FEMP 50

50 Years of Federal Energy Management

Connecting Buildings: Data and Performance

Jason Koman, Jefferey Murrell, Nael Nmair

Learning Objectives

Upon completion of this training, you will be able to:

- Understand how agencies can use building energy data to meet agency goals, through EMIS and metering approaches
- Learn best practices and resources FEMP has helped develop to secure connected OT & GEBs
- Understand how building data can inform O&M

FEMP 50

Federal Energy Management Program

Connecting Buildings: Data and Performance

Jefferey Murrell, PE, MBA

Learning Objectives

- Become familiar with the new Federal Metering Guidance (revised), new water metering best practices guide, water mapping tools, and the new Federal EMIS Guide
- Learn the importance and benefits of a full-functioning and accredited advanced metering infrastructure (AMI), grid-interactive energy buildings (GEB), meter tracking systems, and EMIS
- Understand Federal Government Drivers
- Learn how agencies implement metered data and control systems into Performance Contracting (PC) projects through success stories

Advanced Metering Requirements per Energy Act 2020

What is the Federal Metering Guidance?

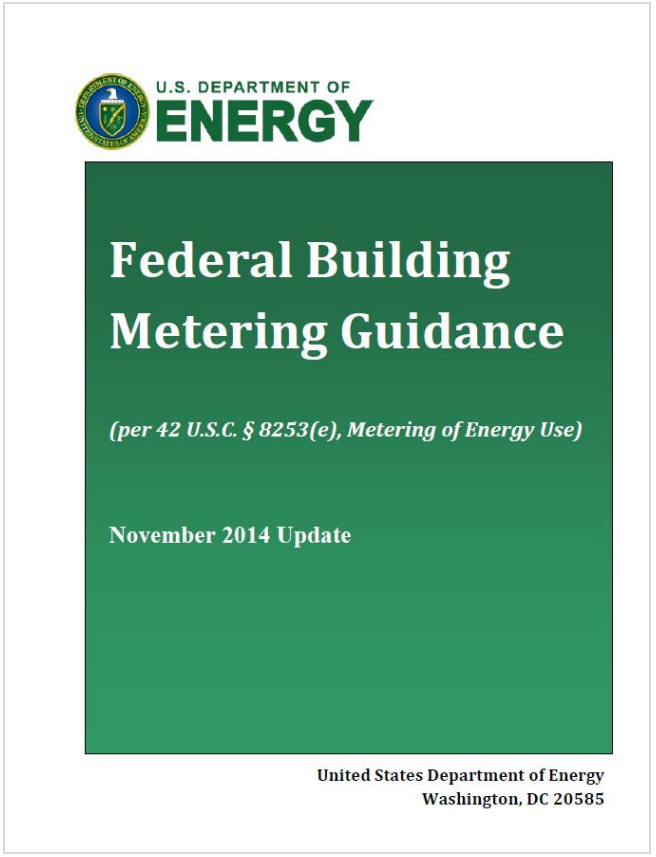
- **Objectives:**
  - Advise Federal agencies on the legal requirements to meter their buildings
  - Recommend a process for prioritizing buildings for metering
- **Intended audience:**
  - Federal energy and water managers
  - Federal facility managers
- **Key elements:**
  - Background and legislative authority
  - Metering Determination Process
  - Five-year Metering Plans
  - New appendix: metering program planning recommendations

Authorizing Legislation

- **EPAct 2005 Section 103**
  - Introduced electricity metering requirement for all Federal buildings
  - Use advanced meters to the "maximum extent practicable"
  - FEMP released first Metering Guidance in 2006
- **EISA 2007**
  - Annual benchmarking of metered buildings that are part of covered facilities
  - Natural gas and steam metering requirement
- **Energy Act of 2020**
  - New requirement for water metering
- **Previous update to Guidance released in 2014**

New Guidance published in October 2022

Previous Guidance



Updated Guidance

Latest Update – Energy Act of 2020

- **Required DOE to update Federal Metering Guidance considering new water metering requirement**
- **Upon publication of update, Federal agencies required to submit updated Metering Plans to FEMP within 180 days**
  - Target submission: April 2023
- **FEMP will continue provide technical assistance to agencies developing Metering Plans**
- **Initial Agency Feedback will shape the FEMP Metering Program in FY24 and beyond**
  - Quarterly Federal Metering Community of Practice Meetings
  - Revised Metering Training and Web-based Federal Metering Best Practices Guide
  - EVSE and Metering Best Practices Guide
  - Carbon Pollution-Free Electricity (CFE) and Metering Tool Guide

Energy Management Information System (EMIS) and Grid Interactive Energy Buildings (GEB) Requirements per Energy Act 2020

Energy Management Information Systems (EMIS) Requirements per Energy Act of 2020

EMIS Definition:

Energy Management Information Systems (EMIS) are a broad and rapidly evolving family of tools that monitor, analyze, and control building energy use and building/metering system performance

EMIS can support and improve site energy management by providing building owners and operators with well-organized building performance and energy consumption data, enabling a host of analytic capabilities. These capabilities include portfolio-wide energy benchmarking, data visualization, and key performance indicator tracking; automated fault detection and diagnostics; automated measurement and verification of energy conservation measures; and supervisory control enabling automated system optimization and demand management.

EMIS Capabilities that Support Federal Requirements and Mandates

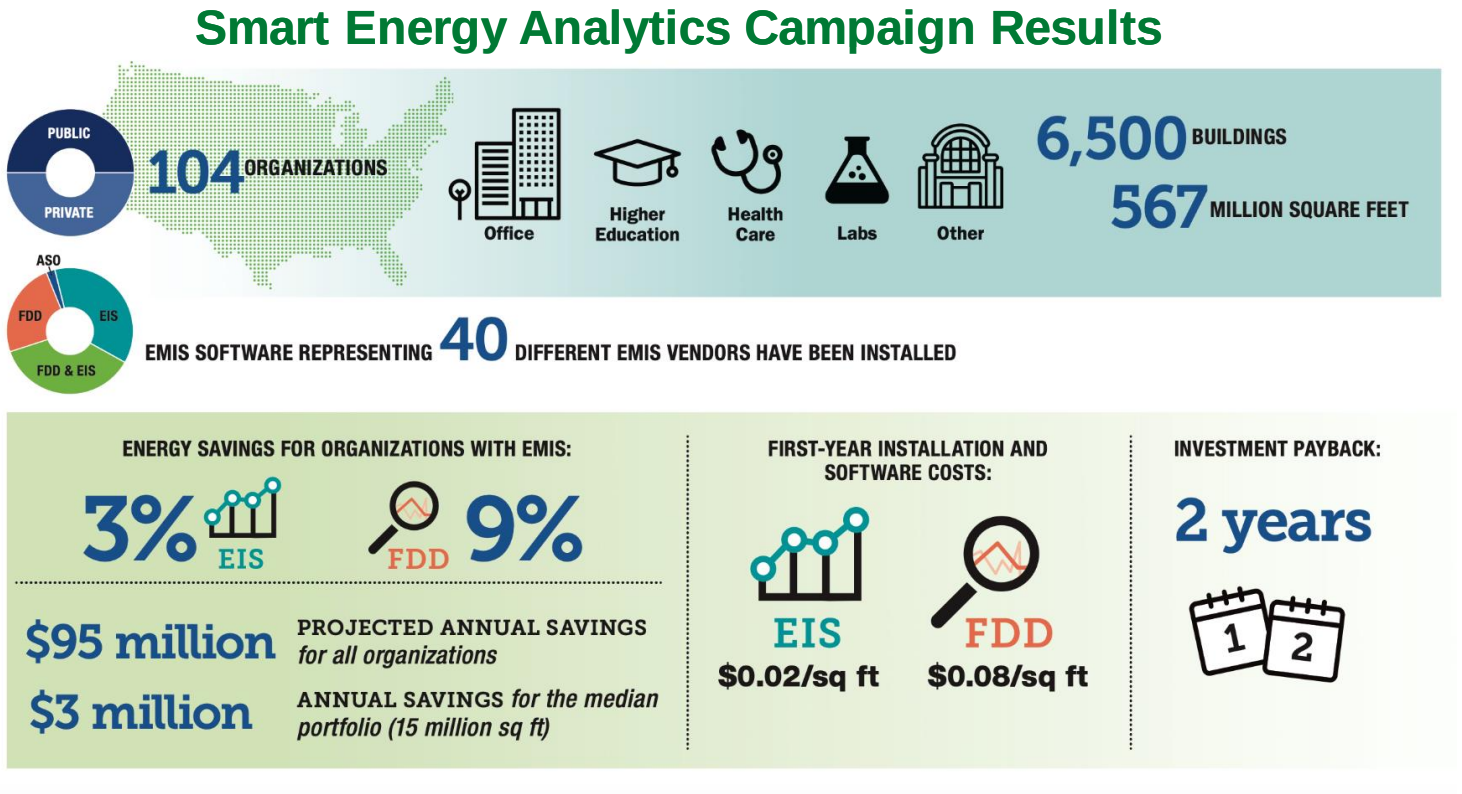
Category From EPAct, EISA 2007, & EO	Centralize, Normalize, Visualize Data	Utility Bill Management	Interval Meter Analytics	Measurement & Verification (M&V)	Automated Fault Detection and Diagnostics (AFDD)	Supervisory Control	O&M Optimization
	EMIS Capabilities						
Energy Reduction	✔	✔	✔	✔	✔	✔	✔
Data Center Management	✔	✔	✔	✔	✔	✔	✔
Benchmarking of Federal Facilities	✔	✔	✔	✔			
Energy and Water Evaluations	✔	✔	✔	✔	✔		✔
Follow Up on Implemented Measures	✔		✔	✔	✔	✔	✔
Recommissioning and Retro-Commisioning	✔		✔	✔	✔	✔	✔
Web Based Certification	✔	✔	✔	✔			
Metering Requirements	✔	✔	✔	✔			
Annual Energy Report	✔	✔	✔	✔			
Renewable Energy Report	✔		✔				
Waste Management	✔	✔					✔
Water Management	✔	✔	✔				✔

Reference: https://www.energy.gov/eere/femp/energy-management-information-systems-federal-facilities

Smart Energy Analytics Campaign Results

EMIS deployment is increasing nationwide

- DOE BTO and LBNL ran SEAC from 2016 to 2020
- EMIS installed on 567 million ft^2
- Campaign results: FDD savings of 9% and EIS savings of 3%



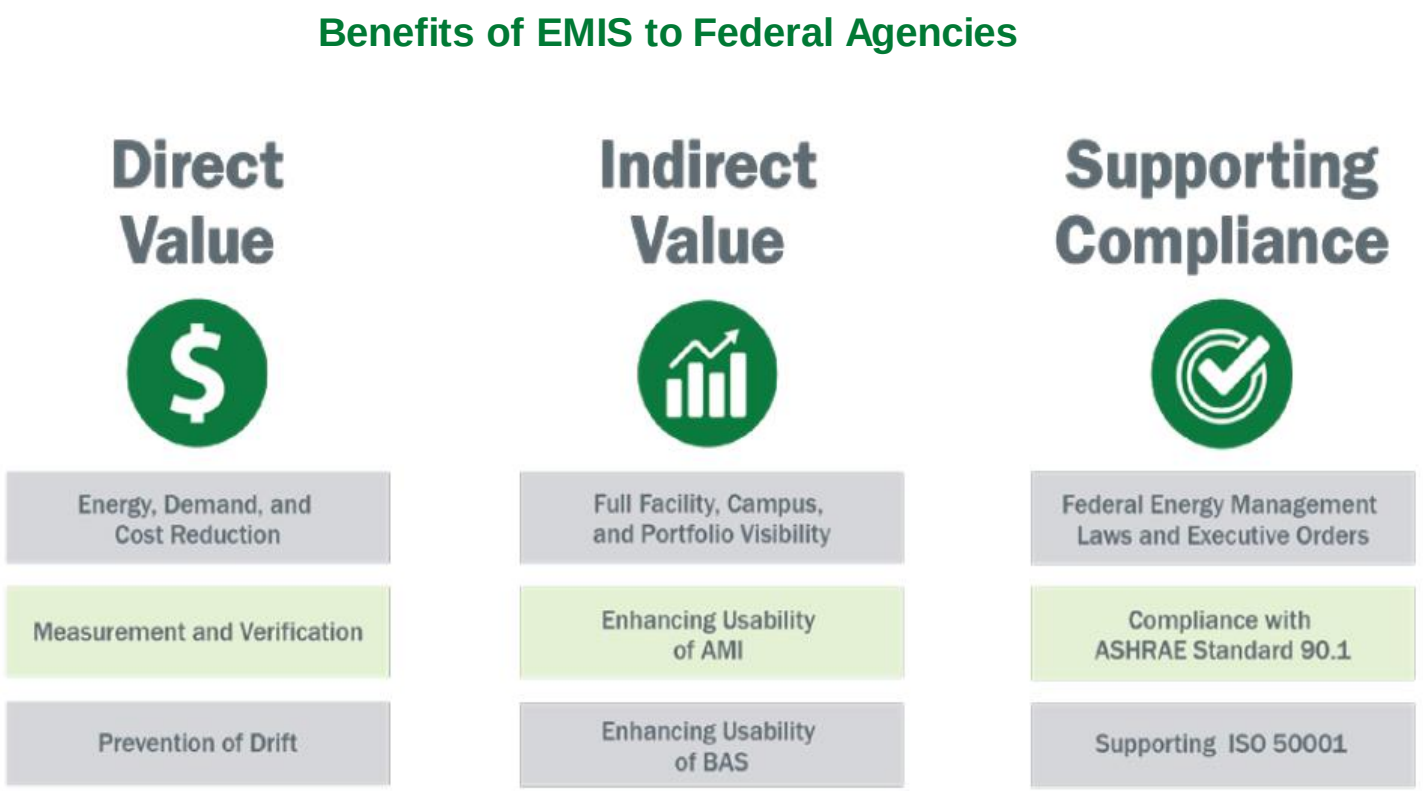
Benefits of EMIS to Federal Agencies

Direct Value

- Reduce energy and demand
- Commercially available EMIS
  the investment

Indirect Value

- Add value to agency's core m
- Meter data systems
- Compliance with laws and re



Reference: https://www.energy.gov/eere/femp/energy-management-information-systems-federal-facilities

FEMP EMIS Webpage

FEMP EMIS Website Content:

- EMIS Technical Resources Report
- EMIS Technical Specification
- EMIS Planning and Procurement
- EMIS Resources
- EMIS Case Studies
- 50001 Ready Program

Completed Publications

- Best Practices for EMIS Metadata Schemas
- EMIS Cybersecurity Best Practices
- Best Practices to Support EMIS Operation at Federal Facilities
- Best Practices for Enhancing Performance Contracts with Monitoring-Based Commissioning (MBCx)

FEMP EMIS Website Content

EMIS Planning and Procurement

Provides steps for planning and procuring an EMIS and includes EMIS procurement support materials.

Learn more

EMIS Resources

Offers supplemental links to websites, tools, and documents to support implementing EMIS in facilities.

Learn more

EMIS Case Study

Covers NREL's Intelligent Campus and how it leverages its own lab buildings to study renewable energy with quantitative measures.

Learn more

50001 Ready Program

Recognizes facilities and organizations that attest to the implementation of an ISO 50001-based energy management system.

Learn more

Reference: https://www.energy.gov/eere/femp/energy-management-information-systems-federal-facilities

Smart Building Technologies and Opportunities

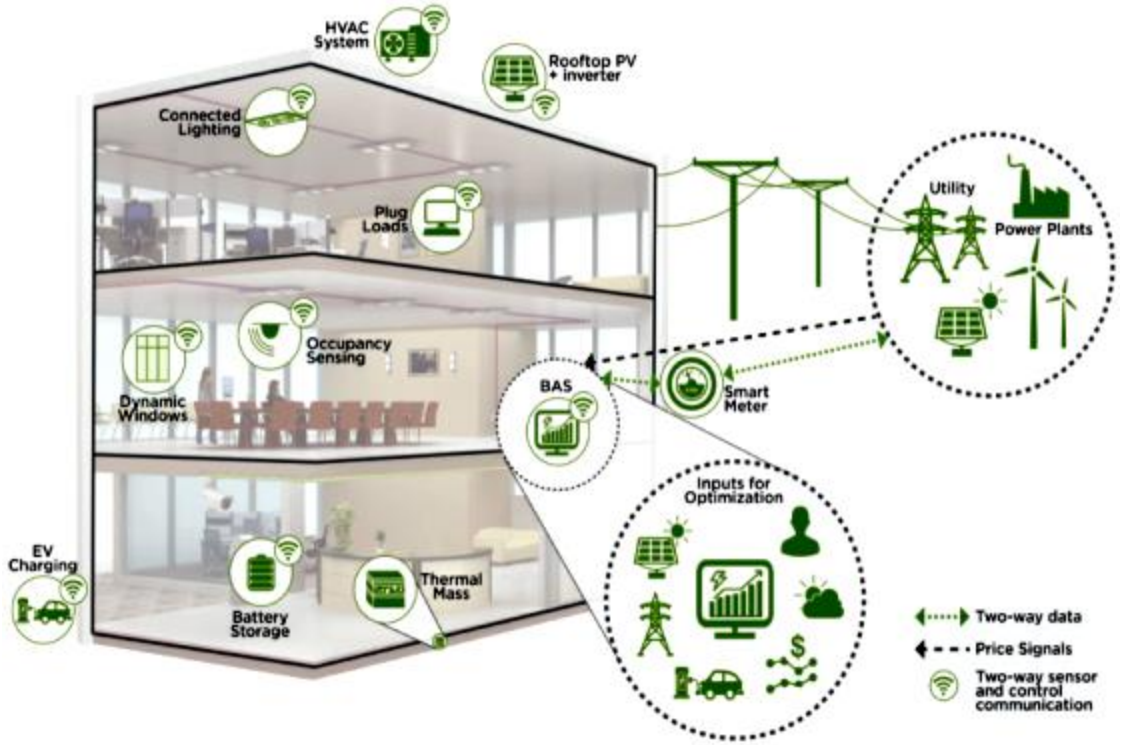


Figure.1 Example Commercial Grid-interactive Efficient Building [1]

The building **Energy Management and Information System (EMIS)** utilizes analytics supported to optimize energy use for occupant patterns and preferences.

- EMIS acts as the "brains" that operate the building from data and information.

Utility price "signals" and weather forecasts are used by the EMIS to stage operations to reduce CO2 output and operating cost.

EMIS can dispatch or stage building loads to offset the irregular, swings from on-site generation PV generation, making distributed renewables easier to implement.

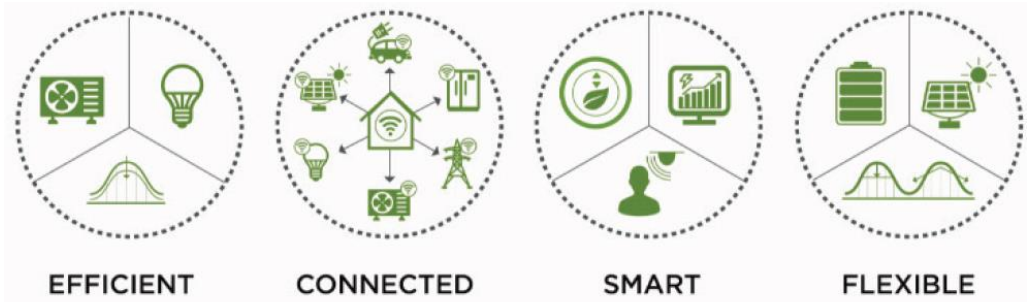
All of this is not possible without devices that can communicate, devices that have controls and variable modes or settings, that are smart and flexible/responsive.

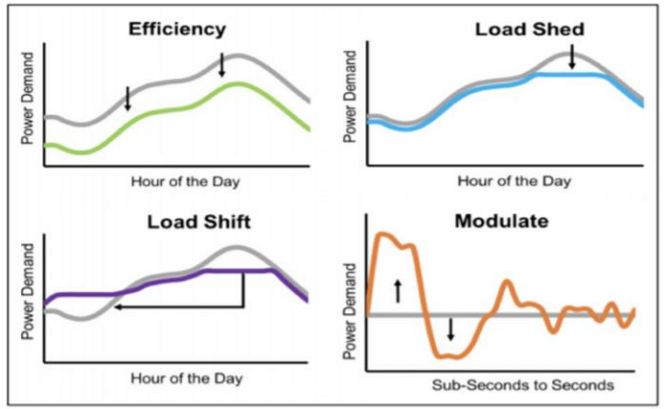
Adapted from Neukomm, M., Nubbe, V., & Fares, R. (2019). Grid-interactive Efficient Buildings: Overview. Office of Energy Efficiency and Renewable Energy, US DOE, Washington, DC, Tech. Rep.

Grid-Interactive Efficient Buildings for Federal Agencies | Department of Energy

FEMP's Grid-interactive Efficient Buildings (GEBs) FEMP's Grid-interactive Efficient Buildings (GEBs)

Per the **Energy Act of 2020**, a GEB is an **energy efficient** building with **connected** and **smart** technologies characterized by use of **flexible** Distributed Energy Resources (DER) to optimize energy use for utility benefits, occupant benefits, new manufacturer offerings, and/or societal benefits in a continuous, integrated manner.





- **Energy-efficient design** — high-quality walls and windows, high-performance appliances and equipment, and optimized whole building design.
- **Connected** — the ability to send and receive "signals" to respond to grid needs and/or other externalities.
- **Smart** — appropriate sensing and responsive controls that use data to benefit operations.
- **Flexible** — the building energy loads can be "shifted" in time to help mitigate solar generation, electric vehicle charging, and/or energy storage.

Adapted from Neukomm, M., Nubbe, V., & Fares, R. (2019). Grid-interactive Efficient Buildings: Overview. Office of Energy Efficiency and Renewable Energy, US DOE, Washington, DC, Tech. Rep.

Water Mapping Tools and Water Metering Best Practices Guide per Energy Act 2020

FEMP Water Metering Resources

- https://www.energy.gov/eere/femp/water-metering-resources

Water Metering Requirements per 42 U.S.C. § 8253(e)

- By October 1, 2022, all federal buildings, for the purposes of efficient use of water and reduction in the cost of water in such buildings, shall be metered.
- Each agency shall use, to the maximum extent practicable, advanced meters or advanced metering devices that provide data at least daily and that measure at least hourly consumption of water in the federal buildings of the agency.
- Meter data shall be incorporated into federal water tracking systems (e.g. ISO 50001, Energy Management Information Systems) and made available to federal facility managers.

Water Meter Selection Considerations

- Meter Size
- Water Demand Profile
- Accuracy
- Pressure Loss

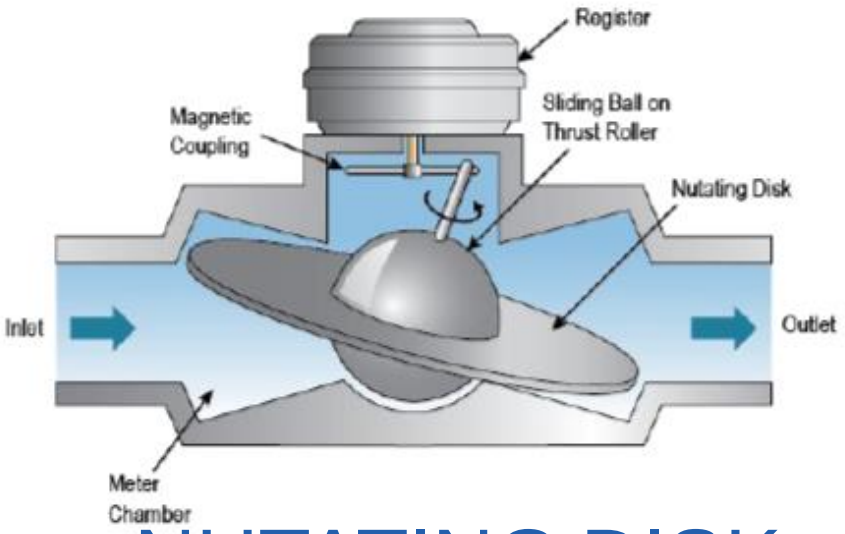
- **Location**
- **Networking and Cyber Security**
- **Communication & Data Management**
- **Cost**

Determining the Water Demand Profile

- To select the right meter type and size, determine the building or application *flow range* and estimate percentages for each:
  - Low flows (0.25 gpm–30 gpm)
  - High flows (30 gpm–1000+ gpm)
  - Maximum continuous duty (varies)

- Temporary data logging may be required to collect water use profile data (minimum of 7 days). The existing meter (typically utility owned) must be tested for valid data logging.

Common Water Meters in Buildings



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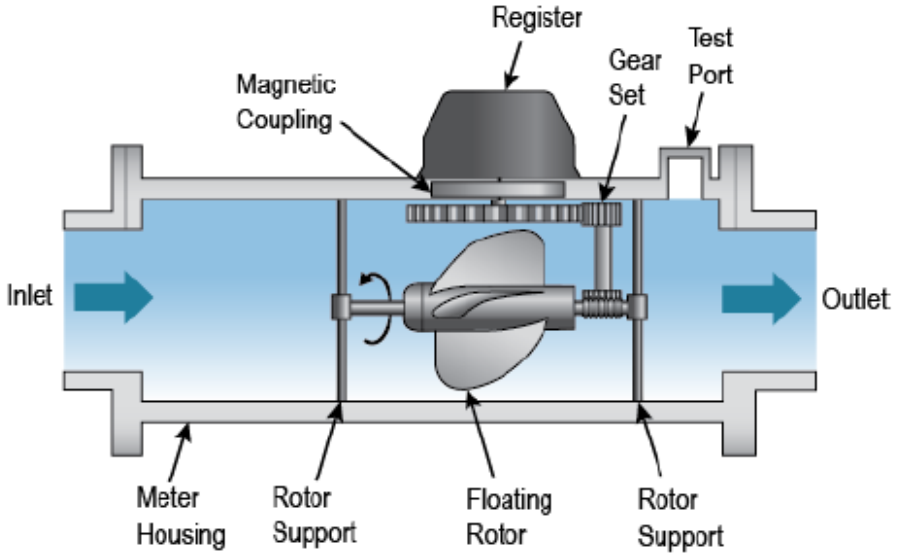
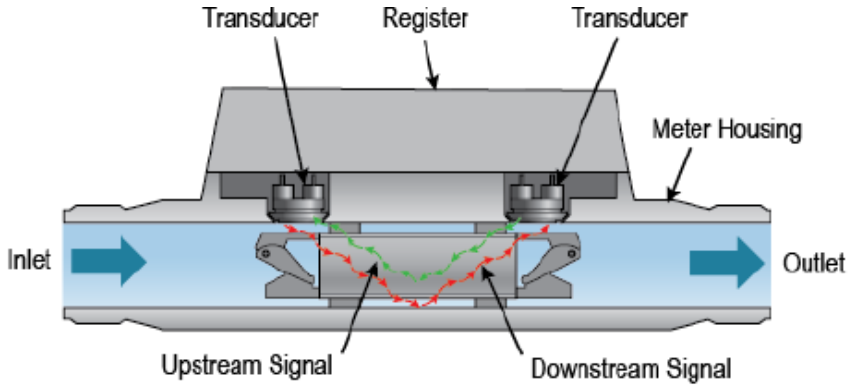
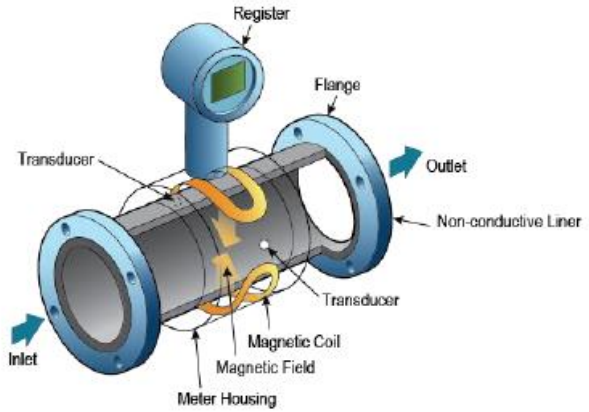


TURBINE/COMPOUND



ULTRASONIC



ELECTROMAGNETIC

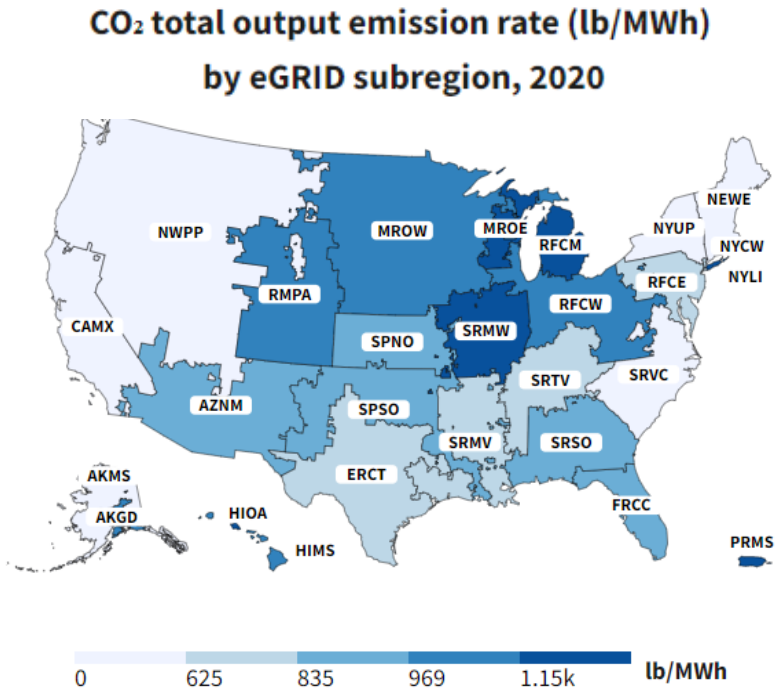
Water Meter Characteristics

Meter Type	Meter Category	Cost	Flow Range (gpm)	Turn Down Ratio (High to Low)	Meter Size Range	Pressure Drop	Applications	Testing Frequency
Water Meters Applicable for Most Building Applications								
Nutating Disk	Positive Displacement	$	0.25 to 400	3:1 to 20:1	5/8" to 2"	Low	Single Family Residential, Small Commercial,	10-15 years
Turbine Class II	Velocity	$$	4 to 12,000	20:1 to 50:1	¼" to 20"	Medium	Large Office, Irrigation, Education, Hospitals	Annual
Ultrasonic	Electronic	$$ to $$$	0.05 to 10,000	100:1	5/8" to 120"	Low	Single Family Residential, Multifamily Residential, Hospital, Commercial, Irrigation	1-5 years
Electro-magnetic	Electronic	$$ to $$$	0.1 to 100,000+	400:1	½" to 72"	Low	Single Family Residential, Multifamily Residential, Hospital, Commercial, Irrigation	1-5years
Compound Class II	Compound	$ to $$	0.25 to 4,500	100:1 to 1,000:1	2 to 8"	High	Multifamily Residential, Hospital, Commercial, Education, Irrigation	1-5 years

CFE and Advanced Metering

What is 24/7 Carbon Pollution-free Electricity (CFE)?

- **24/7 CFE means that during every hour of every day, every kilowatt-hour (kWh) of electricity consumption is matched with a kWh of carbon pollution-free electricity generation**
- Can apply at any scale:
  - Building
  - Campus
  - Grid
- Fossil fuels are part of the grid-supplied electricity generation mix in every region of the U.S.

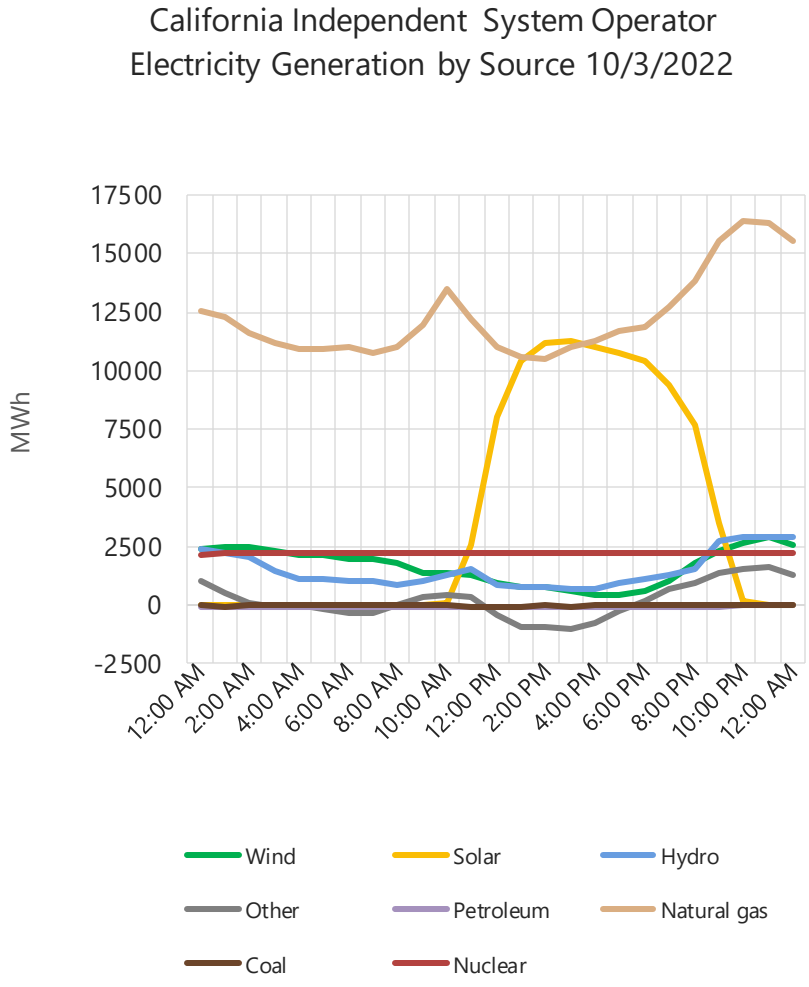


Source: U.S. Environmental Protection Agency

- Currently, any facility that uses grid-supplied power is responsible for Scope 2 greenhouse gas (GHG) emissions from fossil-fueled electricity generation

Ways to achieve 24/7 CFE

- **Demand management**
  - The less electricity a facility uses, the lower its scope 2 GHG emissions, no matter what the regional grid mix is
  - Timing matters—grid emission factors vary throughout the day depending on which generators are online
- **On-site CFE generation and storage**
  - Distributed energy resources, such as rooftop solar, can provide power to a facility directly and displace fossil-fueled power from the grid
  - On-site batteries can provide short-term storage for excess CFE and further displace grid power when CFE resources are unavailable (e.g., after sunset)
- **CFE procurement**
  - Bundled or unbundled purchases of power and/or energy attribute certificates can be matched with facility electricity consumption



Source: U.S. Energy Information Administration

Value of 24/7 CFE

- Acknowledges that timing and geography matter
  - Matching 100% of total electricity use with EACs does not equal 100% hourly CFE
  - Unbundled EACs may come from other regions
- Encourages multi-pronged CFE strategies
  - Demand management
  - On-site CFE generation and storage
  - CFE procurement
- Creates a framework for time-based valuation of CFE generation
  - Higher value for CFE generation during periods of low CFE availability
- Incentivizes investment in clean firm generation technologies
  - Needed to “fill the gaps” left by variable renewable energy (e.g., wind and solar)
  - Geothermal power, nuclear, natural gas with carbon capture & storage, and synthetic and biofuels

24/7 CFE Goals for Federal Agencies

100% Carbon Pollution-Free Electricity by 2030, including 50% on a 24/7 basis

- Executive Order 14057 (*Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*)
  - Ambitious goals for federal facilities and fleets
  - Significant, coordinated federal action needed
- January 2023 Annual Energy Report:
  - Agencies must report on their approach to getting their hourly facility consumption profiles by grid region—advanced meters, utility data
  - Agencies must report the percentage of their electricity consumption by grid region on an hourly basis
- CEQ will issue guidance for 24/7 CFE accounting in FY23
  - Coordinating with DOE-FEMP, EPA, and OMB

Carbon Pollution-Free Electricity Resources for Federal Agencies | Department of Energy

Advanced Metering and 24/7 CFE

- Advanced electricity meters are **critical to the success of 24/7 CFE**—they provide the baseline data required to match a facility's hourly demand with hourly CFE generation
  - An advanced electricity meter records consumption data hourly or more frequently and provides for daily or more frequent transmittal of measurements over a communication network to a central data collection point
  - A standard cumulative electric meter **cannot** be used to demonstrate compliance with 24/7 CFE goals
- Key data sources for calculating a facility's CFE score:
  - Whole-facility advanced electricity meter
  - Submeters for on-site DERs and storage
  - Hourly generation data from purchased CFE
  - Local hourly electric grid mix data

Metered Data, Control Systems, and Performance Contracting

Agency Federal Goals and Requirements

Agency energy projects will enable progress toward several administration and congressional priorities focused on energy and water efficiency, decarbonization, investment, jobs and American manufacturing.

Energy Act of 2020

- Agencies to use performance contracting to address at least 50% of ECMs identified
- Agencies to implement all cost-effective ECMs identified within two years
- FEMP to establish a Federal Smart Building Program

Executive Order 14057

- Government-wide targets for long-term and mid-term GHG reductions
- 100% net zero buildings, zero-emission fleets, 24/7 carbon pollution-free electricity
- Net zero federal government operations by 2050 or sooner

Climate Smart Building Initiative (CSBI)

- Agencies to establish emissions reductions targets delivered through performance contracting
- Increase on-site clean electricity generation
- Support plan to reduce emissions from Federal buildings by 50% by 2032

Federal Building Performance Standard

- Support achievement of net-zero emission for federal building portfolio
- Zero scope 1 emissions from on-site fossil fuel use in 30% of agency's federal buildings (by GSF) by FY 2030
- Applies to federally-owned, EISA-covered facilities in U.S. and U.S territories

Note: Descriptions are illustrative and not comprehensive.

Performance contracting supports all of these goals and requirements

What are Performance Contracts?

Contracts that allow agencies to do energy projects with no up-front costs and no additional appropriations from Congress.

Utility/ESCO

- Develops and installs energy/water conservation measures (ECMs)
- Resulting cost savings to cover project costs

Agency

- Pays utility or ESCO over term of contract from savings
- Contract administration ➔ life of contract

FEMP
Federal Energy Management Program

- Provides support upon request: technical, financing, and contracting expertise

Key Feature of Performance Contracts

Legislated purpose: Achieve energy savings and ancillary benefits

- Max contract term is 25 years (starting with task order award)
- Financing and appropriations may be combined
- Utility/ESCO is responsible for obtaining financing
- Contracts are firm-fixed-price
- Multiple sites may be included in a single task order
- May include advanced metering, energy monitoring information systems/control systems, O&M, repair & replacement

Energy Savings Performance Contract (ESPC)

- Prime contractor = Energy Service Company (ESCO) (DOE IDIQ, ENABLE, Army MATOC)
- Savings guarantees and M&V are required – savings must exceed payments each year
- ESCO is responsible for O&M regardless of who performs O&M

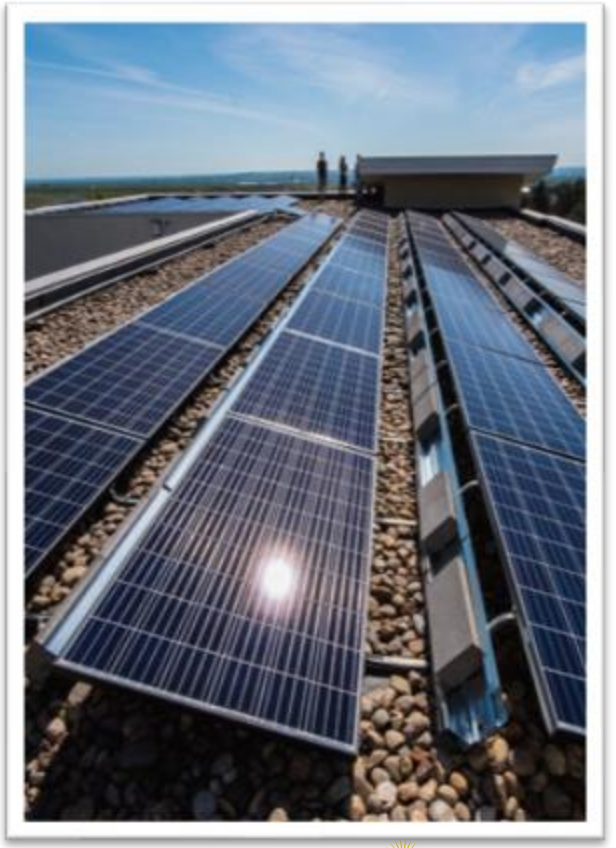
Utility Energy Service Contract (UESC)

- Prime contractor = local serving distribution utility (electric, gas, or water)
- Performance assurance plan or savings guarantees are required – savings to exceed payments over contract term

What can be bought and how is it is paid for?

- Energy and water conservation measures* that meet
  - Virtually any ECMs that reduces energy applied to
  - This can include EV Chargers (EVSE) as part of a related ECM or as an ECM for demand cost savings

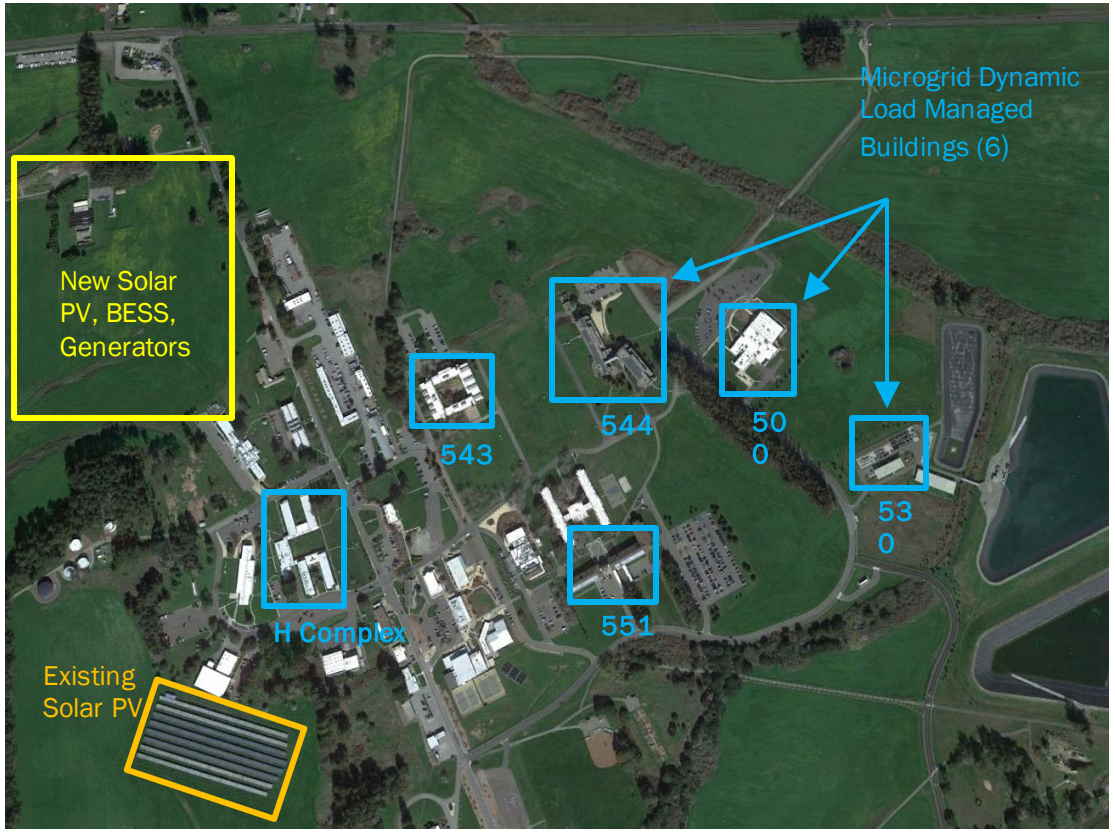
- How to pay for performance contracts
  - Measurable/verified energy, demand, and water cost savings
  - Energy- and water-related cost savings (O&M and R&R)
  - Avoided equipment cost savings
  - Appropriations, grants (e.g., FEMP AFFECT), rebates, renewable energy credits, and other incentives



*Energy Act of 2020

USCG Training Center Petaluma Project Award

- **$48M ESPC award that will accomplish $36.1M in capital investment**
  - Annual savings of $1.2M, 8.7M kWh/yr of electricity and 50.8 kgal/yr of propane
- **Energy resilience ECMs accomplished with an ESPC Energy Sales Agreement**
  - GHG reduction of more than 3,950 tons CO2 equivalent
- **Energy resilience ECMs**
  - **Solar PV - 5MW**
  - **Battery Energy Storage - 11.6MWh**
  - **Backup Generators**
  - **Microgrid**
  - **MV Transformers**
  - **EV Chargers**
  - **Advanced Energy Metering**



Less than 2% of overall project savings but essential to balance the plant.

ESPC ESA Case Study: NIST Campus (Gaithersburg, MD)

Site

- National Institute of Standards and Technology

System

- 5 MW-DC fixed-tilt ground-mounted PV system
- Contract vehicle through ENABLE with an Energy Sales Agreement (ESA) for PV (no other ECMs)
- Awarded May 2018
- Accepted/Completed Dec. 2018
- Estimated First Year Production ~6.1 million kWh
- Guaranteed Annual Cost Savings from PV ~$500,000

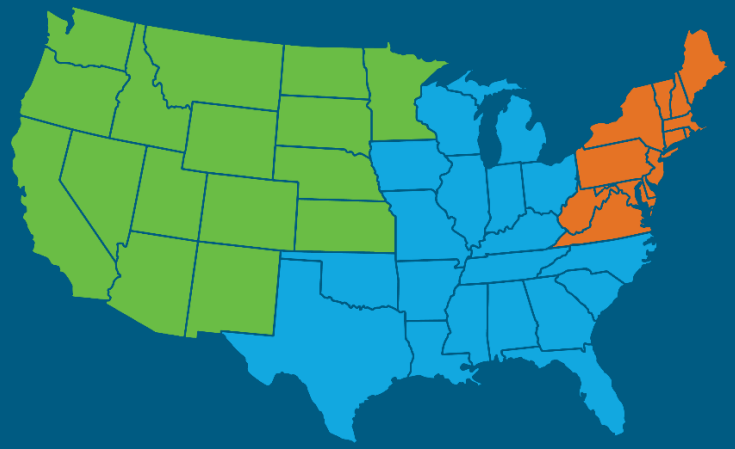
NIST Case Study

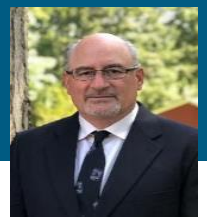
Proposed Next PC project

- Campus-wide EMIS connected to advanced meters
- Smart lab and data center improvements; various ECMs

How to Get Started with a Performance Contract: Your Federal Project Executive (FPE)

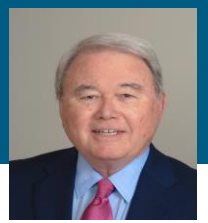
- Help with all performance contracting: ESPC, ENABLE, ESAs and UESCs
- Connect you with lab, Subject Matter Experts (SME), resources





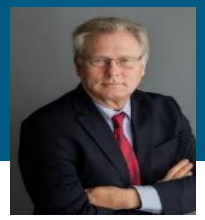
Western Region

Scott Wolf
Western Region plus East Asia and the Pacific; Near, South, and Central Asia
360-866-9163
wolfsc@ornl.gov



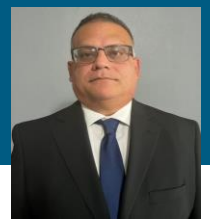
Southeast Region

Doug Culbreth
Southeast Region plus Europe and Western Hemisphere
919-870-0051
culbrethcd@ornl.gov



Northeast Region

Tom Hattery
Northeast Region plus State Dept.
202-256-5986
thomas.hattery@hq.doe.gov



Multi-regional Support

Michael Mungal
All Regions
954-812-7082
mungalmj@ornl.gov

Click here for more information about how FPEs can help you.

Thank You!

Jefferey Murrell, FEMP
Jefferey.murrell@hq.doe.gov

FEMP 50
50 Years of Federal Energy Management

FEMP 50

Federal Energy Management Program

Connected Buildings: Energy Opportunities and Cyber Challenges

Jason Koman

GEB Legislative Drivers

- **EISA 2007**
  - Numerous mentions (114 to be exact!) of “smart”, from smart grid technologies to smart consumer devices and appliances to smart services and practices

- **EA 2020**
  - Smart building acceleration: The section requires the Secretary of Energy, as a part of the Better Building Challenge, to develop smart building accelerators to demonstrate innovative policies and approaches to accelerate the transition to smart buildings. The section also establishes a R&D program focused on building-to-grid integration

- **EO 14057 (Catalyzing America’s Clean Energy Industries and Jobs through Federal Sustainability)**
  - Guidance for both existing facilities (energy efficiency and deep energy retrofits) and new construction and modernization to implement GEB.

Key Characteristics of Grid-Interactive Efficient Buildings (GEBs)

A GEB is an energy-efficient building that uses smart technologies and on-site DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences, in a continuous and integrated way.

EFFICIENT

Persistent low energy use minimizes demand on grid resources and infrastructure

CONNECTED

Two-way communication with flexible technologies, the grid, and occupants

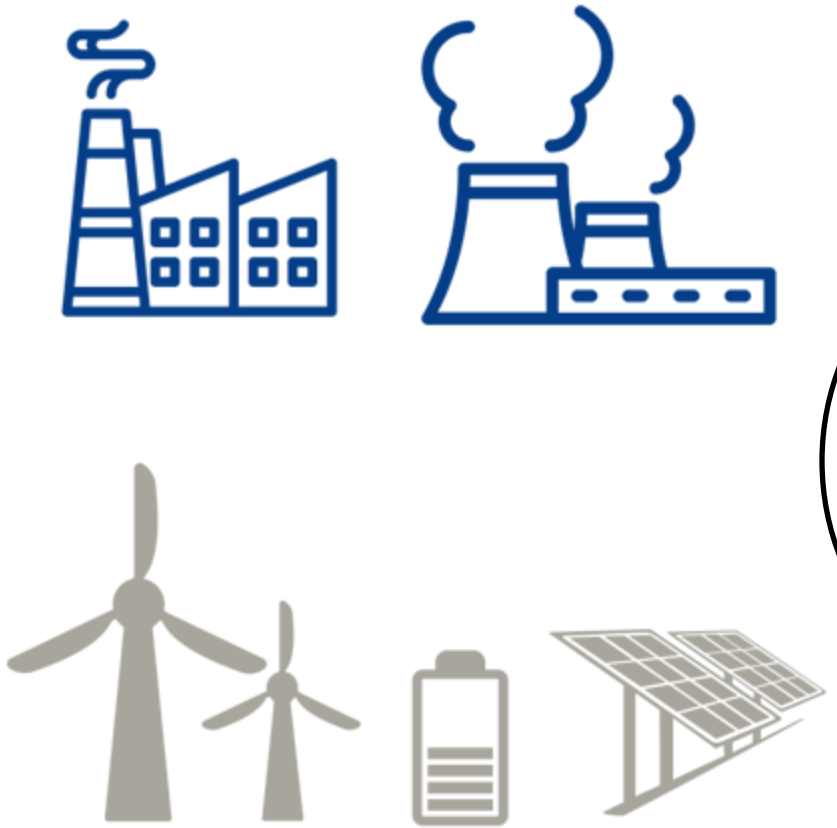
SMART

Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences

FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

GEB is about enabling buildings to provide flexibility in energy use and grid operations



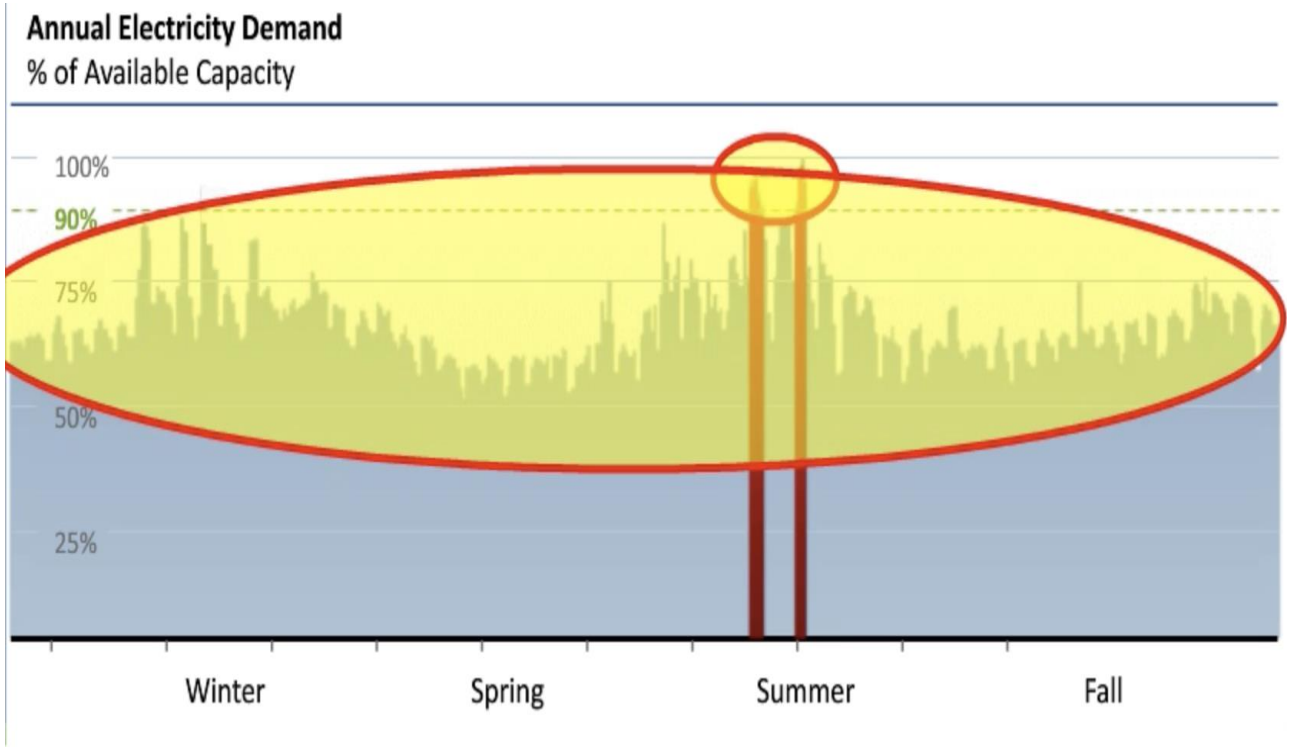
Central Supply

~75% of electricity generation is used in buildings

Distributed Supply and Demand

Building Peaks Drive Grid Peaks

- 80% of grid peak demand is driven by buildings
- >10% of grid infrastructure costs are spent to meet the peak demand that occurs <1% of the time – making those peak times the most expensive, and likely carbon intensive power
- Building level RE exports are coincident with peak grid/utility RE generation

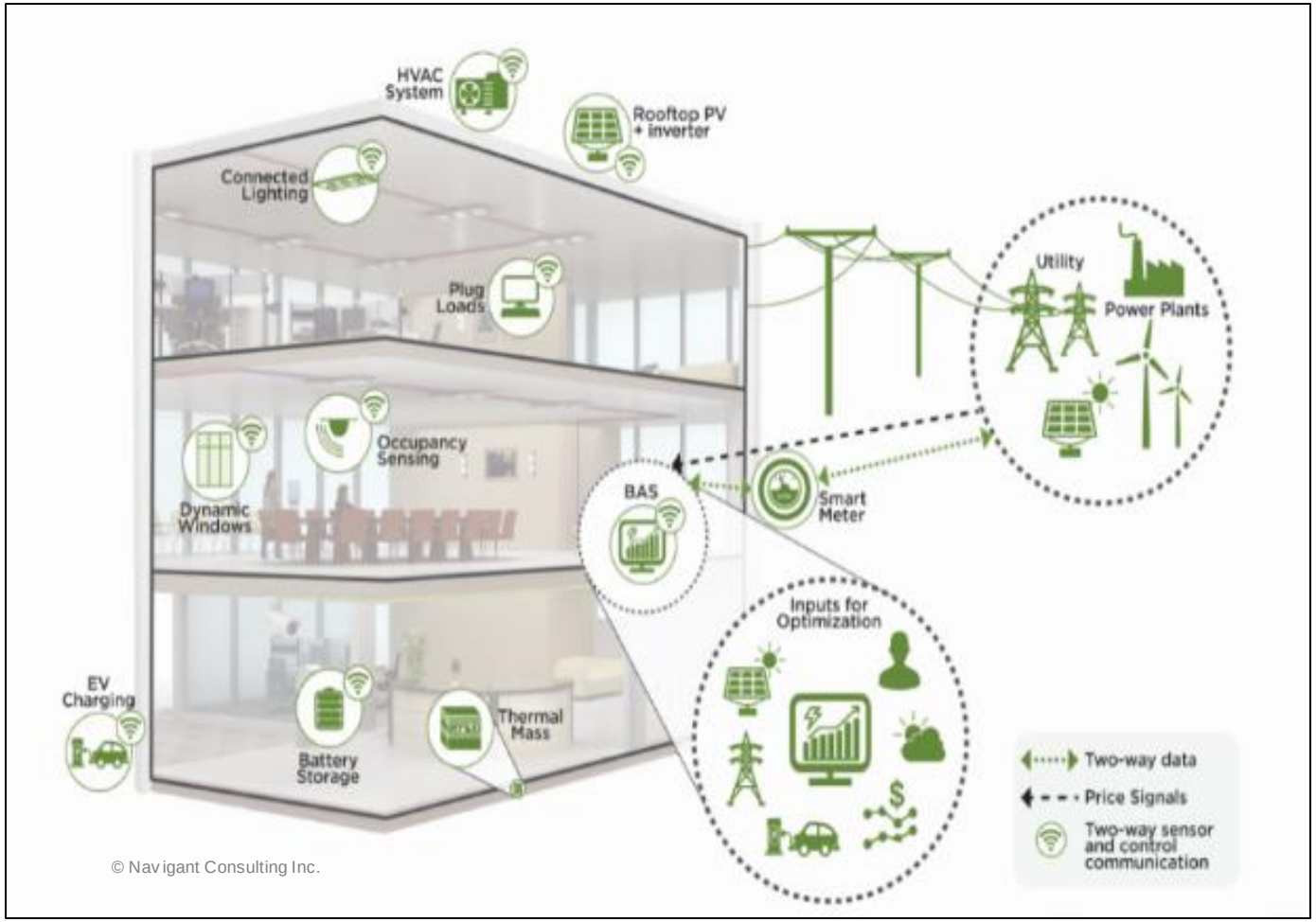


GEBs enable buildings to work with the power grid, not against it – unlocking value and enabling grid decarbonization

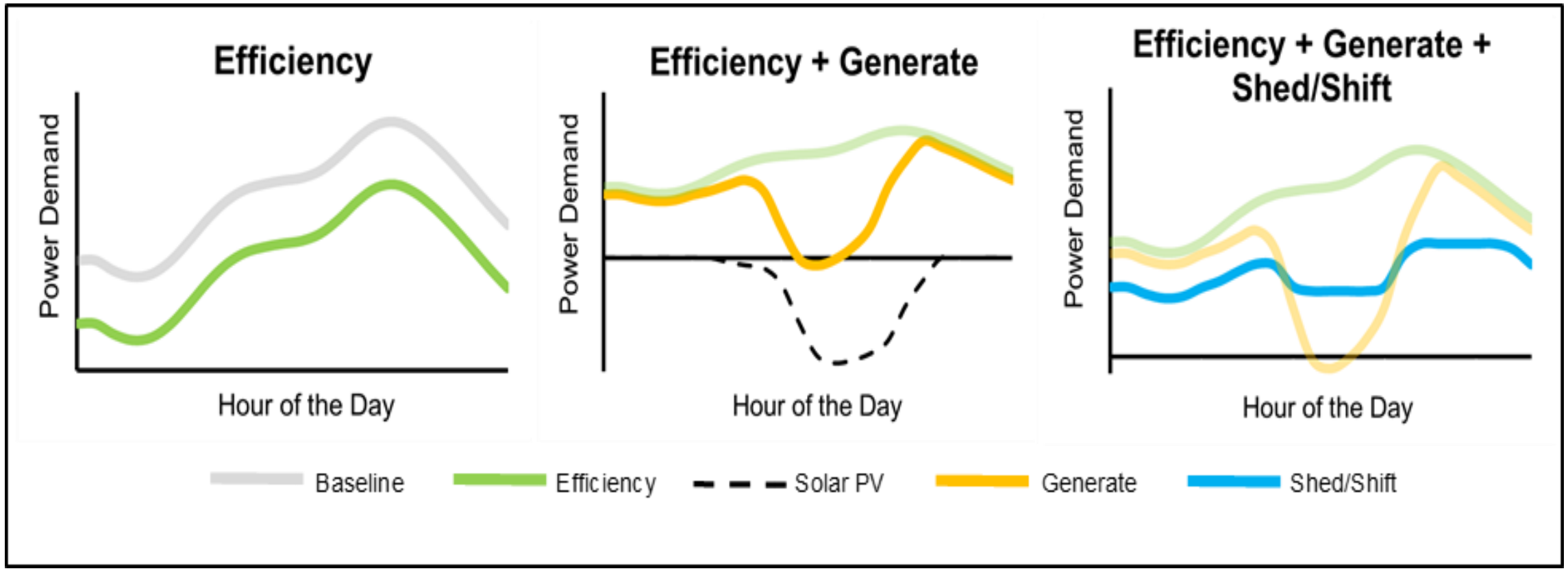
Source: DOE, SEPA

How Can Buildings Provide Flexibility?

- Buildings can provide flexibility by reducing wasted energy, helping balance energy use during times of peak demand and/or plentiful renewable generation, and reducing the risk of frequency deviations.
- As the grid becomes increasingly complex, demand flexibility can play an important role in helping maintain grid reliability, improving energy affordability, and integrating a variety of generation sources.



Demand Flexibility provided by GEB



Commercial GEB Measures

GEB Measure	GEB Control Capability	Load Shed	Load Shift	Demand Response
LED fixture with full control	Dim lights for load shed capability	x		x
Automatic window shade devices	Control for west, south, and east-facing facades to shed solar heat gain during the day	x		x
Staging of electric resistance heating	Stage operation for load shed capability	x		x
Zone space temperature setback	Program setbacks during defined peak demand periods for load shed capability	x		x
Thermal energy storage	Leverage building thermal mass or water storage to shift heating and cooling loads		x	
Staging of AHU fans	Stage operation for load shed capability	x		x
Static pressure reset for demand response	Static reset for load shed capability	x		x
Laptop battery charger staging	Stage battery-based plug-in equipment for load shed capability	x		x
Solar PV	Utilize on-site generation to offset peak load	x		
Battery storage	Utilize battery storage to shed and shift load	x	x	x

More connectivity creates additional cybersecurity concerns…

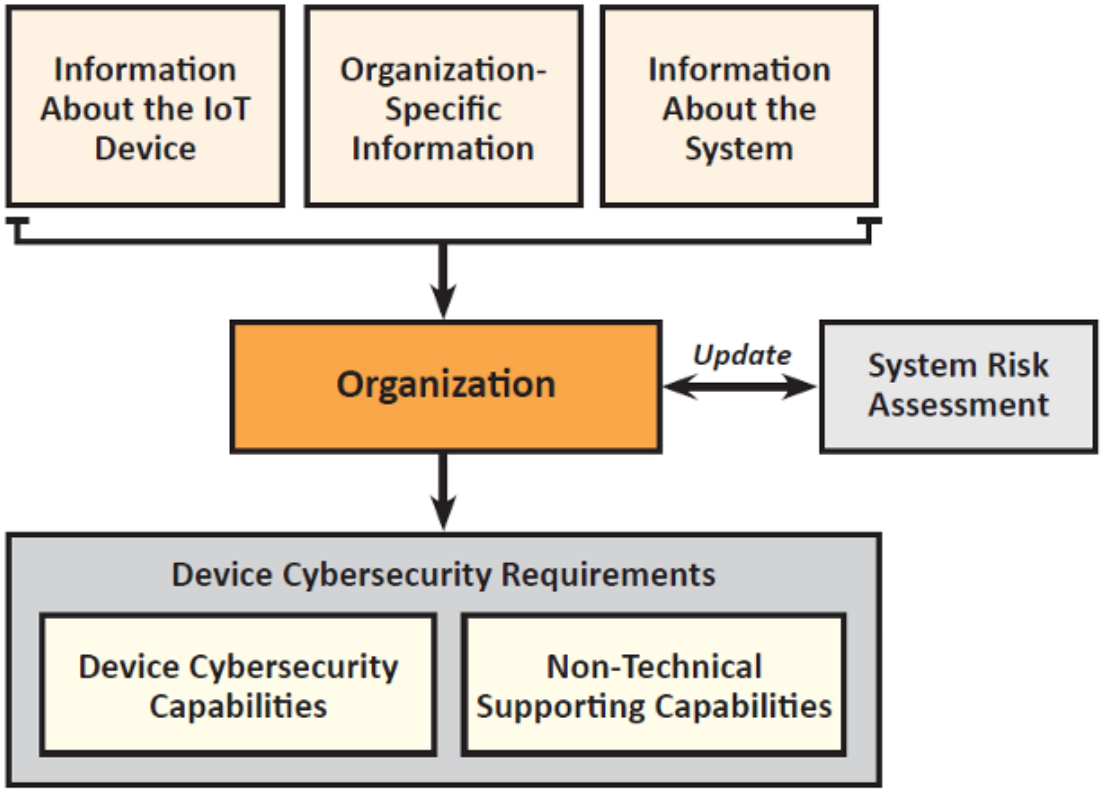
"Next-generation interconnectivity is collapsing the boundary between the digital and physical worlds and exposing some of our most essential systems to disruption. Our factories, power grids, and water treatment facilities, among other essential infrastructure, are increasingly shedding old analog control systems and rapidly bringing online digital operational technology (OT). Advanced wireless technologies, IoT, and space-based assets… will accelerate this trend, moving many of our essential systems online and making cyberattacks inherently more destructive and impactful to our daily lives."

National Cybersecurity Strategy (March 2023)

Federal Cybersecurity Drivers

- Laws & policies require federal agencies to enhance their cybersecurity posture, including:
  - Federal Information Security Modernization Act of 2014 (FISMA 2014)
  - Cybersecurity Enhancement Act of 2014
  - IoT Cybersecurity Improvement Act of 2020
  - Executive Orders
    - EO 13636 – Improving Critical Infrastructure Cybersecurity (2013)
    - EO 13800 – Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure (2017)
    - EO 13870 – America's Cybersecurity Workforce (2019)
    - EO 14028 – Improving the Nation's Cybersecurity (2021)

IoT Cybersecurity Improvement Act of 2020



NIST SP 800-213 *IoT Device Cybersecurity Guidance for the Federal Government: Establishing IoT Device Cybersecurity Requirements* series

- Does not replace other cybersecurity frameworks (such as the Risk Management Framework or Cybersecurity Framework) as foundational security guidance
- NIST SP 800-213 explains the *role* of IoT devices as *elements* of federal systems and provides guidance for addressing their unique risks
- Complemented by NIST SP 800-213A *IoT Device Cybersecurity Requirements Catalog*

Source: https://www.nist.gov/itl/applied-cybersecurity/nist-cybersecurity-iot-program/sp-800-213-series

GEB and Cybersecurity

Increasing # of connected devices and equipment

Increasing amount of targeted ICS/OT cyber attacks

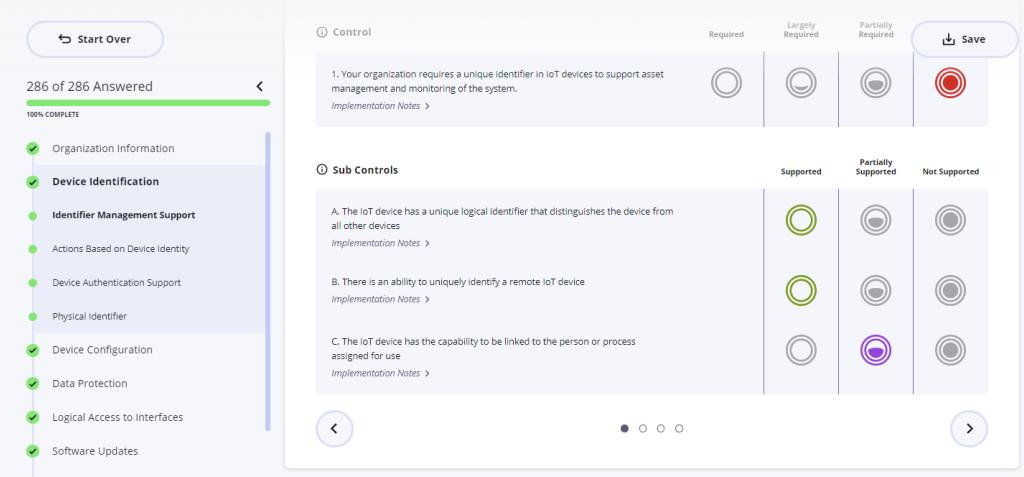
Increasing # of unfilled cyber security positions

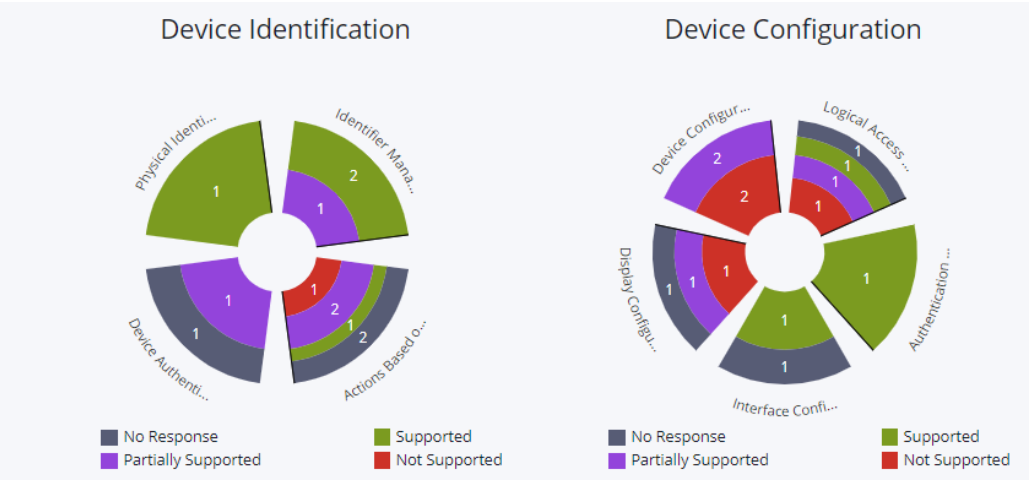
- GEB is a set of strategies, not an exact type or class of technologies
- GEB solutions can interact directly with operational technology (OT) to provide that grid flexibility by controlling physical devices, processes, and events
  - OT systems and equipment need to be accessible so they can be controlled/maintained
  - Losing OT systems and equipment can be hugely costly and impactful to life, health, or safety
  - Older OT systems may not have protections to prevent threat actors from taking advantage of vulnerabilities
  - Traditional IT solutions may not work for OT
  - If compromised, OT technologies could have both cyber **and** physical impacts

FEMP Cybersecurity Program

- FEMP is working to help **Federal facilities actively identify, prioritize, and mitigate the risks of cyber or physical attacks on facility-related control systems and distributed energy resources** without adversely impacting required level of service for efficient operations
- Resources include:
  - Training on Federal facility cybersecurity vulnerability assessments and risk management
  - Developing and validating a facilities cybersecurity framework (FCF) and distributed energy resources cybersecurity framework (DERCF) to meet the requirements of E.O. 13800
  - Developing and validating an interactive training game to address the NIST "Framework for improving critical infrastructure cybersecurity"
  - Developing and launching on-demand trainings for the Distributed Energy Resource Cybersecurity Framework (DERCF)
- Visit: https://www.energy.gov/femp/energy-and-cybersecurity-integration

FCF Internet of Things Assessment Tool



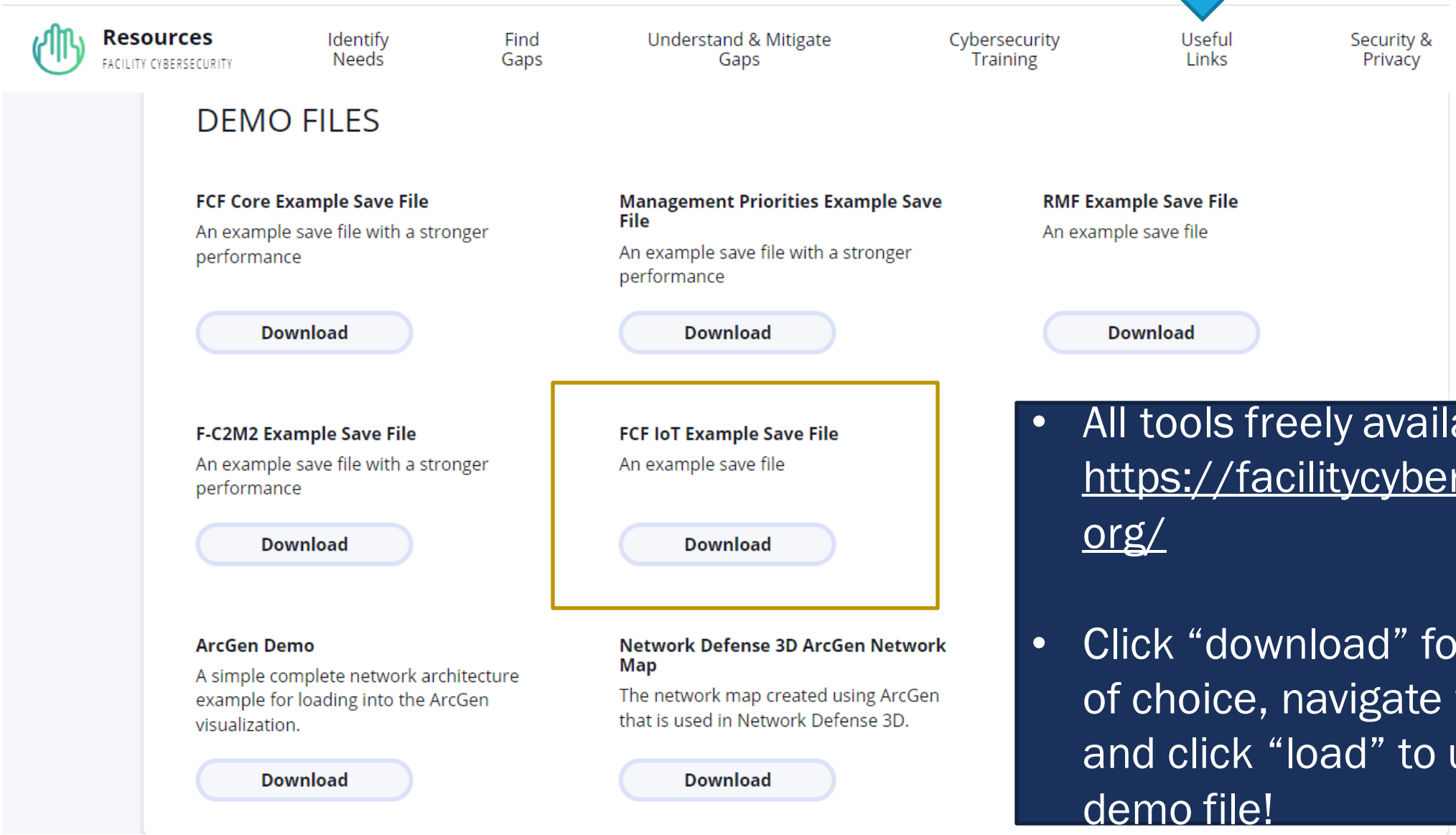


- FCF-IoT supports a set of control catalogs of IoT device cybersecurity capabilities and non-technical supporting capabilities
- Helps organizations assess their IoT device cyber capabilities/ requirements posture, what IoT device capabilities are required for an organization to achieve their mission objective, and what is currently incorporated for the devices
- Generates downloadable report that can help identify gaps

Hosted at: https://facilitycyber.labworks.org/assessments/FCF_IoT

Use a Demo File to Explore

Click Here for Resources



- All tools freely available at: https://facilitycyber.labworks.org/
- Click “download” for demo file of choice, navigate to tool, and click “load” to upload the demo file!

FEMP 50

50 Years of Federal Energy Management

Operations and Maintenance – Data Driven Approach

Mr. Nael Nmair

Supervisor, FEMP Facility and Fleet Optimization

September 13, 2023

Objectives of a Data Driven Approach to Operations & Maintenance

- Develop a comprehensive operations and maintenance (O&M) program
- Identify how facility data can inform your O&M program
- Identify resources and trainings that can help you improve your organization's O&M program

Defining O&M

Decisions/actions regarding control and upkeep of property/equipment.

Some actions focused on scheduling, procedures, and work/systems control and operation.

Not just:

- Preventive maintenance
- Fixing things when they break
- A number to call with complaints

Performance of routine, preventive, predictive, scheduled, and unscheduled actions aimed at preventing equipment failure or decline.

Enhancing efficiency, reliability, and safety.

Defining O&M – A Comprehensive Approach

- Improved Resilience
- Safe Operations
- Healthy Buildings
- Preserve Asset Value
- Meet Mission Requirements
- Energy and Water Efficient Operations

Data Driven Approach: Predictive vs. Preventive Maintenance

Preventive	Predictive
- Based on replacing, overhauling, or remanufacturing - Fixed Interval - Condition not considered	- Based on measuring the condition of equipment to assess failure likelihood (onset of degradation) - Action taken to prevent failure - O&M driven by actual/historical conditions

Predictive(PdM) Maintenance Benefits

- Reduced failures
- Improved Resilience/availability
- Potential energy/water savings

Data Driven Approach: Predictive Maintenance

Common PdM Technologies

- Infrared thermography
- Lubricant and wear particle analysis
- Ultrasonic analysis
- Vibration analysis
- Motor analysis
- *Performance trending.*

Common PdM Applications

- Pumps
- Motors
- Diesel generators
- Condensers
- Circuit breakers
- Valves
- Electrical storage systems
- Transformers
- Tanks and piping.

Information resources:

- O&M Best Practices Guide Chapter 6
- NASA Procedural Requirements – Facilities Maintenance and Operations Management, Appendix F

Data Driven Approach: Key Performance Indicators (KPIs)

KPIs can be used to:

- Measure O&M performance
- Identify areas in need of improvement

Numeric value

Measure/evaluate progress toward a defined goal or objective

Track and trend over time

- Work planning, execution, and administration
- Equipment effectiveness
- Maintenance cost/financial effectiveness
- Programmatic effectiveness
- Safety and environment effectiveness

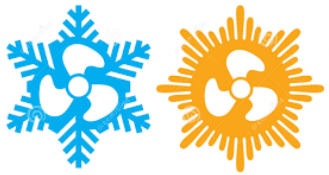
Re-tuning

Data-driven process of improving control of existing building energy systems, centered on the building automation system (BAS) through

- Application of simple principles, embodied in best-practice re-tuning measures
- Drives identification and correction of possible O&M issues
- Adoption of strategies for better monitoring and controls (e.g., utilize trend data and training to manipulate reset parameters for “tuning”)

“Turn it off”

“Turn it down”



“Mitigate simultaneous heating and cooling”

“Reduce infiltration and outside air”

Supports compliance with current statutes/EOs (EISA, EA2020, EO14057)

Data Driven Approach: Re-tuning

- Low-cost approach to optimizing HVAC in buildings, primarily through the building automation system (BAS)
- Typically realize a 5% to 25% reduction in annual building energy use and costs
- Can meet EISA/EA2020 requirements for ongoing commissioning and agency decarbonization goals.
- Extends equipment life, through correct operations and sequencing
- Building Re-tuning resources – training, Building Re-tuning Simulator (BRS), EBCx, and checklists

O&M Tools

Existing Building Commissioning (EBCx) Decision Tool

- User friendly format to assist agencies in determining the best commissioning approach(es)
  - Re-Commissioning
  - Retro-Commissioning
  - Ongoing Commissioning
  - Re-Tuning
- Guides users to the appropriate commissioning approach to address building operating issues, such as comfort complaints
- Helps determine if facility meets Energy Act of 2020 exclusions.

Building Re-tuning Simulator Tool (coming soon)

- Online training tool for Re-tuning Challenge (expected release by end of CY)
- Quick creation of building energy models with a focus on the impact of controls and Re-tuning
- Accurate estimation of energy, cost, and emissions savings for each Re-tuning measure
- Develop new building operations strategies to enhance energy/water savings

FEMP O&M Program Resources

- *FEMP – Facility Optimization*
- FEMP Operations & Maintenance Best Practices, A Guide to Achieving Operational Efficiency (Release 3.0)
- FEMP's O&M Best Practice Resources
  - *Equipment Operations and Maintenance Summaries*
  - *Operations and Maintenance Challenges and Solutions*
- FEMP Existing Building Commissioning Decision Tool
- *Re-tuning in Federal Buildings | Department of Energy*
- PNNL's Building Re-tuning Trainings
  - *Buildings with BAS*
  - *Buildings without BAS*
- *NASA Procedural Requirements – Facilities Maintenance and Operations Management*

Contacts

Mr. Nael Nmair

Supervisor, FEMP Facility and Fleet Optimization

Tel: (240) 702-6607

Nael.Nmair@hq.doe.gov

Mr. Varun Sood

Pacific Northwest National Laboratory

Tel: (509) 371-7969

Varun.Sood@pnnl.gov

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