Office of Energy Efficiency and Renewable Energy

FY 2016 Budget Overview

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Doug Hollett, Deputy Assistant Secretary

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Major Administration Energy Goals

- Reduce GHG emissions by 17% by 2020, 26-28% by 2025 and 83% by 2050 from 2005 baseline
- By 2035, generate 80% of electricity from a diverse set of clean energy resources
- Double energy productivity by 2030
- Reduce net oil imports by half by 2020 from a 2008 baseline
- Reduce CO_2 emissions by 3 billion metric tons cumulatively by 2030 through efficiency standards set between 2009 and 2016

Office of Energy Efficiency and Renewable Energy

EERE Mission:
To create and sustain American leadership in the global transition to a clean energy economy

- **High-Impact Research, Development, and Demonstration to Make Clean Energy as Affordable and Convenient as Traditional Forms of Energy**

- **Breaking Down Market Barriers**

EERE's Guiding Principles

The 5 EERE Core Questions

1. **HIGH IMPACT:** Is this a high impact problem?
2. **ADDITIONALITY:** Will the EERE funding make a large difference relative to what the private sector (or other funding entities) is already doing?
3. **OPENNESS:** Have we made sure to focus on the broad problem we are trying to solve and be open to new ideas, new approaches, and new performers?
4. **ENDURING U.S. ECONOMIC BENEFIT:** How will this EERE funding result in enduring economic benefit to the United States?
5. **PROPER ROLE OF GOVERNMENT:** Why is what we are doing a proper high impact role of government versus something best left to the private sector to address on its own?

Select Recent EERE Accomplishments

Sustainable TRANSPORTATION

- $289/kWh Modeled Li-Ion Battery Cost Achieved in 2014
- SuperTruck – 5 year program exceeded goal of 50% improvement in freight efficiency a year ahead of schedule in 2014
- 3 Pioneering Commercial Cellulosic Ethanol Plants have come online
- Fuel cells - 50% cost reduction, 5 x platinum reduction since 2006

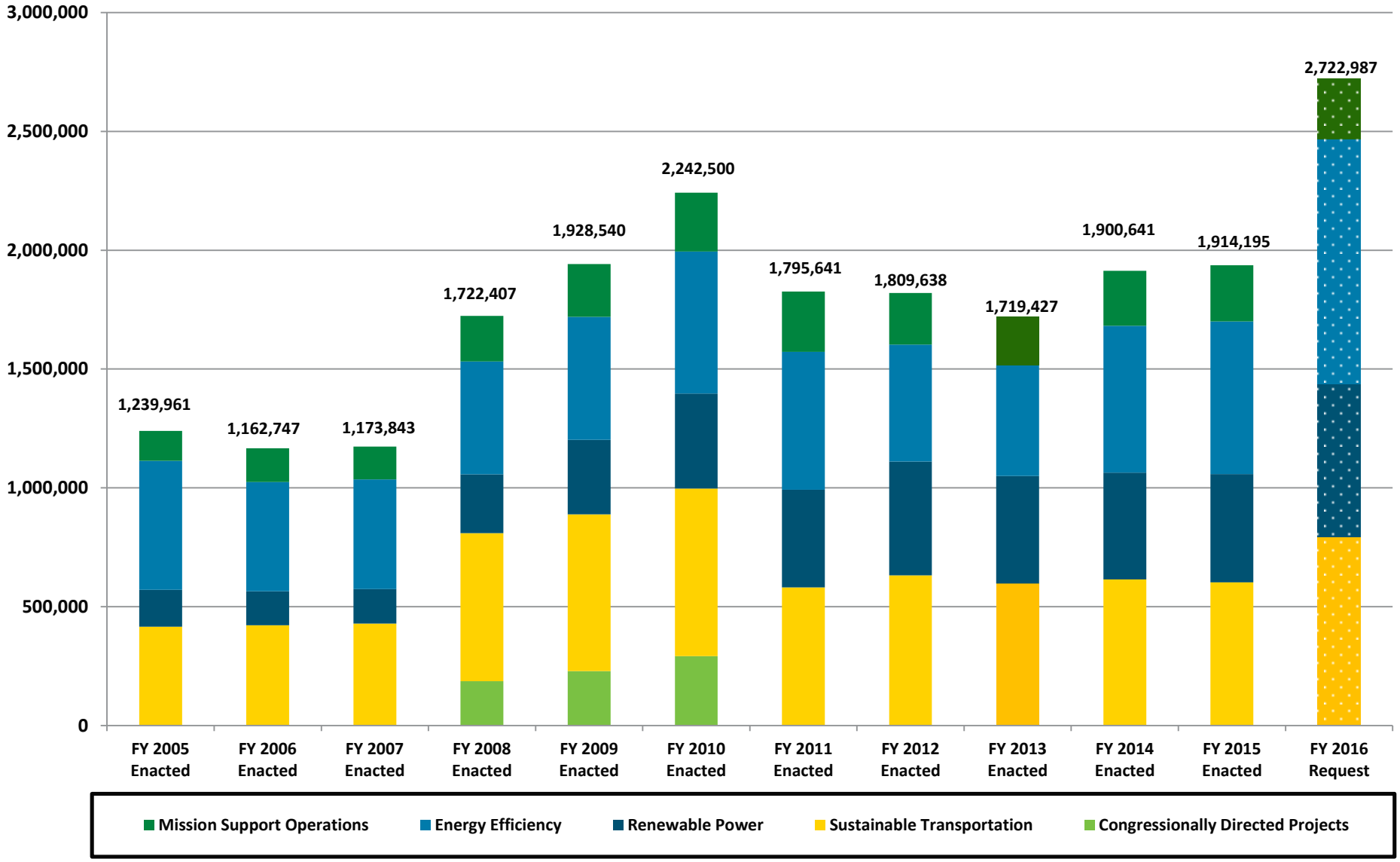
Renewable ELECTRICITY GENERATION

- Achieved more than 60% progress toward SunShot solar PV cost reduction in just first 4 years of 10 year initiative
- Cost of U.S. wind energy decreased by more than one-third in last 5 years to 4.6c/kWh
- First grid connected tidal power plant in US
- First grid connected near-field EGS plant increased power output of nearby operating geothermal field by nearly 38%

Energy Saving HOMES, BUILDINGS, & MANUFACTURING

- Standards enacted since 2009 are projected to avoid a cumulative total of 2.2 billion metric tons of carbon emissions by 2030
- More than 250 DOE partners through the Better Buildings Challenge on track to achieve average energy savings of 2.5% annually and saving 36 TBtus and $300 million since the Better Buildings Challenge began
- LED cost reduction – 90% since 2008

EERE Budget Trends: FY 2004 – FY 2016, ($K)



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

FY 2016 Budget Summary Table

Dollars in Thousands	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs FY 2015
Transportation	**614,955**	**602,000**	**793,000**	**+191,000**
- Vehicle Technologies	289,737	280,000	444,000	+164,000
- Bioenergy Technologies	232,290	225,000	246,000	+21,000
- Hydrogen and Fuel Cell Technologies	92,928	97,000	103,000	+6,000
Renewable Electricity	**449,524**	**456,000**	**645,200**	**+189,200**
- Solar Energy	257,058	233,000	336,700	+103,700
- Wind Energy	88,126	107,000	145,500	+38,500
- Water Power	58,565	61,000	67,000	+6,000
- Geothermal Technologies	45,775	55,000	96,000	+41,000
End-Use Efficiency	**617,449**	**642,000**	**1,029,587**	**+387,587**
- Advanced Manufacturing	180,471	200,000	404,000	+204,000
- Building Technologies	177,868	172,000	264,000	+92,000
- Federal Energy Management Program	28,248	27,000	43,088	+16,088
- Weatherization and Intergovernmental Activities	230,862	243,000	318,499	+75,499
Corporate Support Programs	**231,513**	**237,000**	**255,200**	**+18,200**
Subtotal, Energy Efficiency and Renewable Energy	**1,913,441**	**1,937,000**	**2,722,987**	**+785,987**
- Use of Prior Year Balances	-2,382	0	0	0
- Rescission of Prior Year Balances	-10,418	-22,805	0	NA
Total, Energy Efficiency and Renewable Energy	**1,900,641**	**1,914,195**	**2,722,987**	**+808,792**

Sustainable
TRANSPORTATION

Renewable
ELECTRICITY GENERATION

Energy Saving
HOMES, BUILDINGS, & MANUFACTURING

Mission-Critical Support
OPERATIONS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Renewable ELECTRICITY GENERATION

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Solar Energy Technologies - Overview

Motivation/Focus

- The SunShot Initiative's goal is to drive technology innovation to make solar energy cost-competitive without incentives with conventional energy sources by 2020. Reducing the total installed cost for utility-scale solar electricity to roughly $.06/kWh will enable rapid, large-scale adoption of solar electricity. We aim to re-establish American technological and market leadership in solar energy, improve the Nation's energy security, reduce environmental impacts of electricity generation, and strengthen U.S. economic competitiveness.

Achievements

- **Commercializing CSP technologies**: Technologies developed with DOE investments have led to large scale commercial deployment of CSP systems in the US totaling over 1.3 GW.
- **Leading in PV R&D**: Over the past 35 years, DOE R&D funding at our nation's laboratories has resulted in over 50% of solar cell efficiency world records .
- **Enabling Greater Renewables Integration**: SunShot R&D programs helped inform the Small Generator Interconnection Procedures that will streamline the interconnection of residential and commercial solar
- **Cutting Red Tape**: SunShot works with state & local government, businesses to make the process of going solar faster, easier, and more affordable. The Rooftop Solar Challenge round 1 cut permitting time by 40%, reduced fees by 12%, made it possible for >47 million Americans to install solar (1 week saved across 40,000 systems -- 600MW of residential/commercial solar installed in first year).
- **SunShot Incubator**: Since 2007, SunShot's Incubator program has provided early-stage assistance to small businesses to rapidly bring new products and services to the marketplace. Approx. $100M invested has resulted in over $2B in follow on private capital financing.
- **Building a Skilled Solar Workforce:** DOE's Solar Instructor Training Network (SITN) of over 400 community colleges in 49 states helps meet the growing demand for solar workers, with a focus on recruiting returning veterans. SITN has trained over 30,000 workers to enter the solar field on the way to 50,000 by 2020.

Solar Energy Technologies – FY 2016 Budget Request

Goals/Metrics

- By 2020, achieve cost competitiveness without subsidies. For PV systems, this goal translates to approximately:
  - Utility-scale installed system price: $1.00/Wdc from a 2010 baseline of $3.80/Wdc.
  - Commercial-scale installed system price: $1.25/Wdc from a 2010 baseline of $5.00/Wdc.
  - Residential-scale installed system price: $1.50/Wdc from a 2010 baseline of $6.80/Wdc.
  - By 2020, for CSP, the goal of $0.06/kWh translates to about $3.50/W including 16 hours of thermal storage.
  - By the end of 2014, progress 70% of the way to the 2020 objectives have been achieved.

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Concentrating Solar Power	48,571	46,400	48,400	+2,000
Photovoltaic R&D	56,641	35,300	62,000	+26,700
System Integration	52,816	43,700	76,500	+32,800
Balance of Systems Soft Cost Reduction	42,558	40,700	67,300	+26,600
Innovations in Manufacturing Competitiveness	44,472	57,800	73,400	+15,600
NREL Site-Wide Facility Support	12,000	9,100	9,100	0
Total, Solar Energy Technologies Office	257,058	233,000	336,700	+103,700

Solar Energy Technologies – FY 2016 Budget Highlights

- **Integrated Best-in-Class Concentrating Solar Power Innovations at 1-10 MW Scale ($40M):** Leveraging component level research developed for sub-systems in prior years, CSP Systems Integration will validate the technologies at the 1-10 MW scale.
- **Solar Power Manufacturing Innovation ($44.6M):** Increase America's market share for manufacturing value added commensurate with domestic market demand through focused investments in advanced manufacturing R&D such as low CAPEX and high throughput manufacturing technologies.
- **Manufacturing/Materials Genome ($10M):** Supports DOE's Clean Energy Manufacturing Initiative and Administration's Materials Genome Initiative. Massively Parallel Combinatorial Process Development will use high performance computing and high throughput combinatorial synthesis to accelerate the development of materials from the point of discovery to qualification.
- **Next Generation PV Innovations ($30.6M):** Investigate new concepts for Photovoltaic R&D (PV) cells and module as well as cost reductions that have the potential to disrupt the PV market beyond the 2020 Goals of the DOE SunShot Initiative.
- **Soft Cost Reduction Innovation for Commercial Scale Solar PV ($16.1M):** Collaborative multi-stakeholder partnership to reduce soft costs for commercial scale PV.

Wind Power Technologies – Overview

Motivation/Focus

- EERE's Wind Energy Program seeks to establish a competitive U.S. wind industry through cost reduction activities focused on technology RD&D, offshore demonstrations, efforts to eliminate and reduce market barriers, and efforts to enable the seamless and cost effective integration of growing amounts of wind power into the electric grid.

Achievements

- The unsubsidized cost of U.S. wind energy has decreased by more than 90%—from $0.57 /kilowatt hour (kWh, $2013) in 1980 to $0.046 /kWh ($2013) in 2013 in good to excellent wind resource sites (without subsidies)—and has decreased by more than one-third over just the last 5 years
- Wind deployment has grown substantially, with total cumulative U.S. wind installed capacity at 2014 year-end of approximately 65 GW (4.5% of total U.S. consumption), representing a nearly fourfold increase in installed capacity from 17 GW at 2007 year-end
- Completed the down-select process for the Offshore Wind Advanced Technology Demonstration Projects FOA and funded three Phase 2 offshore wind demonstration projects in U.S. waters. Projects from seven recipients had been competitively awarded through Phase 1 in FY 2013.
- The "Atmosphere to Electrons" (A2e) wind plant optimization R&D consortium was launched as a multi-stakeholder, long-term, R&D initiative with a focus on the R&D activities required to optimize the cost and performance of fully integrated wind plants.

Wind Power Technologies – FY 2016 Budget Request

Goals/Metrics

- Achieve the office's wind power LCOE goals to support deployment of wind at high penetration levels, sufficient to meet up to 20% of projected U.S. electricity demand in 2030.
- Reduce the unsubsidized market LCOE for utility-scale land wind energy systems to $0.057/kWh by 2020 and $0.042/kWh by 2030 (from a reference wind cost of $0.069/kWh in 2014)
- Reduce the unsubsidized market LCOE for offshore fixed-bottom wind energy systems to $0.17/kWh by 2020 and $0.14/kWh by 2030 (from a reference of $0.20/kWh in 2014)

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Technology RD&T and Resource Characterization	0	34,658	58,160	+23,502
Technology Validation and Market Transformation	0	46,250	41,990	-4,260
Mitigate Market Barriers	0	11,207	28,062	+16,855
Modeling and Analysis	0	10,185	12,588	+2,403
NREL Site Wide Facility Support	9,000	4,700	4,700	0
Technology Development and Testing	61,145	0	0	0
Technology Application	17,981	0	0	0
Total, Wind Power Technologies	88,126	107,000	145,500	+38,500

Wind Power Technologies – FY 2016 Budget Highlights

- **Offshore Wind Demonstration Projects ($40M):** Year five of a six fiscal-year Offshore Wind Advanced Technology Demonstration program to support the establishment of a competitive U.S. offshore wind industry through offshore system development and demonstration.
- **Wind Plant Optimization (Atmosphere to Electrons Initiative) ($26.7M):** This initiative approaches wind plant optimization R&D holistically – identifying and assessing the underlying performance barriers and adopting innovative component and system technology options to improve cost and performance of utility-scale wind plants.
- **Advanced Components R&D ($12.2M):** Supports a new generation of rotor innovation incorporating higher tip speeds and new innovative drivetrain concepts that can be economically manufactured and integrated into wind turbines.
- **Advanced Grid Integration ($12.0M):** Supports DOE Grid Modernization Crosscut Team efforts to evaluate regional flexibility capabilities, and will conduct next generation integration studies utilizing newly developed 10-year wind data sets, and further develop wind-based transmission line planning tool architecture.
- **Distributed Wind R&D ($4.4M):** To capture the opportunities of this expanding market, the Competitiveness Improvement Program (CIP) will continue to support both existing and emerging small and medium-sized wind turbine manufacturing companies, and assist them in improving component designs, improving manufacturing competitiveness, and system certification.

Water Power Technologies– Overview

Motivation/Focus

- The mission of EERE's Water Power Technologies Office is to research, develop, test, and demonstrate innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from U.S. water resources at an accelerated pace.
  - **Marine and Hydrokinetic (MHK):** MHK technologies generate energy from highly forecastable waves and currents (tidal, ocean, river). With more than 50% of the American population living within 50 miles of the U.S. coastline, a cost-effective MHK industry could provide a substantial amount of electricity for the nation.
  - **Hydropower** is a proven renewable resource that provides the largest share of U.S. renewable generation. Significant opportunities remain to expand hydropower generation in the United States. Hydropower also provides strategically valuable ancillary benefits uniquely suited to support further integration of variable renewable energy technologies.

Achievements

- The *New Stream-Reach Development (NSD) Assessment* provides a national picture of the hydropower development potential in U.S. rivers and streams. The NSD Assessment concluded that the technical resource potential of these rivers and streams is 85 GW of capacity. When federally protected lands are excluded from the calculation, the potential is roughly 65 GW.
- The Water Power Program partnered with the United States Navy for several rounds of wave energy converter testing at the Navy's Wave Energy Test Site at Marine Corps Base Hawaii. Through a competitive solicitation issued in April, 2014 Ocean Energy USA and Northwest Energy Innovations were selected for testing in October, 2014.
- In September 2014, the Water Power Program launched the Wave Energy Prize Competition a $6.5 million design-build-test prize competition for wave energy converters. The contest has a prize purse and is intended to incentivize game-changing advances in wave energy conversion (WEC) device development.
- Hydropower Vision Launch: In April, 2014 the Water Power Program announced that it was looking toward the future of the hydropower industry by initiating the development of a long-range national Hydropower Vision. This landmark vision will establish the analytical basis for an ambitious roadmap to usher in a new era of growth in sustainable domestic hydropower over the next half century.

Water Power Technologies – FY 2016 Budget Request

Goals/Metrics

- MHK: Demonstrate component improvements that will allow increase in wave energy conversion system power-to-weight ratio (PWR) of 100 percent (baseline for wave is 0.25kW/ton).
- Hydropower: Invigorate hydropower industry innovation, identify or enable opportunities, and solve unique challenges in the United States to support the goal of expanding the contribution of hydropower and pumped storage hydropower in all identified resource classes.

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Hydropower Technologies	**17,290**	**19,200**	**25,500**	**+6,300**
Marine and Hydrokinetic Technologies	**41,275**	**41,100**	**40,800**	**-300**
NREL Site Wide Facility Support	**0**	**700**	**700**	**0**
Total, Water Power Technologies	**58,565**	**61,000**	**67,000**	**+6,000**

Water Power Technologies – FY 2016 Budget Highlights

- **Open Water Test Facility ($5M):** Complete front-end engineering and design for a potential full-scale, grid-connected open water wave test facility; results of the engineering and design will be used to support a programmatic go/no-go decision on further facility construction funding.
- **Wave Energy Conversion RDD&D ($25M):** In FY 2016, the MHK subprogram will focus on demonstrating and validating the performance of current MHK devices and encouraging innovations in advanced controls, power take offs, and optimized structures as key components necessary to achieve significant cost and performance improvements in WEC devices.
- **HydroNEXT - Non-Powered Dams (NPD) and Low-Impact New Development ($15M):** The Hydropower subprogram will initiate activities aimed at developing low cost, modular technologies for hydroelectric generation at non-powered dams. In addition, the subprogram will also invest in Low-Impact New Development (LIND) at undeveloped streams through development of powertrain and component technologies with low-impact, low-cost potential; balance of plant component cost reduction; and tools for environmental performance validation.
- **HydroNEXT - Pumped Storage Hydropower and Grid Integration ($3M):** The Hydropower subprogram will continue to investigate the benefits of modular pumped storage hydropower (PSH) as a means to integrate variable renewables onto the electric grid.
- **Water Power Market Acceleration and Deployment ($12.5M):** The Water Program will continue to invest in MA&D activities in FY 2016 that will help lower the barriers to deployment of innovative water power technologies, including monitoring instrumentation for MHK devices and biological design tools for engineering more sustainable hydropower turbines.

Geothermal Technologies – Overview

Motivation/Focus

- The Geothermal Technologies program accelerates the development and deployment of clean, domestic geothermal energy. It supports innovative technologies that reduce both the risks and costs of bringing geothermal power online.

Achievements

- **Successful EGS RD&D**
  - Ormat Technologies levered DOE funding to demonstrate the nation's first commercial EGS project to supply electricity to the grid, generating an additional 1.7 MW of power at its Desert Peak, NV site.
  - Lawrence Berkeley National Lab completed their fully integrated Thermal-Hydrologic-Mechanical model informed by 2 years of stimulation and injection data from the successful Geysers EGS demonstration project.
  - Baker Hughes completed the preliminary design for a measurement-while-drilling-system for geothermal applications capable of operation at 300°C for 50 hours and at depths of up 30,000 feet and complete with mud pulse telemetry system.
- **Successful Hydrothermal R&D in the Field**
  - Funded 11 Play Fairway Analysis awards promoting several new geographic areas for geothermal exploration.
  - In FY 2014, gradient well drilling at Pilgrim Hot Springs, Alaska was completed, establishing sufficient potential for signing of a power purchase agreement (PPA) by the city of Nome, AK.
- **Low Temperature and Coproduced Resources Successes**
  - Funded nine Mineral Recovery awards focused on improving the value-proposition of low to moderate temperature resources by pursuing additional revenue streams for geothermal operators.
- **Reducing Deployment Barriers**
  - Deployed the National Geothermal Data System (NGDS), a "best-in-class" data collection and dissemination effort. This initiative is critical to advancing geothermal research and resource development.

Geothermal Technologies – FY 2016 Budget Request

Goals/Metrics

- Demonstrate capability to create and sustain a 5MW Enhanced Geothermal Systems (EGS) reservoir by 2020.
- Lower the levelized cost of electricity from newly developed geothermal systems to $0.06/kWh by 2030.

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Enhanced Geothermal Systems	27,084	32,100	45,000	+12,900
Hydrothermal	10,285	12,500	36,500	+24,000
Low Temperature and Coproduced Resources	4,708	6,000	9,000	+3,000
Systems Analysis	3,698	3,900	5,000	+1,100
NREL Site-Wide Facility Support	0	500	500	0
Total, Geothermal Technologies	45,775	55,000	96,000	+41,000

Geothermal Technologies – FY 2016 Budget Highlights

- **Subsurface Technology and Engineering RD&D Crosscut (SubTER) ($71M):** Next generation advances in subsurface technologies will enable access to more than 100 gigawatt-electric (GWe) of clean, renewable geothermal energy. SubTER provides a collaborative structure to identify scientific and technology challenges, efficiently leverage funding and expertise through multi-office collaborations, and avoid redundancy of duplicative efforts.
    - **Frontier Observatory for Research in Geothermal Energy (FORGE) ($35M):** As part of the ongoing subsurface-related R&D, Geothermal Technologies will launch and fully implement phase 3 of FORGE to advance to a down-selected site and field operations.
    - **New Subsurface Signals, Permeability Manipulation, Stress and Induced Seismicity, and Other Ongoing Subsurface Related R&D ($36M):** Advance imaging technologies for subsurface interrogation from the wellbore into adjacent rock bodies, develop new tools and methodologies to measure and manipulate subsurface stress, and reduce cost and risk associated with geothermal exploration and development.
- **Play Fairway Validation (PFA) ($8M):** Advance the PFA initiative towards field validation, through the drilling of select and specifically-located wells in high-potential "Blind" geothermal resources areas, to quantitatively identify the most prospective areas for new geothermal development.
- **Low Temperature Mineral Recovery ($5M):** A new FOA to bridge the gap between R&D and commercial adoption of geothermal mining technologies with cost-shared development of pilot scale extraction technologies at geothermal mining and power production sites.

Questions?

Submit your questions via the “Questions” window on your GoToWebinar dock.

For Further Information

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http://www.eere.energy.gov/

Webinar Slides & Fiscal Year 2016 EERE Budget Request Information:

http://energy.gov/eere/eeres-2016-budget

For more information, please contact

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