U.S. General Services Administration

High Performance Buildings

Submetering

presented by
Kinga Porst, GSA
Fred Winter, PWC

Why is Submetering Important?

Submetering is an important tool for reducing energy in buildings; it provides information at a local level, enabling building occupants and tenant agencies to identify energy intense systems and adjust their behaviors to achieve energy performance goals.

Promotes energy savings:

- ✓ Benchmarking – accurate knowledge of where energy is being consumed is the first step in creating energy savings.
- ✓ Continuous commissioning – Constant monitoring allows the user to gauge the results of an energy savings program.

The Role of Metering

Why meter? *That which is not measured cannot be managed*

Energy Savings – meters enable actions

Action	Observed Savings
Installation of meters	0 to 2% initial impact but savings will not persist
Bill allocation only	2-1/2 to 5% - improved occupant awareness
Building tune-up and load management	5 to 15% - improved awareness, identification of simple operations and maintenance improvements, and managing demand loads per electric rate schedules
Ongoing commissioning	15 to 45% - improved awareness, ongoing identification of simple operations and maintenance improvements, and continuing management attention

Table 3.2 - FEMP Metering Best Practices Guide (August 2011)

Metering data provides visibility to energy use

- **Trending of metered data shows consumption changes to help identify possible operational and equipment problems**
- **Taking action reduces energy costs**

Metering data enhances efficiency strategies – Building Re-tuning and Retro-commissioning to improve financial payback

The Role of Metering

Why aren't more buildings metered or sub-metered?

- **Meters and installation are currently expensive**
- **Analysis of raw data is challenging**

Aren't low cost products available now?

- **Products targeting residential and small commercial buildings exist in England (e.g., OWL), but are not physically robust. Robust US products (Shark 200) cost $600 to $800 per metered point.**

How many Federal buildings are there?

- 430,000 (Metering Best Practices 2011)
- Potential savings of 1.16 billion kilowatt-hours

COMPLETED WORK

- BTRD White Paper: The Power to Control – Submetering of Building Energy and Water Usage National Science and Technology Council, Subcommittee on Buildings Technology Research and Development – October 2011

http://www.whitehouse.gov/sites/default/files/microsites/ostp/submetering_of_building_energy_and_water_usage.pdf

- Energy Submetering Finance paper – November 2012
- Submeter Comparison
- LEASED ASSET ENERGY AND GHG REPORTING INTERPRETIVE GUIDANCE

http://www.gsa.gov/portal/mediaId/179639/fileName/GSA_Leased_Asset_GHG_Guidance_FINAL_071713_508_compliant.action

- FEMP METERING BEST PRACTICES: A GUIDE TO ACHIEVING UTILITY RESOURCE EFFICIENCY 2015

http://energy.gov/eere/femp/downloads/metering-best-practices-guide-achieving-utility-resource-efficiency

- NREL Reducing Plug and Process Loads for a Large Scale, Low Energy Office Building

http://www.nrel.gov/sustainable_nrel/pdfs/49002.pdf

What Type Of Submetering Is Right For Me?

What Kind of Submeter Do I Need?

This simple guide allows you to compare the strengths and limitations of available low-to-moderate cost submeter types so you can match tool capabilities to your project goals. The variety and capability of device-oriented electrical submeters is expanding. But increased options make it more challenging to choose the most effective tool.

When Might Submeters Be Helpful?

Submeters help Facility Managers, energy managers and tenant organizations identify:

1) inefficient equipment;
2) use and configuration alternatives; and
3) equipment and user profile management opportunities.

Submetering Comparison Chart

Simple

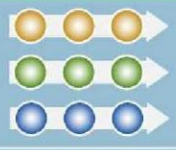
A device able to measure instantaneous power and cumulative energy data but requires manual reading and recording.

Enhanced

A device able to measure and record interval data but requires manual data file download.

Advanced

A device able to measure and record time-series interval data, communicate data to a remote location, and integrated into an energy management or building automation system.

	Simple	Enhanced	Advanced
Data Unprocessed power and energy information collected by the submeters.			
Cost Submetering equipment and installation cost.	$	$ $	$ $ $
Labor The labor required to operate and maintain the submetering effort, such as data recording.			
Analysis Expertise required to utilize the data and apply it to energy management decisions.			

OFHPGB SUBMETERING ACTIVITIES

- **Submetering pilot w/ GSA Leasing, NCR, Vornado**
  - Test the costs and savings achievable from sub-metering fully serviced leased buildings through a landlord/tenant pilot partnership.
- **Low cost wireless meter testing w/DOE/BTO**
  - DOE will conduct a performance test of three working prototypes at the GSA HQ.
- **Plug and Process Load Study in Leased Buildings w/ GSA PBS Leasing, NREL, Hines**
  - The project helps stakeholders make more effective design decisions, enabling benefits such as: (1) reduced capital costs, (2) more energy-efficient system operation, and (3) improved ability of designers to model and optimize multiple interacting systems to achieve aggressive whole-building energy performance goals.
- **Green Proving Ground**
- **Submetering framework and decision making tool SFTool**

VORNADO PILOT

One Skyline Tower
Address: 5107 Leesburg Pike, Falls Church, VA
100% occupied by GSA via two leases (SSA, DOJ)
Number of Floors: 26
Building Size: 517,656 total RSF
130 meter points installed
Detailed Project Approach:
Phase 1: Metering Architecture & System Technical Design (cost $50,000)
Phase 2: Project Management, Coordination & Installation Oversight
Phase 3: System Commissioning, Testing and Startup Services

Cost of Installation per Meter:	$1,460.00
Cost of EFT Connection Sub Total:	$150,000.00
Total Cost:	$339,800

Phase 4: Baseline period 11/01/2014 – 10/31/2015
Research Team:
- Kinga Porst, Gina Ditommasso, Mike Wyatt (GSA)
-Anne Wagner, Dave Hunt (PNNL)
-Jessica Granderson (LBNL)
-Amy Jiron (DOE/BTO)
-Brian Boyd (Vornado)

The Energy Issue in Leased Space

- 95% of PBS's leases are done on a full service basis with utilities included in the rent
- Lack of current utility consumption information requires extrapolation and projection of estimated consumption and associated (scope 3) Green House Gas emissions.
- Disconnect between the user of utilities and the party paying for them (landlord/tenant) does not encourage reductions in energy use.
- Better measurement of utilities being consumed in leased space.
  - –Costs and challenges
  - –Impact on utility reductions
- Better understanding of cost implications to landlords when considering opportunities for policy shift from full service leases to leases net of utilities.

Sub-metering Pilot Goals

1. Acquire a better understanding of energy use and costs in leased facilities where the landlord is paying for utilities;
2. Develop replicable processes for implementation of sub-metering in leased facilities, including an understanding of costs of equipment and installation;
3. Develop duplicable standardized tracking processes for analyzing and reporting energy usage data in sub-metered leased facilities;
4. Explore and test for a method of automated GHG reporting in leased facilities;
5. Develop a thorough understanding of the cost-benefit analysis of sub-metering; and
6. Test alternative approaches to motivating more energy efficient landlord and occupant behaviors and identify factors that encourage or hinder behavioral change.

Research Areas

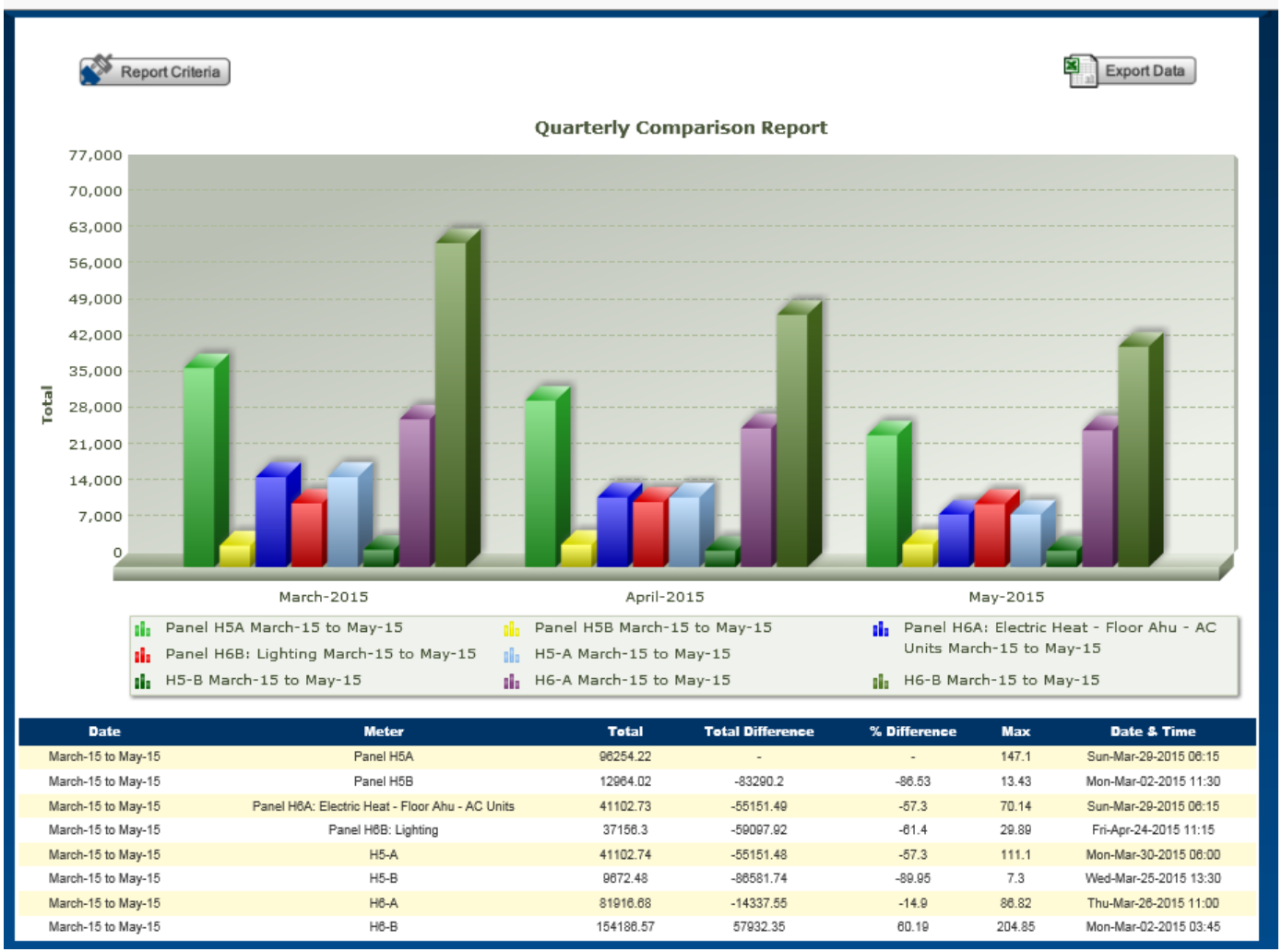
Installation and reporting concerns:

- Does sub-metering of fully serviced leased space in itself reduce energy consumption, and to what extent?
- What are the costs of installing sub-metering and energy management systems in fully serviced leased buildings relative to the payback?
- Is it cost-effective to track energy use of different building components (lighting, HVAC, technologies, vertical transportation, plug loads)? Are only some of these components worth tracking?
- What level of sub-metering delivers the best cost-effective results (per floor, circuit, tenant)?
- What kind/type of sub-meters provide the best results for their cost?
- How can sub-metering be best implemented in multi-tenant buildings? Can it be cost-effective?

Operations and behavioral concerns:

- What types of energy feedback are most effective for what audiences (occupants, building operators, building owners)?
- What level of data is most useful for influencing behavior and for what audiences (e.g., plug loads, HVAC; per floor, per occupant, per building)?
- How will tenants respond to the installation? Will they be motivated to reduce energy consumption if there are no economic consequences of doing so?
- How will individual tenants get credit for energy reductions?

EFT DASHBOARD



Date	Meter	Total	Total Difference	% Difference	Max	Date & Time
March-15 to May-15	Panel H5A	96254.22	-	-	147.1	Sun-Mar-29-2015 06:15
March-15 to May-15	Panel H5B	12964.02	-83290.2	-86.53	13.43	Mon-Mar-02-2015 11:30
March-15 to May-15	Panel H6A: Electric Heat - Floor Ahu - AC Units	41102.73	-55151.49	-57.3	70.14	Sun-Mar-29-2015 06:15
March-15 to May-15	Panel H6B: Lighting	37156.3	-59097.92	-61.4	29.89	Fri-Apr-24-2015 11:15
March-15 to May-15	H5-A	41102.74	-55151.48	-57.3	111.1	Mon-Mar-30-2015 06:00
March-15 to May-15	H5-B	9672.48	-86581.74	-89.95	7.3	Wed-Mar-25-2015 13:30
March-15 to May-15	H6-A	81916.68	-14337.55	-14.9	86.82	Thu-Mar-26-2015 11:00
March-15 to May-15	H6-B	154186.57	57932.35	60.19	204.85	Mon-Mar-02-2015 03:45

DOE LOW COST METERING CHALLENGE

Problems/Needs/Opportunities:

- Current mandate for Federal sector to meter building energy use
- Current cost of metering and data gathering is high

Solution: Produce a wireless sub-metering system specification for commercial buildings that will be used as the basis for meeting the needs

Impacts:

- Radically reduce the price of these metering systems to an estimated $50 -$100 per point based on achieving an estimated 3-year payback period by 1) consolidating demand around a single specification,

  and 2) encouraging volume purchases
- Send clear message to the industry that Federal buildings and private industry require these products now (demonstrate market need)
- Align with DOE's other ongoing efforts in technical specifications and equipment challenges

Specification – Electrical and Electrical Measurements

Sources of electric power for meter system components		120V mains or Power scavenged from circuit measured
Power loss response		Automatic resumption of operation after power loss
Minimum number of measurement points		25
Electricity uses monitored		Electricity usage at whole building level where the utility service enters, at individual panels where the total usage of each panel would be metered, and for individual circuit, where the electricity usage of the circuit served by an individual breaker is measured.
Electrical service types (number of phases) measured		Must support measurement of: • 120V to 240V single-phase • 208V to 600V three-phase
Measurement time period		All raw data must be measured at a time interval of not more than 15 minutes
Minimum number of points		Raw measurements are required at each measurement point for: Voltage (rms) current (rms) time averaged power (in W) total energy use (in Wh). For multiphase measurements, each measured parameter must be provided for each phase individually and for the circuit total.

Specification – Electrical and Electrical Measurements

Ranges of measured parameters		Voltage: 0 to 600 Volts AC or line-to-line 850 Volts AC Current: 5 to 2400 amps
Measurement resolution		Voltage: 0.1 volts Current: 0.5 amps Power: 0.5 watts
Maximum data collection interval		15 minutes
Accuracy of measurements		±1%

PLUG AND PROCESS LOAD STUDY

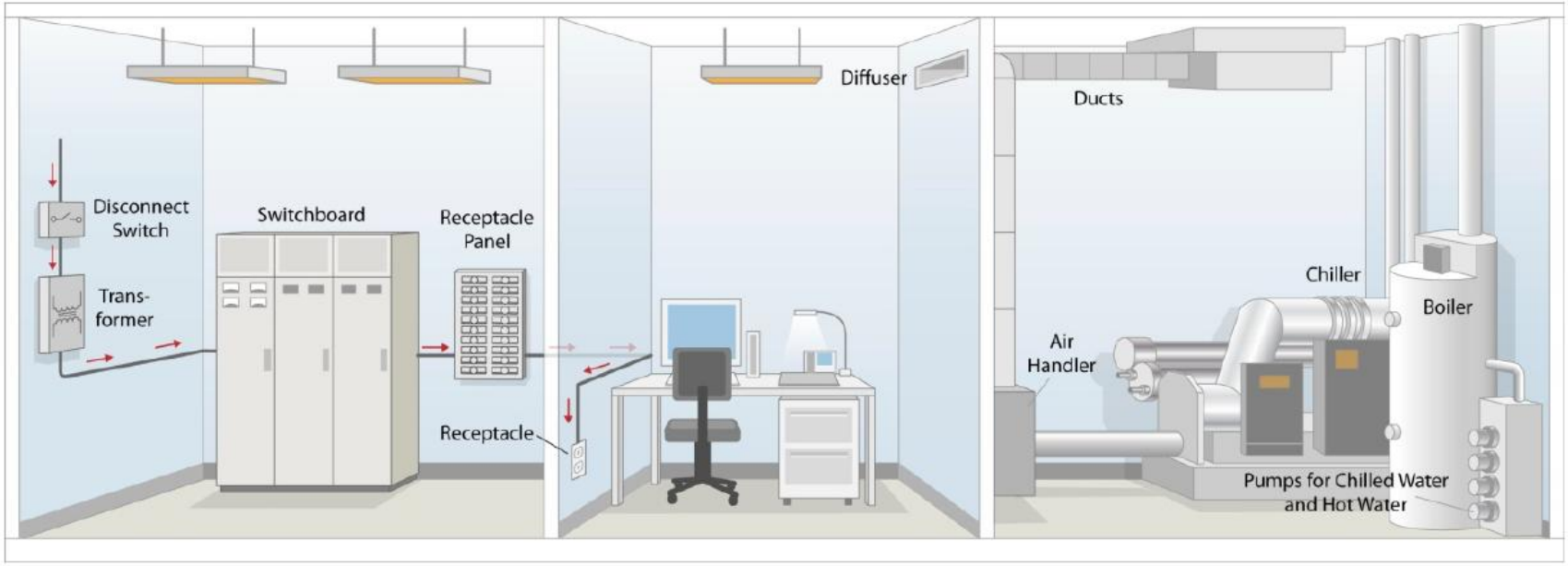


Figure 1–1 Systems that are affected by plug and process load densities specified in lease agreements
(Photo credit: Alfred Hicks/NREL)

- Peak PPL energy use intensity for offices with data centers is 0.88 W/ft2.
-On average, the typical PPL energy use intensity for offices is around 0.28 W/ft2
- Right-sizing HVAC system components led to an average 14% reduction in upfront capital costs and a 3–4% reduction in energy costs.

GREEN PROVING GROUND

- **AutoDesk/Panoramic Power**
- **Plug Load Controls**
- **Integrated Daylighting Systems**
- **Occupant Responsive Lighting**
- **Wireless Sensor Networks**

2015 – AUTODESK/PANORAMIC POWER

How Panoramic Power Works

Our patented sensor technology is coupled with cloud-based analytics to provide insights for optimizing energy management

Wireless, self-powered sensors
By clamping on the outgoing electrical wire from the circuit breaker, the non-invasive sensors harvest the magnetic field as a power source for monitoring the flow of electricity and sending information wirelessly in real-time. No maintenance is ever required on the self powered sensors.

Deployed to deliver real-time data
Hundreds of sensors can be installed in a few hours. Transmitting data wirelessly through the bridge, they deliver energy information every 10 seconds to PowerRadar, the solution's cloud-based analytics platform.

Aggregated and analyzed in an easy to use dashboard
PowerRadar provides users with a powerful interface to monitor, measure, report, and understand electrical energy consumption from the site level to an individual device level. Insight into energy usage enables users to optimize operations, processes and maintenance resources.

Energy Management : Adoption

Advanced Power Strips

- Schedule-based control, where users determine the day and time when a circuit is energized, found to be most effective.
- 26% energy reduction at workstations with advanced computer management already in place, 50% energy reduction in kitchens and printer rooms
- Over 16,000 units deployed at 80 federal facilities across the country
- On GSA Schedule
- www.gsa.gov/gpg

GPG

GPG FINDINGS 01

MARCH 2012

WIRELESS SENSOR NETWORKS FOR DATA CENTERS

OPPORTUNITY

How much energy is used by data centers in the U.S.?

2% OF ALL U.S. ENERGY IS CONSUMED BY DATA CENTERS[1]

~50% GOES TO NON-IT LOADS[2]

TECHNOLOGY

How do Wireless Sensor Networks save energy?

CAPTURE & DISPLAY CRITICAL INFORMATION IN REAL-TIME

OPERATORS IDENTIFY WAYS TO INCREASE ENERGY- EFFICIENCY

M&V

Where did Measurement and Verification occur?

LAWRENCE BERKELEY NATIONAL LABORATORY assessed the effectiveness of collecting real-time information to optimize data-center energy efficiency at the USDA National Information Technology Center in St. Louis, Missouri

RESULTS

How did Wireless Sensor Networks perform in M&V?

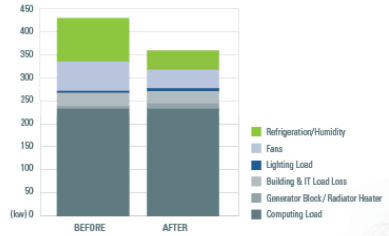
17% ENERGY SAVINGS
48% REDUCTION IN COOLING LOAD[3]

EFFECTIVE TOOL
FOR ON-GOING OPTIMIZATION OF DATA CENTERS[4]

3.4 YEARS
PAYBACK AT $0.045 kWh
< 50% of national average $0.11 kWh[5]

Data Center Power Usage Distribution

48% Cooling Load Reduction, 17% Overall Data Center Energy Reduction



DEPLOYMENT

Where does M&V recommend deploying Wireless Sensor Networks?

ALL DATA CENTERS

Estimated $61 million in annual savings and annual decrease of 532,000 metric tons of CO2, if implemented by tenant agencies throughout the GSA portfolio

Data center assessment kit developed during study reduces deployment time and power interruptions during installation

[1]McKinsey & Company, "Revolutionizing Data Center Efficiency", 2008 [2]Wireless Sensor Network for Improving the Energy Efficiency of Data Centers. Rod Mahdavi, William Tschudi (LBNL), March 2012, p.27 [3]Ibid, p.29 [4]Ibid, p.7 [5]Ibid, p.29

GSA GPG Green Proving Ground Program

The Green Proving Ground program leverages GSA's real estate portfolio to evaluate innovative sustainable building technologies.
www.gsa.gov/gpg | gpg@gsa.gov

Energy Management : Translation

Wireless Network Sensors

- Dense network of wireless sensors provides real-time information enabling facility operator to better manage HVAC.
- 48% reduction in facility cooling load
- 3.4 years simple payback (@ $0.045 kWh < 50% of national average $0.11 kWh)
- Deploying at two GSA-operated data centers
- On GSA Schedule

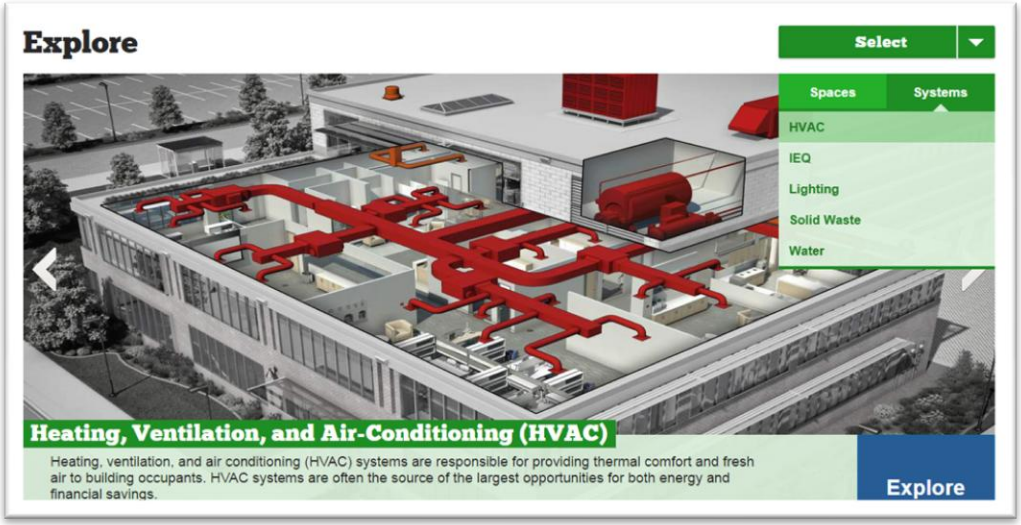
GPG

Submeter Data Framework Design

A Submeter Framework is needed to guide project planning, identify data needs, inform objectives and model cost savings. The Framework is currently designed to collect data that capture comprehensive system benefits.

Submeter Type	Functionalities	Benefits	Unit and Monetary Value
Electrical: • Circuit • System • End-Use Device **Natural Gas** **Water**	• Frequency of data and storage • Visualization, Data Feedback and Dashboards • Resulting Capabilities for Fault, Detection Theft, Power Monitoring • Resource Measurement	**Building Level:** • Reduced Resources Demand & Cost • Reduces O&M Costs **Portfolio Level:** • Capital Savings • O&M Savings	**Data points and formulas to calculate costs saved or avoided from identified benefits.** ***Energy Waste Reduction Value ($)*** = [energy rate ($/kwh)] * [total energy consumption at level (kwh)] * [estimated % of consumption reduction with roll-out]

EXPLORE: SUBMETERING

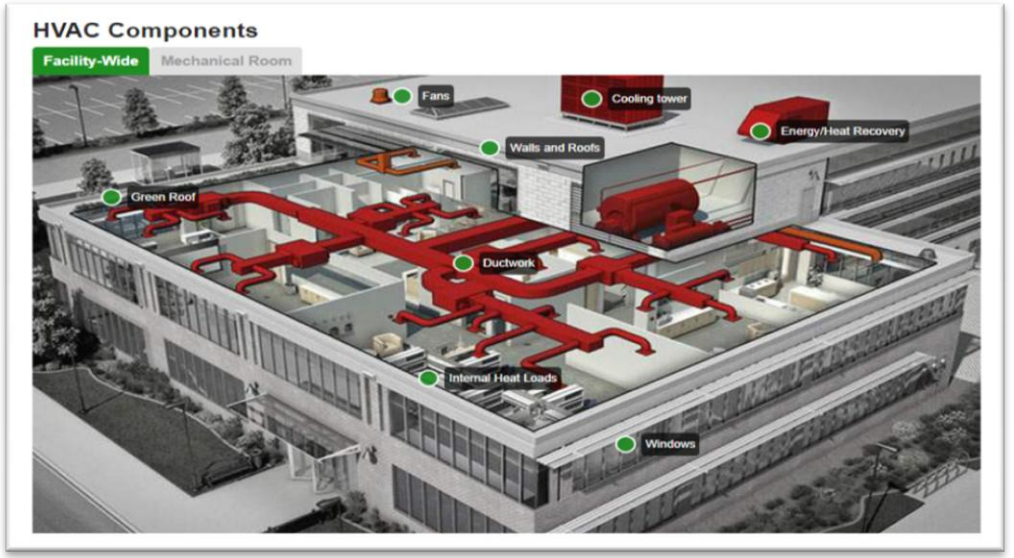


Recent industry trends show that, in addition to the primary utility meter, installation of metering devices after the primary utility meter that measure actual resource consumption provides multiple benefits to building performance. These submetering systems could allow building owners, designers and managers to monitor energy usage for individual tenants, departments, whole floors, pieces of equipment or other loads individually to account for their actual energy usage. This finer-grained facility data could be used to inform strategies for future cost-savings and sustainability projects and initiatives. Achieving sustainability goals will reduce capital investment and operating costs and potentially significantly decrease resource use and environmental footprint.

System Overview

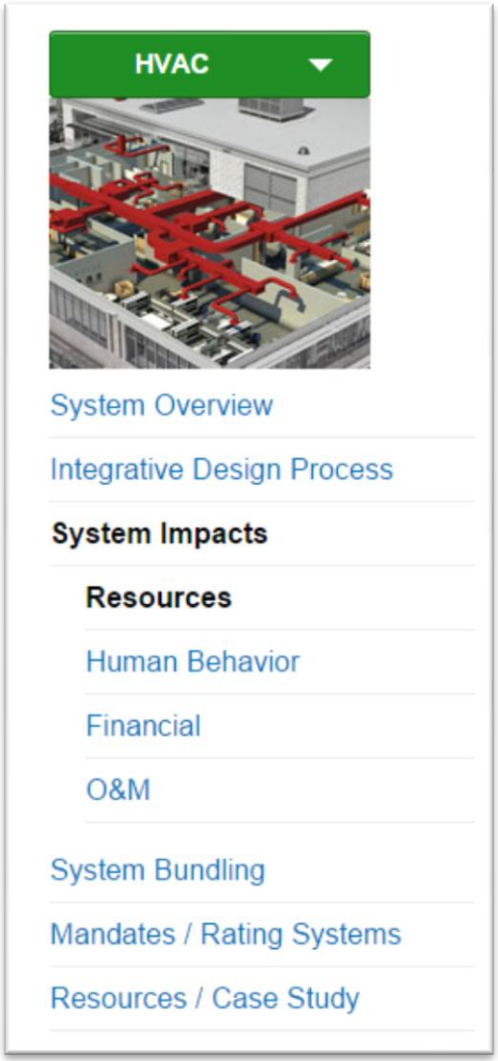
Visualizing submetering systems is helpful for users to understand the differences in submeter types. Define and examine submeter types within the building:

- Electrical – Circuit
- Electrical – System
- Electrical – End Use Device
- Natural Gas
- Water



Similar to the HVAC components diagram, display submeter installations and data roll over points. This page is intended to educate the user with a general understanding of submeter types to enable proper selection of meter type, followed by corresponding functionalities and benefits shown in the framework.

System Impacts



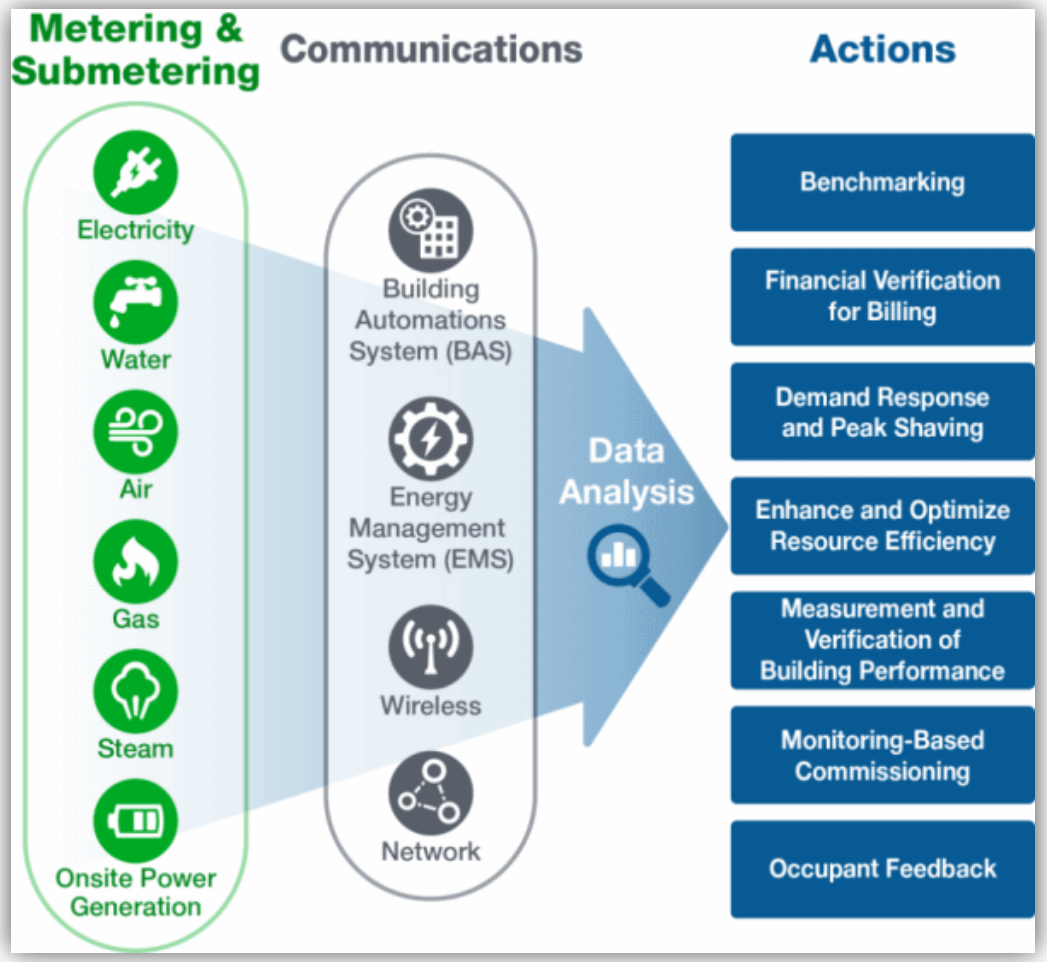
Using the data from submetering systems to better manage building operations and maintenance can have a significant impact on a building's overall resource use.

Use of submetering data:
-Enabling monitor-based commissioning
-Identifying and monitoring efficiency retrofits
-Aligning incentives and enabling behavioral conservation
-Demand response

Based on the knowledge compiled in the framework, submetering system benefits are:
-Economic Benefits
-Reliability Benefits
-Environmental Benefits
-Security Benefits
-Behavioral Benefits

GSA's Office of Federal High-Performance Green Buildings Submetering Framework Review

Fred Winter



Meters and Submetering

One of the best ways to save energy is to manage it.

Meters

Meters are sensors that measure and record resource use, such as energy or water consumption. Conventional metering (or master-metering) typically provides utility readings for an entire building or facility once per month.

Submeters

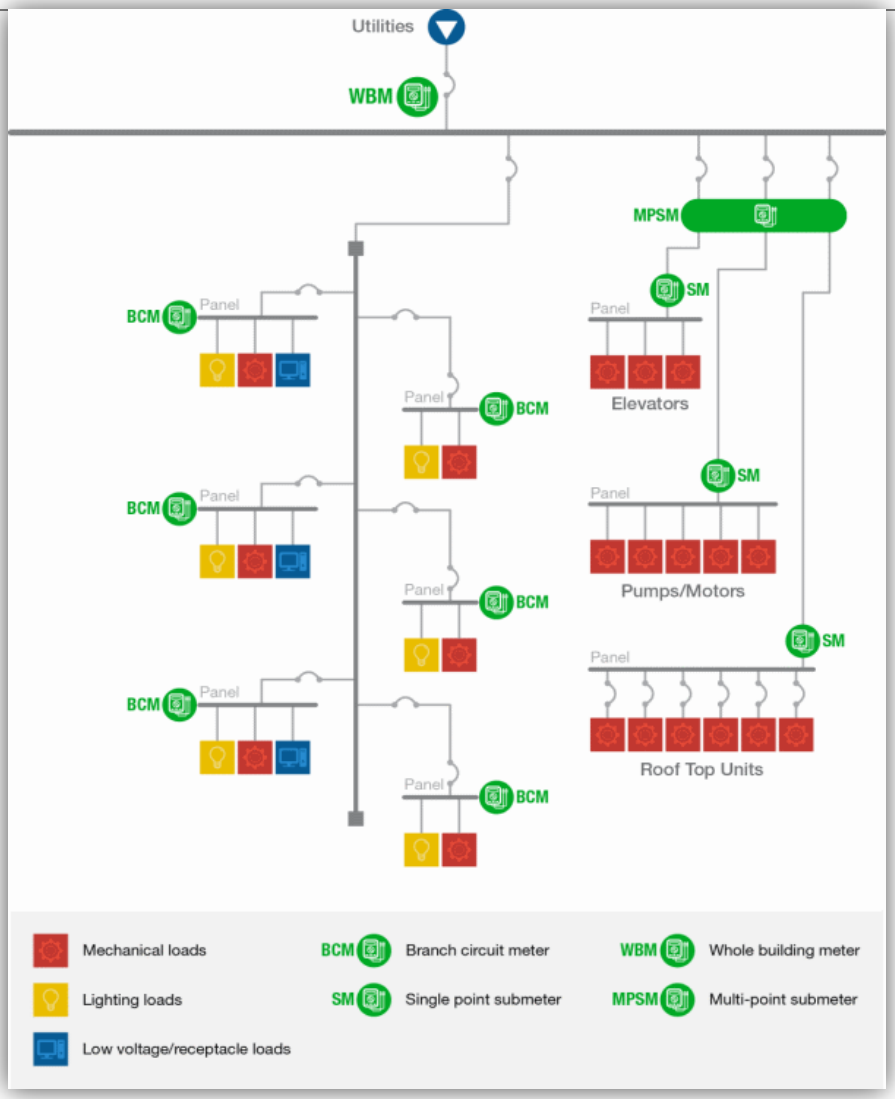
Submeters can measure resource use for different buildings in a multi-building campus, different floors of the same building, different tenants in a multi-tenant office or facility, individual building systems, electrical circuits, or even specific devices. **Data from well designed submetering systems can guide management strategies to significantly reduce energy and greenhouse gas emissions in buildings and portfolios.**

SUBMETERING

Submetering offers a powerful insight into a building's resource use by capturing more detailed consumption information, which helps to identify building inefficiencies, meet performance goals, and improve occupant awareness.

As the saying goes, "what gets measured gets managed."

https://sftool.gov/Explore#building-systems=submetering



Agenda

1. Framework Overview
2. Real-Time Framework Application
3. Online Submeter Wizard Development

1. Framework Overview

SUBMETER FRAMEWORK OVERVIEW

Purpose

As the US Government's lead for enabling and enhancing federal leadership in the field of sustainable real property portfolio management and operations, OFHPGB seeks to leverage technology and innovative management practices to green federal buildings and realize financial and operational benefits.

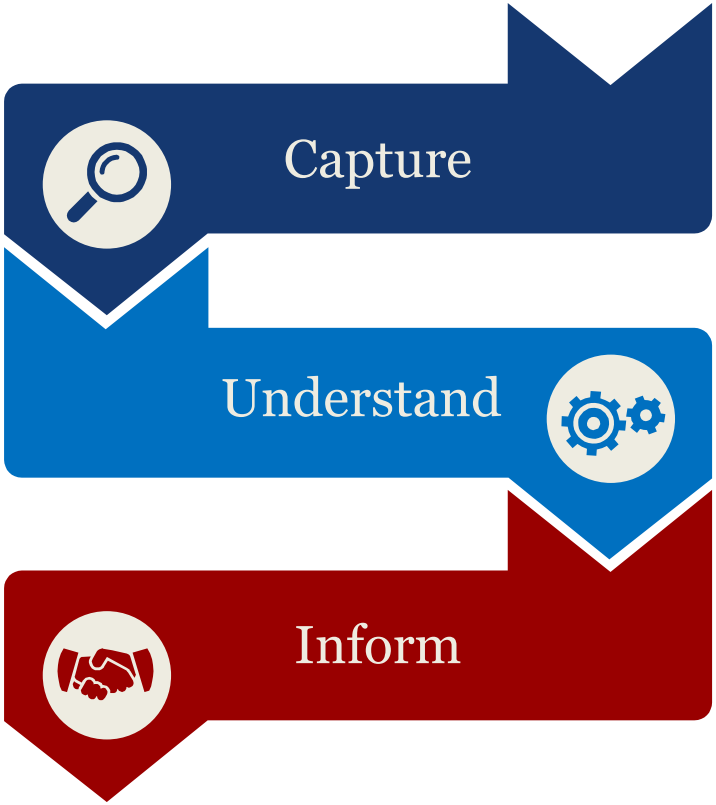
One area of focus is to leverage the deployment of submetering to find new ways of effectively and efficiently managing its real property portfolio and reduce costs.

Submeter Objectives

Submetering technologies can assist GSA in achieving its overall sustainability and energy performance goals. These goals could be realized through operational cost savings, improved building management, and enhanced operational efficiency.

DEVELOPING THE FRAMEWORK

OFHPGB developed a Submeter Data Framework (Framework) that standardizes data capture for mapping submeter functionalities to a range of benefits in order to:



Capture detail on the nature of submeter applications

Understand how submeters are being used, what practices leverage submeter information and what benefits are realized within buildings and regions

Inform the business case for submeter applications by developing resource efficiency practices

Step 4

Content of the Framework

The objective of the Submeter Data Framework is to map submeter functionalities to a range of benefits, assist stakeholders including O&M staff, Energy Managers, and Project Managers with identifying data needed to determine the associated resource benefits resulting from submetering projects.

Submeter Type	***Functionality***	***Benefits***
Electrical • Circuit • Series • End Use Device Natural Gas Water	• Frequencies of data storage • Visualization, data feedback and dashboards • Resulting capabilities for Fault, Detection Theft, Power Monitoring • Resource measurement	Building Level • Reduced resources demand and costs • Reduces O&M costs Portfolio Level • Capital Savings • O&M Savings

THE FRAMEWORK

Using the data captured by the framework type, functionality, and resulting benefit (shown below), a stakeholder can use their personalized mapping to build a business case for submetering.

Type *Functionality* ← *Mapping functionality to benefit* →

Electrical - Circuit	Align circuit data/consumption by tenant in multi-tenant facility	Economic	Building and Regional O&M Savings	Optimize use of assets
				Reduce meter reading cost
				Reduce resource connect and disconnect costs
				Reduce call center/customer care costs
				Reduce billing costs
				Reduce outage identification, localization, prioritization, and restoration time
			Resource Loss Reduction	Reduce electricity theft
			Energy Efficiency	Reduce resource consumption
				Improve space resource use
			Electricity Cost Savings	Reduce demand
		Reliability	Decrease Power Interruptions	Reduced outage frequency
				Reduced outage duration
		Behavioral	Occupant energy-use behavioral awareness	Reduction in energy waste
	Data is accessible to building occupants in graphical form	Economic	Energy Efficiency	Reduce resource consumption
			Electricity Cost Savings	Reduce demand
		Behavioral	Occupant energy-use behavioral awareness	Reduction in energy waste
	Enables space management	Economic	Energy Efficiency	Reduce resource consumption
				Improve space resource use
			Electricity Cost Savings	Reduce demand

2. Real-Time Framework Application

APPLICATIONS TO THE SUBMETER FRAMEWORK

GSA Building Highlights

OFHPGB identified three exemplary building case studies to review as a sample subset of GSA's submetering progress in realizing building-level and portfolio-level efficiencies and benefits. A review of each building case was conducted leveraging the industry leading practices and the Submeter Data Framework to document the current state of submetering deployment and associated benefits.

1800 F Street GSA Headquarters

Edith Green-Wendell Wyatt Federal Building

Wayne Aspinall Federal Building & US Courthouse

MAPPING EDITH GREEN-WENDELL WYATT

The Edith Green-Wendell Wyatt Building project team and Operations and Maintenance Staff leveraged the provided Submeter Framework to identify the full range of benefits realized from each submeter functionality.

Align circuit data/consumption by tenant in multi-tenant facility	**Economic**	**Building and Regional O&M Savings**	Optimize use of assets
			Reduce meter reading cost
			Reduce resource connect and disconnect costs
			Reduce call center/customer care costs
			Reduce billing costs
			Reduce outage identification, localization, prioritization, and restoration time
		Resource Loss Reduction	Reduce electricity theft
		Energy Efficiency	Reduce resource consumption
			Improve space resource use
		Electricity Cost Savings	Reduce demand
	Reliability	**Decrease Power Interruptions**	Reduced outage frequency
			Reduced outage duration
	Behavioral	**Occupant energy-use behavioral awareness**	Reduction in energy waste
Data is accessible to building occupants in graphical form	**Economic**	**Energy Efficiency**	Reduce resource consumption
		Electricity Cost Savings	Reduce demand
	Behavioral	**Occupant energy-use behavioral awareness**	Reduction in energy waste
Enables space management	**Economic**	**Energy Efficiency**	Reduce resource consumption
			Improve space resource use
		Electricity Cost Savings	Reduce demand
		Improve Asset Utilization	Optimize building system operation
			Improve economic operation of plants
			Extended useful life of assets due to optimized utilization
		Building and Regional Capital Savings	Reduce onsite generation capacity investments
			Defer onsite generation capacity investments
			Defer building system investments
			Optimize use of capital for major maintenance and repairs
			Optimize use of capital for retrofits

EGWW Submeter Framework

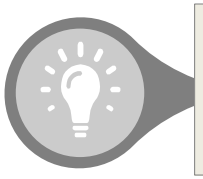
Submeter Types and Functionalities	Objective and Achieved Benefits
Electrical- Circuit • Align circuit data/consumption by tenant in multi-tenant facility • Fault or anomaly detection • Remote Meter Reading • Frequent data collection • Measure resource use • Identification of where resource is consumed **Electrical- End-Use Device** • More frequent end device energy data collection • Ability to align circuit data and consumption by end device • Visibility of end device performance data • Remote Meter Reading • Measure Resource Use • Ability to trend end use device energy consumption **Water** • Measure Resource Use • Remote Meter Reading	**Objectives:** • Fine-tune building performance • Measurement and Verification • Facilitate Load Shifting, Demand Response and Improved Renewable generation performance • Trend System Performance to Optimize System Efficiency **Achieved Benefits:** • Fine-Tune Initial Building Performance • Building O&M savings through Fault Detection • Measurement and Verification of Building Performance • Remote Meter Reading leading to O&M Savings • Reducing Consumption through Improve Occupant Engagement • Measure Resource Use to Reduce Peak Usage

Key Findings and Trends

The framework helps to identify existing submeter assets that are not being utilized for the range of accessible benefits or practices.

Measurement and verification (M&V) and fine-tuning of building systems and equipment are the primary uses for submetering in reviewed case studies.

Training, education and communication are key to achieve and sustain submeter benefits going forward.

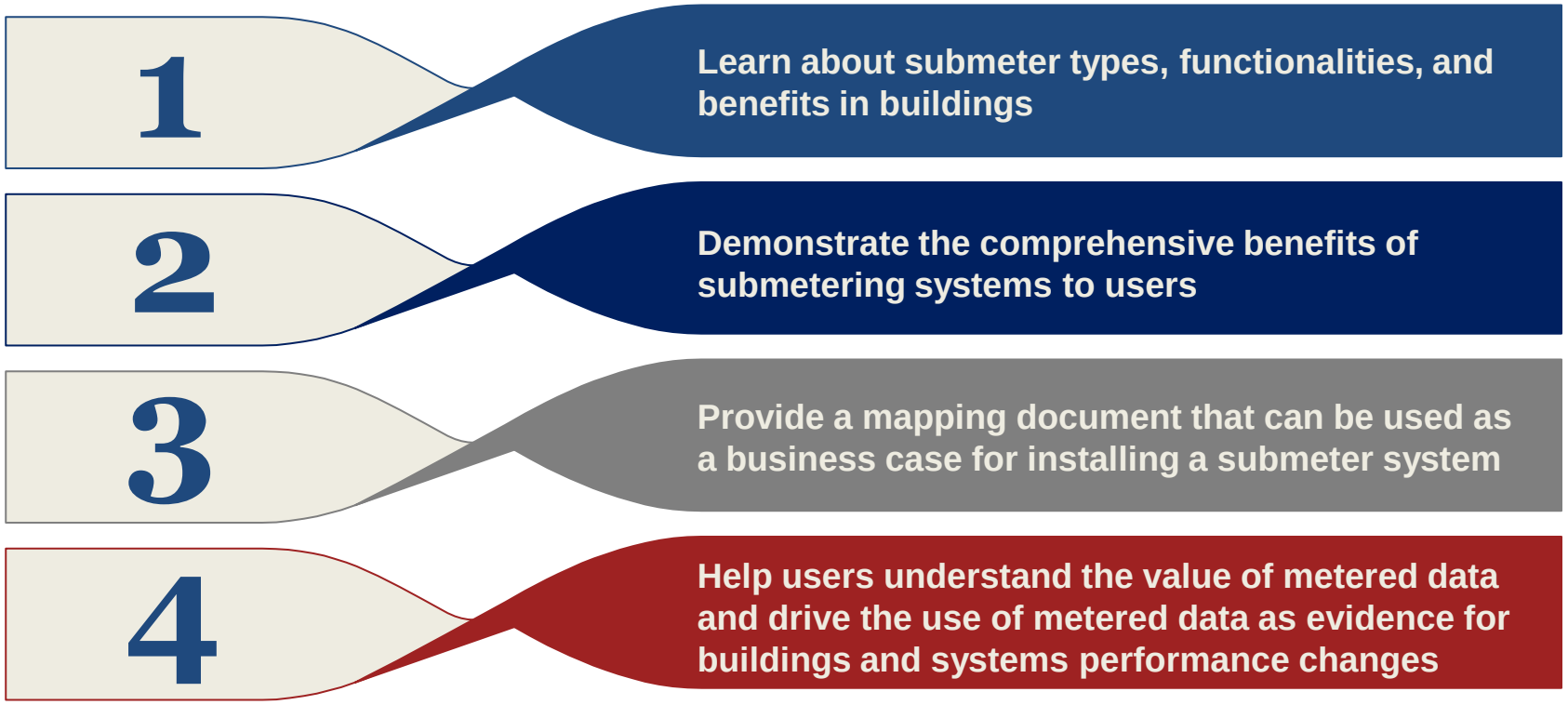


Adoption of a methodology such as the Submeter Framework could standardize submeter planning and deployment to further performance benefits and costs savings.

3. Online Submeter Tool Development

SUBMETER WIZARD OBJECTIVES

The Submeter Wizard will help users understand the comprehensive benefits of submetering programs by providing a guided tutorial of submeter types by functionality.



Submetering

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Electrical Circuit

An electrical circuit submeter measures a specific closed loop circuit in a building which is comprised of an interconnection of many electrical elements that can measure utility consumption to the tenant or the occupant level

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Electrical End Use Device

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Electrical System

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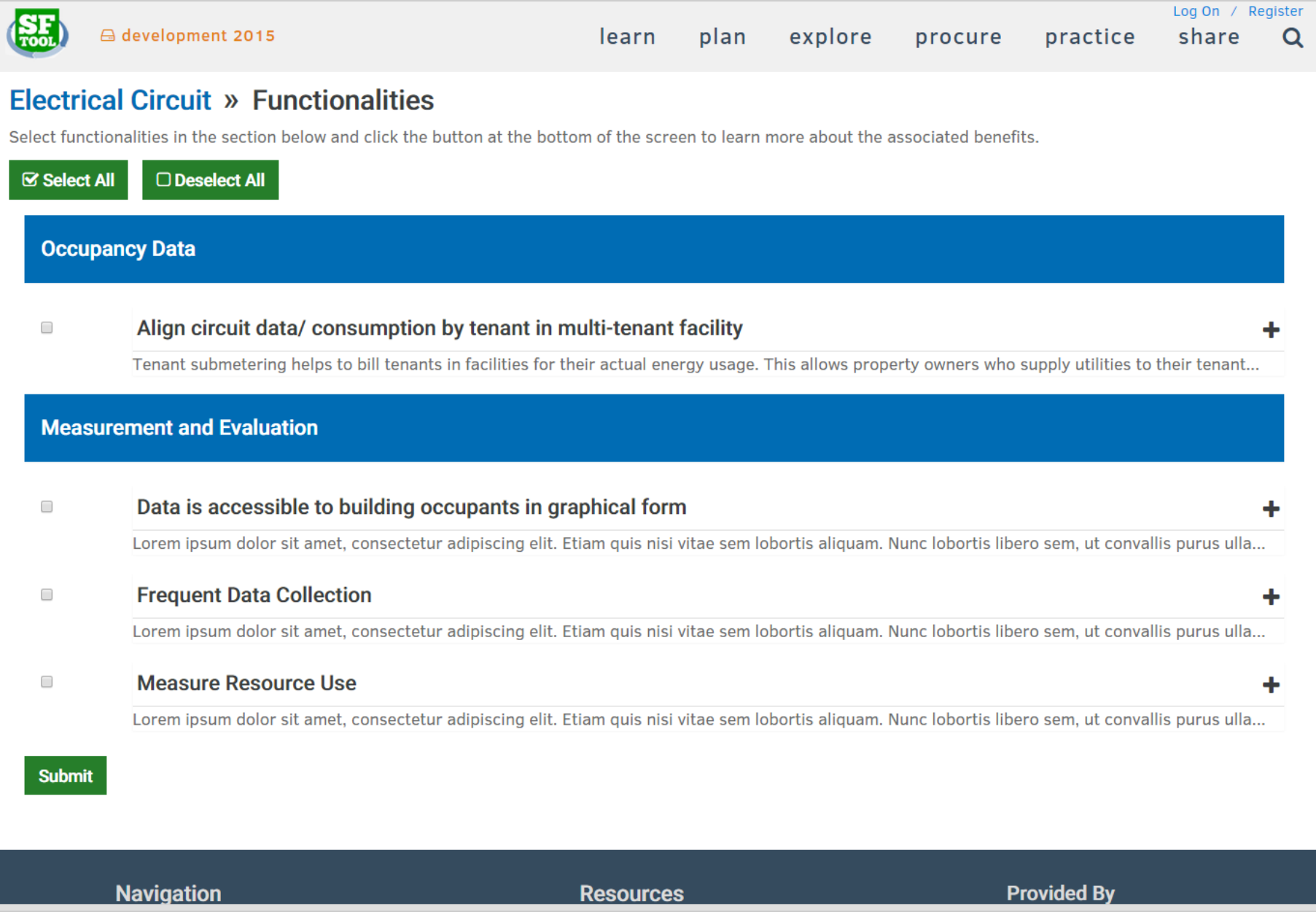

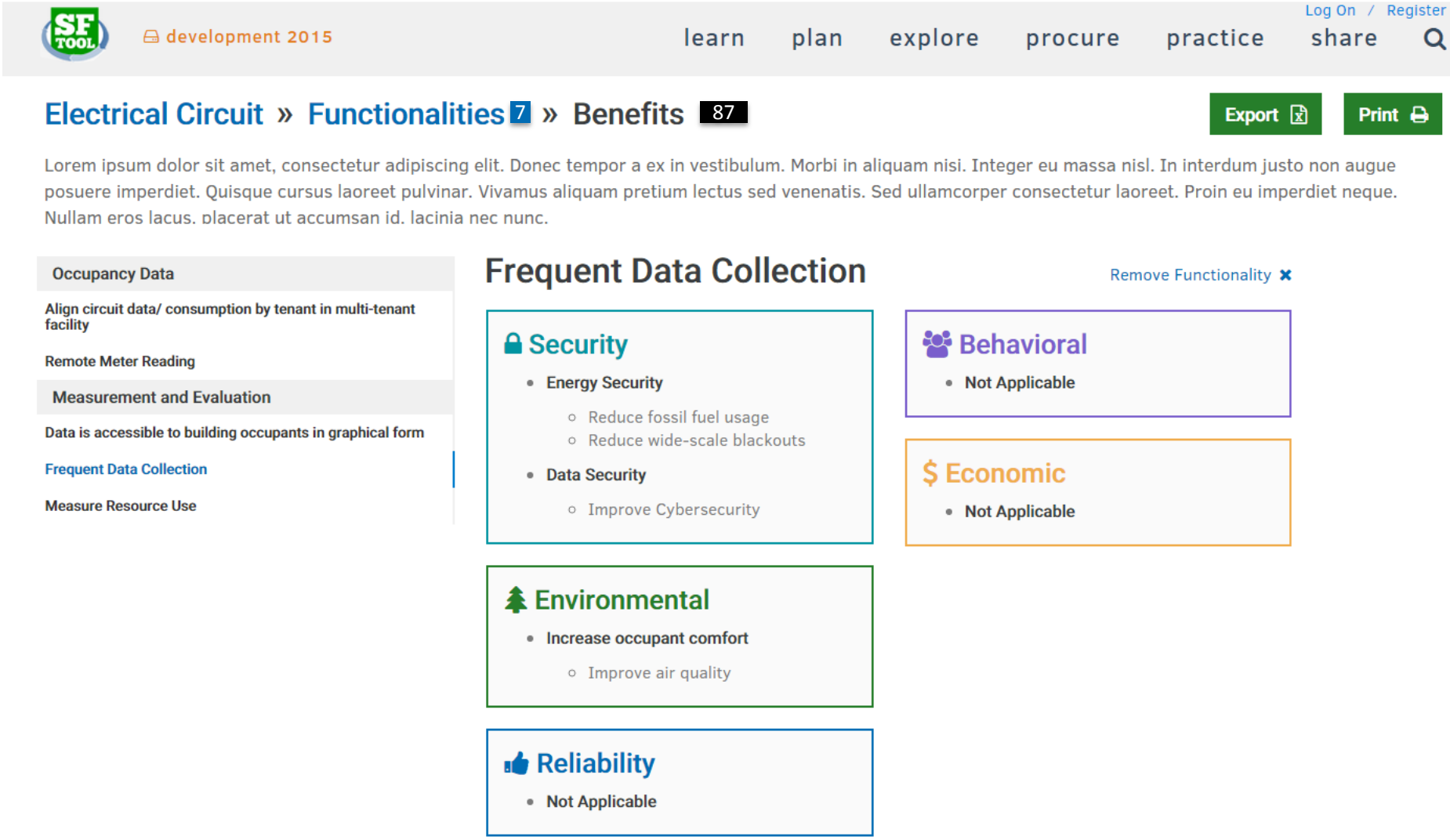

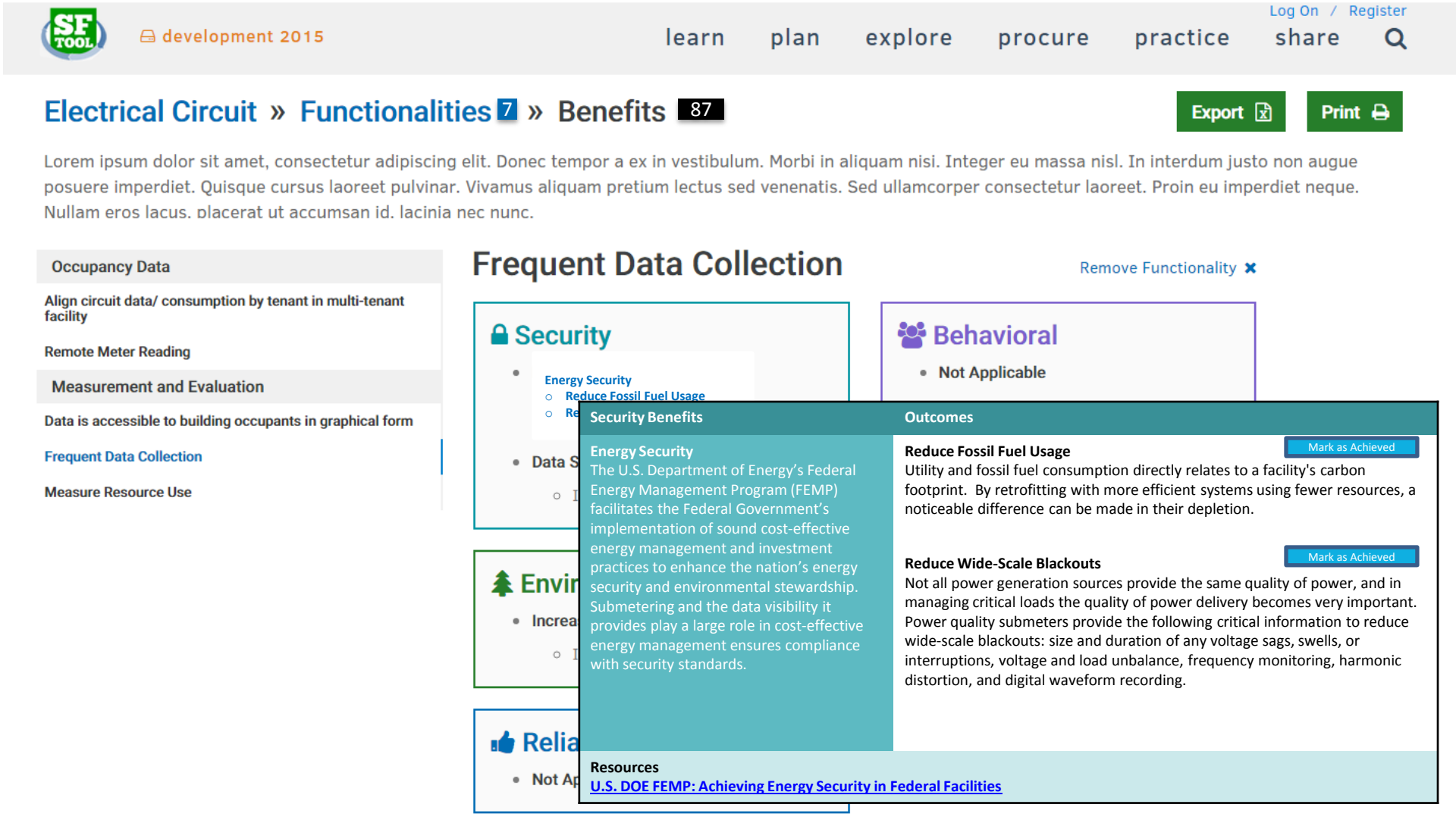

Thank You!

Although submetering by itself does not save energy; it should be viewed as a technology that enables optimized performance and energy efficiency.

RESOURCES

- **Sustainable Facilities Tool https://sftool.gov**
- **GSA Green Proving Ground www.gsa.gov/gpg**
- **GSA Office of Federal High Performance Green Buildings www.gsa.gov/hpgb**
- **NREL Plug and Process Load www.nrel.gov/docs/fy14osti/60266.pdf**

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