M ^{4/}	0	0	0	0	0	0	0
11 Corps of Eng. O & M ^{4/}	1	0	0	0	0	0	0
12 L. Snake River Comp. Plan O & M ^{4/}	0	0	0	0	0	0	0
13 Total Assoc. Project Costs	28	57	24	15	16	13	15
C. CAPITAL TRANSFERS							
Amortization							
14 Bonneville Bonds ^{6/}	287	370	352	457	426	388	400
15 Bureau of Reclamation Appropriations	17	14	0	0	0	0	0
16 Corps of Engineers Appropriations	258	3	56	0	0	0	0
17 Lower Snake River Comp. Plan	0	0	0	0	0	0	0
18 Bonneville Appropriations	7	21	0	0	0	0	0
19 Total Capital Transfers ^{8/}	569	409	408	457	426	388	400
D. OTHER PAYMENTS							
20 Unfunded Post-Retirement Liability ^{5/}	40	31	38	40	41	42	43
21 TOTAL TREASURY PAYMENTS	862	776	702	767	785	756	794

These notes are an integral part of this table.

^{1/} This interest cost is capitalized and included in BPA's Transmission System Development, System Replacements, and Associated Projects Capital programs.

AFUDC is financed through the sale of bonds.

^{2/} Includes interest on construction funding for Corp of Engineers (Corps) fish bypass facilities at Corps dams in the Columbia River Basin, including Lower Monumental, Ice Harbor, and The Dalles.

^{3/} Includes payments paid by Reclamation to the U.S. Treasury on behalf of Bonneville.

^{4/} Costs for power O&M is funded directly by Bonneville as follows (in millions):

	FISCAL YEAR						
	2018	2019	2020	2021	2022	2023	2024
Bureau of Reclamation	153	163	165	163	166	170	174
Corps of Engineers	245	256	256	256	261	267	273
Subtotal Bureau and Corps	398	419	420	418	427	437	447
Lower Snake River Comp. Plan	31	33	33	33	34	35	36
Total	429	452	454	452	462	472	482

^{5/} See Interest Expense, Pension and Post-retirement Benefits and Capital Transfers section of this budget for a complete discussion of these cost estimates.

^{6/} In this FY 2020 budget, Bonneville "bond(s)" refers to all bonds issued by Bonneville to and advances received from the U.S. Treasury. This reference is consistent with section 13 (a) of the Transmission Act, which defines Bonneville bonds as all bonds, notes, and other evidences of indebtedness issued and sold by Bonneville to the U.S. Treasury.

Does not include Treasury bond premiums on refinanced Treasury bonds.

^{8/} FY 2018 data reflects rate case planned capital transfer.

Status of U.S. Treasury Principal Repayment

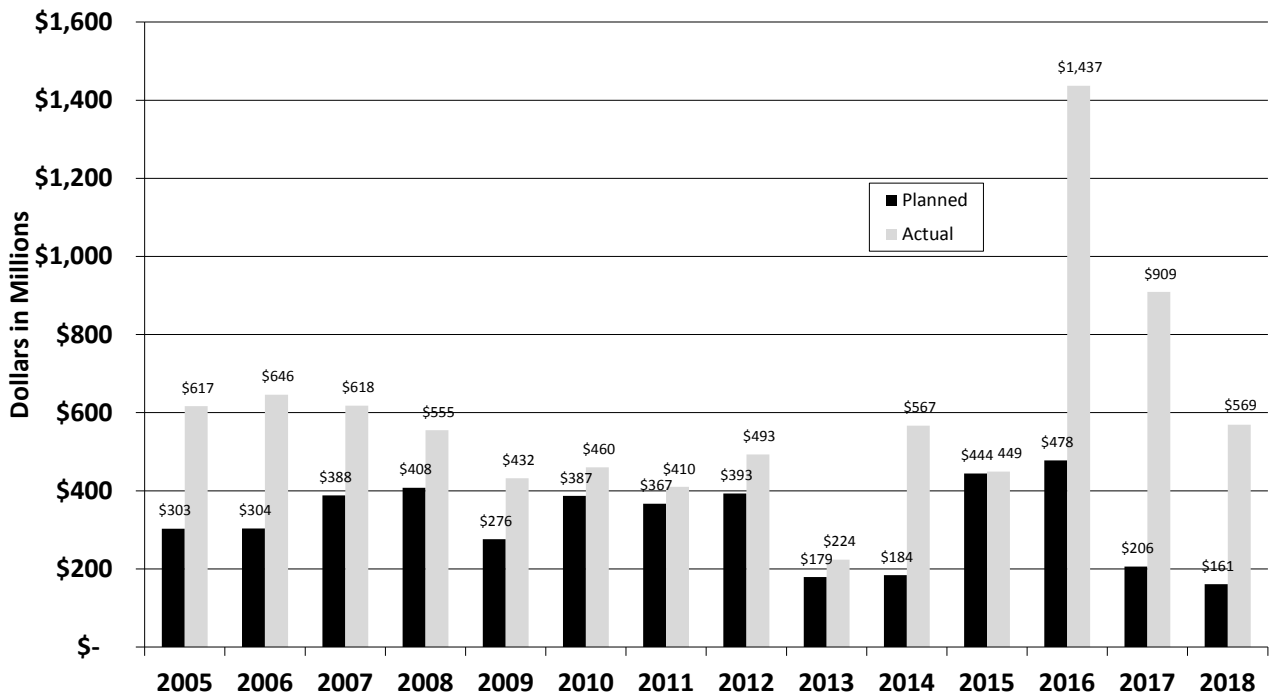


Chart Notes

^{1/} This chart displays principal repayment only.

^{2/} U.S. Treasury payment outyear estimates for planned amortization of principal are based on rate case estimates when available and are planned amortization for future rate case periods. These estimates may change due to revised capital investment plans, actual U.S. Treasury borrowing, and advanced amortization payments. Bonneville's aggregate FY 2018 U.S. Treasury payment was \$862 million, composed of \$569 million in principal repayment (including \$275 million in early retirement of higher interest rate U.S. Treasury debt), \$226 million in interest, and \$68 million for other costs.

^{3/} FYs 2002-2012 payments include portions of advance amortization amounts consistent with Bonneville's capital strategy plan and the Bonneville /Energy Northwest debt optimization program.

^{4/} Advance amortization due to sale of transmission facilities includes \$12.7 million in FY 2003, \$5.3 million in FY 2006, \$2.0 million in FY 2011, \$0.4 million in FY 2013 and \$0.4 million in FY 2014, and \$0.6 million in FY 2017.

^{5/} The cumulative amount of actual advance amortization payments as of the end of FY 2018 is \$5,503 million.

^{6/} FYs 2014-2018 include advance amortization under the Regional Cooperation Debt initiative with Energy Northwest (EN) under which EN extended maturities on Bonneville-backed debt which enabled the early amortization of higher cost appropriations.

OBJECT CLASSIFICATION STATEMENT

(in millions of dollars)

ESTIMATES

	2018 act.	2019	2020
11.1 Full-time permanent	280	327	305
11.3 Other than full-time permanent	1	1	1
11.5 Other personnel compensation	45	52	48
11.9 Total personnel compensation	326	379	355
12.1 Civilian personnel benefits	115	134	125
13.0 Benefits for former personnel	-	-	-
21.0 Travel and transportation of persons	4	5	5
22.0 Transportation of things	4	4	4
23.1 Rental payments to GSA	1	1	1
23.2 Rents, other	21	25	23
23.3 Communication, utilities & misc. charges	7	8	8
25.1 Consulting Services	73	85	79
25.2 Other Services	2,810	2,782	2,603
25.5 R & D Contracts	7	6	2
26.0 Supplies and materials	29	34	32
31.0 Equipment	140	163	152
32.0 Lands and structures	87	102	95
41.0 Grants, subsidies, contributions	30	35	33
43.0 Interest and dividends	205	238	223
99.0 Total obligations	3,860	4,002	3,739

Estimate of Receipts
(in millions of dollars)

	Fiscal Year						
	2018	2019	2020	2021	2022	2023	2024
Reclamation Interest	2	6	1	1	1	1	1
Reclamation Amortization	17	14	0	0	0	0	0
Reclamation O&M	0	0	0	0	0	0	0
Reclamation Irrig. Assist.	27	57	24	15	16	13	15
Revenues Collected by Reclamation Distributed in Treasury Account (credit)	-17	-7	-7	-7	-7	-7	-7
Colville Settlement (credit)	-5	-5	-5	-5	-5	-5	-5
Total 1/ Reclamation Fund	24	65	13	4	5	2	4
Corps O&M							
CSRS	40	31	38	40	41	42	43
Total 2/ Repayments on misc.costs	40	31	38	40	41	42	43

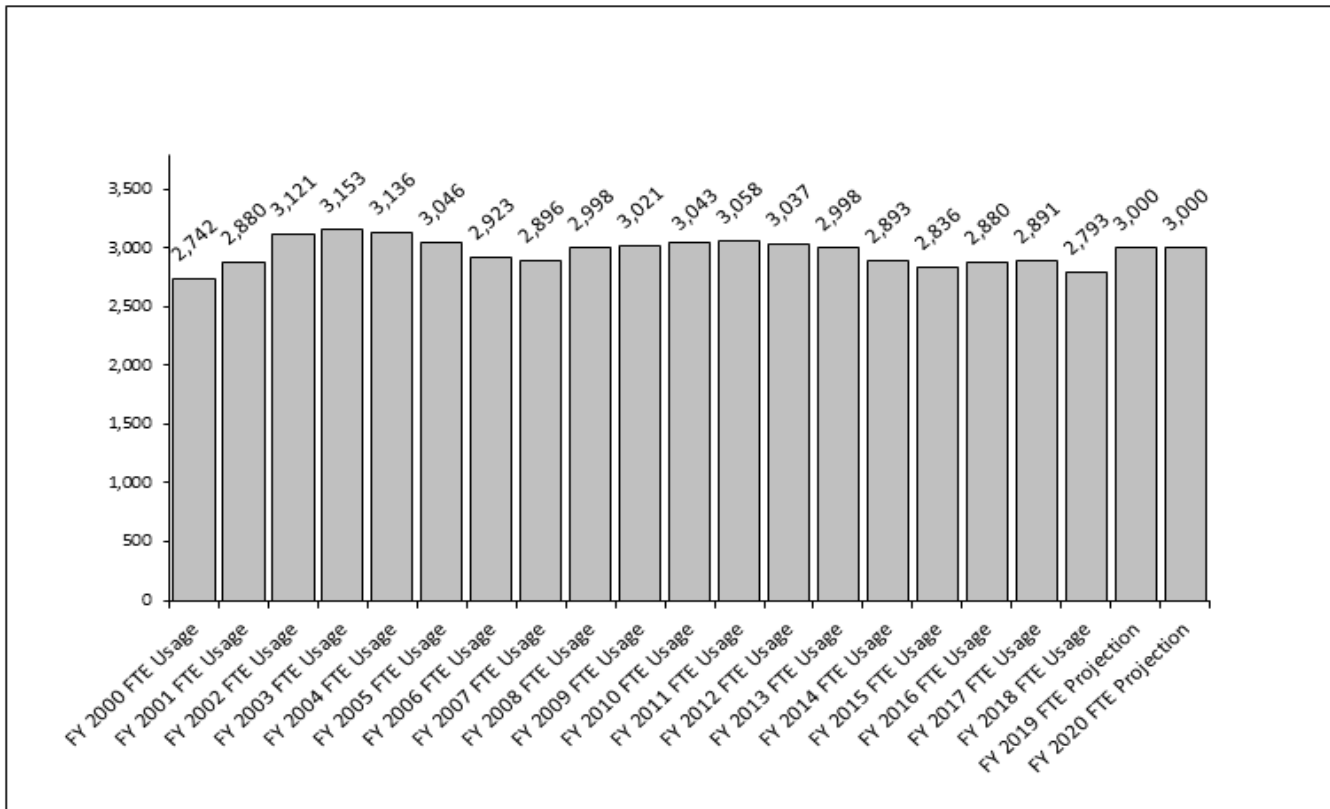
1/ Includes amortization of appropriations and irrigation assistance, and interest costs for Reclamation. The cost of power O&M for Reclamation is no longer included in Proprietary Receipts due to Direct Funding by Bonneville. Represents transfer to Account #895000.26

2/ The costs of power O&M for the Corps and Lower Snake River Comp. Plan are no longer included in Proprietary Receipts due to Direct Funding by Bonneville. Represents transfers to Account #892889, Repayments on misc. recoverable costs, not otherwise classified. Costs for power O&M is funded directly by Bonneville as follows (in millions)

	2018	2019	2020	2021	2022	2023	2024
Bureau of Reclamation	153	163	165	163	166	170	174
Corps of Engineers	245	256	256	256	261	267	273
Lower Snake River Comp. Plan	31	33	33	33	34	35	36
Total	429	452	454	452	462	472	482

See Interest Expense, Pension and Post-retirement Benefits and Capital Transfers section of this budget for a complete discussion of these cost estimates.

BONNEVILLE FTE



These notes are an integral part of this chart.

1. Actual FTE data is consistent with DOE personnel reports.
2. FTE outyear data are estimates and may change. Bonneville is facing a dynamic and changing transmission marketplace and operations while, at the same time, many of its employees are eligible to retire in the near future. It is important that Bonneville continue to attract and retain skilled individuals to meet the growing demands of a competitive and rapidly changing industry. Accordingly, FTE estimates may need to be adjusted in the future.
3. As of September 30, 2018 DOE HR staff has reported FY 2018 BPA's FTE usage at 2,793.

Total Cost of BPA Fish & Wildlife Actions (\$ in millions)

COST ELEMENT	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CAPITAL INVESTMENTS ^{1/}											
BPA FISH AND WILDLIFE	25.5	27.4	40.0	90.2	57.5	52.1	37.4	21.4	16.0	5.4	30.7
BPA SOFTWARE DEVELOPMENT COSTS	1.3	0.6	1.2	0.8	0.4	0.0	0.1	1.4	1.2	1.4	0.8
ASSOCIATED PROJECTS (FEDERAL HYDRO)	37.3	135.7	56.4	103.0	114.5	103.6	101.7	81.4	34.1	58.9	51.8
TOTAL CAPITAL INVESTMENTS	64.2	163.7	97.6	193.9	172.3	155.7	139.2	104.1	51.4	65.7	83.2
PROGRAM EXPENSES											
BPA DIRECT FISH AND WILDLIFE PROGRAM	148.9	177.9	199.6	221.1	248.9	239.0	231.8	258.2	258.1	254.7	258.7
FISH & WILDLIFE SOFTWARE EXPENSE COSTS	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.1	0.0	0.0	0.1
SUPPLEMENTAL MITIGATION PROGRAM EXPENSES ^{2/}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REIMBURSABLE/DIRECT-FUNDED PROJECTS ^{3/}											
O & M LOWER SNAKE RIVER HATCHERIES	19.4	20.8	23.3	24.5	22.0	28.7	31.0	30.9	28.6	26.0	31.4
O & M CORPS OF ENGINEERS	34.4	34.3	36.5	40.3	41.1	39.2	47.8	46.4	48.2	46.8	47.1
O & M BUREAU OF RECLAMATION	4.3	4.5	5.2	5.0	5.3	5.6	6.6	2.6	6.0	7.0	5.2
NW POWER AND CONSERVATION COUNCIL ALLOCATED @ 50%	4.1	4.7	4.7	4.5	4.6	5.0	4.9	4.9	5.4	5.4	5.5
SUBTOTAL (REIMB/DIRECT-FUNDED)	62.2	64.3	69.7	74.3	73.0	78.5	90.3	84.9	88.2	85.2	89.2
TOTAL OPERATING EXPENSES	211.1	242.1	269.3	295.3	321.9	317.70	322.40	343.17	346.34	339.90	347.97
PROGRAM RELATED FIXED EXPENSES ^{4/}											
INTEREST EXPENSE	76.9	78.7	80.5	79.2	80.6	89.1	83.4	89.2	85.6	58.6	41.0
AMORTIZATION EXPENSE	24.4	24.6	25.0	28.3	30.2	35.7	38.7	41.3	42.5	42.5	43.4
DEPRECIATION EXPENSE	14.9	16.7	18.0	19.6	20.7	18.6	19.2	20.1	20.1	20.3	20.8
TOTAL FIXED EXPENSES	116.2	120.0	123.5	127.2	131.5	143.4	141.3	150.6	148.2	121.4	105.1
GRAND TOTAL PROGRAM EXPENSES	327.3	362.1	392.8	422.5	453.4	461.1	463.7	493.7	494.6	461.3	453.0
FORGONE REVENUES AND POWER PURCHASES											
FOREGONE REVENUES	273.5	142.8	99.4	156.7	152.2	135.5	122.7	195.8	76.6	9.6	2.9
BPA POWER PURCH. FOR FISH ENHANCEMENT	274.9	240.3	310.1	70.7	38.5	85.8	196.2	67.5	50.3	(20.5)	24.3
TOTAL FOREGONE REVENUES AND POWER PURCHASES	548.5	383.1	409.5	227.4	190.7	221.3	318.9	263.3	126.9	(10.9)	27.2
TOTAL PROGRAM EXPENSES, FOREGONE REVENUES, & POWER PURCHASES	875.8	745.3	802.3	649.9	644.1	682.4	782.6	757.0	621.5	450.4	480.2
CREDITS											
4(h)(10)(C)	(100.5)	(99.5)	(122.8)	(85.3)	(77.0)	(84.1)	(103.9)	(77.7)	(72.6)	(53.7)	(70.2)
TOTAL CREDITS	(100.5)	(99.5)	(122.8)	(85.3)	(77.0)	(84.1)	(103.9)	(77.7)	(72.6)	(53.7)	(70.2)

This information has been made publicly available by BPA. The figures shown are consistent with audited actuals that contain Agency approved financial information, except for forgone revenues and power purchases which are estimates and do not contain Agency approved financial information

1/ Capital Investments include both BPA's direct Fish and Wildlife Program capital investments, funded by BPA's Treasury borrowing, and "Associated Projects", which include capital investments at Corps of Engineers' and Bureau of Reclamation projects, funded by appropriations and repaid by BPA. The annual expenses associated with these investments are included in "Program-Related Fixed Expenses", below.

2/ Includes High Priority and Action Plan Expenses and other supplemental programs.

3/ "Reimbursable/Direct-Funded Projects" includes the portion of costs BPA pays to or on behalf of other entities that is determined to be for fish and wildlife purposes.

4/ "Fixed Expenses" include depreciation, amortization and interest on investments on the Corps and Bureau's projects, and amortization and interest on the investments associated with BPA's direct Fish and Wildlife Program.

Fossil Energy Research and Development

**Fossil Energy
Research and
Development**

Fossil Energy Research and Development

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**FOSSIL ENERGY RESEARCH AND DEVELOPMENT
PROPOSED APPROPRIATION LANGUAGE**

For Department of Energy expenses necessary in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), [\$740,000,000]\$562,000,000, to remain available until expended: *Provided*, That of such amount [\$61,070,000]\$61,045,000 shall be available until September 30, [2020]2021, for program direction.
(Energy and Water Development and Related Agencies Appropriations Act, 2019.)

Public Law Authorizations

CCS and Power Systems:

- Public Law 95-91.

Natural Gas Technologies:

- Public Law 91-91, "Department of Energy Organization Act", 1977
- Public Law 109-58, "Energy Policy Act of 2005".

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies:

- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 109-58, "Energy Policy Act of 2005".

NETL Infrastructure and Operations/Plant and Capital Equipment (formerly Plant and Capital Equipment):

- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 108-153, "21st Century Nanotechnology Research and Development Act 2003"
- Public Law 109-58, "Energy Policy Act of 2005".
- Public Law 110-69, "America COMPETES Act of 2007"
- Public Law 110-140, "Energy Independence and Security Act 2007"
- Public Law 111-358, "America COMPETES Act of 2010"

NETL Infrastructure and Operations /Environmental Restoration (formerly Environmental Restoration):

- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 108-153, "21st Century Nanotechnology Research and Development Act 2003"
- Public Law 109-58, "Energy Policy Act of 2005".
- Public Law 110-69, "America COMPETES Act of 2007"
- Public Law 111-358, "America COMPETES Act of 2010"

Special Recruitment Programs:

- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 108-153, "21st Century Nanotechnology Research and Development Act 2003"
- Public Law 109-58, "Energy Policy Act of 2005".
- Public Law 110-69, "America COMPETES Act of 2007"

Public Law 111-358, "America COMPETES Act of 2010"

**Fossil Energy Research and Development
(FER&D)
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$726,817	\$740,000	\$562,000	-\$178,000

Overview

The Fossil Energy Research and Development (FER&D) program offices advance transformative science and innovative technologies that enable the reliable, efficient, affordable, and environmentally sound use of fossil fuels. Fossil energy sources constitute over 77% of the country’s total energy use,¹ and are critical to the nation’s security, economic prosperity and growth. FER&D conducts R&D on advanced fossil energy systems, crosscutting fossil energy research, and Carbon Capture Utilization and Storage (CCUS) technologies. FER&D also conducts research related to the prudent and sustainable development of domestic oil and gas resources, with a focus on natural gas technologies and unconventional resources. Finally, FER&D includes funding for the research, operations, and infrastructure of the National Energy Technology Laboratory (NETL).

The Office of Fossil Energy invests in research and development (R&D) as part of the Department of Energy’s (DOE) broad portfolio approach to addressing our Nation’s energy and environmental challenges. This Budget Request focuses DOE resources toward early-stage R&D and reflects an increased reliance on the private sector to fund later-stage research, development, and commercialization of energy technologies. It emphasizes energy technologies best positioned to support American energy independence and domestic job-growth in the near- to mid-term. Funding for FER&D will enable the discovery, integration, and maturity of technology solutions to enhance the nation’s energy foundation and protect the environment for future generations.

FER&D early-stage research focuses on technology challenges that present a significant degree of scientific or technical uncertainty across a relatively long period, making it unlikely that industry will invest significant R&D on their own. Industry typically focuses on near term (2-4 years) investments in marginal improvements to operational performance, while FER&D early-stage R&D focuses on longer-range (5-15 years) transformational technologies, materials, and processes. Thus, this request maintains the most critical core capabilities and infrastructure at DOE National Laboratories related to advanced fossil energy technologies.

The FER&D FY 2020 Budget Request is informed by guiding principles of energy dominance, security, strong domestic energy production, and advancing clean coal technologies through early stage R&D to revitalize the coal industry. Driven by the Administration’s support of the coal industry and the competitiveness of the existing coal fleet, the FER&D budget focuses on cutting edge, early-stage R&D that will prepare innovative new technologies for the private sector to further develop, scale-up, and deploy. R&D will advance small-scale modular coal plants of the future, which are highly efficient and flexible, with near-zero emissions, and develop next-generation materials, components, and systems to improve the performance, reliability, and efficiency of the existing coal-fired fleet. Maintaining U.S global economic competitiveness with the best energy technologies and affordable energy prices is essential to strengthen and grow our economy, create new jobs, and enhance our national security. Developing advanced, clean, high-efficiency technologies underpins our national economy and creates new products for export.

¹ <https://www.eia.gov/todayinenergy/detail.php?id=26912>

Highlights and Major Changes in the 2020 Budget Request

The FER&D FY 2020 Budget Request focuses resources on impactful early-stage research and development that enables domestic energy production and enhances energy security and independence. After initial investment by FER&D, these technologies will then be poised for further advancement, development, and/or scale-up by industry. These investments will drive innovation to support economic growth and provide affordable, reliable, and environmentally sustainable energy. The Office of Fossil Energy will also continue the Department's initiative on streamlining the program to become more accountable and efficient, examining organizational efficiencies at both headquarters and NETL.

The proposed restructure of Advanced Energy Systems (AES) & CCUS within FER&D improves the alignment of the budget structure to the research focus areas, repositioning the Department to more effectively enable industry to commercialize and deploy advanced technologies necessary to support a secure and reliable power grid. FER&D will support early-stage research in advanced technologies (in materials, sensors, and processes, etc.) to expand the knowledge-base upon which industry can improve the efficiency, flexibility, and resilience of the existing fleet of coal fired power plants. The restructure also focuses funding on early-stage research that enables the next generation of high efficiency, and low emission coal fired power plants that can directly compete with other sources of electricity in the market and provide low cost reliable and interminable power.

For comparability, all discussions of funding changes that follow assume the FY 2020 proposed budget structure. Funding crosswalks in the Budget Structure Crosswalks chapter of this narrative provide details of the proposed changes.

Advanced Coal Energy Systems & CCUS (\$387.425M)

Descriptions of major funding and programmatic changes and highlights within the Advanced Coal Energy Systems & CCUS program for FY 2020 are as follows:

Advanced Energy Systems (AES) (\$220.3M):

The FY 2020 Budget provides \$220.3 million to enhance the mission of the Advanced Energy Systems (AES) subprogram to increase the availability, efficiency, and reliability of fossil energy power systems while maintaining environmental standards through early-stage R&D. Specific efforts will focus on six activities:

- Gasification Systems activities will develop modular technologies that could overcome siting, operating, and logistical constraints that inhibit the deployment of large scale plants. The budget also provides funding to continue R&D on innovative design development for a high-performance, low-cost gasifier as well as advance designs and fabrication of form refractories to provide better heat and temperature distribution inside a gasifier and lower capital costs.
- Advanced Turbines activities will focus on competitively funded new awards with industry to develop advanced steam turbines as well as sCO₂ turbines. The budget also provides funding to advance early-stage pressure gain combustion R&D with the DOE National Laboratories. These activities will include research on key turbine system components that, with additional development by industry, could be capable of achieving a 4-5 percentage point efficiency increase relative to existing combined cycle turbines.
- Solid Oxide Fuel Cells (SOFC) activities will focus on advancing R&D with the DOE National Laboratories that addresses the technical challenges to SOFC commercialization, such as cell power enhancement, advanced materials development for low temperature operation, materials characterization, and systems analysis.
- Advanced Sensors and Controls activities will focus on advanced controls, harsh environment sensors, and load following systems. Novel instrumentation that can withstand harsh environments has the ability to replace inferred process conditions with actual measurements which can facilitate faster/safer response times. In addition, the budget provides support for National Laboratory R&D to test lab-scale sensors in a relevant plant environment to enable technology transfer.
- Power Generation Efficiency activities will focus on new competitive funding opportunities for Phase II efforts of the coal plant of the future. This funding specifically focuses on R&D on critical component design, advanced design methods (e.g., parametric approaches), advanced combustion, and engineering design. The budget also funds a new competitive funding opportunity to improve performance of the existing fleet. These funding opportunities will focus on improving plant efficiency through topping cycles, advanced materials, recovery of low grade waste heat,

improvements in water usage, lower parasitic losses and the development of advanced sensors, instrumentation, and artificial intelligence control systems based on dynamic data analysis.

- Advanced Energy Materials activities will focus on developing cost effective structural and functional materials for advanced fossil energy power production technologies, and to reduce the cost and time needed to develop and commercialize new materials for FE applications in extreme operating environments. These advancements are used to promote technologies that enhance plant optimization that reduce operations and maintenance costs of both existing coal-fired plants and new fossil energy infrastructure.
- Advanced Coal Processing will focus on converting coal to high value products, including high-performance carbon materials (carbon fibers etc.), and the development of Novel Lab/Bench-Scale Coal Utilization Technologies.

Crosscutting Research (\$60.325M):

The FY 2020 Budget provides \$60.325 million to support R&D that bridges basic and applied research by targeting concepts with the greatest potential for transformational breakthroughs. As such, the program focuses on advancing early-stage research in areas such as materials, rare earth recovery from coal and coal byproducts, fluid dynamics, and fuel preparation characteristics (i.e., coal particle sizing and drying). The program also aims to obtain new knowledge regarding plant phenomena and operation that can be incorporated into a new generation of plant control technologies. Specific efforts will focus on the following activities:

- Critical Minerals contains the Critical Materials Initiative, allowing DOE to continue developing technologies with the goal of enabling additional domestic supplies of Rare Earth Elements (REE), reducing environmental impact of coal REE production, and delivering technologies that can be manufactured within the United States. DOE has accomplished much in this area, including the evaluation of pilot-scale processing options and the nature and distribution of REE in U.S. coal deposits.
- Water Management R&D Activities will focus on early-stage development of technologies that increase power plant efficiency and decrease water consumption; field testing of promising technologies that reduce the energy requirements and operating costs of waste water treatment for power plants. The budget also funds DOE National Laboratories to conduct techno-economic assessments to guide water management and to field test wastewater treatment technologies for fossil energy power plants that improve our understanding of the complex water issues facing today's coal fleet as it relates to energy production.
- Modeling, Simulation & Analysis comprises of modeling, simulation and techno-economic analysis to optimize—and reduce the cost—of areas such as water use, emissions, solid waste disposal, materials development, and power plant operations. This activity supports program strategic planning by identifying major challenges, technologies, and advanced concepts that have the potential to improve the efficiency, cost, and/or environmental performance of fossil energy systems.
- University Training and Research provides grants to colleges and universities to support research consistent with the goals of the Advanced Coal Energy Systems and CCUS program. This element provides a two-fold benefit: conducting directed energy research for the Department, and at the same time providing support for expanding the research capabilities and education of the next generation of scientists and engineers. The Historically Black Colleges and Universities (HBCU) and Other Minority Institutions (OMI) education and training program awards research grants to qualifying universities and institutions, with project results being used to further DOE's commitment to fossil energy research.
- Harsh Environment Materials Initiative: A coordinated effort to exploit synergies in materials and component manufacturing R&D for advanced thermoelectric power plants. Specifically, this initiative would leverage NE and FE R&D activities related to advanced reactor technologies and high efficiency low emissions modular coal plants, respectively, to align R&D of novel materials, integrated sensors, and manufacturing processes relevant for advanced thermoelectric power plants.
- Advanced Energy Storage Initiative: A coordinated effort across DOE that will accelerate the development of energy storage and system flexibility technologies. Leveraging the full suite of DOE technologies, the Advanced Energy Storage Initiative will focus the Agency's efforts to take a more holistic and system-wide perspective to address emerging challenges, improve the reliability and resilience of the electrical grid, and ensure the affordability and security of energy for transportation.

Carbon Capture, Utilization and Storage (\$68.8M):

The CCUS subprogram focuses on early-stage research and development on post-combustion and pre-combustion CO₂ capture, novel compression technologies for new and existing fossil fuel-fired power plants, and CO₂ utilization technologies to convert CO₂ to valuable products and commodities. Specific efforts will focus on the following activities:

- **Carbon Capture:** FY 2020 activities represent a purposeful shift away from later-stage R&D such as development and scale-up of 2nd generation capture technologies through small and large pilot projects, as incentives exist for industry to adapt, develop, and scale these technologies for cost-competitive deployment. Specifically, in FY 2020, the budget provides \$39.8 million to the Carbon Capture activity for early-stage pre- and post-combustion capture R&D on transformational gas separation technologies (at least 90% of the CO₂ at 95% purity) that can significantly reduce the cost of CO₂ capture. Transformational capture systems are a set of disruptive technologies that can significantly reduce the cost of capture, targeting a cost of electricity (COE) at least 30% less than state of the art (~\$30/tonne). These transformational technologies will be designed to adapt to the operational demands of advanced power systems and adjust to the increasing need for fossil fuel power plants to at times be load-following/demand responsive electricity generators. The activity will also investigate approaches to utilize CO₂ and optimize capture process.
- **Carbon Utilization:** The Budget provides \$6 million to focus on early-stage CO₂ utilization technologies that develop additional markets for fossil energy resources. Areas of research include, but are not limited to, projects focused on the catalytic conversion to chemicals and polymers, mineralization to building products, and biological processes optimized for the conversion of coal based carbon (CO₂ and methane) to higher value products such as nutraceuticals, bio plastics, and animal feed.
- **Carbon Storage:** Activities will focus on early-stage R&D in five primary storage types: saline formations, oil and natural gas reservoirs, unmineable coal seams, basalts, and organic shales—and in geologic reservoirs across eleven different geologic storage depositional classes. Coupled simulation tools, characterization methods, and monitoring technologies developed and validated through the Carbon Storage activity will improve storage efficiency, reduce overall cost, decrease subsurface uncertainties, and identify ways to ensure that operations are safe, economically viable, and environmentally benign.
- **Emissions Control:** The Budget provides \$3 million to initiates new efforts on addressing non-CO₂ emissions (e.g., trace metals, etc.).

NETL Coal Research and Development (\$38M):

- **NETL Coal R&D:** The request of \$38 million funds the Federal costs for NETL's in-house research efforts. Specifically, the funding supports the NETL staff of scientists and engineers who conduct in-house research activities for FE R&D programs, including salaries and benefits, travel, personal protective equipment, and other employee costs.

Natural Gas Technologies (\$10.73M):

- The Gas Hydrates subprogram, through DOE National Laboratory and university-led efforts, will continue early-stage R&D to evaluate the occurrence, nature, and behavior of naturally occurring gas hydrates and the resulting resource, hazard, and environmental implications.
- The Natural Gas Infrastructure Research subprogram will focus on early-stage, foundational research on materials, coatings and sensors to improve the operational efficiency and safety of natural gas supply and delivery infrastructure, which is needed to support the increased reliance on gas as both a domestic energy source and a vital export market. The federal government will continue to have a significant role in addressing areas of public interest and concern, to include pipeline safety and reliability, resource stewardship, and infrastructure security.

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies (\$19M):

- The Request will continue early-stage R&D in the current field laboratories in the Marcellus, Utica, Eagle Ford, Appalachia, Delaware, and Tuscaloosa shale basins in the United States. R&D at these field sites addresses fluid flow

and physio-chemical interactions in unconventional reservoirs, with a focus on improving the technical understanding of fracturing dynamics that can contribute to game-changing increases in recovery factor from the typical single-digit range. Success would also decrease the footprint of shale development and lower water use.

- The program will also address areas of public interest to include reducing the impacts from development and improving the amount of resource recovered per well by conducting research to understand the precise factors that will allow improved injection practices including real-time, dynamic management and manipulation of the subsurface environment, and reduced risk to critical national infrastructure.

National Energy Technology Laboratory (\$110.674M for NETL; and an additional \$34.171M for HQ Program Direction and Special Recruitment):

- The Office of Fossil Energy is committed to supporting the National Energy Technology Laboratory's (NETL) capabilities and competitiveness. NETL, whose primary funding source is the Office of Fossil Energy, is the only federally owned and operated laboratory in the DOE National Laboratory system.
- NETL Infrastructure: The request of \$43.1 million supports the fixed costs of maintaining NETL's lab footprint three geographic locations: Morgantown, WV; Pittsburgh, PA; and Albany, OR. These sites include approximately 240 acres of land, including 116 buildings with over 1,100,000 square feet of space.
- NETL Research and Operations: The request of \$40 million supports NETL's science and technology development and commercialization functions, including technical program management and strategic scientific planning and partnerships. Specifically, funding supports the NETL staff of engineers, and technical project managers who conduct extramural research activities for FER&D programs, including salaries and benefits, travel, and other employee costs. This request also supports the variable operating costs of NETL's research sites.
- NETL and HQ Program Direction and Special Recruitment Programs: The request of \$61.745 million (\$33.471 million for headquarters, \$27.574 million for NETL, and \$0.7 million for Special Recruitment) provides for the FER&D organization's federal workforce and contractor support in the Washington, D.C. area including salaries and benefits, support service contracts, travel, training, the working capital fund, and other employee costs. These staff are responsible for the oversight and administration of the FER&D Programs and Natural Gas regulatory activities. In addition, funding for NETL federal technical staff and contractor support that provide Acquisition, Finance and Legal functions is supported. Funding to advance FER&D workforce reshaping is also included.

Cybersecurity: DOE is engaged in two categories of cyber-related activities: protecting the DOE enterprise from a range of cyber threats that can adversely impact mission capabilities and improving cybersecurity in the electric power subsector and the oil and natural gas subsector. The Cybersecurity Crosscut supports central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center (JC3) for incident response and the implementation of Department-wide Identity, Credentials, and Access Management (ICAM).

FY 2020 Crosscuts (\$K)

	Cybersecurity	Harsh Environment Materials Initiative	Advanced Energy Storage Initiative	Total
NETL Infrastructure	4,416	0	0	4,416
Program Direction	920	0	0	920
Crosscutting Research	0	500	4,500	5,000
Total, Crosscuts	5,336	500	4,500	10,336

**Fossil Energy Research and Development
Funding by Congressional Control (\$K)
(Comparable)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Advanced Coal Energy Systems and CCUS				
Advanced Energy Systems	139,500	157,683	220,300	+62,617
Cross-cutting	45,850	46,350	60,325	+13,975
Carbon Capture, Utilization and Storage	198,767	198,767	68,800	-129,967
STEP (Supercritical CO ₂)	24,000	22,430	---	-22,430
Transformational Coal Pilots (formerly Fossil Proviso) ¹	35,000	25,000	---	-25,000
NETL Coal Research and Development	38,000	36,000	38,000	+2,000
Subtotal, Advanced Coal Energy Systems and CCUS	481,117	486,230	387,425	-98,805
Natural Gas Technologies	50,000	51,000	10,730	-40,270
Unconventional Fossil Energy Technologies from Petroleum - Oil Technologies	40,000	46,000	19,000	-27,000
Program Direction	60,000	61,070	61,045	-25
Special Recruitment Programs	700	700	700	0
NETL Infrastructure	45,000	45,000	43,100	-1,900
NETL Research and Operations	50,000	50,000	40,000	-10,000
Total, Fossil Energy Research & Development	726,817	740,000	562,000	-178,000
Federal FTEs	634	630	657	+27

¹ In prior years, Transformational Coal Pilots was called Fossil Proviso and was separate from other funding. This causes the comparable subtotals to be different than the non-comparable subtotals.

**Fossil Energy Research and Development
Funding by Congressional Control (\$K)
(Non-Comparable)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Coal				
CCS AND POWER SYSTEMS				
Carbon Capture	100,671	100,671	---	-100,671
Carbon Storage	98,096	98,096	---	-98,096
Advanced Energy Systems	112,000	129,683	---	-129,683
Cross-cutting Research	58,350	56,350	---	-56,350
Supercritical Transformational Electric Power	24,000	22,430	---	-22,430
Transformational Coal Pilots	35,000	25,000	---	-25,000
NETL Coal Research and Development	53,000	54,000	---	-54,000
Total, CCS and Power Systems	481,117	486,230	---	-486,230
Natural Gas Technologies	---	---	---	---
Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies	---	---	---	---
Program Direction	---	---	---	---
Special Recruitment Program	---	---	---	---
NETL Infrastructure	---	---	---	---
NETL Research and Operations	---	---	---	---
Subtotal, Fossil Energy Research & Development	---	---	---	---
Total, Fossil Energy Research & Development	---	---	---	---
Federal FTEs				
Advanced Energy Systems	---	---	220,300	+220,300
Cross-cutting	---	---	60,325	+60,325
Carbon Capture, Utilization and Storage	---	---	68,800	+68,800
STEP (Supercritical) CO ₂	---	---	---	---
Transformational Coal Pilots	---	---	---	---
NETL Coal Research and Development	---	---	38,000	+38,000
Total, Advanced Coal Energy Systems and CCUS	---	---	387,425	+387,425
Natural Gas Technologies	50,000	51,000	10,730	-40,270
Unconventional Fossil Energy Technologies from Petroleum - Oil Technologies	40,000	46,000	19,000	-27,000
Program Direction	60,000	61,070	61,045	-25
Special Recruitment Programs	700	700	700	---
NETL Infrastructure	45,000	45,000	43,100	-1,900
NETL Research and Operations	50,000	50,000	40,000	-10,000

Subtotal, Fossil Energy Research & Development	726,817	740,000	562,000	-178,000
Total, Fossil Energy Research & Development	726,817	740,000	562,000	-178,000
Federal FTEs	634	630	657	+27

SBIR/STTR:

- FY 2018 Transferred: SBIR \$14,876; STTR: \$2,092
- FY 2019 Enacted: SBIR \$12,997; STTR: \$1,828
- FY 2020 Request: SBIR \$8,916; STTR: \$1,254

		Advanced Coal Energy Systems & CCUS							
		Advanced Energy Systems							
		Advanced Systems				Advanced Materials			Total, Advanced Energy Systems
19 Enacted (\$'s in thousands)		Advanced Combustion/ Gasification Systems	Advanced Turbines	Solid Oxide Fuel Cells	Advanced Sensors and Controls	Advanced Coal Processing	Power Generation Efficiency	Advanced Energy Materials	
Current Budget Structure	Advanced Energy Systems								
	<i>Advanced Combustion Systems</i>	-	-	-	-	-	-	-	-
	<i>Gasification Systems</i>	18,000	-	-	-	-	-	-	18,000
	<i>Advanced Turbines</i>	-	20,000	-	-	-	-	-	20,000
	<i>Solid Oxide Fuel Cells</i>	-	-	30,000	-	-	-	-	30,000
	<i>Coal Beneficiation</i>	-	-	-	-	13,000	-	-	13,000
	<i>Transformative Power Generation</i>	-	-	-	-	-	48,683	-	48,683
	Cross Cutting Research	-	-	-	-	-	-	-	-
	<i>Sensors and Controls</i>	-	-	-	8,000	-	-	-	8,000
	<i>Crosscutting Materials R&D</i>	-	-	-	-	-	-	5,000	5,000
	<i>Advanced Ultra Supercritical Materials R&D</i>	-	-	-	-	-	-	15,000	15,000
Total	18,000	20,000	30,000	8,000	13,000	48,683	20,000	157,683	

		Advanced Coal Energy Systems & CCUS					
		Crosscutting Research					
19 Enacted (\$'s in thousands)		Water Management R&D	Modeling, Simulation & Analysis	Critical Minerals	University Training & Research	International Activities	Total, Crosscutting Research
Current Budget Structure	Cross-cutting Research						
	Plant Optimization Technologies	-	-	-	-	-	-
	<i>Sensors and Controls</i>	-	-	-	-	-	-
	<i>Crosscutting Materials R&D</i>	-	-	-	-	-	-
	<i>Advanced Ultra Supercritical Materials R&D</i>	-	-	-	-	-	-
	<i>Water Management R&D</i>	8,000	-	-	-	-	8,000
	Coal Utilization Science	-	-	-	-	-	-
	<i>Simulation Based Engineering</i>	-	14,000	-	-	-	14,000
	<i>Computational System Dynamics</i>	-	-	-	-	-	-
	<i>Focus Area for Computational Energy Science</i>	-	-	-	-	-	-
	Energy Analyses	-	-	-	-	-	-
	<i>Environmental Activities</i>	-	-	-	-	-	-
	<i>Technical and Economic Analyses</i>	-	1,000	-	-	-	1,000
	International Activities	-	-	-	-	300	300
	University Training and Research	-	-	-	-	-	-
	<i>University Coal Research</i>	-	-	-	3,000	-	3,000
	<i>HBCUs, Education, and Training</i>	-	-	-	2,050	-	2,050
	Critical Materials Initiative	-	-	-	-	-	-
	NETL Coal Research and Development	-	-	-	-	-	-
<i>Feasibility of Recovering REEs</i>	-	-	18,000	-	-	18,000	
Total		8,000	15,000	18,000	5,050	300	46,350

		Advanced Coal Energy Systems & CCUS					
		Carbon Capture, Utilization and Storage					
		Carbon Utilization	Carbon Capture		Carbon Storage		
19 Enacted (\$'s in thousands)		Carbon Use and Reuse	Post-Combustion Capture Systems	Pre-Combustion Capture Systems	Storage Infrastructure	Advanced Storage R&D	Total, Carbon Capture, Utilization and Storage
Current Budget Structure	Carbon Capture						
	<i>Post-Combustion Capture Systems</i>	-	94,671	-	-	-	94,671
	<i>Pre-Combustion Capture Systems</i>	-	-	6,000	-	-	6,000
	Carbon Storage	-	-	-	-	-	-
	<i>Storage Infrastructure</i>	-	-	-	57,500	-	57,500
	<i>Advanced Storage R&D</i>	-	-	-	-	21,696	21,696
	<i>Monitoring, Verification, Accounting, and Assessment</i>	-	-	-	-	-	-
	<i>Carbon Use and Reuse</i>	12,000	-	-	-	-	12,000
	<i>Sub-disciplinary Storage R&D</i>	-	-	-	-	6,900	6,900
Total	12,000	94,671	6,000	57,500	28,596	198,767	

		Advanced Coal Energy Systems & CCUS			
19 Enacted (\$'s in thousands)		STEP (Supercritical CO2)	Transformational Coal Pilots	NETL Coal R&D	Total
Current Budget Structure	<i>STEP (Supercritical CO2)</i>	22,430	-	-	22,430
	<i>Fossil Carbon Materials Hub</i>	-	-	-	-
	<i>Critical Materials Initiative</i>	-	-	-	-
	<i>Transformational Coal Pilots</i>	-	25,000	-	25,000
	<i>NETL Coal Research and Development</i>	-	-	-	-
	<i>NETL Coal R&D (Other)</i>	-	-	36,000	36,000
Total		22,430	25,000	36,000	83,430

Advanced Coal Energy Systems & CCUS

Overview

For the foreseeable future, coal will continue to be a major source of electricity generation, in the United States and globally. Coal is the most abundant domestic energy resource in the U.S., and it is an important part of the domestic energy mix, providing about 30% of the Nation's electricity. Advancing affordable, lower emission, and reliable domestic energy production from coal supports the economy, the environment, and energy security here and abroad.

The Advanced Coal Energy Systems & Carbon Capture, Utilization and Storage (CCUS) program invests in early-stage energy technologies that improve the affordability, competitiveness, and environmental performance of domestic coal generation; improve electric grid reliability and resilience; and increase the domestic and international accessibility to American energy resources and technologies. The program develops transformational energy technologies as part of the Administration's all-of-the-above energy portfolio that enables greater private-sector participation in driving market outcomes to enhance America's competitiveness.

The program's research and development (R&D) focus is on early-stage technologies that have the potential to improve the competitiveness and performance of both new and existing coal-fired plants. The U.S. coal fleet is aging, and less efficient coal plants are shutting down and retiring at unprecedented rates, a challenge exacerbated by the current economic pressures on the coal sector. These retirements negatively impact the overall resiliency and reliability of the electric power grid. Government-supported early-stage R&D in areas such as next-generation materials, advanced power cycles and power generation components, environmental controls, and novel plant controls can help to improve the efficiency and performance of these aging systems, which industry can further develop or deploy. Such advancements are critical to the maintaining the electric power grid's resiliency and reliability.

The FY 2020 Advanced Coal Energy Systems and CCUS Budget Request will continue to support early-stage, transformational R&D that has the potential to modernize our fossil generation infrastructure, provide economic benefits to consumers, and provide resiliency to the grid. The request emphasizes R&D that will advance the following priorities:

- **Improving the performance, reliability, and efficiency of the existing coal-fired fleet.** R&D is essential to address performance concerns at the unit, plant, and grid level, caused by aging or increased time spent in cycling mode. More cycling leads to less economic units, lower efficiency, and more stress on equipment, leading to a shortened expected plant life thereby reducing the reliability and resiliency of the electric power generation system. Developing advanced methods and equipment that reduce the costs and waste from existing environmental control processes will also improve their reliability, costs and efficiency of the existing fleet.
- **Developing technologies that will underpin the coal plant of the future.** The coal plant of the future will need to be small (50 to 350 MW), highly efficient, flexible, reliable, and environmentally responsible to compete with other sources of power generation. The program's Coal FIRST (Flexible, Innovative, Resilient, Small, Transformative) initiative will develop technologies for such future plants and provide secure, stable, and reliable power. This early-stage R&D will underpin coal-fired power plants that are capable of flexible operations to meet the needs of the grid; use innovative and cutting-edge components that improve efficiency and reduce emissions; provide resilient power to Americans; are small compared to today's conventional utility-scale coal; and will transform how coal technologies are designed and manufactured. Technologies developed through this program will not only benefit the US coal fleet, but also provide export opportunities to a number of overseas markets.
- **Reducing the cost of carbon capture.** Cost-competitive carbon capture technologies have the potential to support the fossil sector while advancing U.S. leadership in high efficiency, low-emission (HELE) generation technologies. Further, R&D that reduces the cost of carbon capture technologies can be applied to both the existing fleet of fossil fuel-fired plants and new plants.

- **Creating new market opportunities for coal.** This request also advances efforts to create additional market opportunities for coal, including developing products from coal and carbon dioxide (CO₂), and extracting critical minerals from coal and its byproducts, creating new economic opportunities for the coal sector.

To ensure that investments across the Department are efficiently leveraged and coordinated, the FY 2020 Budget Request also includes two intra-Departmental initiatives: Harsh Environment Materials Initiative (HEMI), which aligns shared R&D across the Offices of Fossil Energy, Nuclear Energy, and Energy Efficiency and Renewable Energy in materials, sensors, and advanced manufacturing related to small modular technologies; and Advanced Energy Storage Initiative (AESI), which aligns shared R&D across the Offices of Fossil Energy, Electricity, and Energy Efficiency and Renewable Energy in energy storage. Further details can be found in the Crosscutting Research section.

The FY 2020 Budget Request re-proposes a restructure of the Advanced Energy Systems (AES), Crosscutting Research, and Carbon Capture and Storage programs within the FER&D Program. The restructuring aims to streamline how the program's budget is organized and to clarify research priorities. For comparability, all discussions of funding changes that follow assume the FY 2020 proposed budget structure. A funding crosswalk in the Budget Structure Crosswalks chapter of this narrative provides details of the proposed changes.

In addition, the FY 2020 Budget Request proposes a new Emissions Control initiative that will develop new and innovative technologies to improve plant and process efficiency, and reduce the costs and environmental impacts of non-CO₂ emissions from coal-fired power plants (e.g., trace metals emissions in solid, liquid and gaseous effluents) to improve their competitiveness.

Highlights of the FY 2020 Budget Request

The Advanced Coal Energy Systems & CCUS program will pursue the following major activities in FY 2020:

Advanced Energy Systems

The mission of the Advanced Energy Systems (AES) subprogram is to increase the availability, efficiency, and reliability of fossil energy power systems while maintaining environmental standards. Early-stage R&D will focus on developing and testing power plant components; novel combustion processes; advanced coal processing; and advanced materials for components, turbines, and fuel cells that will improve the competitiveness of new and existing coal-fired power plants. Development of advanced coal power plants of the future will restore U.S. technical leadership in this area while maintaining the required technical advancements to service the existing fleet for grid stability.

Specific efforts will focus on seven R&D activities: 1) Advanced Gasification Systems, 2) Advanced Turbines, 3) Solid Oxide Fuel Cells, 4) Advanced Sensors and Controls and Other Novel Concepts, 5) Advanced Coal Processing 6) Power Generation Efficiency, and 7) Advanced Energy Materials. R&D advances in these areas will support performance improvements for the existing coal fleet, which in turn can also apply to the future fleet. Two key goals of the AES subprogram are to improve the average modeled efficiency (heat rate) of a typical plant in the existing fleet by 5% (i.e., to 32.5% from the 2017 baseline of 31%) by the end of FY 2022, and of an advanced or new coal plant by 5+% by the end of FY 2023 (i.e., to 40+% from the 2017 baseline of 38% of the most recently constructed plants). Further, while the primary focus is on coal-based power systems, improvements to these technologies are also accretive to other fossil energy systems.

Crosscutting Research

The Crosscutting Research subprogram advances and accelerates promising fossil energy technology by supporting innovative early-stage R&D that improves the reliability, availability, efficiency, and environmental performance of advanced fossil-based power systems. The program also aims to obtain new knowledge regarding plant performance and operation that can be incorporated into a new generation of plant control technologies. Crosscutting Research is focused on four primary R&D activities: 1) Critical Minerals; 2) Water Management R&D; 3) Modeling, Simulation and Analysis; and 4) University Training and Research. A new crosscutting focus in the FY 2020 Budget are the intra-departmental initiatives,

HEMI and AESI, designed to exploit synergies across the Applied Energy Offices in the areas of advanced materials and energy storage.

Carbon Capture, Utilization & Storage

The CCUS subprogram is focused on early-stage R&D that 1) reduces the cost of capturing CO₂ from fossil and industrial sources, 2) advances approaches to safely and securely store CO₂ underground long-term, and 3) advances novel approaches to using CO₂, such as developing useable products and fuels. Specifically, carbon capture R&D is focused on the development of transformational CO₂ separation technologies—membranes, sorbents, solvents, and cryogenic—for both pre- and post-combustion coal-fired power plants systems that will capture CO₂ at approximately \$30 per tonne. Carbon utilization R&D is focused on using captured CO₂ and/or carbon-containing substances, or directly using CO₂ from flue gas or other gas streams, and converting it into valuable products. Carbon storage R&D supports the development and testing of advanced monitoring technologies, subsurface flow models, and risk assessment tools to ensure the safety, economic feasibility, and permanence of CO₂ storage in geologic formations. A goal of the CCUS subprogram is to support a new coal-fired plant with CO₂ capture at a cost of electricity at least 30% lower than a supercritical PC with CO₂ capture, or approximately \$30 per tonne of CO₂ captured by 2030. For existing plant retrofits, the subprogram's goal is to reduce the cost of capture by 30% (actual cost of capture varies for each unit).

In FY 2020, the CCUS subprogram proposes to develop new and innovative technologies to improve plant and process efficiency, and reduce the costs and environmental impacts of non-CO₂ emissions from coal-fired power plants (e.g., trace metals emissions in solid, liquid and gaseous effluents) to improve their competitiveness.

**Advanced Coal Energy Systems & CCUS
Funding by Congressional Control (\$K)
(Comparable)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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**Advanced Coal Energy Systems & CCUS
Advanced Energy Systems**

Advanced Gasification Systems	28,000	18,000	10,300	-7,700
Advanced Turbines	20,000	20,000	17,000	-3,000
Solid Oxide Fuel Cells	30,000	30,000	3,000	-27,000
Advanced Sensors and Controls and other Novel Concepts	7,500	8,000	10,000	+2,000
 Advanced Coal Processing	 8,000	 13,000	 10,000	 -3,000
Power Generation Efficiency	26,000	48,683	145,000	+96,317
Advanced Energy Materials	20,000	20,000	25,000	+5,000
Total Advanced Energy Systems	139,500	157,683	220,300	+62,617
 Crosscutting Research				
Water Management R&D	7,000	8,000	10,000	+2,000
Modeling, Simulation & Analysis	20,300	15,000	17,000	+2,000
Harsh Environment Material Initiative	---	---	500	+500
Advanced Energy Storage Initiative	---	---	4,500	+4,500
Critical Minerals				
Feasibility of Recovering REEs	15,000	18,000	15,000	-3,000
Critical Materials	---	---	7,500	+7,500
Subtotal Critical Minerals	15,000	18,000	22,500	+4,500
University Training and Research	3,250	5,050	5,825	+775
International Activities	300	300	---	-300
Total Crosscutting Research	45,850	46,350	+60,325	+13,975

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Carbon Capture, Utilization and Storage				
Carbon Capture				
Post-Combustion Capture Systems	88,671	94,671	35,800	-58,871
Pre-Combustion Capture Systems	12,000	6,000	4,000	-2,000
Subtotal Carbon Capture	100,671	100,671	39,800	-60,871
Carbon Utilization				
Carbon Use and Reuse	12,000	12,000	6,000	-6,000
Subtotal Carbon Utilization	12,000	12,000	6,000	-6,000
Carbon Storage				
Storage Infrastructure	45,000	57,500	5,000	-52,500
Advanced Storage R&D	41,096	28,596	15,000	-13,596
Subtotal Carbon Storage	86,096	86,096	20,000	-66,096
Emissions Control	---	---	3,000	+3,000
Total Carbon Capture, Utilization and Storage	198,767	198,767	68,800	-129,967
STEP (Supercritical CO2)	24,000	22,430	---	-22,430
Transformational Coal Pilots	35,000	25,000	---	-25,000
NETL Coal Research and Development	38,000	36,000	38,000	+2,000
Total, Advanced Coal Energy Systems & CCUS	481,117	486,230	387,425	-98,805

**Advanced Coal Energy Systems & CCUS
Funding by Congressional Control (\$K)
(Non-Comparable)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Coal				
CCS and Power Systems				
Carbon Capture				
Post-Combustion Capture Systems	88,671	94,671	---	-94,671
Pre-Combustion Capture Systems	12,000	6,000	---	-6,000
Subtotal Carbon Capture	100,671	100,671	---	-100,671
Carbon Storage				
Storage Field Management	45,000	57,500	---	-57,500
Advanced Storage R&D	30,096	21,696	---	-21,696
Carbon Use and Reuse	12,000	12,000	---	-12,000
Sub-disciplinary Storage R&D	11,000	6,900	---	-6,900
Subtotal Carbon Storage	98,096	98,096	---	-98,096
Advanced Energy Systems				
Advanced Combustion Systems	2,980	---	---	---
Gasification Systems	25,000	18,000	---	-18,000
Advanced Turbines	20,000	20,000	---	-20,000
Coal and Coal Biomass to Liquids	20	---	---	---
Solid Oxide Fuel Cells	30,000	30,000	---	-30,000
Coal Beneficiation	8,000	13,000	---	-13,000
Transformative Power Generation	26,000	48,683	---	-48,683
Subtotal Advanced Energy Systems	112,000	129,683	---	-129,683
Crosscutting Research				
Plant Optimization Technologies				
Sensors, Controls and Other Novel Concepts	7,500	8,000	---	-8,000
Crosscutting Materials R&D	2,000	5,000	---	-5,000
Advanced Ultrasupercritical Materials R&D	18,000	15,000	---	-15,000
Water Management R&D	7,000	8,000	---	-8,000
Subtotal Plant Optimization Technologies	34,500	36,000	---	-36,000

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Coal Utilization Science				
Simulation Based Engineering	---	14,000	---	-14,000
Computational System Dynamics	10,000	---	---	---
Focus Area for Computational Energy Science	10,000	---	---	---
Subtotal Coal Utilization Science	20,000	14,000	---	-14,000
Energy Analyses				
Environmental Activities	---	---	---	---
Technical and Economic Analysis	300	1,000	---	-1,000
Subtotal Energy Analyses	300	1,000	---	-1,000
University Training and Research				
University Coal Research	2,250	3,000	---	-3,000
HBCUs, Education, and Training	1,000	2,050	---	-2,050
Subtotal University Training and Research	3,250	5,050	---	-5,050
International Activities				
International Program Support	300	300	---	-300
Subtotal International Activities	300	300	---	-300
Total Crosscutting Research	58,350	56,350	---	-56,350
NETL Coal Research and Development				
Feasibility of Recovering Rare Earth Elements	15,000	18,000	---	-18,000
NETL Coal R&D	38,000	36,000	---	-36,000
Subtotal NETL Coal Research and Development	53,000	54,000	---	-54,000
Supercritical Transformational Electric Power Transformational Coal Pilots	24,000	22,430	---	-22,430
Transformational Coal Pilots	35,000	25,000	---	-25,000
Total CCS and Power Systems	481,117	486,230	---	-486,230
Advanced Coal Energy Systems & CCUS				
Advanced Energy Systems				
Advanced Systems				
Advanced Combustion/Gasification Systems	---	---	10,300	+10,300

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Advanced Turbines	---	---	17,000	+17,000
Solid Oxide Fuel Cells	---	---	3,000	+3,000
Advanced Sensors and Controls and other Novel Concepts	---	---	10,000	+10,000
Subtotal Advanced Systems	---	---	40,300	+40,300
Advanced Materials				
Advanced Coal Processing	---	---	10,000	+10,000
Power Generation Efficiency	---	---	145,000	+145,000
Advanced Energy Materials	---	---	25,000	+25,000
Subtotal Advanced Materials	---	---	180,000	+180,000
Total Advanced Energy Systems	---	---	220,300	+220,300
Crosscutting Research				
Water Management R&D	---	---	10,000	+10,000
Modeling, Simulation & Analysis	---	---	17,000	+17,000
Harsh Environment Material Initiative	---	---	500	+500
Advanced Energy Storage Initiative	---	---	4,500	+4,500
Critical Minerals				
Feasibility of Recovering REEs	---	---	15,000	+15,000
Critical Materials	---	---	7,500	+7,500
Subtotal Critical Minerals	---	---	22,500	+22,500
University Training and Research	---	---	5,825	+5,825
Total Crosscutting Research	---	---	+60,325	+60,325
Carbon Capture, Utilization and Storage				
Carbon Capture				
Post-Combustion Capture Systems	---	---	35,800	+35,800
Pre-Combustion Capture Systems	---	---	4,000	+4,000
Subtotal Carbon Capture	---	---	39,800	+39,800
Carbon Utilization				
Carbon Use and Reuse	---	---	6,000	+6,000
Subtotal Carbon Utilization	---	---	6,000	+6,000
Carbon Storage				

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Storage Infrastructure	---	---	5,000	+5,000
Advanced Storage R&D	---	---	15,000	+15,000
Subtotal Carbon Storage	---	---	20,000	+20,000
Emissions Control	---	---	3,000	+3,000
Total Carbon Capture, Utilization and Storage STEP (Supercritical CO2)	---	---	68,800	+68,800
NETL Coal Research and Development	---	---	38,000	+38,000
Total, Advanced Coal Energy Systems & CCUS	---	---	387,425	+387,425

SBIR/STTR:

- FY 2018 Transferred: SBIR \$12,167; STTR: \$1,711
- FY 2019 Enacted: SBIR \$10,318; STTR: \$1,451
- FY 2020 Request: SBIR \$8,086; STTR: \$1,137

**Advanced Coal Energy Systems and CCUS
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

Advanced Coal Energy Systems & CCUS

<p>Advanced Energy Systems: The proposed funding increase will support new competitive funding with industry to improve the reliability, efficiency, and performance of the existing coal fleet. It will also support new competitive funding to advance Phase II R&D in technologies that will underpin the coal plant of the future.</p>	<p>+62,617</p>
<p>Crosscutting Research: The proposed funding increase will support completion of Critical Minerals R&D activities that are focused on extracting critical minerals from coal and coal byproducts in an economically feasible manner.</p>	<p>+13,975</p>
<p>Carbon Capture, Utilization and Storage: The proposed funding decrease represents a re-prioritization of the R&D programs away from later stage R&D and will support early-stage R&D in carbon capture and carbon storage to reduce the cost of CO₂ capture by 30% by 2030. The proposed funding will also initiate a new activity in Emissions Control that will address non-CO₂ emissions from coal-fired power plants (e.g., trace metals emissions in solid, liquid and gaseous effluents) that are potential areas of concern.</p>	<p>-129,967</p>
<p>STEP (Supercritical CO₂): No funding is requested for the STEP 10MW pilot as it was fully funded with prior year funding through FY 2019.</p>	<p>-22,430</p>
<p>Transformational Coal Pilots: No funding is requested in FY 2020.</p>	<p>-25,000</p>
<p>NETL Coal R&D: Funding level will enable an increase to NETL's Federal researcher workforce of 10FTEs, or 6%, in the areas of Systems Engineering & Analysis, Structural Materials, and Geological & Environmental Systems. Additional expertise and bench strength in these areas is required to continue to meet mission objectives.</p>	<p>+2,000</p>
<p>Total, Advanced Coal Energy Systems & CCUS</p>	<p>-98,805</p>

Advanced Coal Energy Systems & CCUS Advanced Energy Systems

Description

Coal plays a critical role in powering the Nation's electricity demand, providing resilient baseload power. However, the U.S. coal fleet is aging, and less efficient coal plants are shutting down and retiring at unprecedented rates, a challenge exacerbated by the current economic pressures on the coal sector. Government-supported early-stage research and development in advanced energy systems can improve the efficiency and performance of these aging systems, increasing their competitiveness. R&D in areas such as advanced materials that can withstand extreme environments, next-generation plant power cycles, manufacturing techniques, and controls can lead to more efficient components and systems that industry can further develop or deploy. Such improvements to the efficiency and reliability of coal-fired power plants will also reduce their emissions and allow these assets to provide continued low-cost baseload power and resilient grid services.

The mission of the Advanced Energy Systems (AES) subprogram is to increase the availability, efficiency, and reliability of fossil energy power systems while maintaining environmental standards through early-stage R&D. The subprogram comprises seven activities: 1) Advanced Gasification Systems, 2) Advanced Turbines, 3) Solid Oxide Fuel Cells, 4) Advanced Sensors and Controls and Other Novel Concepts, 5) Advanced Coal Processing 6) Power Generation Efficiency, and 7) Advanced Energy Materials. While the primary focus is on coal-based power systems, improvements to these technologies are also applicable to other fossil energy systems. Two key goals of the AES subprogram are to improve the average modeled efficiency (heat rate) of a typical plant in the existing fleet by 5% by the end of FY 2022 (i.e., to 32.5% from the 2017 baseline of 31%), and of an advanced or new coal plant by 5% by the end of FY 2023 (i.e., to 40% from the 2017 baseline of 38%).

The proposed restructure of Advanced Energy Systems (AES) intends to streamline and improve the alignment of the budget structure to the research focus areas. A crosswalk of the proposed restructure is included in the Fossil Energy R&D Overview section.

Advanced Energy Systems – Explanation of Budget Structure Changes

- Gasification Systems will become a standalone subprogram. Advanced Combustion R&D is combined under the Power Generation Efficiency subprogram.
- Sensors and Controls and other Novel Concepts will move from Cross Cutting Research and be renamed Advanced Sensors and Controls and other Novel Concepts
- Coal Beneficiation will be renamed Advanced Coal Processing
- Transformative Power Generation will be renamed Power Generation Efficiency, and combines Advanced Combustion (All activities were previously in AES)
- Crosscutting Materials R&D and Advanced Ultra Supercritical Materials R&D will move from Cross Cutting Research and be combined into a single subprogram, Advanced Energy Materials

Gasification Systems

Coal gasification is a process that combines oxygen, steam, and coal in a gasifier to produce syngas, a mixture of hydrogen and carbon monoxide through a series of chemical reactions under high temperature and pressure. The syngas can be further converted to hydrogen and CO₂ over a catalyst in a water-gas shift reactor for efficient electricity generation. Syngas can also be used to produce ammonia, fertilizer, liquid fuels, or other high-value chemicals. Currently, all commercially established coal gasification-based power plants use Integrated Gasification Combined Cycle (IGCC) technology. Although IGCC is one of the cleanest and most efficient technologies to convert coal to electricity, the technology involves a complex set of systems tailored for utility-scale electricity generation from a large, centralized power plant. A consequence of tailoring the IGCC technology in this fashion is that technology adopters are required to invest

many years of design and construction activity as well as billions of dollars of capital costs. In response, gasification R&D is focused on modularization, which would result in technology solutions that can be implemented quickly and with lower total capital investment.

In FY 2020, the budget provides \$5 million for early-stage R&D with DOE National Laboratories to develop modular technologies that could overcome siting, operating, and logistical constraints that inhibit the deployment of large-scale plants. Moreover, modular gasification technologies could provide power to remote or rural areas. The budget also provides \$3 million to continue R&D on innovative design development for a high-performance, low-cost gasifier as well as \$2.3 million to advance design and fabrication of form refractories to provide better heat and temperature distribution inside a gasifier and lower capital costs.

Advanced Turbines

Coal based boilers provide heat for steam turbine based Rankine cycles. These power plants represent one of the largest sources of power in the U.S., about 30% of the U.S. generation mix in 2016. Historically, these plants have been based loaded and provided the lowest cost of electricity to the Nation. Today, the future of coal-fired electricity generation is challenged by aging, inefficient coal plants. To maintain the base load benefits and coal-fueled capital assets, in FY 2020, the budget provides \$15 million to competitively fund new awards with industry to develop advanced steam turbines as well as sCO₂ turbines. This early stage research is expected to render measurable outcomes that will meet the Advanced Turbine program and sCO₂ Power Cycle program goals. In addition to addressing technology advancements that improve turbine performance, research efforts will continue to advance technology for sCO₂ power cycles. The budget also provides \$2 million to advance early-stage pressure gain combustion R&D with the DOE National Laboratories. These activities will include research on key turbine system components that, with additional development by industry, could be capable of achieving a 4-5 percentage point efficiency increase relative to existing combined cycle turbines. In addition, due to the minimal time spent at peak combustion temperature, NO_x emissions may also be reduced. Projects selected through a competitive solicitation will support early stage R&D to enable development of a 1300°F, 3600psi steam turbine. R&D will focus on existing advanced manufacturing processes in a new application: to produce lower cost and higher performance parts to repair/retrofit steam turbines, with the goal of developing a modular scale high efficiency steam turbine for supercritical steam conditions applicable to modular coal boilers. This early stage R&D will lead to lower cost and higher performance options for steam cycles in coal boilers and thereby lower the cost of electricity and CO₂ emissions per MWh. A portion of the request will also be coordinated with the Offices of Nuclear Energy, and Energy Efficiency and Renewable Energy as part of the Harsh Environment Materials Initiative to leverage common investments—approximately \$60 million across the three Program Offices in FY 2020— and expertise in materials and component manufacturing R&D for advanced thermoelectric plants.

Solid Oxide Fuel Cells

This activity focuses on early-stage R&D to enable efficient, cost-effective solid oxide fuel cell (SOFC) electricity generation from coal or natural gas with near-zero atmospheric emissions of CO₂ and air pollutants; benefits of SOFCs also include minimal water use in both distributed generation and central power generation applications. In FY 2020, the budget provides \$3 million to advance R&D with the DOE National Laboratories that addresses the technical challenges to SOFC commercialization, such as cell power enhancement, advanced materials development for low temperature operation, materials characterization, and systems analysis. The request will also advance activities to combined modeling and operational data to understand and lower fuel cell system degradation.

Advanced Sensors and Controls and other Novel Concepts

This activity, formerly funded under Crosscutting Research, focuses on early-stage R&D on low-cost and reliable multi-sensing technologies capable of reading temperature, pressure and gas species that, with additional investment by industry, could be capable of providing real-time measurements critical to the operation, optimization, reliability and efficiency of the next-generation of power systems. Advanced Sensors and Controls and other Novel Concepts will enable industry to shift from the current time-based preventive maintenance schedules to one focused on condition-based maintenance with improved operability and overall plant economics. Advanced sensors can also be used to monitor and identify transients associated with a cyber-attack, providing increased reliability and grid stability. In FY 2020, the budget

provides \$8 million for a new competitive funding announcement on advanced controls, harsh environment sensors, and load following systems. Novel instrumentation that can withstand harsh environments has the ability to replace inferred process conditions with actual measurements which can facilitate faster/safer response times. In addition, the budget provides \$2 million to support DOE National Laboratory R&D to test lab-scale sensors in a relevant plant environment to enable technology transfer.

Advanced Energy Materials

The Advanced Energy Materials subprogram focuses on developing cost effective structural and functional materials for advanced fossil energy power production technologies, and to reduce the cost and time needed to develop and commercialize new materials for FE applications in extreme operating environments. High-Performance Material (HPC4Mat) development concentrates on advanced manufacturing methods and computational materials modeling as an enabling technology. These advancements are used to promote technologies that enhance plant optimization that reduce operations and maintenance costs of both existing coal-fired plants and new fossil energy infrastructure. Advanced manufacturing techniques explore processes that can effectively manufacture, develop, and distribute prototype technology.

Extreme environment materials (EEM) development focuses on creating cost effective structural and functional materials for advanced fossil energy power production technologies, and reducing the cost and time needed to develop and commercialize new materials for FE applications in extreme operating environments. EEM development also focuses on advanced manufacturing methods for high-performance materials and computational materials modeling as enabling technologies. A major barrier to the use of new EEMs is the high cost of the constitutive elements in the material. Moreover, EEM manufacturing costs increase as the complexity and performance capabilities of such materials increase. For example, the cost of structural alloys for FE power plants increases exponentially as the temperature limit of the alloys increases.

The FY 2020 request of \$25 million will provide funding for computational based methods for design and prediction of long term (300,000 hours) mechanical and corrosion behavior of structural and functional components in FE power plants; the production and testing of nickel superalloy components for AUSC steam Rankin cycles; and advanced manufacturing methods to reduce fabrication costs. \$20.5 million will be utilized for National Lab R&D in Advanced Joining Methods for High-Temperature Fossil Energy Power Cycle Components and R&D focused on low TRL innovative advanced manufacturing methods for lowering costs. The budget also provides \$4.5 million for the ComTEST facility, a component testing facility for advanced materials and parts to be used in boilers for advanced supercritical power plants. In addition, work will continue on High Performance Computing for Materials (HPC4Mat) that brings together the materials expertise and computational power of the National Laboratories to work with industry to solve critical materials problems. The Advanced Energy Materials budget request will also be coordinated with the Offices of Nuclear Energy, and Energy Efficiency and Renewable Energy as part of the Harsh Environment Materials Initiative to leverage common investments—approximately \$60 million across the three Program Offices in FY 2020— and expertise in materials and component manufacturing R&D for advanced thermoelectric plants.

Advanced Coal Processing

This activity combines basic chemistry and combustion science along with basic and fundamental research on thermo-physical properties, materials interactions, and heat transfer to improve how coal is processed and utilized in order to expand the market opportunities for coal. In FY 2020, the budget provides \$8 million to the DOE National Laboratories to develop novel lab or bench-scale processing and utilization technologies, and \$2 million for industry to continue R&D that uses gaseous or solid carbon materials as feedstock (raw material) to produce marketable products that show a positive life cycle analysis and demonstrate potential to generate a marketable product.

Power Generation Efficiency

Changes to the U.S. electricity industry are forcing a paradigm shift in how the nation's generating assets are operated. Coal-fired power plants optimized as baseload resources are being increasingly relied on as load-following resources to support

electricity generated from intermittent renewable capacity. These fundamental changes to the operating and economic environment in which coal plants function are expected to persist into the next decade and beyond. To meet these demands, the Nation's coal generation fleet must be able to provide flexibility, economic security, and be counted on to help address future energy challenges.

The Power Generation Efficiency activity is focused on early-stage R&D to: 1) increase the performance and competitiveness and reduce emissions of existing coal-fired power plants, and 2) advance the coal-fired power plants of the future, which industry can further develop and deploy. Specifically, this activity will continue to advance next-generation R&D that improves the operational flexibility, efficiency, and reliability of our existing coal fleet. In parallel, this activity prioritizes R&D to enable the coal plant of the future. This effort—the Coal FIRST (Flexible, Innovative, Resilient, Small, Transformative) initiative—will allow industry to develop the coal plant of the future needed to provide secure, stable, and reliable power. This R&D will underpin coal-fired power plants that are capable of *flexible* operations to meet the needs of the grid; use *innovative* and cutting-edge components that improve efficiency and reduce emissions; provide *resilient* power to Americans; are *small* compared to today's conventional utility-scale coal plants; and will *transform* how coal technologies are designed and manufactured.

In FY 2020, the budget provides \$70 million for new competitive funding opportunities that focus on phase II efforts of the coal plant of the future. This funding is specifically focused on R&D on critical component design, advanced design methods (e.g., parametric approaches), advanced combustion, and engineering design. This early-stage research will more effectively enable industry to design, commercialize, and deploy these coal plants of the future. The budget also provides \$30 million to fund a new competitive funding opportunity to improve performance of the existing fleet and will focus on improving plant efficiency through topping cycles, recovery of low grade waste heat, improvements in water usage, and lower parasitic losses. Further, the activity provides \$30.3 million to continue existing projects with industry and DOE National Laboratories that support both the existing and future coal fleet R&D initiatives in areas including technology and systems integration, advanced coal combustion, and chemical looping research; as well as \$14.7 million for a new competitive solicitation targeting academic institutions and DOE National Laboratories to focus on the application of artificial intelligence and machine learning to improve plant operations; technology testing; systems analysis; and technology transfer to industry.

**Advanced Coal Energy Systems & CCUS
Advanced Energy Systems**

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<i>Advanced Energy Systems: \$157,683,000</i>	<i>\$220,300,000</i>	<i>+\$62,617,000</i>
<i>Advanced Combustion/Gasification Systems: \$18,000,000</i>	<i>\$10,300,000</i>	<i>-\$7,700,000</i>
<ul style="list-style-type: none"> • FY 2019 enacted amount will focus on development of low cost oxygen carriers to improve performance and durability and component development for gasification deployment with low disruptive costs. • Continue the development of new materials and computational modeling that can be adapted by industry to design smaller, more reliable and efficient reactors. • Issue a new funding opportunity announcement and competitively select gasification and chemical looping projects focused on advancement of technologies for modularity. 	<ul style="list-style-type: none"> • Radically Engineered Modular Systems: Continue R&D on the innovative design development of high performance, low cost gasifier/reactor. • Advance modular technologies to help generate electricity in remote or rural areas. • Refractory design and fabrication of form refractories to provide better heat/temperature distribution inside a gasifier and lower capital cost. 	<ul style="list-style-type: none"> • The decrease in funding reflects the change in priorities to Power Generation Efficiency. In addition, all combustion funding has been moved from this subprogram.
Advanced Turbines \$20,000,000	\$17,000,000	-\$3,000,000

<ul style="list-style-type: none"> FY 2019 enacted amount will be used to advance component technologies for high pressure ratio and high temperature turbine technologies. Continues NETL in-house activities on pressure gain combustion. Issue a new funding opportunity announcement and competitively select R&D activities that would lead to performance improvements in steam based power cycles applicable to coal fueled boilers. 	<ul style="list-style-type: none"> FOA for development of advanced steam turbine. FOA for sCO₂ turbine R&D. Pressure Gain Combustion R&D. 	<ul style="list-style-type: none"> The decrease in funding reflects the change in priorities to Power Generation Efficiency.
Solid Oxide Fuel Cells \$30,000,000	\$3,000,000	-\$27,000,000
<ul style="list-style-type: none"> FY 2019 enacted amount will focus on R&D to enable efficient, cost-effective electricity generation with minimal use of water and the use of abundant domestic coal and natural gas resources with near-zero atmospheric emissions of CO₂ and pollutants. 	<ul style="list-style-type: none"> R&D to address the technical challenges to commercialization, such as, cell power enhancement, advanced materials development for low- temperature operation, materials characterization, and systems analysis. Combine modeling and operational data to understand and lower fuel cell system degradation. 	<ul style="list-style-type: none"> The decrease in funding reflects a focus on materials development with academia and/or National laboratories.
Advanced Sensors & Controls and other Novel Concepts \$8,000,000	\$10,000,000	+\$2,000,000
<ul style="list-style-type: none"> Continues early stage R&D (TRL 2-3) of novel sensor concepts beneficial to coal-based generating assets. Measurements of interest include high temperature pH, harsh environment temperature/pressure/strain, and in-situ gas composition. Advanced monitoring and diagnostics, including control optimization, to improve efficiency and reliability of plants. Issue a new funding opportunity announcement and competitively select sensor technology projects focused on additive manufacturing of embedded sensor technologies into components. 	<ul style="list-style-type: none"> Advanced controls development for condition-based monitoring. Development of harsh environment sensors for fossil power generation applications. Advanced controls R&D for increased flexibility of FE-based systems in response to load-following; leverages machine learning approaches. 	<ul style="list-style-type: none"> The increase in funding will support early-stage testing of advanced sensor technologies developed within relevant plant environments to improve reliability, availability and efficiency and to enable technology transfer.
Advanced Coal Processing \$13,000,000	\$10,000,000	-\$3,000,000

<ul style="list-style-type: none"> • Early-stage development of technologies that reduce the moisture content of high-moisture U.S. coals • Develop a national coal database, drawing on data and expertise at the DOE National Laboratories and academia to provide detailed technical information on the impact of coal properties and composition on the performance and emissions of power generation facilities 	<ul style="list-style-type: none"> • Coal to High Value Products. • Development of Novel Lab/Bench-Scale Coal Utilization Technologies. 	<ul style="list-style-type: none"> • Funding remains consistent with FY 2019.
Advanced Energy Materials \$20,000,000	\$25,000,000	+\$5,000,000
<ul style="list-style-type: none"> • Materials research to maximize steam pressures and temperatures for new power cycles. • Early-stage research on the incorporation of advanced power generation cycles that can be further developed and scaled up by industry to increase plant efficiency or lead to the repowering of existing coal power generation assets. • Continue the development of models to increase the temperature of ferric alloys by 50°C.v 	<ul style="list-style-type: none"> • ComTEST Advanced Ultra Supercritical (AUSC) and supply chain development. • Improve casting and heat treatment processes for nickel superalloys. • Advanced Joining Methods for High-Temperature Fossil Energy Power Cycle Components. • R&D focuses on low TRL innovative advanced manufacturing methods for lowering the cost of HX. • Next Generation Ultra-High Temperature Structural Materials. • Next Generation Fe-9Cr Alloys. 	<ul style="list-style-type: none"> • The increase over FY 2019 represents coordinated R&D with the Offices of Nuclear Energy and Energy Efficiency and Renewable Energy as part of the Harsh Environment Materials Initiative. • Funding of the HPC4Material projects with National Laboratories and Industry to address critical material issues. • Early-stage development of technologies that reduce the moisture content of highmoisture U.S. coals
Power Generation Efficiency \$48,683,000	\$145,000,000	+\$96,317,000
<ul style="list-style-type: none"> • Materials research to maximize steam pressures and temperatures for new power cycles. • Early-stage research on the incorporation of advanced power generation cycles that can be further developed and scaled up by industry to increase plant efficiency or lead to the repowering of existing coal power generation assets. • Continue the development of models to increase the temperature of ferric alloys by 50°C. 	<ul style="list-style-type: none"> • \$70 million for new competitive funding opportunities on Critical Components R&D, in support of the Coal FIRST initiative. • \$30 million fund a new competitive funding opportunity to improve performance of the existing fleet. • \$30.3 million to continue existing projects with industry and DOE National Laboratories that support 	<ul style="list-style-type: none"> • The increased request would fully fund Phase II of the Coal FIRST initiative; requisition long lead components and materials for advanced technologies to improve the reliability of existing and new modular fossil-based power generation; conduct additional early-stage critical component R&D, pre-FEED selections, and initiate FEED studies that will position industry to ultimately deploy these technologies.

	<p>both the existing and future coal fleet.</p> <ul style="list-style-type: none">• \$14.7 million for a new competitive Lab and University call focused on the application of artificial intelligence and machine learning to improve plant operations; technology testing; systems analysis; and technology transfer to industry.	
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Advanced Coal Energy Systems & CCUS Crosscutting Research

Description

Coal plays a critical role in powering the Nation's electricity generation, and is forecasted to do so for the foreseeable future.¹ However, aging coal generation assets face decreased performance due to the state of the equipment and transient operating conditions— a challenge exacerbated by the current economic pressures on the coal sector. To address the challenges of an aging coal fleet, opportunities exist to support early-stage technologies for further advancement by industry, to ultimately repower or retrofit existing facilities with new components that significantly improve plant performance and lower emissions.

The Crosscutting Research subprogram supports innovative early-stage R&D for improving reliability, availability, efficiency, and environmental performance of advanced fossil-based power systems. The subprogram bridges basic and applied research by targeting concepts with the greatest potential for transformational breakthroughs. Research is focused on four activities: 1) Critical Minerals; 2) Water Management R&D; 3) Modeling, Simulation and Analysis; and 4) University Training and Research, which comprises funding for University Coal Research, Historically Black Colleges and Universities and other Minority-Serving Institutions (MSI), and the University Turbine Systems Research.

Critical Minerals

The development of a domestic, economical competitive supply of rare earth elements (REE) and other critical minerals can help fuel our nation's economic growth; secure our energy independence by reducing our reliance on foreign REE sources; and increase our national security. R&D under this activity has so far generated over a thousand rock analyses from materials in 14 states. Achieving an economic pathway requires (1) finding the highest REE contents (assays) available in these materials, (2) characterizing these materials from the standpoint of economic REE extraction, and (3) development of plant designs to achieve the extraction. To achieve this, the program has five key focus areas:

1. Resource Sampling and Characterization – Characterize physical and chemical properties to identify the optimal coal and coal by-product resources for REEs
2. Separation Technology Development – Develop REE separation and extraction capabilities from coal-based resources that are economically feasible and environmentally friendly
3. REE Sensor Development – Create portable sensors to identify promising REE coal-based resources at field sites and determine the concentrations of REEs within flow streams during the separation process
4. Process and Systems Modeling – Develop models to use as virtual test platforms to optimize process separation designs
5. Techno-Economic Analysis – To evaluate the international REE market and assess the economics of commercial production of REEs.

This activity has been underway since 2014, and thousands of samples from twelve coal-producing states have been analyzed. Since the program's inception, between four to five thousand coal-based samples from around the country have been analyzed. Materials have been found in Appalachia with REE concentrations that exceed the ore grades of some REE projects that are under development worldwide. In addition to sampling and analysis activities, search activities to date have been assisted by new techniques for processing well log data developed by FE from the oil and gas industry. Results from this search have included finding materials associated with U.S. coal beds that exceed the ore grades of some REE mining projects under development worldwide. Laboratory characterization work of the samples has thus far indicated REE presence in the materials in the form of conventional minerals, such as monazite and xenotime. However, the work has also found the presence of materials from which REEs can be recovered using an ion-exchange solution, a technique that accounts for about 30% of Chinese REE production. Material of this type has been previously unknown to exist in the U.S., and thus offers an opportunity for REE production with less intensive processing steps required to produce REEs from conventional ores. As part of this program, these new technologies, developed by industry and academia, are being tested at small-scale facilities to determine their usefulness in producing REEs from coal-based resources.

¹ U.S. Energy Information Administration, *Annual Energy Outlook 2018 with projections to 2050*, p. 69, www.eia.gov/aeo

The FY 2020 budget of \$22.5 million will be used to advance current bench-scale projects to engineering scale, as well as validate the technical and economic feasibility of producing high purity (90-99% (900,000-990,000 ppm), salable rare earth oxides from 300 parts per million REE-containing coal-based feedstock materials, using conventional extraction, separation and recovery.

Water Management R&D

Water is a fixed resource with increasing competing demands and increased uncertainty in reliably meeting energy needs. The mission of the Water Management R&D activity is to advance sustainable and efficient water and energy use; develop cost-competitive technology solutions; and enhance understanding of the life cycle relationship between energy and water resources. Thermoelectric power generation accounts for² over 40% of freshwater withdrawals and over 4% of freshwater consumption in the United States, while 3% of electricity is used for water infrastructure (e.g., treatment, pumping). Energy is the largest cost for water utilities. Effective water use is important for a stable and secure energy supply. The Water Management R&D activity is focused on addressing these needs.

Proposed activities in FY 2020 include \$6 million for a new competitive funding announcement focused on early-stage development of technologies that increase power plant efficiency and decrease water consumption; field testing of promising technologies that reduce the energy requirements and operating costs of waste water treatment for power plants. The budget also provides \$4 million to DOE National Laboratories to conduct techno-economic assessments to guide water management and to field test wastewater treatment technologies for fossil energy power plants that improve our understanding of the complex water issues facing today's coal fleet as it relates to energy production.

Modeling, Simulation and Analysis

This activity comprises modeling, simulation and techno-economic analysis to optimize, and reduce the cost of areas such as water use, emissions, materials development, and power plant operations. This activity also supports program strategic planning by identifying major challenges, technologies, and advanced concepts that have the potential to improve the efficiency, cost, and/or environmental performance of fossil energy systems.

In FY 2020, the budget provides \$17 million to continue funding DOE National Laboratory R&D, including existing modeling and analysis projects funded under the Grid Modernization Initiative; and the NETL-led Institute for the Design of Advanced Energy Systems (IDAES) in collaboration with Sandia National Laboratories and Lawrence Berkeley National Laboratory, which develops process systems engineering tools and optimized approaches in the conceptual design and process intensification of innovative systems. The Multiphase Flow with Interphase exchanges (MFIx) element, led by NETL, will also support computational efforts to process operational data from plants using Advanced Pattern Recognition to try to identify advance indicators of component failures that operators could use to reduce unexpected forced outages in plants.

University Training and Research

The University Training and Research activity focuses on developing the next-generation of scientists and engineers to strengthen the fossil industry workforce. The FY 2020 budget will provide \$5.825 million for a new competitive funding announcement for U.S. academic institutions of higher learning to support fundamental research that cuts across FE's research focus areas. Such funding aims to sustain a national university program of research in energy and environmental science and engineering related to coal that focuses on innovative and fundamental investigations pertinent to advancing the goals of the Advanced Coal Energy Systems & CCUS program. This activity comprises three areas, which are competitively funded on an annual basis to encourage broad participation:

University Coal Research: This sub-activity provides funding to colleges and universities to support early-stage research consistent with the goals of the program to improve the performance of the existing fleet, develop technologies that will underpin the coal plant of the future, reduce the cost of carbon capture, and create new market opportunities for coal. This sub-activity provides a two-fold benefit: conducting directed energy research in a cost-effective environment, and expanding the research capabilities and education of the next generation of scientists and engineers.

² Water Energy Nexus Report:

<https://www.energy.gov/sites/prod/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf>

Historically Black Colleges and Universities (HBCU) and other Minority-Serving Institutions (MSI): This sub-activity targets education programs that conduct research related to improving efficiencies and reliabilities of advanced energy systems. This is an area consistent with the goals of the Crosscutting Research subprogram. Grants awarded under this program are intended to maintain and upgrade the educational, training and research capabilities of HBCUs/MSIs in the fields of science and technology, with project results being used to further DOE's commitment to fossil energy research.

University Turbine Systems Research (UTSR): This sub-activity provides the continued support to the turbines program to university to improve the efficiencies of gas, steam and sCO₂ turbines and components. Key research areas include improving the efficiency of steam turbines for both existing coal plants and conducting R&D and analysis in support of turbines for use in future plants; and reducing the risk of scale-up for use in commercial scale machines, including combustor components, rotating parts, and cooling systems.

Advanced Energy Storage Initiative (AESI)

AESI is a coordinated effort across DOE that will accelerate the development of energy storage R&D as a key to increasing energy security, reliability, resilience and system flexibility technologies. Leveraging the full suite of DOE technologies, the Advanced Energy Storage Initiative will focus DOE's efforts to take a broad, more holistic view of energy storage as a set of capabilities that enable temporal flexibility in the conversion of energy resources to useful energy services. Building on OE, EERE, FER&D, and NE activities, the initiative would develop a coordinated strategy for aligning DOE R&D and establish aggressive, yet achievable goals for cost competitive energy storage services. Crosscutting research and analysis in this area will include thermal, mechanical, and/or chemical storage that can be feasibly and economically integrated with existing and future fossil energy power systems.

Harsh Environment Materials Initiative

This new coordinated effort will leverage related R&D in materials, sensors, and component manufacturing R&D for advanced thermoelectric power plants between FE and the Office of Nuclear Energy (NE). Investments will also be aligned with EERE's Advanced Manufacturing Office R&D in materials and manufacturing process research, as well as flexible combined heat and power systems. The FY 2020 Budget request includes \$0.5 million to coordinate this \$60 million R&D activity across the three Program Offices. FE R&D's budget request for Advanced Energy Materials includes funding for this initiative.

Crosscutting Research

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<i>Crosscutting Research \$46,350,000</i>	<i>\$60,325,000</i>	<i>+\$13,975,000</i>
Critical Minerals \$18,000,000	\$22,500,000	+\$4,500,000
<ul style="list-style-type: none"> Develop technologies that can be economically deployed, enabling additional domestic supplies of Rare Earth Elements (REE). Reduce the environmental impact of coal and REE production through advances in REE production from coal and coal by-products. Deliver advanced technologies that can be developed and manufactured within the United States. Stand up a new Critical Materials initiative. Invest in National Labs and Academia to investigate early stage transformational concentration and separation technologies. 	<ul style="list-style-type: none"> R&D will advance current bench-scale projects to engineering scale, as well as validate the technical and economic feasibility of producing high purity (90-99% (900,000-990,000 ppm), salable rare earth oxides from 300 parts per million REE-containing coal-based feedstock materials, using conventional extraction, separation and recovery 	<ul style="list-style-type: none"> Additional Funds will support accelerated REE extraction and separation from feedstock resources including coal prep/refuse materials and clay-based resources for the generation of salable quantities of REE product generated.
Water Management R&D \$8,000,000	\$10,000,000	+\$2,000,000
<ul style="list-style-type: none"> R&D to improve water efficiency, heat utilization, and heat transfer of plant processes with the goal of reducing overall water usage of power plant. Explore novel treatment and monitoring techniques of plant effluents in order to assist with environmental regulations. Develop enhanced water recovery options for applications within plants, thereby reducing water demands and reducing quantity of plant waste streams. 	<ul style="list-style-type: none"> Field testing, in power plants, of promising technologies developed to reduce energy requirements and operating costs of power plant wastewater treatment. Development techno-economic assessments of promising technologies to guide technology development pathways. Increase efficiency of power plants to decrease water consumption (\$2M). National Lab. Techno-Economic Assessments to Guide Water Management R&D; Field Testing of Wastewater Treatment Technologies for Fossil Energy Power Plants. 	<ul style="list-style-type: none"> Funding for Water Management R&D remains consistent with FY 2019

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Modeling, Simulation and Analysis \$15,000,000 <ul style="list-style-type: none"> Continue maintenance of NETL's multiphase computational fluid dynamics (CFD) code, MFIX. Continue National Lab- and University-based support of IDAES consortium. Select and award grants for 1-2 research projects focused on developing concepts related to advanced power, restricted to only HBCU/MSI applicants. 	\$17,000,000 <ul style="list-style-type: none"> IDAES Consortium in Process Simulation. NETL-Led National Lab Consortium to accelerate design of new extreme environment materials. Multiphase Flow Science Modeling - MFIX Toolset Maintenance. NETL Techno-economic and System Analysis. 	+\$2,000,000 <ul style="list-style-type: none"> Accelerate code development for the identification of extreme environment materials. Increase efforts to analyze plant operational data to identify common patterns preceding unexpected plant outages. Provide techno-economic and systems studies to for efficiency improvements of new and existing plants.
Harsh Environment Materials Initiative \$0 <ul style="list-style-type: none"> No funding requested. 	\$500,000 <ul style="list-style-type: none"> This request will facilitate coordination across the DOE programs and include a joint workshop and roadmapping activities in support of this new initiative. 	+\$500,000 <ul style="list-style-type: none"> New Initiative
Advanced Energy Storage Initiative \$0 <ul style="list-style-type: none"> No funding requested. 	\$4,500,000 <ul style="list-style-type: none"> Crosscutting research and analysis in this area will include thermal, mechanical, and/or chemical storage that can be feasibly and economically integrated with existing and future fossil energy power systems. 	+\$4,500,000 <ul style="list-style-type: none"> New Initiative
University Training and Research \$5,050,000 <ul style="list-style-type: none"> Select and award grants for university-based research projects focused on developing concepts related to advanced power systems, open to all university-based applicants. 	\$5,825,000 <ul style="list-style-type: none"> Select and award grants for university based research projects focused on developing concepts related to advanced power systems, open to all university-based applicants. 	+\$775,000 <ul style="list-style-type: none"> The increase reflects an additional 3-4 awards to university-based applicants
International Activities \$300,000 <ul style="list-style-type: none"> Funding will support FE International commitments 	\$0 <ul style="list-style-type: none"> No funding is requested. 	-\$300,000 <ul style="list-style-type: none"> Activities transfer to the DOE Office of International Affairs.

Advanced Coal Energy Systems & CCUS Carbon Capture, Utilization & Storage

Description

For the foreseeable future, coal will continue to play a critical role in powering the Nation's electricity generation, especially for base-load power plants. Coal is the Nation's most abundant domestic energy resource, and is an important part of the domestic energy mix, providing about 30% of the Nation's electricity. Coal plants provide reliable, affordable electricity that powers homes, industry, businesses, and commerce. Over the years, with federal R&D investment, coal-fired power plants have made significant progress in reducing emissions of sulfur dioxide, nitrogen oxide, particulate matter, and mercury.

The Carbon Capture, Utilization and Storage subprogram pursues research and development for a new generation of clean, coal-fueled energy conversion systems capable of producing competitively priced electric power with a focus on improving efficiency, increasing plant availability, reducing cooling water requirements, and achieving ultra-low emissions. A key aspect of this research is to enable affordable capture including conversion techniques for the utilization of carbon dioxide (CO₂), as well as safe and secure storage of capture CO₂. As such, the program's investments will develop innovative and cost-effective CCUS and emissions control technologies that make progress towards the program goals of reducing the cost of capture by 30% by 2030, for both 1) an existing coal-fired power plant retrofitted with CO₂ capture, and 2) a new coal-fired power plant with CO₂ capture, such as those plants that could utilize technologies developed in the Advanced Energy Systems and Crosscutting R&D Programs.

Carbon Capture

Advancements in carbon capture technologies can put the United States within closer reach of cost-competitive, low CO₂ emission power generation. Carbon capture from fossil fuel-fired generation is a technology solution for mitigating CO₂ emissions, and for concentrating CO₂ for high-value applications such as enhanced oil recovery (EOR). Transformational carbon capture technologies have the potential to support the coal and natural gas sector while advancing U.S. leadership in low-emission generation technology innovation. Many of the same CO₂ capture technologies can be adapted by industry and applied to other industrial sources and natural gas fired power plants to address unique challenges such as differences in pollution control systems, oxygen content, and CO₂ concentrations, which will demand modifications to both the materials and systems configurations.

The Carbon Capture subprogram is focused on early-stage research and development on post-combustion and pre-combustion CO₂ capture, novel compression technologies for new and existing fossil fuel-fired power plants and CO₂ utilization technologies to convert CO₂ to valuable products and commodities. Significant improvements are required to reduce parasitic energy load, and lower capital costs that can support the market potential for large quantities of CO₂ for economic utilization in EOR operations and conversion to high-value products. Low cost CO₂ can strengthen U.S. energy security by enabling the production of up to 60 billion barrels of stranded oil that would otherwise be uneconomic with current recovery practices.¹ Next generation EOR technology could increase recoverable domestic oil to over 130 billion barrels if "next generation" EOR techniques and transformational low cost CO₂ are available.² There is not enough low cost CO₂ available from natural sources or natural gas processing facilities to facilitate this recovery to occur. Transformational, low cost CO₂ capture could be adopted by industry through R&D conducted in this subprogram and will enable this important domestic energy resource to be recovered by allowing economic recovery of CO₂ from power plants and other industrial sources.

The Carbon Capture activity has completed its efforts in 1st generation technology through successful demonstration projects. FY 2020 activities represent a purposeful shift away from later-stage R&D such as development and scale-up of 2nd generation capture technologies through small and large pilot projects, as incentives exist for industry to adapt, develop, and scale these technologies for cost-competitive deployment. Specifically, in FY 2020, the budget provides \$39.8 million to

¹ ARI. (2011). Improving Domestic Energy Security and Lowering CO₂ Emissions with "Next Generation" CO₂-Enhanced Oil Recovery (CO₂-EOR).

² Ibid

the Carbon Capture activity for early-stage pre- and post-combustion capture R&D on transformational gas separation technologies (at least 90% of the CO₂ at 95% purity) that can significantly reduce the cost of CO₂ capture. Transformational capture systems are a set of disruptive technologies that can significantly reduce the cost of capture, targeting a cost of electricity (COE) at least 30% less than state of the art (~\$30/tonne). These transformational technologies will be designed to adapt to the operational demands of advanced power systems and adjust to the increasing need for fossil fuel power plants to at times be load-following/demand responsive electricity generators. The activity will also investigate approaches to utilize CO₂ and optimize capture process.

Key R&D challenges for carbon capture include:

- Improving Thermodynamics – reducing energetic requirements through better regeneration energy, lower pressure drops, lower required temperatures, process optimization
- Improving Kinetics – improving equipment through faster, more selective chemical/physical separation pathways
- Reducing Capital Cost – reducing total required equipment and costs through advanced manufacturing, process intensification, integration and optimization
- Improving Scalability – providing economic viability all relevant process scales
- Improving Durability – rugged long-term performance with slow degradation rates
- Improving Flexibility – improving process dynamics by improving turn down and operation at variable capture rates

Post-Combustion Capture Systems

Post-combustion capture refers to removal of the CO₂ after the fuel is combusted. The Carbon Capture program budget includes \$35.8 million for R&D in Post-Combustion Capture Systems, for early-stage R&D on transformational CO₂ separation at both new and existing fossil fuel-fired power plants, and can achieve a 30% reduction in COE compared to a facility operating with current state of the art amine systems. Critical R&D milestones have been achieved since 2008 in laboratory through pilot-scale testing of 2nd generation CO₂ capture approaches through multiple small-scale (0.5-1 MWe) slipstream tests; it is expected that industry will continue the development, adoption, and commercialization of these technologies.

Activities in FY 2020 will continue to focus on the early-stage R&D on novel CO₂ separation technologies such as non-aqueous solvents, membranes, advanced sorbents, and cryogenic processes. This will be achieved through the use of advanced computational tools for rational material discovery, design of advanced capture systems components, and synthesis of these materials with characterization of their physical properties. Funding will support the National Carbon Capture Center and the scale up of Discovery of Carbon Capture Substances and Systems (DOCCSS) technologies to test on actual flue gas. DOCCSS will improve data collection/generation methods to target the most impactful materials performance characteristics, and rigorous materials/devices/systems optimization in a holistic collaboration designed to accelerate commercialization. The budget will also support small scale and/or bench scale testing and Pre-FEED studies.

Pre-Combustion Capture Systems

Pre-combustion capture refers to removal of the CO₂ from the syngas prior to its combustion for power production.³ DOE's pre-combustion carbon capture program is focused on pursuing transformational capture goals which require capture of at least 90% of the CO₂, at 95% purity at a cost of approximately \$30 tonne/CO₂ captured. The Carbon Capture program budget includes \$4 million for Pre-Combustion Capture Systems R&D, to develop transformational technologies for pre-combustion capture that achieve a 30% reduction in the COE relative to state of the art capture technologies. Technologies for pre-combustion capture complement research that is ongoing in creating new fundamental knowledge of advanced gasification systems, and could be applied to other industrial processes in the chemical industry. Lowering the cost of CO₂ separation from pre-combustion systems is a critical step toward enabling industry to develop and commercialize technologies that open markets for the use of this captured CO₂ for EOR and conversion to higher value products or enabling long term storage. FY 2020 funds will continue to support discovery of new gas separation materials and

³ Syngas is primarily hydrogen (H₂) and carbon monoxide (CO) but can include other gaseous constituents. After the syngas is produced, it is further processed in a Water Gas Shift (WGS) reactor to prepare it for pre-combustion capture. WGS converts CO and water to additional H₂ and CO₂.

laboratory- and bench-scale tests of transformational technologies such as advanced solvents, sorbents, and membranes, including process intensification efforts that combine two or more technology concepts.

Carbon Utilization

Carbon utilization R&D focuses on pathways and novel approaches for developing beneficial uses of CO₂ in areas where geologic storage may not be an optimal solution. Carbon utilization is the conversion of carbon-containing feedstocks to some other high-value product, or the direct utilization of these materials for some economic benefit. CO₂ is one such feedstock that can be converted into other products or used directly. The Carbon Utilization activity focuses on using captured/concentrated CO₂ and/or carbon-containing substances, or directly using CO₂ from flue gas or mixed gas streams, and converting it into valuable products. Some methods are already commercially available while others are in the very early stages of R&D.

Critical challenges identified in the utilization focus area include the cost-effective use of CO₂ and other carbon-containing substances as a feedstock for chemical synthesis, or its integration into pre-existing products while ensuring that additional CO₂ is not being produced beyond what is already being removed or going into the atmosphere. The efficiency of reaction conversion, amount of CO₂ stored in a product and energy use of these utilization processes also represent a critical challenge that FE is uniquely positioned to address.

In FY 2020, the budget provides \$6 million to this activity for early-stage CO₂ utilization technologies that have the potential to develop additional markets for fossil energy resources. Areas of research include, but are not limited to, new projects focused on the catalytic conversion to chemicals and polymers, mineralization to building products, and biological processes optimized for the conversion of coal based carbon (CO₂ and methane) to higher value products such as nutraceuticals, bio plastics, and animal feed. Specific focus on catalysts made from low-cost materials, using nano-manufacturing and rational design, will be pursued to lower the energy penalty and capital cost of the conversion process. Funding will support Laboratory and bench scale component technologies, and the development of one early-stage, fully integrated technology to convert fossil derived carbon (CO₂, CH₄, and other product and waste streams) into valuable products such as chemicals, fuels, and building products.

Carbon Storage

The Carbon Storage subprogram is focused on development of technologies for the safe and permanent geologic storage of captured CO₂. Federal government sponsored research and development in this area is critical to validating and increasing confidence in the safety, economic feasibility, and permanence of CO₂ injection and storage. This area of research is in the national interest as it has long-term economic and environmental benefits for the U.S. and industry. Further advancements in this area will help ensure that industry has verifiable information to economically and safely assess and monitor long-term storage of CO₂, ensuring the viability of geologic carbon storage as an effective technology solution that can be implemented on a large-scale.

Captured CO₂ can be stored in deep saline formations and/or injected for EOR operations. For example, over 60 billion barrels of known U.S. oil reserves exist that could be produced with EOR if large quantities of low cost CO₂ were available. The production of additional tens of billions of barrels could be enabled by advancements in CO₂ storage technologies that optimize pore space utilization and could optimize retention of the CO₂ in the subsurface.⁴

The budget provides \$20 million for early-stage R&D in five primary storage types: saline formations, oil and natural gas reservoirs, unmineable coal seams, basalts, and organic shales—and in geologic reservoirs across eleven different geologic storage depositional classes. Coupled simulation tools, characterization methods, and monitoring technologies developed and validated through the Carbon Storage activity will improve storage efficiency, reduce overall cost, decrease subsurface uncertainties, and identify ways to ensure that operations are safe, economically viable, and environmentally benign.

⁴ ARI. (2011). Improving Domestic Energy Security and Lowering CO₂ Emissions with “Next Generation” CO₂-Enhanced Oil Recovery (CO₂-EOR).

Storage Infrastructure

The Storage Infrastructure sub-activity is focused on early-stage R&D to identify on and offshore geologic storage resources across various depositional environments; evaluate mitigation strategies associated with future injection projects that have existing wellbores, faults, and fractures; and assess features that affect the probability and mitigation of local and regional seismic events from changes in the state of stress during injection.

The Carbon Storage budget includes \$5 million for Storage Infrastructure R&D that leverage existing field R&D. Specifically, FE has funded field projects to conduct regional and site-specific characterization and validation; simulation and risk assessment; and applied monitoring, verification, accounting, and assessment technologies (MVAA) to various onshore and offshore storage reservoirs, including both EOR and saline. These projects have been successful in improving our understanding of CO₂ injection, fluid flow and pressure migration, and geochemical impacts from CO₂ injection. They have also aided development of cost-effective monitoring technologies in all storage types. FY 2020 funding will support high priority early stage R&D activities for existing projects and infrastructure network studies and analyses for source and storage matching.

Advanced Storage R&D

The Advanced Storage R&D sub-activity is focused on developing and validating storage monitoring, simulation and risk assessment technologies, and advanced wellbore technologies to detect and mitigate wellbore issues from both short and long term exposure of CO₂. These advanced technologies have the potential to safely, permanently, and cost effectively manage the injection and associated storage of CO₂ in geologic reservoirs in both onshore and offshore project settings.

The Carbon Storage budget includes \$15 million for Advanced Storage R&D in FY 2020. Early-stage research will focus on adaptive reservoir management with emphasis on reducing the risks of carbon storage in the subsurface. Specifically, FY 2020 funds will support activities for the National Risk Assessment Partnership (NRAP) to improve risk management and reduce uncertainty and development of the Energy Data Exchange (EDX) system to maintain project data curation and platform maintenance and upgrades. Technical tasks being addressed include the validation of risk assessment tools and methodologies using synthetic and field data and the assessment of environmental risks at storage sites. Efforts will include developing tools and methods for improved monitoring, detection, mapping and simulation of fractures and faults, as well as microseismic data analysis and interpretation, to increasing our ability to monitor and manage the stress state of the subsurface at field and basin-scales. These work elements may include uncertainty quantification to aid in the development of risk management strategies.

Emissions Control

In FY 2020, the subprogram proposes creating an Emissions Control activity focused on reducing the costs and emissions of non-CO₂ pollutants associated with the use and conversion of coal. This effort would conduct systems analyses and technical assessments to identify and address non-CO₂ emissions from coal-fired power plants (i.e., trace metals emissions in solid, liquid and gaseous effluents that are potential areas of concern).

**Advanced Coal Energy Systems & CCUS
Carbon Capture, Utilization & Storage
Explanation of Changes**

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Carbon Capture, Utilization & Storage: \$198,767,000	\$68,800,000	-\$129,967,000
Carbon Capture: \$100,671,000	\$39,800,000	-\$60,871,000
Post-Combustion Capture Systems: \$94,671,000	\$35,800,000	-\$58,871,000
<ul style="list-style-type: none"> Funding will provide additional support for the four laboratories awarded for the DOCCSS initiative and focused on the use of computational chemistry and rational design of novel CO₂ separation materials, rapid synthesis and testing, and advanced manufacturing to accelerate the discovery of transformational capture materials and systems. A new FOA will be issued to select projects that represent a partnership between industry and academia to develop these transformational CO₂ capture processes. 	<ul style="list-style-type: none"> Discovery of Carbon Capture Substances and Systems (DOCCSS) supports three centers and scale-up of one DOCCSS technology to test on actual flue gas. Supports up to four Small Scale and/or Bench Scale Carbon Capture Testing on Actual Flue Gases. National Carbon Capture Center (NCCC): Fund and operate the NCCC post combustion carbon capture test facility. Initiate Phase One of one additional DOCCSS project. 	<ul style="list-style-type: none"> The decrease in funding reflects a reprioritized focus on early-stage research throughout the coal R&D portfolio.
Pre-Combustion Capture Systems: \$6,000,000	\$4,000,000	-\$2,000,000
<ul style="list-style-type: none"> Issue a FOA to select a limited number of projects focused on the discovery of new pre-combustion capture processes. 	<ul style="list-style-type: none"> Lab/bench-scale Transformational Carbon Capture. 	<ul style="list-style-type: none"> The decrease in funding reflects the program shift towards emphasizing post-combustion R&D technologies.
Carbon Utilization: \$12,000,000	\$6,000,000	-\$6,000,000
<ul style="list-style-type: none"> Early-stage research projects focused on catalysis of carbon wastes from coal will focus on catalytic materials made from low cost materials and nano-manufacturing to reduce capital and energy costs for conversion to useful products. 	<ul style="list-style-type: none"> Laboratory and bench-scale technologies to convert fossil-derived carbon (CO₂, CH₄, and other product and waste streams) in valuable products such as chemicals, fuels, and building products. Support and development of one early-stage integrated technology. 	<ul style="list-style-type: none"> The decrease in funding reflects a reprioritized focus on the development of alternative market opportunities for coal and coal-byproducts.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Carbon Storage \$86,096,000	\$20,000,000	-\$66,096,000
Storage Infrastructure \$57,500,000	\$5,000,000	-\$52,500,000
<ul style="list-style-type: none"> Support Phase III of the CarbonSAFE initiative and the next phase of the Regional Carbon Sequestration Partnerships (RCSPs). 	<ul style="list-style-type: none"> Perform infrastructure network studies and analyses for CO₂ source and EOR/storage matching, and early stage R&D for high priority activities. 	<ul style="list-style-type: none"> The decrease in funding reflects priority on infrastructure studies and analyses and support for only those existing projects determined to be high priority.
Advanced Storage R&D \$28,596,000	\$15,000,000	-\$13,596,000
<ul style="list-style-type: none"> Funding will support existing or new early-stage research focused on adaptive reservoir management to include wellbore integrity, simulations and reservoir performance and storage efficiency for associated storage in hydrocarbon bearing and saline field projects, plume behavior, pressure front, stresses, geomechanical deformation, mechanical and flow properties for reservoirs, seals, and fracture networks on various reservoirs, and tools for improved subsurface characterization including improved mapping of fractures and faults. NRAP Research will focus on storage assessment and model validation for long-term and system-wide modeling including uncertainty quantification; integration of monitoring within risk assessment models; development of capabilities to test risk assessment and monitoring capabilities; studies on conformance; and evaluation of mitigation options will be supported. 	<ul style="list-style-type: none"> Continue support on R&D activities on reservoir performance, advanced MVA, geomechanics, wellbore integrity, and risk assessment identified as high priority. Continue support for National Risk Assessment Partnership (NRAP). Machine learning R&D to advance forecasting capabilities and improve real-time operational performance. Supports development and deployment of the Energy Data Exchange (EDX). 	<ul style="list-style-type: none"> The decrease in funding reflects the prioritized efforts needed to maintain essential early-stage R&D activities.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<ul style="list-style-type: none"> Expansion of EDX from a NETL-centric resource to an Office of Fossil Energy-wide intramural and extramural resource in support of subsurface science R&D will be supported. 		
Emissions Control: \$0	\$3,000,000	+\$3,000,000
	<ul style="list-style-type: none"> Conduct systems analyses and technical assessments to identify and address non-CO₂ emissions from coal-fired power plants (i.e., trace metals emissions in solid, liquid and gaseous effluents that are potential areas of concern). 	<ul style="list-style-type: none"> New Initiative

**Advanced Coal Energy Systems & CCUS
Supercritical Transformational Electric Power (STEP)**

Description

The STEP activity line was created within Advanced Coal Energy Systems (formerly CCS and Power Systems) by FY 2015 Enacted appropriations.

The STEP program is focused on R&D to advance higher efficiency and lower cost technologies that advance use of Supercritical CO₂ (sCO₂) power cycles, enabling greater operational efficiency. In FY 2020, the program will continue to work toward design, construction, start-up, shakedown, and operation of the test facility and testing to establish operability and performance of selected sCO₂ cycles. This effort includes the design, development, and fabrication of all components in the cycle (i.e., turbomachinery, recuperators, heat source integration, etc.). During operation, the test facility will demonstrate operability of a sCO₂ Recompression Brayton Cycle.

No funding is requested for the STEP 10MW pilot as prior year balances have fully funded this project.

**Supercritical Transformational Electric Power (STEP)
Activities and Explanation of Changes**

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Supercritical Transformational Electric Power (STEP) \$22,430,000	\$0	-\$22,430,000
<ul style="list-style-type: none"> Announce FOAs to support advances in the next generation of lower cost, higher performance recuperators as well as the next generation turbine components such as seals, bearings, and rotors needed to improve efficiency, reduce cost, and increase durability of power systems that use supercritical CO₂ as a working fluid. 	<ul style="list-style-type: none"> No funding is requested in the FY 2020 budget. 	<ul style="list-style-type: none"> Per the original scope of work, FY 2019 funding would fully fund design and construction of the facility.

Advanced Coal Energy Systems & CCUS Transformational Coal Pilots

Overview

The Consolidated Appropriations Act of 2017 provided \$50 million “to remain available until expended, shall be for the transformational coal technologies pilot program described in the explanatory statement described in section 4 (in the matter preceding division A of this consolidated Act).” (H.R. 244) The funding is to support a new solicitation for two large-scale pilots that focus on transformational coal technologies that represent a new way to convert energy to enable a step change in performance, efficiency, and the cost of electricity compared to today’s technologies. Such technologies include thermodynamic improvements in energy conversion and heat transfer, such as pressurized oxygen combustion and chemical looping, and improvements in carbon capture systems technology. In making the awards for large-scale pilots, the Department should prioritize entities that have previously received funding for these technologies at the lab and bench scale.

In accordance with this legislation, the solicitation was announced by the Department in August of 2017, with successful Phase I applications announced in FY 2018. FY 2019 funds will be carried over into FY 2020. Approximately \$15M will be obligated in August 2019 for five Phase II (design) awards. The balance will be obligated in FY 2019 and FY 2020 for at least one Phase III (construction/operation) awards.

Description

No funding is requested in FY 2020. Prior year funding will be used to award up to 4 full front end engineering and design (FEED) studies that will proceed into a down-select to 2 large pilots.

**Advanced Coal Energy Systems & CCUS
Transformational Coal Pilots**

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
<p>Transformational Coal Pilots \$25,000,000</p> <ul style="list-style-type: none"> Per the FY 2019 Appropriation “The agreement includes \$25,000,000 to continue to support the solicitation for two large scale pilots that focus on transformational coal technologies that represent a new way to convert energy to enable a step change in performance, efficiency, and the cost of electricity compared to today’s technologies. Such technologies include thermodynamic improvements in energy conversion and heat transfer, such as pressurized oxygen combustion and chemical looping, and improvements in carbon capture systems technology. In making the awards for large-scale pilots, the Department should prioritize entities that have previously received funding for these technologies at the lab and bench scale”. 	<p>\$0</p> <ul style="list-style-type: none"> No funding is requested. 	<p>-\$25,000,000</p> <ul style="list-style-type: none"> Prior year funding will be used to award up to 4 full front end engineering and design (FEED) studies that will proceed into a down-select to 2 large pilots.

**Advanced Coal Energy Systems & CCUS
NETL Coal Research and Development**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$38,000	\$36,000	\$38,000	+2,000

Overview

The National Energy Technology Laboratory (NETL) is an integral part of the U.S. Department of Energy (DOE) national laboratory system. There are 17 laboratories in the DOE laboratory system; NETL is unique in that it is the only government owned, government operated laboratory. NETL supports the DOE mission to advance the energy security of the United States, as well as Administration interests in domestic energy production, clean coal technologies, and reviving America’s coal industry.

NETL Coal Research and Development funds all NETL in-house research efforts. Specifically, NETL Coal Research and Development funding supports Federal researcher salaries and benefits, travel, personal protective equipment and other employee costs for the NETL staff of scientists and engineers who conduct in-house research activities for Fossil Energy Research and Development (FER&D) programs. Funding also supports NETL’s Research & Innovation Center strategic efforts such as the Fossil Energy Roadmap and NETL Science & Technology competency assessments. This program supports research capabilities in the areas of computational engineering, material engineering and manufacturing, and geological and environmental systems. NETL in-house research supports program-specific activities in the areas of carbon capture, carbon storage, advanced energy systems, and crosscutting research. This program also funds costs related to collaboration with universities, other national labs, state and local governments, and industry, as well as strategic energy analysis and research data management.

Highlights of the FY 2020 Budget Request

The NETL Coal Research & Development request of \$38.0M is \$2.0M higher than the FY 2019 Enacted level. The FY 2020 request increase will enable an increase to NETL’s Federal researcher workforce of 10 FTEs, or 6%, in the areas of Systems Engineering & Analysis, Structural Materials, and Geological & Environmental Systems. Additional expertise and bench strength in these areas is required to continue to meet mission objectives.

**Advanced Coal Energy Systems & CCUS
NETL Coal Research and Development**

Funding (\$K)	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
NETL Coal Research and Development				
NETL Coal Research and Development	38,000	36,000	38,000	+2,000
Federal FTEs	165	165	175	+10

Explanation of Major Changes (\$K)

NETL Coal Research & Development: A requested increase of \$2,000,000 from the FY 2019 Enacted funding level will enable an increase to NETL's Federal researcher workforce of 10FTEs, or 6%, in the areas of Systems Engineering & Analysis, Structural Materials, and Geological & Environmental Systems. Additional expertise and bench strength in these areas is required to continue to meet mission objectives.

FY 2020 Request vs FY 2019 Enacted

+2,000

Total, NETL Coal Research & Development	+2,000
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**Advanced Coal Energy Systems & CCUS
NETL Coal Research and Development**

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
NETL Coal Research and Development \$36,000,000	\$38,000,000	+\$2,000,000
<ul style="list-style-type: none"> Research and Development funding supports salaries and benefits, travel, personal protective equipment and other employee costs for the NETL staff of scientists and engineers who conduct in-house research activities for Fossil Energy Research and Development (FER&D) programs. Funding also is included for research-specific equipment maintenance agreements and software licenses and mission-critical laboratory equipment refresh. Funding also provides for costs targeted toward collaboration, strategic energy analysis and research data management areas. 	<ul style="list-style-type: none"> Research and Development funding supports salaries and benefits, travel, personal protective equipment and other employee costs for the NETL staff of scientists and engineers who conduct in-house research activities for Fossil Energy Research and Development (FER&D) programs. Funding also supports NETL’s Research & Innovation Center strategic efforts such as the Fossil Energy Roadmap and NETL Science & Technology competency assessments. Funding also provides for costs targeted toward collaboration, strategic energy analysis and research data management areas. 	<ul style="list-style-type: none"> The requested increase will enable an increase to NETL’s Federal researcher workforce of 10FTEs, or 6%, in the areas of Systems Engineering & Analysis, Structural Materials, and Geological & Environmental Systems. Additional expertise and bench strength in these areas is required to continue to meet mission objectives.

**Natural Gas Technologies
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$50,000	\$51,000	\$10,730	-\$40,270

Overview

Natural gas sourced from shales has significantly increased America’s security of energy supply and lowered prices for consumers. Along with oil and natural gas liquids, natural gas from shales is the foundation of America’s newly emergent global energy dominance. Although shale gas has been produced in the United States for many decades, domestic reserves were relatively modest. As recently as 2006, the Energy Information Administration was projecting significant imports of natural gas to meet domestic demand. It has only been over the last decade that new horizontal drilling and hydraulic fracturing technologies have facilitated increased economic production. It is important to note that the “shale revolution” had its early start in technology R&D and field tests conducted by the DOE, leading to subsequent adoption and advancement by industry.

The Natural Gas Technologies Program addresses critical and emergent issues pertaining to the safe and sustainable production and transmission of domestic natural gas. Specifically, the Program’s mission is to conduct early-stage R&D that supports the prudent development, distribution and storage of natural gas resources. The Program comprises two subprograms: Natural Gas Infrastructure Research and Development and Gas Hydrates. Given the importance of natural gas in our energy system, it is critical to ensure the safety and reliability of related infrastructure to protect energy access. To that end, the new Natural Gas Infrastructure Research and Development subprogram will support early-stage R&D focused on innovative sensors and materials that enable industry to detect and reduce waste and improve the reliability and operational efficiency of natural gas transmission, distribution, and storage facilities. Specifically, the subprogram will conduct research in electrochemical point sensors for quantification of corrosion rates and environmental monitoring (e.g. pH), as well as distributed optical sensors for measuring temperature, pressure, natural gas composition, vibration and strain.

While shale gas has been discovered in sufficient quantities to now support and warrant U.S. liquefied natural gas (LNG) exports, the most plentiful supplies of natural gas throughout the world may, in fact, be the methane molecules trapped in ice-like structures called hydrates. The Gas Hydrates subprogram supports unique early-stage research to evaluate the occurrence, nature, and behavior of the potentially enormous naturally-occurring gas hydrate resources within the United States, with particular focus on the Arctic and Gulf of Mexico regions.

Highlights of the FY 2020 Budget Request

The Natural Gas Technologies Program will pursue the following major activities in FY 2020:

- Evaluate the occurrence, nature, and behavior of naturally occurring gas hydrates. The subprogram will assess the fundamental physio-chemical properties of hydrate bearing sediments for this potentially vast resource. In FY 2020, the subprogram intends to translate potential hydrate resources into latent energy assets via numerical simulations and pore scale visualization of hydrate bearing sediments. The subprogram will conduct a long-term flow test on the North Slope of Alaska that will include drilling production and monitoring wells. Additionally, the subprogram will conduct field investigations in the Gulf of Mexico to confirm the nature and regional context of gas hydrate deposits.
- Proposes a Natural Gas Infrastructure Research and Development (R&D) subprogram to support energy security and economic growth. The subprogram will focus efforts on early-stage research that will provide knowledge that industry can use to improve U.S. natural gas infrastructure. The FY 2020 request will fund technologies in targeted areas such as advanced materials and sensor research and development. When these technologies are further developed and deployed by industry they will improve the operational efficiency of natural gas transmission, distribution, and storage facilities. The FY 2020 request will seek to develop advanced modular technologies capable of being deployed near

wellheads and natural gas processing and transportation infrastructure for the purpose of beneficially utilizing otherwise flared, vented, or stranded natural gas.

- Proposes closeout and termination of the Environmentally Prudent Development subprogram.
- Proposes closeout and termination of the Emissions Mitigation and Quantification subprogram.

**Natural Gas Technologies
Funding (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Natural Gas Technologies

Gas Hydrates	20,000	20,000	8,730	-11,270
Emissions Mitigation from Midstream Infrastructure	10,000	10,000	---	-10,000
Emissions Quantification from Natural Gas Infrastructure	5,000	5,000	---	-5,000
Environmentally Prudent Development	15,000	16,000	---	-16,000
Natural Gas Infrastructure Research	---	---	2,000	+2,000
Total, Natural Gas Technologies	50,000	51,000	10,730	-40,270

SBIR/STTR:

- FY 2018 Transferred: SBIR \$1,505: STTR: \$212
- FY 2019 Enacted: SBIR \$1,327: STTR: \$187
- FY 2020 Request: SBIR \$291: STTR: \$41

**Natural Gas Technologies
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

Natural Gas Technologies

Gas Hydrates: The decrease in funding is due to the completion of drilling the stratigraphic well in Alaska and requested funding is for the Alaska field flow testing and development activities .	-11,270
Emissions Mitigation from Midstream Infrastructure: No funding is requested for the Emissions Mitigation from Midstream Infrastructure subprogram in FY 2020.	-10,000
Emissions Quantification from Natural Gas Infrastructure: No funding is requested for the Emissions Quantification from Natural Gas Infrastructure subprogram in FY 2020.	-5,000
Environmentally Prudent Development: No funding is requested for the Environmentally Prudent Development subprogram in FY 2020.	-16,000
Natural Gas Infrastructure Research: New program, funding reflects research on advanced materials and sensors for midstream infrastructure and conversion technologies for stranded and vented gas.	+2,000
Total, Natural Gas Technologies	-40,270

Natural Gas Technologies

Description

Gas Hydrates

The Gas Hydrates subprogram will continue to evaluate the occurrence, nature, and behavior of naturally occurring gas hydrates. In order to take advantage of the immense, future potential energy supply from hydrates, the subprogram is leading efforts to characterize hydrate resources through early-stage research in several ways: numerical simulations, fundamental property characterization, and pore-scale visualization of hydrate-bearing sediments. This unique R&D will provide the foundation for industry investment in development and transformation of these resources to energy assets. Industry funding for research on developing gas hydrate energy resources and understanding associated environmental issues, even in collaboration with the federal government, remains limited due to the current abundant supply of economically recoverable natural gas resources, increasing industry concern about operational liabilities associated with deep-water scientific drilling using industry ships, and constraints within industry that prevent dedicating technical staff and other resources to long-range projects over near-term corporate profitability.

Subprogram activities funded in FY 2020 through competitively selected DOE National Lab R&D and existing projects will focus on characterization of laboratory-synthesized hydrate bearing sediments, which will provide critical input parameters for reservoir simulation of gas production. Numerical simulation efforts are designed to isolate and understand fundamental aspects of gas hydrate system behavior. This work will provide new insight into interactions between hydrate structure and matrix, and surrounding fluids and material. The subprogram intends to develop a comprehensive dataset for hydrate characterization and enhance understanding of hydrate behavior in natural settings. In FY 2020, the subprogram will also continue analyzing the results from field investigation work conducted during FY 2017 through existing projects under the FY 2016 funding opportunity announcement in the Gulf of Mexico to confirm the nature and regional context of gas hydrate deposits, and the physical properties and characteristics of gas hydrate-bearing sediments. This work will build on preliminary results gained from previously acquired seismic analysis, by analyzing and interpreting pressurized and unpressurized core samples and performing pressure perturbation experiments in the laboratory. The subprogram will conduct extensive field work in FY 2020 in both the Gulf of Mexico and Alaska. In the Gulf of Mexico, the subprogram will conduct a field expedition that will include drilling scientific wells and extracting pressurized hydrate cores that will allow a more complete characterization of Gulf of Mexico hydrate resources. In Alaska, the subprogram will conduct field work on the North Slope that will include drilling both production and monitoring wells to allow for a long-term flow test that will assess the potential viability of hydrate reservoirs for commercial production.

Natural Gas Infrastructure Research

The new Natural Gas Infrastructure Research subprogram is committed to generating new knowledge that industry can use to develop advanced, cost-effective technologies to improve operational reliability and reduce loss from natural gas transmission, distribution, and storage facilities. Priority areas for the subprogram include early-stage research in advanced materials for pipeline integrity and initiation of research on new passive sensor platforms. Development of magnetoelastic materials will allow for novel applications that are not feasible using other adaptive materials, while R&D in electrochemical materials will lead to the ability to quantify corrosion rates.

The subprogram will accelerate advances in materials science that, with additional scale up by industry, can enhance pipe integrity, reduce leaks, and improve the efficiency of midstream infrastructure operations. FER&D will specifically focus on early development of novel materials that can be utilized in liners and coatings. The subprogram will also support early-stage research through competitively selected DOE National Lab R&D on novel sensor technologies that can provide predictive analytics on pipeline corrosion rates via detection and monitoring

of temperature, pressure, natural gas composition, vibration and strain. The proposed research entails topics and categories not addressed through efforts in other agencies, such as the Pipeline and Hazardous Materials Safety Administration, and that industry will not fund because the Federal and State gas pipeline operators and local utility distribution systems, which achieve a return on their investment through rate cases, are currently prohibited from including an R&D fee in customer rates and billing. Additionally, there is continuing reluctance within industry to dedicate technical assets and funds to projects with limited immediate discernible impact on profitability.

The subprogram will develop advanced modular technologies capable of being deployed near wellheads and natural gas processing and transportation infrastructure for the purpose of beneficially utilizing otherwise flared, vented, or stranded natural gas. The program envisions a new R&D effort focused on developing and field testing new and disruptive technologies aimed at converting primarily methane and ethane into electricity or value-added, easily-transportable products.

Natural Gas Technologies

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Natural Gas Technologies \$51,000,000	\$10,730,000	-\$40,270,000
Gas Hydrates \$20,000,000	\$8,730,000	-\$11,270,000
<ul style="list-style-type: none"> • Conduct early-stage research such as numerical simulations, fundamental property characterization, and pore-scale visualization of hydrate bearing sediments. • Conduct the drilling of a stratigraphic well on the North Slope of Alaska and associated follow on analysis of collected materials to prepare for a long-term reservoir flow test. 	<ul style="list-style-type: none"> • Conduct early-stage research such as numerical simulations, fundamental property characterization, and pore-scale visualization of hydrate bearing sediments. • Pursue long-term reservoir flow test on the North Slope of Alaska. 	<ul style="list-style-type: none"> • Decrease reflects completion of the stratigraphic well and completion of the analysis of previous field work from the Gulf of Mexico.
Emissions Mitigation from Midstream Infrastructure \$10,000,000	\$0	-\$10,000,000
<ul style="list-style-type: none"> • Develop advanced technologies to detect and mitigate methane emissions from natural gas transmission, distribution, and storage infrastructure. 	<ul style="list-style-type: none"> • No funding requested within the Natural Gas Technologies budget request. 	<ul style="list-style-type: none"> • Decrease reflects the termination of the Emissions Mitigation subprogram. Research on improving midstream operational efficiency is funded under the Natural Gas Infrastructure Research subprogram.

Natural Gas Technologies

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Emissions Quantification from Natural Gas Infrastructure \$5,000,000	\$0	-\$5,000,000
<ul style="list-style-type: none"> Develop technologies, sensors, and models focused on better quantifying methane emissions from the natural gas value chain. 	<ul style="list-style-type: none"> No funding requested within the Natural Gas Technologies budget request. 	<ul style="list-style-type: none"> No funding requested.
Environmentally Prudent Development \$16,000,000	\$0	-\$16,000,000
<ul style="list-style-type: none"> Research to reduce the impact of unconventional oil and gas development, as well as improve understanding of shale geology, fracture dynamics, chemical interactions, and fluid flow in unconventional reservoirs. 	<ul style="list-style-type: none"> No funding requested within the Natural Gas Technologies budget request. 	<ul style="list-style-type: none"> No funding requested.
Natural Gas Infrastructure Research \$0	\$2,000,000	+\$2,000,000
<ul style="list-style-type: none"> No funding appropriated for Natural Gas Infrastructure Research. 	<ul style="list-style-type: none"> Funding will support research on advanced materials and sensors for midstream infrastructure. Funding to develop advanced modular conversion technologies for stranded and flared natural gas. 	<ul style="list-style-type: none"> Increase reflects additional research on advanced materials and sensors for midstream infrastructure and conversion technologies for stranded and vented gas.

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$40,000	\$46,000	\$19,000	-\$27,000

Overview

The overall mission of the Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies Program is to provide information and generate knowledge that can be advanced by industry to enable sustainable and responsible development of domestic unconventional fossil energy resources. The prudent development of these natural resources supports the Nation’s continued energy resilience and security.

Historically, most of the Nation’s oil and natural gas has come from geologic formations that are termed “conventional”: they have reservoir characteristics such as permeability and porosity, which typically make production and volumetric assessments relatively straightforward. With the advent of production from shales over the past decade, the United States has increasingly turned to “unconventional” reservoirs for domestic production. These “unconventional” reservoirs require complicated engineering measures, such as hydraulic fracturing, to improve reservoir access and enable production of oil and gas at commercially viable rates. The United States’ unconventional oil and natural gas resources represent a fast-growing component of its energy portfolio.

Despite the dramatic success by industry in producing hydrocarbons from shales, there remain key technical and scientific questions that require early-stage R&D, and which are best addressed through targeted federal investment. At the request level the program will conduct both lab-based and field work on specific topics and challenges that, while of ultimate interest to industry, are early-stage and hence not yet able to attract industry investment. These include novel mechanisms for breaking rock to dramatically increase recovery factors, beyond the current industry standard of 7-10% of unconventional formations (conventional reservoirs have typical recovery factors of 25-40% of the original oil in place). It also includes better understanding of flow mechanisms and mechanics, and enhancing the ability to dynamically engineer the subsurface.

Highlights of the FY 2020 Budget Request

The Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies Program will pursue the following major activities in FY 2020:

- Fund on-going field laboratory research to improve understanding of shale geology and fracture dynamics in key and emerging shale plays. These projects conduct field testing that complements research, modeling, and experimentation related to unconventional oil and natural gas development. Activities of these projects include borehole tests on the efficacy of production methods, surface and borehole geophysical and geochemical sampling of rocks and fluids, and determination and monitoring of water and gas chemistry at active oil and natural gas production sites.
- Conduct basin-specific research and analysis on fluid flow and chemical interactions in unconventional reservoirs, Enhanced Oil Recovery (EOR), produced water characterization and development of modular/mobile treatment technologies, and develop models for predictive analysis using high-performance computing and big data.
- Offshore oil and gas research that will include seismic data analysis, and integration of data with the offshore risk assessment model, high pressure and high temperature materials and pipe coatings, which will be conducted in conjunction with the DOE-wide Harsh Environment Materials initiative.

**Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Unconventional Fossil Energy Oil Technologies from Petroleum – Oil Technologies				
Unconventional Fossil Energy Oil Technologies from Petroleum – Oil Technologies	40,000	46,000	19,000	-\$27,000
Total, Unconventional Fossil Energy Oil Technologies from Petroleum – Oil Technologies	40,000	46,000	19,000	-\$27,000

SBIR/STTR:

- FY 2018 Transferred: SBIR \$1,204: STTR: \$169
- FY 2019 Enacted: SBIR \$1,352: STTR: \$190
- FY 2020 Request: SBIR \$539: STTR: \$76

Explanation of Major Changes (\$K)

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies:

- The decrease in funding will focus research on the current field test sites as well as on produced water characterization and treatment, predictive modeling using high performance computing, offshore oil and gas, and the Alaska North Slope and arctic offshore. **-\$27,000**

Total, Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies **-\$27,000**

FY 2020 Request vs FY 2019 Enacted

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies

Description

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies

The Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies Program will conduct early-stage research focused on increasing understanding of shale geology and fracture dynamics through research and technology development at technology readiness levels ranging from proof of concept up to testing and prototype validation. The research and development activities will be conducted at existing Field Laboratories in key shale plays, gathering field data to inform modeling and analysis. Work will include fundamental research on fluid flow and chemical interactions in unconventional reservoirs, produced water treatment and reuse, and high-performance computing for predictive analysis. In FY 2020, these activities will be conducted through existing projects from previous competitive funding solicitations, new projects selected through a competitive solicitations, and competitively selected DOE National Laboratory R&D.

Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies \$46,000,000	\$19,000,000	-\$27,000,000
<ul style="list-style-type: none"> • Early-stage research on shale geology and fracture dynamics through existing and new Field Laboratories in emerging plays. • Conduct early-stage research in fluid flow and chemical interactions in unconventional reservoirs and evaluation of causative factors of induced seismicity. • Conduct research into advanced materials and technologies for treatment and reuse of produced water from unconventional oil & gas production. 	<ul style="list-style-type: none"> • Basin-specific produced water characterization and development of treatment technologies and management tools. • Field laboratory research. • Develop models using high performance computing and big data for predictive analysis. • Research on Enhanced Oil Recovery (EOR) to include the Permian and Bakken formations. • Offshore oil and gas research to include high-pressure high-temperature resistant materials and pipe coatings. • Unconventional oil and gas research on safe and efficient drilling on the Alaska North Slope and arctic offshore. 	<ul style="list-style-type: none"> • The decrease in funding is due to no additional field test sites and will focus research on current field laboratory projects, as well as, produced water treatment technologies, high performance computing, offshore and Arctic research.

**Special Recruitment Programs
(\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$700	\$700	\$700	0

Overview

The Office of Fossil Energy (FE) utilizes educational programs, such as the Mickey Leland Energy Fellowship (MLEF), Minority Educational Institution Student Partnership Program (MEISPP), and the DOE Scholars Program to support an increase in the number of females and under-represented minorities entering the scientific and engineering career fields within the U.S. workforce. The MLEF Program, developed by FE, is a ten-week summer educational program that offers undergraduate, graduate, and post-graduate students majoring in science, technology, engineering, and mathematic (STEM) disciplines the opportunity to learn about the programs, policies, and research and development initiatives within the Office of Fossil Energy and the challenges in providing clean, affordable energy for future generations. The MEISPP and DOE Scholars Programs also provide students the opportunity to gain work experience and learn about the FE and DOE missions.

Highlights of the FY 2020 Budget Request

In FY 2020, a diverse group of undergraduate, graduate, and post-graduate students in science, technology, engineering, and mathematic majors will be recruited and selected to participate in the MLEF program. All participants in the MLEF will complete a hands-on research project under the mentorship of a Fossil Energy scientist, researcher, or program official. Students may also be selected into the MEISPP and DOE Scholars Program, as funding permits. MEISPP and DOE Scholars will participate on challenging assignments supporting the FE mission.

**Special Recruitment Programs
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Special Recruitment Programs	700	700	700	0
Total, Special Recruitment Programs	700	700	700	0

**Special Recruitment Programs
Explanation of Major Changes (\$K)**

FY 2020 Request vs FY 2019 Enacted

Special Recruitment Programs: Funding is at historical levels. **0**

Total, Special Recruitment Programs **0**

Special Recruitment Programs

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Special Recruitment Programs \$700,000	\$700,000	+\$0
<ul style="list-style-type: none"> A diverse group of undergraduate, graduate, and post-graduate students in science, technology, engineering and mathematic majors will be recruited and selected to participate in the MLEF program, the MEISPP, or DOE Scholars program. Provides students opportunity to gain hands-on research and work experience and learn more about the DOE and FE missions. 	<ul style="list-style-type: none"> A diverse group of undergraduate, graduate, and post-graduate students in science, technology, engineering and mathematic majors will be recruited and selected to participate in the MLEF program, the MEISPP, or DOE Scholars program. Provides students opportunity to gain hands-on research and work experience and learn more about the DOE and FE missions. 	<ul style="list-style-type: none"> No change in funding request.

Program Direction

Overview

Program Direction provides for the Headquarters workforce responsible for the oversight and administration of the Fossil Energy Research and Development (FER&D) program. It also provides for technical staff at the National Energy Technology Laboratory (NETL) who perform Procurement, Finance and Legal functions, as well as Federal workforce and contractor support for Communications. It does not include NETL scientific researchers or project managers.

Also included in Program Direction is funding for the operations of the Import/Export Authorization Office. Import/Export Authorization is managed by the Division of Natural Gas Regulatory Activities within the Office of Oil & Natural Gas. The program has responsibility for regulating natural gas and liquefied natural gas (LNG) imports and exports under the Natural Gas Act of 1938, section 3, using both Federal staff and contractor support.

Each of these elements also fund the DOE-wide Human Resources Shared Service Center in Oak Ridge and the FE program office contribution to the DOE Working Capital Fund.

Highlights of the FY 2020 Budget Request

The FY 2020 request increases program oversight and administration of Fossil Energy programs, including the regulation of natural gas and liquefied natural gas imports and exports, supports R&D efforts at NETL to oversee, award, manage, and closeout R&D programs and projects and reduces risk of noncompliance and avoids increase in cycle-time to execute government R&D work. This budget request supports the Department's efforts to evaluate ways to improve operational efficiency.

**Program Direction
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Program Direction Summary				
Washington Headquarters				
Salaries and Benefits	16,674	19,313	20,799	+1,486
Travel	600	765	403	-362
Support Services	650	670	558	-112
Other Related Expenses	11,830	10,857	9,362	-1,495
Total, Washington Headquarters	29,754	31,605	31,122	-483
National Energy Technology Laboratory				
Salaries and Benefits	16,915	15,339	16,000	+661
Travel	400	450	485	+35
Support Services	7,481	8,241	7,988	-253
Other Related Expenses	3,200	3,200	3,101	-99
Total, National Energy Technology Laboratory	27,996	27,230	27,574	+344
Import/Export Authorization				
Salaries and Benefits	1,367	1,422	1,536	+114
Travel	20	20	18	-2
Support Services	250	200	231	+31
Other Related Expenses	613	593	564	-29
Total, Import/Export Authorization	2,250	2,235	2,349	+114

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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Total Program Direction

Salaries and Benefits	34,956	36,074	38,335	+2,261
Travel	1,020	1,235	906	-329
Support Services	8,381	9,111	8,777	-334
Other Related Expenses	15,643	14,650	13,027	-1,623
Total Program Direction	60,000	61,070	61,045	-25
Federal FTEs – HQ	112	113	121	+8
Federal FTEs – NETL¹	121	116	121	+5
Federal FTEs - Total	233	229	242	+13

Support Services

Technical Support

Headquarters	650	670	558	-112
NETL	0	0	0	0
Import/Export Authorization	250	200	231	+31
Total, Technical Support	900	870	789	-81

Management Support

Headquarters	0	0	0	0
NETL	7,481	8,241	7,988	-253
Import/Export Authorization	0	0	0	0
Total Management Support	7,481	8,241	7,988	-253
Total, Support Services	8,381	9,111	8,777	-334

¹ Additional NETL FTEs are funded within the NETL Coal Research and Development and NETL Research and Operations budget lines.

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Other Related Expenses				
Headquarters	11,830	10,857	9,362	-1,495
NETL	3,200	3,200	3,101	-99
Import / Export Authorization	613	593	564	-29
Total, Other Related Expenses	15,643	14,650	13,027	-1,623

**Program Direction
Activities and Explanation of Changes**

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Program Direction \$61,070,000	\$61,045,000	-\$25,000
Salaries and Benefits \$36,074,000	\$38,335,000	+\$2,261,000
<ul style="list-style-type: none"> The funding supports HQ Federal staff who provide monitoring (oversight and audit) activities for the FER&D portfolio. The funding supports the technical Federal staff at the National Energy Technology Laboratory. The staff covered in this area provide for management of the Lab, communications, legal, acquisition and finance activities. 	<ul style="list-style-type: none"> The funding supports HQ Federal staff who provide monitoring (oversight and audit) activities for the FER&D portfolio. The funding supports the technical Federal staff at the National Energy Technology Laboratory. The staff covered in this area provide for management of the Lab, communications, legal, acquisition and finance activities. 	<ul style="list-style-type: none"> HQ net increase of \$1.6 million allows HQ to fully staff at the requested FTE level of 121. This includes 8 FTEs not transferred to IA, and an increase of 5 FTEs to key positions to accommodate expanded program scope. NETL increase of \$.661 million allows NETL to fully staff at the requested level of FTEs. The 2019 Enacted Salaries & Benefits required vacancies in certain key positions.
Travel \$1,235,000	\$906,000	-\$329,000
<ul style="list-style-type: none"> Travel includes funding for management meetings, training, etc. Instituted travel reduction to comply with the OMB directive for reduced travel from FY 2010 levels. 	<ul style="list-style-type: none"> Travel includes funding for management meetings, training, etc. Instituted travel reduction to comply with the OMB directive for reduced travel from FY 2010 levels. 	<ul style="list-style-type: none"> Funding is consistent with prior year travel requirements and is driven by reductions in HQ travel, consistent with reduced extramural research activities.
Support Services \$9,111,000	\$8,777,000	-\$334,000
<ul style="list-style-type: none"> Support Services at Headquarters includes; technical support, IT support, site operations support, administrative support. Support services at NETL include management and communications support, as well as finance and acquisition technicians. 	<ul style="list-style-type: none"> Support Services at Headquarters includes; technical support, IT support, site operations support, administrative support. Support services at NETL include management and communications support, as well as finance and acquisition technicians. 	<ul style="list-style-type: none"> Reduction is primarily due to a slight decrease in technical support services requirements.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Other Related Expenses \$14,650,000	\$13,027,000	-\$1,623,000
<ul style="list-style-type: none"> The activities supported by this line item include E-Government initiatives, Working Capital fund, computer systems and support, contractual services for HQ and environmental, security, safety, and health requirements at HQ and Human Resources shared service center payments. 	<ul style="list-style-type: none"> The activities supported by this line item include E-Government initiatives, Working Capital fund, computer systems and support, contractual services for HQ and environmental, security, safety, and health requirements at HQ and Human Resources shared service center payments. 	<ul style="list-style-type: none"> The reduction at HQ is due primarily to the transfer of CyberOne costs to the Office of Chief Information Officer’s (OCIO). Given the CyberOne transfer, NETL’s request is consistent with prior requirements.

NETL Infrastructure

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$45,000	\$45,000	\$43,100	-\$1,900

Overview

The NETL Infrastructure Program supports the fixed costs of NETL’s lab footprint in three geographic locations: Morgantown, WV; Pittsburgh, PA; and Albany, OR. Table 1 below provides relevant information on the relative sizes of the sites.

The NETL Infrastructure Program comprises the following subprograms:

- (1) **High Performance Computer** provides funding for the renewal of a 3-year lease of Joule, NETL’s high performance computer (HPC). The current Joule configuration was funded via a 3-year lease, with funding first provided in FY 2017. This FY 2020 request includes \$6.0M to initiate a new 3-year lease upon the expiration of the current lease.
- (2) **Laboratory and Site wide Facilities** includes repairs to existing laboratory facilities and general-purpose buildings and site-wide infrastructure and the continued reduction of deferred maintenance balances. Priorities for funding are established to ensure compliance with life safety standards, ensure critical laboratory research facilities and infrastructure, and comply with High Performance Sustainable Building goals.
- (3) **Safeguards and Security** provides funds to ensure protection of workers (physical and cyber), the public, the environment, facilities, and operations in performing the FER&D mission.
- (4) **Environmental Restoration** supports NETL’s Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) obligations across all NETL sites and two off-site locations in Wyoming.

Table 1¹: Comparison of Physical Footprint, Workforce, and Value of Assets by Campus and in Total, National Energy Technology Laboratory as of November 30, 2018

	Morgantown	Pittsburgh	Albany	Total NETL
Buildings	48	30	38	116
Sq. Ft. of building space	455,724	430,918	253,894	1,140,536
Acres	136.0	57.4	43.9	237.3
NETL Federal Workforce (FTEs)	217	210	36	466 ²
NETL Contractor Workforce (FTEs)	326	343	83	754 ³
Assets Replacement Value	\$246.7M	\$214.7M	\$116.0M	\$577.4M

¹ Table 1 uses on board employees as of November 30, 2018 and Table 2 uses authorized and requested FTEs.

² Total NETL includes two employees located in Houston TX and one located in Germantown MD.

³ Total NETL includes two contractors located in Houston TX.

Table 2: Reconciliation of FER&D Federal Employees (FTEs)

Program FTEs are funded in:				
		FY 2018	FY 2019	FY 2020
NETL Coal Research & Development		165	165	175
NETL Program Direction		121	116	121
NETL Research & Operations		236	236	240
TOTAL NETL		522	517	536
FE HQ Program Direction		112	113	121
TOTAL FER&D		634	630	657

Highlights of the FY 2020 Budget Request

The NETL Infrastructure request is \$1.9M lower than the FY 2019 Enacted level. While the NETL Infrastructure line funds primarily fixed costs, the overall reduction in Fossil Energy R&D requested funding necessitates the prudent identification of cost reduction opportunities across the board. The request includes an anticipated \$0.5M increase in annual HPC lease costs and a \$1.2M increase in costs for cybersecurity compliance. Within Laboratory and Site-wide facilities, funding for the completion of deferred maintenance is prioritized, to ensure the safety and security of NETL employees and to reduce the risk of costly and preventable damage in the future. These increases are offset by a \$3.6M decrease in operational costs across NETL’s three sites, resulting in a reduced level of contractor services.

FY 2020 Departmental Crosscuts (\$K)

	Cybersecurity	
	2019 Enacted	2020 Request
NETL Infrastructure	3,881	4,416

Within the FY 2020 Budget Request, the NETL Infrastructure line supports one Departmental Crosscut: Cybersecurity. For FER&D, this includes operation and enhancement of the FER&D cybersecurity policy and program as it relates to the enterprise computing environment at field locations. Key activities include cybersecurity policy implementation, governance and oversight activities, incident detection and response through continuous monitoring and diagnostics, and meeting Departmental requirements for the Identity Control and Access Management initiative. Within the FY 2020 budget request for NETL Infrastructure, \$4.416 million will be used to support these crosscutting cyber activities. Cybersecurity is funded under the Safeguards and Security subprogram.

**NETL Infrastructure
Funding (\$K)**

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
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NETL Infrastructure				
Super Computer	5,500	5,500	6,000	+500
Laboratory & Site-wide Facilities	30,400	30,400	27,300	-3,100
Safeguards and Security	7,000	7,000	7,800	+800
Environmental Restoration	2,100	2,100	2,000	-100
Total, NETL Infrastructure	45,000	45,000	43,100	-1,900

NETL Infrastructure
Explanation of Major Changes (\$K)

FY 2020 Request vs FY 2019 Enacted

NETL Infrastructure: A requested decrease of \$1,900,000 from the FY 2019 Enacted funding level reflects an anticipated \$0.5M increase in annual HPC lease costs and a \$1.2M increase in costs for cybersecurity compliance. These increases are offset by a \$3.6M decrease in operational costs for NETL's three sites.

-1,900

Total, NETL Infrastructure

-1,900

NETL Infrastructure

Activities and Explanation of Changes

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
NETL Infrastructure \$45,000,000	\$43,100,000	-\$1,900,000
High Performance Computer \$5,500,000	\$6,000,000	+\$500,000
<ul style="list-style-type: none"> Funding is for the 3rd year of an ongoing 3-year lease of Joule, NETL's high performance computer. Joule was originally commissioned in 2012 and funding was first provided for a refresh in FY 2017. 	<ul style="list-style-type: none"> Funding is for the renewal of a 3-year lease of Joule, NETL's high performance computer. Funding was first provided for a 3-year lease to refresh the processing units in FY 2017. This request includes funding to initiate a new 3-year lease. 	<ul style="list-style-type: none"> Increase reflects the anticipated increase in costs of HPC equipment during the 3-year period of the current lease.
Laboratory and Site wide Facilities \$30,400,000	\$27,300,000	-\$3,100,000
<ul style="list-style-type: none"> Funding includes construction of new, and renovation of existing, laboratory facilities and general-purpose buildings and site-wide infrastructure. Priorities for funding are established to ensure compliance with life safety standards, ensure critical laboratory research facilities and infrastructure, and comply with High Performance Sustainable Building goals. 	<ul style="list-style-type: none"> Funding includes repairs to existing, laboratory facilities and general-purpose buildings and site-wide infrastructure. Priorities for funding are established to ensure compliance with life safety standards, ensure critical laboratory research facilities and infrastructure, and comply with High Performance Sustainable Building goals. 	<ul style="list-style-type: none"> Impacts will be to research capability in bench scale carbon capture technology and functional materials from reduced funding for laboratory engineering and structural upgrades. Also with these cuts, NETL will be accepting more operational risk related to its role as a devolution site for certain DOE offices.
Safeguard and Securities \$7,000,000	\$7,800,000	+\$800,000
<ul style="list-style-type: none"> Funding is to ensure protection of workers (physical and cyber), the public, the environment, facilities, and operations in performing the FER&D mission. 	<ul style="list-style-type: none"> Funding is to ensure protection of workers (physical and cyber), the public, the environment, facilities, and operations in performing the FER&D mission. 	<ul style="list-style-type: none"> Funding increase reflects cost increases in cyber security compliance.

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
Environmental Restoration \$2,100,000	\$2,000,000	-\$100,000
<ul style="list-style-type: none"> Continue active operation and maintenance of the air sparge remediation system at Rock Springs Sites 4, 6, 7, 9, and 12 as well as well as a 10-year surface revegetation at the Hoe Creek Site. Continue RCRA-related on-site regulatory, corrective, preventative, and maintenance activities – such as asbestos and lead abatement, waste minimization, and pollution prevention – along with the NETL Albany ground water investigation and compliance activities. 	<ul style="list-style-type: none"> Continue active operation and maintenance of the air sparge remediation system at Rock Springs Sites 4, 6, 7, 9, and 12 as well as well as a 10-year surface revegetation at the Hoe Creek Site. Continue RCRA-related on-site regulatory, corrective, preventative, and maintenance activities – such as asbestos and lead abatement, waste minimization, and pollution prevention – along with the NETL Albany ground water investigation and compliance activities. 	<ul style="list-style-type: none"> Slight reduction in funding requested mirrors the gradual reduction in ongoing maintenance activities required as remediation activities are completed.

**Plant and Capital Equipment
Capital Summary (\$K)**

	Total	Prior Years	FY 2018 Enacted	FY 2018 Actuals	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Capital Operating Expenses Summary (including Major Items of Equipment (MIE))							
Plant Projects (GPP and IGPP) (<\$10M)	n/a	n/a	15,782	15,782	17,000	17,000	0
Total, Capital Operating Expenses	n/a	n/a	15,782	15,782	17,000	17,000	0
Plant Projects (GPP and IGPP) (Total Estimated Cost (TEC) <\$10M)							
Total Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$5M)	n/a	n/a	15,782	15,782	17,000	17,000	0
Total, Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$10M)	n/a	n/a	15,782	15,782	17,000	17,000	0
Total, Capital Summary	n/a	n/a	15,782	15,782	17,000	17,000	0

Outyears (\$K)

	FY 2021 Estimate	FY 2022 Estimate	FY 2023 Estimate	FY 2024 Estimate
Capital Operating Expenses Summary (including Major Items of Equipment (MIE))				
Plant Projects (GPP and IGPP) (<\$10M)	17,000	17,500	17,500	17,500
Total, Capital Operating Expenses	17,000	17,500	17,500	17,500
Capital Equipment > \$500K (including MIE)				
Plant Projects (GPP and IGPP) (Total Estimated Cost (TEC) <\$10M)				
Total Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$5M)	17,000	17,500	17,500	17,500
Total, Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$10M)	17,000	17,500	17,500	17,500
Total, Capital Summary	17,000	17,500	17,500	17,500

NETL Research and Operations

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
\$50,000	\$50,000	\$40,000	-10,000

Overview

NETL supports the DOE mission to advance the energy security of the United States, as well as Administration interests in domestic energy production, clean coal technologies, and reviving America's coal industry. NETL has expertise in coal, natural gas, and oil technologies; contract and project management; and analysis of fossil energy systems.

The NETL Research and Operations Program supports variable costs in NETL's science and technology activities. The Program comprises three subprograms:

- (1) **Research and Development** funds NETL science and technology development functions, including technical program management. Specifically, Research and Development funding supports salaries and benefits, travel, and other employee costs for the NETL staff of engineers and technical project managers who conduct collaborative research activities for Fossil Energy Research and Development (FER&D) programs. This subprogram also funds contractor costs related to these collaborative research activities.
- (2) **Site Operations** includes funding for: (a) building operations and maintenance such as structural repairs, utilities, and janitorial support; and (b) grounds maintenance including parking lot repair, mowing, snow removal, etc.
- (3) **Program oversight** includes funding for Federal employees and contractors performing research-enabling functions such as financial assistance, legal, and finance oversight of research grants and awards.

Highlights of the FY 2020 Budget Request

The NETL Research and Operations request is \$10M lower than the FY 2019 Enacted level. The overall reduction in Fossil Energy R&D requested funding necessitates the prudent identification of cost reduction opportunities across the board. The FY 2019 Enacted bill provided funding for university partnerships to support efforts to increase production of unconventional fossil fuels through big data analytics. Ongoing funding for this initiative is not requested in FY 2020. The Request also reflects additional cost reductions through more optimal procurement. These cost reductions will result in a reduced level of contractor services (~40 FTE).

**NETL Research and Operations
Funding (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
NETL Research and Operations				
Research and Development	26,000	26,000	20,500	-5,500
Site Operations	15,000	15,000	12,000	-3,000
Program Oversight	9,000	9,000	7,500	-1,500
TOTAL NETL Research and Operations	50,000	50,000	40,000	-10,000
Federal FTEs	236	236	240	+4

Federal FTEs shown above include technical project managers and procurement and finance personnel providing support to DOE’s Office of Energy Efficiency and Renewable Energy (EERE), Office of Cybersecurity, Energy Security, and Emergency Response (CESER), and Office of Electricity (OE). These NETL personnel are funded by those non-FER&D offices to the extent that their time is spent supporting those offices. The FY 2020 request increases federal FTEs by four in the Cybersecurity and Energy Security areas to ensure proper Federal oversight of these high-risk areas.

Explanation of Major Changes (\$K)

FY 2020 Request vs FY 2019 Enacted

NETL Research and Operations: The FY 2019 Enacted bill provided funding for university partnerships to support efforts to increase production of unconventional fossil fuels through big data analytics. Ongoing funding for this initiative is not requested in FY 2020. The Request also reflects additional cost reductions through more optimal procurement. These cost reductions will result in a reduced level of contractor services (~40 FTE).	-10,000
<hr/> Total, NETL Research and Operations	-10,000

**NETL Research and Operations
Activities and Explanation of Changes**

FY 2019 Enacted	FY 2020 Request	Explanation of Changes FY 2020 Request vs FY 2019 Enacted
NETL Research and Operations \$50,000,000	\$40,000,000	-10,000,000
Research and Development \$26,000,000	\$20,500,000	-\$5,500,000
<ul style="list-style-type: none"> • Research and Development funding at NETL provides for collaborative research and development activities, including Federal salaries/benefits, travel and employee costs for engineers, and technical project managers associated with the fossil programs. • Funding also provides for contractor costs supporting the collaborative research activities. • Funding also provides for ongoing operation and maintenance of project management information systems. 	<ul style="list-style-type: none"> • Research and Development funding at NETL provides for collaborative research and development activities, including Federal salaries/benefits, travel and employee costs for engineers, and technical project managers associated with the fossil programs. • Funding also provides for contractor costs supporting the collaborative research activities. • Funding also provides for ongoing operation and maintenance of project management information systems. 	<ul style="list-style-type: none"> • In FY 2019, funding was provided for university partnerships to support efforts to increase production of unconventional fossil fuels through big data analytics. Ongoing funding for this initiative is not requested in FY 2020.
Site Operations \$15,000,000	\$12,000,000	-\$3,000,000
<ul style="list-style-type: none"> • Site Operations funding supports variable costs of operating NETL’s laboratories and research sites. Funding provides for operations personnel along with support contractors for building operations, grounds maintenance, utilities, etc. 	<ul style="list-style-type: none"> • Site Operations funding supports variable costs of operating NETL’s laboratories and research sites. Funding provides for operations personnel along with support contractors for building operations, grounds maintenance, utilities, etc. 	<ul style="list-style-type: none"> • Reduced operational funding will result in reductions to site wide operations support, specifically contractor services for property management, warehousing, and industrial hygiene, consistent with the overall reduction in R&D funding. NETL will seek efficiencies gained through more optimal procurement methods.
Program Oversight \$9,000,000	\$7,500,000	-\$1,500,000
<ul style="list-style-type: none"> • Program Oversight funding at NETL supports salaries/benefits for federal employees performing research-enabling support functions necessary for the performance of NETL’s research activities. 	<ul style="list-style-type: none"> • Program Oversight funding at NETL supports salaries/benefits for federal employees performing research-enabling support functions necessary for the performance of NETL’s research activities. 	<ul style="list-style-type: none"> • Reduced program oversight funding will result in reductions to contractor services for project monitoring and closeout activities, consistent with the overall reduction in R&D funding. NETL will seek efficiencies gained through more optimal procurement methods.

**Fossil Energy Research and Development
Facilities Maintenance and Repair**

The Department’s Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. Facilities Maintenance and Repair activities funded by this budget are displayed below.

Costs for Direct-Funded Maintenance and Repair (including Deferred Maintenance Reduction) (\$K)

	FY 2018 Actual Cost	FY 2018 Planned Cost	FY 2019 Planned Cost	FY 2020 Planned Cost
National Energy Technology Laboratory	15,667	14,363	14,794	15,238
Total, Direct-Funded Maintenance and Repair	15,667	14,363	14,794	15,238

Report on FY 2018 Expenditures for Maintenance and Repair

This report responds to legislative language set forth in Conference Report (H.R. Conf. Rep. No. 108-10) accompanying the Consolidated Appropriations Resolution, 2003 (Public Law 108-7) (pages 886-887), which requests the Department of Energy provide an annual year-end report on maintenance expenditures to the Committees on Appropriations. This report compares the actual maintenance expenditures in FY 2018 to the amount planned for FY 2018, including Congressionally directed changes.

Total Costs for Maintenance and Repair (\$K)

	FY 2018 Actual Cost	FY 2018 Planned Cost
National Energy Technology Laboratory	15,667	14,363
Total, Direct-Funded Maintenance and Repair	15,667	14,363

In review of the planned vs actual costs for FY2018, the National Energy Technology Laboratory utilized an additional \$1,304(K) of capital funding toward multiple small projects for maintenance and repair to limit growth in deferred maintenance levels. The Actual Cost includes funding from program direction and Plant and Capital Equipment accounts. Planned funding is identified from program direction.

Excess Facilities

Excess Facilities are facilities no longer required to support the Department’s needs, present or future missions or functions, or the discharge of its responsibilities. This table reports the funding to deactivate and dispose of excess infrastructure, including stabilization and risk reduction activities at high-risk excess facilities, resulting in surveillance and maintenance cost avoidance and reduced risk to workers, the public, the environment, and programs. This includes maintenance of excess facilities (including high-risk excess facilities) necessary to minimize the risk posed by those facilities prior to disposition.

Fossil Energy Research and Development Excess Facilities

Costs for Direct-Funded Excess Facilities (\$K)

	FY 2018 Actual Cost	FY 2018 Planned Cost	FY 2019 Planned Cost	FY 2020 Planned Cost
National Energy Technology Laboratory (All)	261	301	252	76
NA	0,000	0,000	0,000	0,000
Total, Direct-Funded Excess Facilities	261	301	252	76

Fossil Energy Research & Development Capital Summary (\$K)

	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Capital Operating Expenses Summary (including (Major Items of Equipment (MIE))			
Plant Projects (GPP and IGPP) (<\$10M)	17,000	16,000	-1,000
Total, Capital Operating Expenses	17,000	16,000	-1,000
Plant Projects (GPP and IGPP) (Total Estimated Cost (TEC) <\$10M)			
Total Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$5M)	17,000	16,000	-1,000
Total, Plant Projects (GPP/IGPP) (Total Estimated Cost (TEC) <\$10M)	17,000	16,000	-1,000
Total, Capital Summary	17,000	16,000	-1,000

**Fossil Energy Research and Development
Research and Development (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Basic	33,082	32,934	26,406	-6,529
Applied	628,553	625,751	501,720	-124,056
Development	0	0	0	0
Subtotal, R&D	661,635	658,685	528,126	-130,585
Equipment	21,282	22,500	23,000	+500
Construction	0	0	0	0
Total, R&D	682,917	681,185	551,126	-130,085

Fossil Energy Research and Development
Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) (\$K)

	FY 2018 Enacted/ Transferred	FY 2019 Enacted Projected Transfer	FY 2020 Request/ Projected Transfer	FY 2020 Request vs FY 2019 Enacted
CCS and Power Systems				
SBIR	12,167	10,318	8,086	-2,232
STTR	1,711	1,451	1,137	-314
Natural Gas Technologies				
SBIR	1,505	1,327	291	-1,036
STTR	212	187	41	-146
Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies				
SBIR	1,204	1,352	539	-813
STTR	169	190	76	-114
Total, SBIR/STTR	16,968	14,825	10,170	-4,655

**Fossil Energy Research and Development
Safeguards and Security (\$K)**

	FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request	FY 2020 Request vs FY 2019 Enacted
Protective Forces	2,840	2,840	2,983	+143
Physical Security Systems	151	151	159	+8
Information Security	91	91	98	+7
Cyber Security*	2,387	3,881	4,416	+535
Personnel Security	154	154	225	+71
Material Control and Accountability	0	0	0	0
Research and Development	0	0	0	0
Program Management	254	254	271	+17
Security Investigations	0	0	0	0
Transportation Security	0	0	0	0
Construction	0	0	0	0
Total, Safeguards and Security	5,877	7,371	8,152	+781

*Does not include Fossil Energy R&D-funded HQ cybersecurity (FY 2018, \$843K; FY 2019, \$884K; FY 2020, \$439K)

NETL - Within the Budget Request, the NETL Infrastructure line supports one Departmental Crosscut: Cybersecurity. For FER&D, this includes operation and enhancement of the FER&D cybersecurity policy and program as it relates to the enterprise computing environment at field locations. Key activities include cybersecurity policy implementation, governance and oversight activities, incident detection and response through continuous monitoring and diagnostics, and meeting Departmental requirements for the Identity Control and Access Management initiative. The NETL totals for Cybersecurity are: FY 20= \$4.416M; FY 19 = 3.881M; FY 18 =2.387M.

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Fossil Energy Research and Development	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Ames Laboratory			
CCS and Power Systems			
Advanced Energy Systems	500	500	0
Cross Cutting Research	1,154	300	0
Total, CCS and Power Systems	1,654	800	0
Advanced Coal Energy Systems and CCUS			
Crosscutting Research	0	0	667
Total, Ames Laboratory	1,654	800	667
Idaho National Laboratory			
Advanced Coal Energy Systems and CCUS			
Crosscutting Research	0	0	667
Total, Idaho National Laboratory	0	0	667
Lawrence Berkeley National Laboratory			
CCS and Power Systems			
Carbon Capture	6,231	331	0
Carbon Storage	4,978	1,950	0
Cross Cutting Research	2,570	2,400	0
Total, CCS and Power Systems	13,779	4,681	0
Advanced Coal Energy Systems and CCUS			
Carbon Capture Utilization and Storage	0	0	1,565
Crosscutting Research	0	0	2,494
Total, Advanced Coal Energy Systems and CCUS	0	0	4,059
Natural Gas Technologies			
Natural Gas Technologies	1,720	1,625	700
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	995	1,667	1,000
Total, Lawrence Berkeley National Laboratory	16,494	7,973	5,759

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Fossil Energy Research and Development	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Lawrence Livermore National Laboratory			
CCS and Power Systems			
Carbon Capture	3,849	475	0
Cross Cutting Research	279	0	0
Total, CCS and Power Systems	4,128	475	0
Advanced Coal Energy Systems and CCUS			
Carbon Capture Utilization and Storage	0	0	1,250
Crosscutting Research	0	0	667
Total, Advanced Coal Energy Systems and CCUS	0	0	1,917
Natural Gas Technologies			
Natural Gas Technologies	0	22	0
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	1,050	1,050	1,000
Total, Lawrence Livermore National Laboratory	5,178	1,547	2,917
Los Alamos National Laboratory			
CCS and Power Systems			
Carbon Capture	1,195	1,345	0
Carbon Storage	4,380	1,950	0
Cross Cutting Research	930	0	0
Total, CCS and Power Systems	6,505	3,295	0
Advanced Coal Energy Systems and CCUS			
Carbon Capture Utilization and Storage	0	0	2,185
Crosscutting Research	0	0	667
Total, Advanced Coal Energy Systems and CCUS	0	0	2,852
Natural Gas Technologies			
Natural Gas Technologies	800	800	0
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	123	122	100
Total, Los Alamos National Laboratory	7,428	4,217	2,952

Department Of Energy
FY 2020 Congressional Budget
Funding by Appropriation by Site
(\$K)

Fossil Energy Research and Development

National Energy Technology Lab

CCS and Power Systems

	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Carbon Capture	41,791	42,187	0
Carbon Storage	69,679	33,754	0
Advanced Energy Systems	49,621	32,552	0
Cross Cutting Research	37,634	43,435	0
STEP (Supercritical CO2)	24,000	22,430	0
Transformational Coal Pilots	35,000	25,000	0
NETL Coal R&D	53,000	54,000	0

Total, CCS and Power Systems

310,725 253,358 0

Advanced Coal Energy Systems and CCUS

Advanced Energy Systems	0	0	219,895
Carbon Capture Utilization and Storage	0	0	61,054
NETL Coal Research and Development	0	0	38,000
Crosscutting Research	0	0	51,150

Total, Advanced Coal Energy Systems and CCUS

0 0 370,099

Natural Gas Technologies

Natural Gas Technologies	39,750	40,306	7,930
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Program Direction

NETL Program Direction	27,996	27,230	27,574
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Unconventional FE Technologies from Petroleum – Oil

Unconventional FE Technologies from Petroleum – Oil	33,786	13,238	13,350
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NETL Research and Operations

NETL Research and Operations	50,000	50,000	40,000
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NETL Infrastructure

NETL Infrastructure	45,000	45,000	43,100
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Total, National Energy Technology Lab

507,257 429,132 502,053

Oak Ridge National Laboratory

CCS and Power Systems

Carbon Capture	500	0	0
Carbon Storage	235	50	0
Advanced Energy Systems	500	500	0
Cross Cutting Research	3,724	0	0

Total, CCS and Power Systems

4,959 550 0

Advanced Coal Energy Systems and CCUS

Crosscutting Research	0	0	667
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Natural Gas Technologies

Natural Gas Technologies	450	450	0
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Total, Oak Ridge National Laboratory

5,409 1,000 667

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Fossil Energy Research and Development	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Pacific Northwest National Laboratory			
CCS and Power Systems			
Carbon Capture	4,673	829	0
Cross Cutting Research	1,174	320	0
Total, CCS and Power Systems	5,847	1,149	0
Advanced Coal Energy Systems and CCUS			
Advanced Energy Systems	0	0	405
Carbon Capture Utilization and Storage	0	0	2,551
Crosscutting Research	0	0	667
Total, Advanced Coal Energy Systems and CCUS	0	0	3,623
Natural Gas Technologies			
Natural Gas Technologies	600	600	100
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	500	0	0
Total, Pacific Northwest National Laboratory	6,947	1,749	3,723
Sandia National Laboratories			
CCS and Power Systems			
Carbon Storage	952	350	0
Advanced Energy Systems	250	250	0
Cross Cutting Research	3,079	2,495	0
Total, CCS and Power Systems	4,281	3,095	0
Advanced Coal Energy Systems and CCUS			
Carbon Capture Utilization and Storage	0	0	195
Crosscutting Research	0	0	2,679
Total, Advanced Coal Energy Systems and CCUS	0	0	2,874
Natural Gas Technologies			
Natural Gas Technologies	1,000	1,000	0
Total, Sandia National Laboratories	5,281	4,095	2,874
SLAC National Accelerator Laboratory			
Natural Gas Technologies			
Natural Gas Technologies	1,150	1,150	0
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	150	252	150
Total, SLAC National Accelerator Laboratory	1,300	1,402	150

Department Of Energy
 FY 2020 Congressional Budget
 Funding by Appropriation by Site
 (\$K)

Fossil Energy Research and Development	FY 2018 Total Enacted	FY 2019 Enacted	FY 2020 Request
Washington Headquarters			
CCS and Power Systems			
Carbon Capture	42,432	55,504	0
Carbon Storage	17,872	60,042	0
Advanced Energy Systems	61,129	95,881	0
Cross Cutting Research	7,806	7,400	0
Total, CCS and Power Systems	129,239	218,827	0
Natural Gas Technologies			
Natural Gas Technologies	4,530	5,047	2,000
Program Direction			
Headquarters Program Direction	32,004	33,840	33,471
Special Recruitment Programs			
Special Recruitment Programs	700	700	700
Unconventional FE Technologies from Petroleum – Oil			
Unconventional FE Technologies from Petroleum – Oil	3,396	29,671	3,400
Total, Washington Headquarters	169,869	288,085	39,571
Total, Fossil Energy Research and Development	726,817	740,000	562,000

GENERAL PROVISIONS—DEPARTMENT OF ENERGY
(INCLUDING TRANSFER OF FUNDS)

SEC. 301. (a) No appropriation, funds, or authority made available by this title for the Department of Energy shall be used to initiate or resume any program, project, or activity or to prepare or initiate Requests For Proposals or similar arrangements (including Requests for Quotations, Requests for Information, and Funding Opportunity Announcements) for a program, project, or activity if the program, project, or activity has not been funded by Congress.

(b)(1) Unless the Secretary of Energy notifies the Committees on Appropriations of both Houses of Congress at least 3 full business days in advance, none of the funds made available in this title may be used to—

(A) make a grant allocation or discretionary grant award totaling \$1,000,000 or more;

(B) make a discretionary contract award or Other Transaction Agreement totaling \$1,000,000 or more, including a contract covered by the Federal Acquisition Regulation;

(C) issue a letter of intent to make an allocation, award, or Agreement in excess of the limits in subparagraph (A) or (B); or

(D) announce publicly the intention to make an allocation, award, or Agreement in excess of the limits in subparagraph (A) or (B).

(2) The Secretary of Energy shall submit to the Committees on Appropriations of both Houses of Congress within 15 days of the conclusion of each quarter a report detailing each grant allocation or discretionary grant award totaling less than \$1,000,000 provided during the previous quarter.

(3) The notification required by paragraph (1) and the report required by paragraph (2) shall include the recipient of the award, the amount of the award, the fiscal year for which the funds for the award were appropriated, the account and program, project, or activity from which the funds are being drawn, the title of the award, and a brief description of the activity for which the award is made.

(c) The Department of Energy may not, with respect to any program, project, or activity that uses budget authority made available in this title under the heading "Department of Energy—Energy Programs", enter into a multiyear contract, award a multiyear grant, or enter into a multiyear cooperative agreement unless—

(1) the contract, grant, or cooperative agreement is funded for the full period of performance as anticipated at the time of award; or

(2) the contract, grant, or cooperative agreement includes a clause conditioning the Federal Government's obligation on the availability of future year budget authority and the Secretary notifies the Committees on Appropriations of both Houses of Congress at least 3 days in advance.

(d) Except as provided in subsections (e), (f), and (g), the amounts made available by this title shall be expended as authorized by law for the programs, projects, and activities specified in the "Conference" column in the "Department of Energy" table included under the heading "Title III—Department of Energy" in the joint explanatory statement accompanying this Act.

(e) The amounts made available by this title may be reprogrammed for any program, project, or activity, and the Department shall notify, and obtain the prior approval of, the Committees on Appropriations of both Houses of Congress at least 30 days prior to the use of any proposed reprogramming that would cause any program, project, or activity funding level to increase or decrease by more than \$5,000,000 or 10 percent, whichever is less, during the time period covered by this Act.

(f) None of the funds provided in this title shall be available for obligation or expenditure through a reprogramming of funds that—

(1) creates, initiates, or eliminates a program, project, or activity;

(2) increases funds or personnel for any program, project, or activity for which funds are denied or restricted by this Act; or

(3) reduces funds that are directed to be used for a specific program, project, or activity by this Act.

(g)(1) The Secretary of Energy may waive any requirement or restriction in this section that applies to the use of funds made available for the Department of Energy if compliance with such requirement or restriction would pose a substantial risk to human health, the environment, welfare, or national security.

(2) The Secretary of Energy shall notify the Committees on Appropriations of both Houses of Congress of any waiver under paragraph (1) as soon as practicable, but not later than 3 days after the date of the activity to which a requirement or restriction would otherwise have applied. Such notice shall include an explanation of the substantial risk under paragraph (1) that permitted such waiver.

(h) The unexpended balances of prior appropriations provided for activities in this Act may be available to the same appropriation accounts for such activities established pursuant to this title. Available balances may be merged with funds in the applicable established accounts and thereafter may be accounted for as one fund for the same time period as originally enacted.

SEC. 302. Funds appropriated by this or any other Act, or made available by the transfer of funds in this Act, for intelligence activities are deemed to be specifically authorized by the Congress for purposes of section 504 of the National Security Act of 1947 (50 U.S.C. 3094) during fiscal year [2019]2020 until the enactment of the Intelligence Authorization Act for fiscal year [2019]2020.

SEC. 303. None of the funds made available in this title shall be used for the construction of facilities classified as high-hazard nuclear facilities under 10 CFR Part 830 unless independent oversight is conducted by the Office of Enterprise Assessments to ensure the project is in compliance with nuclear safety requirements.

SEC. 304. None of the funds made available in this title may be used to approve critical decision–2 or critical decision–3 under Department of Energy Order 413.3B, or any successive departmental guidance, for construction projects where the total project cost exceeds \$100,000,000, until a separate independent cost estimate has been developed for the project for that critical decision.

[SEC. 305. The Secretary of Energy may not transfer more than \$274,833,000 from the amounts made available under this title to the working capital fund established under section 653 of the Department of Energy Organization Act (42 U.S.C. 7263): *Provided*, That the Secretary may transfer additional amounts to the working capital fund after the Secretary provides notification in advance of any such transfer to the Committees on Appropriations of both Houses of Congress: *Provided further*, That any such notification shall identify the sources of funds by program, project, or activity: *Provided further*, That the Secretary shall notify the Committees on Appropriations of both Houses of Congress before adding or removing any activities from the fund.]

SEC. [306]305. (a) None of the funds made available in this or any prior Act under the heading "Defense Nuclear Nonproliferation" may be made available to enter into new contracts with, or new agreements for Federal assistance to, the Russian Federation. (b) The Secretary of Energy may waive the prohibition in subsection (a) if the Secretary determines that such activity is in the national security interests of the United States. This waiver authority may not be delegated. (c) A waiver under subsection (b) shall not be effective until 15 days after the date on which the Secretary submits to the Committees on Appropriations of both Houses of Congress, in classified form if necessary, a report on the justification for the waiver.

[SEC. 307. (a) NEW REGIONAL RESERVES.—The Secretary of Energy may not establish any new regional petroleum product reserve unless funding for the proposed regional petroleum product reserve is explicitly requested in advance in an annual budget submission and approved by the Congress in an appropriations Act.

(b) The budget request or notification shall include—

(1) the justification for the new reserve;

(2) a cost estimate for the establishment, operation, and maintenance of the reserve, including funding sources;

(3) a detailed plan for operation of the reserve, including the conditions upon which the products may be released;

(4) the location of the reserve; and

(5) the estimate of the total inventory of the reserve.]

SEC. [308]306. Notwithstanding section 161 of the Energy Policy and Conservation Act (42 U.S.C. 6241), upon a determination by the President in this fiscal year that a regional supply shortage of refined petroleum product of significant scope and duration exists, that a severe increase in the price of refined petroleum product will likely result from such shortage, and that a draw down and sale of refined petroleum product would assist directly and

significantly in reducing the adverse impact of such shortage, the Secretary of Energy may draw down and sell refined petroleum product from the Strategic Petroleum Reserve. Proceeds from a sale under this section shall be deposited into the SPR Petroleum Account established in section 167 of the Energy Policy and Conservation Act (42 U.S.C. 6247), and such amounts shall be available for obligation, without fiscal year limitation, consistent with that section.

SEC. 307. Section 310 of the Omnibus Appropriations Act, 2009 (Public Law 111–8; 50 U.S.C. 2743a note) and section 306 of the Consolidated Appropriations Act, 2012 (Public Law 112–74; 50 U.S.C. 2743a) are repealed.

SEC. 308. Not to exceed 5 percent of any appropriation made available for Department of Energy activities funded in this Act may be transferred between such appropriations, but no such appropriation, except as otherwise provided, shall be increased or decreased by more than 5 percent by any such transfers, and notification of any such transfers shall be submitted promptly to the Committees on Appropriations of the House of Representatives and the Senate.

SEC. 309. (a) Allowable Costs.— (1) Section 4801(b) of the Atomic Energy Defense Act (50 U.S.C. 2781(b)) is amended— (A) by striking "(1)" and all that follows through "the Secretary" and inserting "The Secretary"; and (B) by striking paragraph (2). (2) Section 305 of the Energy and Water Development Appropriation Act, 1988, as contained in section 101(d) of Public Law 100–202 (101 Stat. 1329–125), is repealed. (b) Regulations Revised.—The Secretary of Energy shall revise existing regulations consistent with the repeal of 50 U.S.C. 2781(b)(2) and section 305 of Public Law 100–202 and shall issue regulations to implement 50 U.S.C. 2781(b), as amended by subsection (a), no later than 150 days after the date of the enactment of this Act. Such regulations shall be consistent with the Federal Acquisition Regulation 48 C.F.R. 31.205–22.

SEC. 310. Notwithstanding provisions of title 5, United States Code, the Southeastern Power Administration shall pay power system dispatchers at basic pay and premium pay rates that are based on those prevailing for similar occupations in the electric power industry. Pay may not be paid, by reason of this section, at a rate in excess of the rate of basic pay for level V of the Executive Schedule.

SEC. 311. Section 3131 of the National Defense Authorization Act for Fiscal Year 2000 (Public Law 106–65; 10 U.S.C. 2701 note) is amended by striking "or the defense activities of the Department of Energy".

(Energy and Water Development and Related Agencies Appropriations Act, 2019.)

TITLE V – GENERAL PROVISIONS

SEC. 501. None of the funds appropriated by this Act may be used in any way, directly or indirectly, to influence congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. 1913.

SEC. 502. (a) None of the funds made available in title III of this Act may be transferred to any department, agency, or instrumentality of the United States Government, except pursuant to a transfer made by or transfer authority provided in this Act or any other appropriations Act for any fiscal year, transfer authority referenced in the joint explanatory statement accompanying this Act, or any authority whereby a department, agency, or instrumentality of the United States Government may provide goods or services to another department, agency, or instrumentality. (b) None of the funds made available for any department, agency, or instrumentality of the United States Government may be transferred to accounts funded in title III of this Act, except pursuant to a transfer made by or transfer authority provided in this Act or any other appropriations Act for any fiscal year, transfer authority referenced in the joint explanatory statement accompanying this Act, or any authority whereby a department, agency, or instrumentality of the United States Government may provide goods or services to another department, agency, or instrumentality. (c) The head of any relevant department or agency funded in this Act utilizing any transfer authority shall submit to the Committees on Appropriations of both Houses of Congress a semiannual report detailing the transfer authorities, except for any authority whereby a department, agency, or instrumentality of the United States Government may provide goods or services to another department, agency, or instrumentality, used in the previous 6 months and in the year-to-date. This report shall include the amounts transferred and the purposes for which they were transferred, and shall not replace or modify existing notification requirements for each authority.

SEC. 503. None of the funds made available by this Act may be used in contravention of Executive Order No. 12898 of February 11, 1994 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations).

SEC. 504. (a) None of the funds made available in this Act may be used to maintain or establish a computer network unless such network blocks the viewing, downloading, and exchanging of pornography. (b) Nothing in subsection (a) shall limit the use of funds necessary for any Federal, State, tribal, or local law enforcement agency or any other entity carrying out criminal investigations, prosecution, or adjudication activities.

SEC. 505. Section 611 of the Energy and Water Development Appropriations Act, 2000 (P.L. 106–60; 10 U.S.C. 2701 note) is amended as follows: (a) In subsection (a), by striking "the Army, acting through the Chief of Engineers" and inserting "Energy". (b) In subsection (a)(6), by striking "by the Secretary of the Army, acting through the Chief of Engineers" and striking ", which may be transferred upon completion of remediation to the administrative jurisdiction of the Secretary of Energy". (c) In subsection (a), by adding after paragraph (6) the following undesignated matter: "Upon completion of remediation of a site acquired by the Secretary of the Army prior to fiscal year 2020, the Secretary of the Army may transfer administrative jurisdiction of such site to the Secretary of Energy.". (d) In subsection (b), by striking "the Army, acting through the Chief of Engineers," and inserting "Energy". (e) In subsection (c), by striking "amounts made available to carry out that program and shall be available until expended for costs of response actions for any eligible site" and inserting "'Other Defense Activities' appropriation account or successor appropriation account and shall be available until expended for costs of response actions for any eligible Formerly Utilized Sites Remedial Action Program Site". (f) By redesignating subsection (f) as subsection (g). (g) By inserting after subsection (e) the following new subsection: "(f) The Secretary of Energy, in carrying out subsection (a), shall enter into an agreement with the Secretary of the Army to carry out the functions and activities described in subsections (a)(1) through (a)(6).".

[SEC. 505. For an additional amount for "Department of the Interior—Bureau of Reclamation—Water and Related Resources", \$21,400,000, to remain available until expended, for transfer to Reclamation's Upper Colorado River Basin Fund to carry out environmental stewardship and endangered species recovery efforts pursuant to the Grand

Canyon Protection Act of 1992 (Public Law 102–575), Public Law 106–392, the Colorado River Basin Project Act (43 U.S.C. 1551(b)), and the Act of April 11, 1956 (commonly known as the "Colorado River Storage Project Act") (43 U.S.C. 620n). This division may be cited as the "Energy and Water Development and Related Agencies Appropriations Act, 2019".]

(Energy and Water Development and Related Agencies Appropriations Act, 2019.)

