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Federal Metering Data Analysis Needs and Existing Tools

July 2015

JW Henderson
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Background

This report is a description of data analysis needs and existing tools that can be used to address the recent legislative and executive order requirements.

Authority

The Energy Independence and Security Act of 2007 (EISA), the Energy Policy Act of 2005 (EPAct) and the March 19, 2015 Executive Order - *Planning for Federal Sustainability in the Next Decade*, have

Covered facility: A facility that an agency has designated as subject to the requirements of section 432 of the Energy Independence and Security Act of 2007 (Pub. L. No. 110-140, as codified at 42 U.S.C. § 8253(f)), which requires agencies to designate covered facilities comprising at least 75 percent of their total facility energy use. A covered facility may be defined as a group of facilities at a single location or multiple locations managed as an integrated operation. A covered facility may also be a single building, if so identified by the agency.

established that agencies are to install electricity, natural gas, steam, and water meters on all (appropriate) Federal buildings and incorporate the usage data into **Federal energy tracking systems and make the data available to Federal facility managers**. Since 2005, many agencies have developed data management systems for tracking metered data. Executive Order 13963 requires agencies to enter monthly energy and water data for “covered facilities” into the Environmental Protection Agency’s (EPA) ENERGY STAR Portfolio Manager (herein referred to as Portfolio Manager) to enable **performance management and benchmarking**. The Executive Order addresses the goal of “incorporating, where feasible, the consensus-based, industry standard Green Button data access system into reporting, data analytics, and automation processes” **to facilitate energy data analysis and management**. Agencies are also required to post and update building performance data in the U.S. Department of Energy’s (DOE) Compliance Tracking System (CTS).

Metering

Electricity, natural gas, steam, and water meters must be installed and the metered data used to identify efficiency measures for Federal buildings deemed “appropriate” and “cost effective” per the *Federal Building Metering Guidance*¹. The guidance outlines a two-step process for the installation of meters in Federal buildings:

Step 1: Criteria are provided for determining the types of Federal buildings for which the installation of meters is “appropriate.”

Step 2: Criteria are provided for the installation of meters at all “appropriate” Federal buildings, while recommending a cost-effective prioritization process for agencies with resource limitations.

The Federal guidance also directs agencies to update metering implementation plans providing a five-year plan for installing the meters and how the data will be used with Portfolio Manager and/or other systems.

Energy Star® Portfolio Manager is a benchmarking tool that ranks the annual energy use of a building compared to average commercial buildings data. Each building receives a score between zero and 100. Buildings with scores above 50 can be considered better than average. Buildings with scores above 75 can receive an Energy Star Buildings Label that recognizes the building as performing in the top 25% of nationwide energy performance.

Benchmarking

Portfolio Manager is the building energy use benchmarking system which Federal Agencies are required to provide monthly building energy use data. DOE uses this data to report to Congress on Energy Use in covered facilities. Portfolio Manager can track the energy use intensity of a campus or other collection of buildings at the same geographic location. All energy use streams, such as natural gas, chilled water, etc., need to be entered into Portfolio Manager. If metered values are not available for all energy use

¹ See Federal Building Metering Guidance (per 42 U.S.C. § 8253(e), Metering of Energy Use), Federal Leadership on Energy Management (November, 2014), http://energy.gov/sites/prod/files/2014/11/f19/metering_guidance.pdf.

streams the values can be estimated. If a building is also metered for water use, the water data must be included in Portfolio Manager as well. Agencies should prioritize benchmarking larger buildings first.

Green Button Initiative²

Green Button is an industry-led initiative driven by a call from the White House for electric utilities to provide easy access to energy data for its customers in a computer-friendly format. The goal is to provide secure, electronically-transmitted, data to customers of the utilities and third-party energy service providers for the purpose of improved energy management. Under the initiative, the North American Energy Standards Board (NAESB) provides the Energy Services Provider Interface (ESPI) standard (a.k.a. the Green Button standard) for utilities, agencies, and service providers to build applications to allow for easier exchange of energy use data and energy analysis. Testing, certification, and user agreements are established through the UCA International Users Group (UCAIug) and will validate that the utility is complying with the NAESB ESPI standard.³ The utilities offering Certified Green Button services are posted on the web.⁴ On-line resources are available for Green Button application developers.⁵

Shortly after implementation, the Army's Meter Data Management System identified simultaneous heating and cooling in the same building. Once corrected, the finding demonstrated significant energy reduction.

Agency Challenges

The vast majority of Federal buildings and “covered facilities” are found within campus settings (base, garrison, etc.) of ten buildings or more.⁶ In campus settings, utility revenue meters may only track energy or water for the full campus or for sizable groups of buildings along with many electrical loads external to those buildings such as parking lights. For building-level energy management, Federal facility managers need access to metered data for the individual buildings in addition to campus-level data. Installing agency owned and managed meters has been a challenge for a variety of reasons. Those challenges include:

- **Funding** the meter installation, meter maintenance, data collection system, data management, and data analysis
- Finding available **staff time** to perform all of the needed tasks
- Providing **training** to staff to select and maintain the meters and the data management system
- Defining the **metering technical needs** for each building within an agency's portfolio, which includes an understanding of the Federal requirements related to metering
- Selecting, purchasing, installing, and calibrating the meters
- Addressing agency **information technology/cyber security concerns** about the use of meters and related communication systems
- Developing or procuring an agency-level **data management** system
- Performing monthly **data analysis** to identify efficiency opportunities
- Developing systems for the Portfolio Manager and CTS **reporting requirements**
- Addressing agency **security concerns** related to reporting utility usage information

² See An Overview of the Green Button Initiative: <http://www.greenbuttondata.org/learn/> and Green Button: <http://energy.gov/data/green-button>

³ See UCAIug's Green Button Interoperability Testing and Certification Authority: <http://www.ucaiug.org/GreenButton/Wiki%20Pages/Home.aspx>

⁴ See UCAIug's Green Button Certificates: <http://www.ucaiug.org/GreenButton/Lists/Green%20Button%20Certificates/AllItems.aspx>

⁵ See For Developers and Green Button Documents Library: <http://www.greenbuttondata.org/build/> and <http://www.greenbuttondata.org/library/>

⁶ Derived from FY- 2012 GSA Federal Real Property Portfolio data.

- Funding efficiency opportunities and performing measurement and verification to document savings

Funding

With budgetary constraints agencies might not have the resources necessary for immediate implementation of advanced meters. Agencies are expected to prioritize the order in which advanced meters and advanced metering devices are to be applied to their Federal buildings. There is a recommended method for prioritization in the *Federal Building Metering Guidance*, not a required method. Thus, the individuals responsible for agency metering planning have the ability to develop and document a prioritization method that suits the needs of the organization.

Start-up funding is needed for establishing data collection and management systems, developing data analysis tools, and initial staff training. Annual funding is needed for meter maintenance, data collection and management system maintenance, data analysis, and training.

Clearly identifying the funding needs and potential funding sources is the first step. Prioritizing the metering efforts based on available funding is the realistic next step.

Staff Time

A metering program is only successful if the metered data are used to improve operations. After the data become available, staff time and expertise are the next critical piece of the puzzle. Staffing resources are needed to install, maintain and, operate a metering system, as well as analyze the metered data. Staff need to be appropriately trained and afforded the necessary time to operate and maintain the metering equipment and system. Training and time need to be allotted for analysis of the metered data in order to gain the benefits of the metering system.

Training

There are a variety of training needs in support of a successful metering program: regulatory requirements, energy management, and metering system management to name a few. First, a clear understanding of the Federal metering and benchmarking requirements and energy efficiency goals will enable energy managers to focus on the aspects of their energy program that have the greatest impact potential. Second, staff need a strong understanding of energy systems and how to assess energy data when it is available. Certified Energy Manager (CEM) training is an example of the type of training that would offer agency and building energy managers the detailed knowledge needed to improve energy operations. Staff also need enough knowledge to specify, operate, and maintain meters, communication systems, and the data management system.

Metering Technical Needs

Agencies will have a diversity of metering technical needs across their organization. Managing that diversity is a challenge. Determining the metering standards and identifying likely exceptions is a highly technical effort that also requires coordination across regions, utilities, and different parts of the agency (e.g., billing, building managers, energy management companies, etc.). The complexity of an individual building's metering needs is compounded based on diverse building locations, functions, and utility providers.

Information Technology/Cyber Security

There are various agency-specific security barriers, such as DoD's Information Assurance Certification and Accreditation Process, that add additional challenges to selecting, installing and connecting advanced meters or advanced metering devices. Increased occurrences of sophisticated cyber-attacks heighten the importance of securing Federal assets. Connecting the meter to a data management system introduces additional security concerns.

Cyber security concerns will likely need to be addressed regarding whether the data can be transmitted over existing network systems, or if a separate communication system will be required, which means that energy professionals will need to engage agency cybersecurity professionals early in the process of selecting and installing metering and related communication systems.

Data Management

For metered data to be consistently evaluated and maintained, a metered data management system needs to be in place to capture the data. The system can consist of simple spreadsheet/database tools generated by a site or agency, or more complex, commercially available software packages. Choosing the appropriate system, tailored to the needs/specifications of the site is crucial. Automating as much of the process as possible may serve to minimize data entry errors, data loss and management costs. Designing, developing and maintaining an energy data management system is a challenging and likely expensive task. The details of an agency's data management system need to be carefully considered so that a high-end product is not developed when a simple approach might suffice.

The Navy is using its own in-house system, CIRCUITS, which has been successful in streamlining bill processing and reducing cost. The CIRCUITS program is currently growing and the system will soon incorporate more benchmarking and analysis capabilities.

Data Analysis

Performing at least monthly data analysis is crucial to identifying efficiency opportunities and a Federal requirement for Covered Facilities. But before analysis can be performed, often the data within the metered data management system needs to be verified, checked for gaps & errors, cleaned, and organized. Training on what to look for, and how to fix these occurrences is needed. What is also needed is an established standard set of analysis techniques using interval data. These analysis techniques may include:

Interval data: Time-stamped utility usage values recorded at regular periods. The value of interval data is the consistent recording of incremental use (e.g., 15 minute) offering increased resolution and diagnostic capability.

- Basic Analysis
 - Annual Energy Use Intensity (EUI)
 - Monthly EUI
- Interval Data Analysis
 - Seasonal Load Profiles
 - Weekly Load Profiles
 - Daily Load Profiles
 - Granular Time-Interval Analysis

Reporting Requirements

Metering systems need to address the Portfolio Manager and CTS reporting requirements, and possibly additional agency-specific reporting. Consistently reporting what is required can be a challenge. A clear understanding of the reporting requirements is a critical first step. Once the reporting requirements are understood, automating the data outputs from the agency data management system may be a mechanism to address the technical and consistency aspects of this challenge.

Existing Tools

For metered data to provide a benefit to an agency, it must be used. One of the key challenges described above is the ability to analyze the data. Existing Federal and private sector tools are available that may be of use to agencies.

Agency Developed Tools

Some agencies may have their own, internally developed, tools that are not known in the private or public sector. These tools are often developed for their own specific needs, using internal resources and

systems and are not available to outside entities. Some examples of these types of tools are shown in Table 1 below.

Table 1 – Agency Developed Tools

Tool (links)	Developer/ Sponsor	Specialty	Bench- marking	Data Display	Energy Analysis					
					Basic Analysis	Interval Data Analysis	Financial Analysis	Demand Response	Control Management	
CIRCUITS	NAVFAC	Utility Payment	✗	✗	✗	✗	✗	✗	✗	✗
MDMS	Army	Meter Data Analysis	✓	✓	✓	✓	✗	✗	✗	✗
Team Track	USAR	Utility Payment	✗	✗	✗	✗	✗	✗	✗	✗
EUAS	GSA	Energy Usage Analysis System	✗	✗	✗	✗	✗	✗	✗	✗

Table notes:

✓ Indicates that the tool has the capability indicated.

✗ Indicates that the tool does not have the capability indicated.

Benchmarking is the ability to compare data to other similar systems, historical benchmarks or industry standards.

Data Display is the capability to present the data in a summarized table or graphical figure.

Basic Analysis refers to simply, normalized analysis techniques such as annual or monthly energy use intensities.

Interval Data Analysis is the ability to incorporate and analyze interval data (e.g. 15-minute interval data).

Financial Analysis includes the capacity to perform simple savings estimations or energy cost predictions.

Demand Response is the ability to respond to demand response signals (e.g. manual, semi-automatic, automatic).

Control Management represents the ability of the tool or software to control building systems.

Federally Developed Tools

A list of federally developed tools potentially useful for Federal agencies can be found in Table 2. In these tables the features highlighted are aspects of energy analysis tools considered important when selecting a tool. All of these tools are free and available for public and Federal agency use. Benchmarking using Portfolio Manager is a requirement for all Covered Facilities; however other benchmarking tools may offer additional insight into a building’s performance improvement opportunities.

Table 2 – Federally Developed Tools

Tool (links)	Developer/ Sponsor	Platform	Specialty	Bench- marking	Data Display	Energy Analysis				
						Basic Analysis	Interval Data Analysis	Financial Analysis	Demand Response	Control Management
ENERGY STAR Portfolio Manager	EPA	Web Tool	Benchmarking, Rating System	✓	✓	✓	✗	✗	✗	✗
Labs21	LBNL	Web Tool	Benchmarking, Rating System	✓	✓	✓	✗	✗	✗	✗
Commercial Building Asset Score	DOE	Web Tool	Energy Efficiency Score (Physical and Structural)	✓	✗	✗	✗	✗	✗	✗
BEDES	DOE	Open Source	Data Exchange Specification	✗	✗	✗	✗	✗	✗	✗
SEED	DOE	Open Source	Open Source Software	✗	✗	✗	✗	✗	✗	✗
Building Energy Fingerprint	LBNL	Web Tool, Open Source	Green Button Data Analysis	✗	✓	✓	✓	✗	✗	✗
Green Button Grapher	LBNL	Web Tool	Green Button Data Analysis	✗	✓	✓	✓	✓	✗	✗
BuildingSync	NREL (DOE)	XML Schema	Commercial Building Energy Audis	✗	✗	✗	✗	✗	✗	✗
OpenStudio	NREL (DOE)	Open Source, Software	“Operating System” for Building Energy Modeling	✓	✓	✓	✓	✓	✗	✗

Commercially Developed Tools

Additional tools were found, but were considered to have a lower likelihood of being applicable to most Federal agencies. These are commercially developed products that range from being free; excel based, interval data analysis tools such as ECAM (Energy Charting and Metrics) to full enterprise systems with paid subscriptions required. A list of some of these tools is in Table 3.

Table 3 – Commercially Developed Tools

Tool (links)	Developer/ Sponsor	Availability	Bench- marking	Data Display	Energy Analysis				
					Basic Analysis	Interval Data Analysis	Financial Analysis	Demand Response	Control Management
5Twenty	SPARC Inc.	Public	✓	✓	✓	✓	✓	✗	✗
Commercial Energy Suite	Apogee Interactive	Public	✓	✓	✓	✓	✓	✓	✗
ECAM+	NorthWrite	Public	✓	✓	✓	✓	✗	✗	✗
EEM Suite	McKinstry	Public	✓	✓	✓	✓	✓	✗	✓
EfficiencySMART	EnerNOC	Public	✓	✓	✓	✓	✓	✓	✗
EIServer	Energy/CT	Public	✓	✓	✓	✓	✓	✓	✓
Energy Information Platform	Ziphany	Public	✓	✓	✓	✓	✓	✓	✓
Energy Manager	Pulse Energy	Public	✓	✓	✓	✓	✓	✗	✓
Energy Profiler Online	Schneider PowerLogic	Public	✓	✓	✓	✓	✓	✓	✗
Energy Worksite	NorthWrite	Public	✓	✓	✓	✓	✓	✓	✓
EnergyWitness	Interval Data Systems	Public	✓	✓	✓	✓	✓	✗	✗
Enterprise Energy Dashboard (E2D)	SAIC	Public	✓	✓	✓	✓	✓	✗	✗
EnterprizeEM	Energetics	Public	✓	✓	✓	✓	✗	✗	✗
FirstFuel	FirstFuel	Public	✓	✓	✓	✓	✓	✗	✗
Green Energy Management System	Green Impact Campaign	Public	✓	✓	✓	✓	✓	✓	✓
GridConnect	Energy Connect by Johnson Controls	Public	✓	✓	✓	✓	✓	✓	✓
Intelligent Building Interface System	Integrated Building Solutions	Public	✓	✓	✓	✓	✓	✓	✓
Ion EEM	Schneider Powerlogic	Public	✓	✓	✓	✓	✓	✗	✓
Load Profiler	Automated Energy	Public	✓	✓	✓	✓	✓	✗	✗
Micro Thermo	Sporlan Online	Public	✓	✓	✓	✓	✓	✓	✓
Noveda Smart Data Products	Noveda	Public	✓	✓	✓	✓	✓	✗	✓
Operational Insight	Matrikon / Honeywell	Public	✓	✓	✓	✓	✗	✗	✓

Opus Orchestrator	Novar	Public	✓	✓	✓	✓	✓	✓	✓
Power TakeOff	Power TakeOff	Public	✓	✓	✓	✓	✓	✓	✓
Retroficiency	Retroficiency	Public	✓	✓	✓	✓	✓	✗	✗
Spara Technology	Powerit Solutions	Public	✓	✓	✓	✓	✓	✓	✓
Stepwise	Parasense	Public	✓	✓	✓	✓	✗	✗	✓
Utility Vision	Chevron Energy Solutions	Public	✓	✓	✓	✓	✗	✗	✗
Vykon Energy Suite	Tridium	Public	✓	✓	✓	✓	✓	✗	✗
WebCTRL	Automated Logic	Public	✓	✓	✓	✓	✗	✗	✓
WegoWise	WegoWise	Public	✓	✓	✓	✓	✓	✗	✗

The federally developed tools listed above and some of the commercially developed tools are described in the following sections.

Federal Tools

*ENERGY STAR Portfolio Manager*⁷

Portfolio Manager is a peer benchmarking tool developed by the EPA. The tool tracks monthly energy and water performance and provides benchmarking and target projections. The tool requires meta-data such as square footage, number of personal computers, building type, year constructed, location, percent heated and cooled, and number of occupants.

*Labs21*⁸

Labs for the 21st Century (Labs21) was developed by the Lawrence Berkeley National Laboratory (LBNL) to offer a benchmarking tool for laboratories. Labs21 *“allows laboratories to compare annual energy performance of similar buildings within the database”* and *“requires similar meta-data (but less) to Portfolio Manager.”*

*Commercial Building Asset Score*⁹

DOE’s Commercial Building Asset Score is *“is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. The Asset Score generates a simple energy efficiency rating that enables comparison among buildings, and identifies opportunities to invest in energy efficiency upgrades.”*

⁷ See U.S. Environmental Protection Agency ENERGY STAR Portfolio Manager: <http://www.energystar.gov/buildings>

⁸ See Labs for the 21st Century (Labs21): <http://labs21benchmarking.lbl.gov/>

⁹ See Commercial Building Asset Score: <http://energy.gov/eere/buildings/building-energy-asset-score>

*BEDES*¹⁰

The Building Energy Data Exchange Specification (BEDES) is a building energy data dictionary. It offers a “*dictionary of terms, definitions, and field formats which was created to help facilitate the exchange of information on building characteristics and energy use. It is intended to be used in tools and activities that help stakeholders make energy investment decisions, track building performance, and implement energy efficient policies and programs.*”

*SEED*¹¹

The Standard Energy Efficiency Data (SEED) Platform™ is an open source software application developed by DOE to help agencies and organizations manage large datasets for groups of buildings pertaining to energy performance. The SEED Platform™ allows users to combine, clean, validate and share data from various sources and is described as being flexible for a wide range of potential purposes.

*Building Energy Fingerprint*¹²

The Building Energy Fingerprint was developed by LBNL under the direction of DOE. The tool was intended to provide building owners with an easy tool for analysis of interval data in a standard format (Green Button data). The tool provides simple performance indicators such as average daily minimum, average daily maximum and annual amounts of energy consumption. The Building Energy Fingerprint tool also provides more detailed charts such as a typical weekly profile, power heat map, daily mean & extremes, and thermal response. The input file required for this tool is either an XML (extensible markup language) or zip file of your Green Button data along with some simple meta data (e.g. building name, zip code, year of construction, floor area, type, heating and cooling type, and number of occupants).

*Green Button Grapher*¹³

The Green Button Grapher is a webpage interface that “*allows users with Green Button Data to chart their usage and experiment with how reducing power consumption could impact their power bill.*”

*BuildingSync*¹⁴

Led by the National Renewable Energy Laboratory (NREL), BuildingSync was developed by a working group of industry partners and organizations and other national laboratories. In the form of an XML schema, BuildingSync is a standard language for commercial building energy audit data “*that can be utilized by different software and databases involved in the energy audit process. It allows data to be more easily aggregated, compared and exchanged between different databases and software tools. This streamlines the energy audit process, improving the value of the data and facilitating achievement of greater energy efficiency.*”

*OpenStudio*¹⁵

OpenStudio is a free, open-source, cross-platform (Windows, Mac, and Linux) operating system developed by NREL and DOE for building energy modeling. In 2008 OpenStudio was initially created as a geometry creation plug-in for EnergyPlus. Since then, the tool has developed into a robust software development kit that helps in the automation of functions associated with the creation and modification of energy models.

¹⁰ See The Building Energy Data Exchange Specification (BEDES): <http://energy.gov/eere/buildings/building-energy-data-exchange-specification-bedes>

¹¹ See The Standard Energy Efficiency Data (SEED) Platform™: <http://energy.gov/eere/buildings/standard-energy-efficiency-data-platform>

¹² See Building Energy Fingerprint: <https://fingerprint.lbl.gov/>

¹³ See Green Button Grapher: <http://mtmckenna.github.io/green-button-grapher/>

¹⁴ See BuildingSync: <http://www.nrel.gov/buildings/buildingsync.html>

¹⁵ See OpenStudio: <http://energy.gov/eere/buildings/downloads/openstudio-0>

[DOE Building Energy Software Tools Directory](#)¹⁶

In addition to the tools specified in this document, DOE has sponsored the development of a Building Energy Software Tools Directory that provides information on 417 tools (some of which are specified above) for evaluating energy efficiency, renewable energy and sustainability. “DOE developed this directory because many Office of Building Technology, State and Community Program (BTS) programs develop software tools to help researchers, designers, architects, engineers, builders, code officials, and others involved in the building life-cycle to evaluate and rank potential energy-efficiency technologies and renewable energy strategies in new or existing buildings.”

Non Federal Interval Data Analysis Tools

ECAM is an example of a free, non-Federal tool capable of incorporating interval data in the standard green button format. See description below.

[ECAM](#)¹⁷

The Energy Charting and Metrics (ECAM+) tool was developed by NorthWrite to facilitate the analysis of energy information from buildings using interval data. ECAM+ is an add-on for Microsoft Excel and uses pivot tables and charts to evaluate performance and assist in re-tuning. Some key features of ECAM+ include:

- Creation schedules and day-type information
- Time series analysis
- Occupancy loads
- Temperature binned weather data
- Pre/post comparisons
- Normalizing data
- Various load profiles
- Scatter charts for data selected by the user

Desirable Tool Parameters

This section describes some tool parameters to consider when developing a new tool or selecting a data analysis and/or data management tool. First, the tool should be geared toward the key needs of Federal building operators and campus/agency managers. Second, the tool should provide quick, action-based analysis of interval data. Additional considerations when evaluating existing or developing new tools include:

Who are the key audiences?

- Building operators
- Campus energy managers
- Agency energy managers

What are the current energy analysis, management, and reporting challenges?

- No metered data
- No meta-data
- No time to collect, manipulate, and analyze data
- Additional skills/training may be needed to collect, manipulate, and analyze the data

What types of analysis tools are needed?

- Provides building-, campus-, and enterprise-level energy analysis graphics for Federal buildings

¹⁶ See DOE Building Energy Software Tools Directory: http://apps1.eere.energy.gov/buildings/tools_directory/

¹⁷ See ECAM+ (Energy Charting and Metrics) Tool: <http://www.northwrite.com/ecam.asp>

- Capable of using Green Button formatted data with other energy data and meta-data provided in a standard format
- Excel plug-in or equivalent easy to use tool that generates typical energy analysis charts for building-, campus-, or enterprise-level investigation

What are the specific analysis needs?

- Annual EUI
- Monthly EUI
- Seasonal Load Profiles
- Weekly Load Profiles
- Daily Load Profiles
- Granular Time-Interval Analysis

Agencies have been working to improve their metering data collection, management, and analysis efforts over the last decade (since EAct 2005) and will continue to address these challenges as new requirements and data needs come into place. Unfortunately there is no “one-size-fits-all” solution. As agencies continue to expand their capabilities to use metered consumption data to reducing resource use and improve operations, the hope is that shared knowledge will empower others to follow suit.

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