EMERGING USES FOR BUILDING ENERGY DATA FOR UTILITIES

Institute for Market Transformation

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PUTTING DATA TO WORK

REPORT

IMT
INSTITUTE FOR MARKET TRANSFORMATION

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ABOUT IMT

The Institute for Market Transformation (IMT) is a national nonprofit organization focused on increasing energy efficiency in buildings to save money, drive economic growth and job creation, reduce harmful pollution, and tackle climate change. IMT ignites greater investment in energy-efficient buildings through hands-on expert guidance, technical and market research, policy and program development and deployment, and promotion of best practices and knowledge exchange. For more information, visit imt.org

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PUTTING DATA TO WORK

This resource was developed as part of *Putting Data to Work,* a three-year pilot project aimed at using building performance data and asset information to help efficiency program implementers better target their outreach to building owners and increase the number of projects executed within these programs. The project used building performance data generated by city policies to improve energy efficiency program design and delivery in the District of Columbia and New York City, and developed a toolkit of resources to enable local governments, utilities, and program implementers to learn from activities to replicate successes.

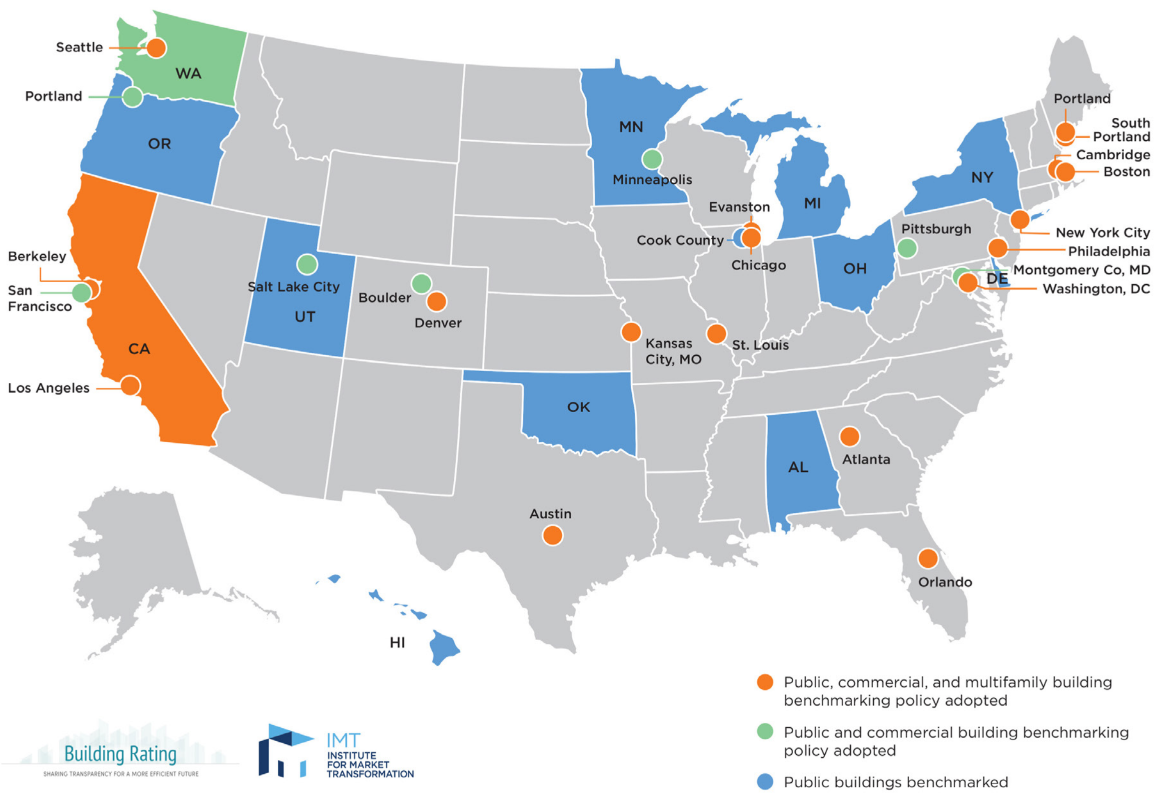
This report describes the opportunities that energy utilities can realize from the growing wealth of data about building energy performance generated by activities at the state and local level. Energy utilities—including investor-owned, municipal, or cooperative retail entities—that provide resources ranging from electricity and natural gas to steam or efficiency, can use the development of building performance policies or programs by cities as an opportunity for innovation internally. This report first describes the types of data that voluntary or mandatory city building performance programs create. It next summarizes several emerging ways to use this data and their potential value to utilities. Finally, it describes actions that utilities can take internally to realize these benefits.

While data about building systems and performance can be used to enhance energy efficiency offerings, it also has new applications that are not yet fully explored.

Introduction

Recognizing the environmental, economic, and health benefits that society acquires from improving building energy use, a growing number of state and local jurisdictions encourage or require building owners to benchmark[1] their buildings' energy use—or undergo energy audits, retrocommissioning, or other activities—to support more informed decisions as to how to improve the efficiency of buildings across the U.S. This growing wealth of building energy data presents a unique set of opportunities for utilities. While data about building systems and performance can be used to enhance energy efficiency offerings, it also has new applications that are not yet fully explored. By collaborating with state and local jurisdictions, utilities can leverage new data sources to manage their distribution systems more effectively, support local resilience, enhance load forecasting, and design new rate structures.

U.S. Building Benchmarking and Transparency Policies



As a whole, city policies can overcome existing hurdles to increase the data utilities can use to improve their business. While utilities already have direct access to *some* building performance data, obtaining other data elements, such as the energy systems within a particular building, would require utilities to establish data-sharing arrangements with building owners or cities. Building performance policies enable utilities to leap frog these obstacles by generating multiple types of data that are relevant to utilities.

1 Benchmarking means to compare the energy usage of a building to that of similar buildings using a tool like ENERGY STAR Portfolio Manager.

First, building performance policies generate energy performance data that utilities can use to improve their operations and customer service. For example, building owners who want to understand their buildings' energy consumption or comply with city benchmarking ordinances depend on utilities to provide complete, accurate, and useful monthly whole-building data that includes the total energy consumption of all occupants in a building.[2] Not only can this whole-building data be used to benchmark the building and compare its energy performance, but it can provide opportunities to reach out to customers proactively about energy efficiency opportunities and even equipment malfunctions. As this report will discuss, utilities and cities are beginning to use energy performance information to not only improve customer service, but also to provide more targeted outreach for energy efficiency programs.

Second, building performance policies generate new data on building characteristics, and sometimes connect existing data in new ways. Data on certain building characteristics, such as square footage, may already be publicly available through local government databases. However, other data—such as occupancy rates, fuel sources, types of building energy systems and equipment, and recommended future upgrades—may not be readily available. As cities begin collecting this information, utilities can work with cities that gather, clean, and connect these types of data to improve their operations. For example, to understand their building stock better, New York City and Los Angeles require building owners to submit information about building energy systems and equipment. Additionally, building owners complying with New York City's building ordinances[3] must submit the energy efficiency measures that are recommended when they undergo an audit or retrocommissioning. As this paper will discuss, this type of new information could inform utility operations in the future, including more effective distribution grid management, more granular load forecasting, and greater resilience to support planning for natural disasters.

Note: *For those readers interested in exploring opportunities for sharing building performance data between cities and utilities, see the* Putting Data to Work *tool, "Implementation Guide for Program Administrators: How Utilities and Cities Can Use Building Energy Data to Improve Energy Efficiency."*

Improving Utility Operations Using Building Data

Building energy data creates opportunities for highly regulated entities to engage their customers more precisely, use ratepayer dollars more efficiently, and increase safety and reliability. This section summarizes several emerging ways that building energy data can be used by utilities.

2 "Best Practices for Providing Whole-Building Energy Data: A Guide for Utilities," U.S. Department of Energy Better Buildings Energy Data Accelerator, 2016, https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/Best%20Practices%20for%20Providing%20Whole-Building%20Energy%20Data%20-%20Guide%20for%20Utilities.pdf.

3 "Greener, Greater Buildings Plan," New York City Mayor's Office of Sustainability, January 5, 2018, http://www.nyc.gov/html/gbee/html/plan/plan.shtml

Enhancing Energy Efficiency Programs and Services

Leading utilities are beginning to see more advanced uses for the information generated by cities' building energy performance policies. Information about the characteristics of buildings that must comply with those policies, the energy systems and equipment within those buildings, and the whole-building energy usage of those buildings can be used to inform the design and implementation of energy efficiency programs and services. Furthermore, the process of meter mapping—or identifying the customers, premises, accounts, or meters associated with a building in order to aggregate whole-building energy usage at a monthly level—can also be applied to more granular interval data, creating a profile of how energy is used in a building over time, which can be disaggregated to the equipment level for more tailored recommendations on efficiency upgrades.

While many utility programs explore market segmentation and propensity modeling using demographic data and surveys, city building performance policies provide a wealth of data drawn from customers' actual energy usage data and building characteristics.

Leveraging building energy data to enhance utility energy efficiency offerings is critical because, in most states, utilities are required by state law or regulation to pursue energy savings where they are a cost-effective alternative to power supply. However, increasing energy codes and standards have made it more difficult for utilities to obtain traditional "low-hanging fruit" energy conservation measures (ECMs), such as one-off lighting upgrades. Meanwhile, even utilities that have been running programs for decades report low levels of participation due to lack of information or awareness, difficulty applying for rebates, the "split incentive" between building owners and tenants, and other barriers.

Utilities are increasingly exploring analytics-based pilots and programs in order to broaden their outreach to customers and make it more effective, ideally breaking down the barriers that prevent participation in energy efficiency programs.

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Saving Ratepayer Money through Efficient Distribution System Management

Data about building energy use, building energy systems, recommended upgrades, and owner contacts may support more efficient and effective utility distribution system management. U.S. utilities anticipate spending significant sums in coming years to upgrade their distribution and transmission systems,[4] and because utilities earn a rate of return on capital investments, they may be incentivized to build infrastructure. However, with better data, some capital investments—such as new distribution substations—can be deferred or avoided through "non-wires alternatives," such as energy efficiency, demand response, and solar plus storage systems. A 2015 report for the Northeast Energy Efficiency Partnerships found that energy efficiency could be geographically targeted (geo-targeted) to customers in cost-effective ways to avoid specific capital distribution and transmission investments.[5]

The question of whether capital investments can be deferred depends on where energy demand is growing within a utility's service territory. Some entities rely on individualized account managers to conduct geo-targeted outreach to customers about energy efficiency, whereas others have provided special, higher rebates to customers in particular areas. However, where utilities have insight into what equipment uses energy within buildings, whether particular buildings are located in areas of growth, and who the decision makers are who are associated with any given building, they can conduct more sophisticated outreach for participation in energy efficiency and demand response programs.

RELATED RESOURCES

For those interested in learning more about specific initiatives underway in DC and New York, the *Putting Data to Work* toolkit provides case studies of how the D.C. Sustainable Energy Utility and the New York City Retrofit Accelerator conduct targeted outreach to customers based on their buildings' energy performance, combined with information about building characteristics and neighborhood demographics. (See "Increasing Customer Engagement with Data: District of Columbia Sustainable Energy Utility" and "Successful Partnership to Accelerate Efficiency: NYC Retrofit Accelerator," respectively.)

In addition, *Putting Data to Work's* "Implementation Guide for Program Administrators: How Utilities and Cities Can Use Building Energy Data to Improve Energy Efficiency" discusses how utilities can develop energy efficiency programs in collaboration with cities, based on lessons learned from these and similar efforts. The guide specifically describes how information-sharing between New York City and Con Edison about the prevalence of steam heating have led to modifications to multifamily steam rebate offerings.

For example, Con Edison has long been a leader in integrating energy efficiency into its transmission and distribution planning; it is also one of the few electric utilities that has explicitly used an approach that involves whole-building data. As part of the Brooklyn-Queens Demand Management Program in New York, which is seeking to delay construction of a new substation, Con Edison contracted with Retroficiency (now Ecova) to identify commercial buildings and customers with

4 Chris Neme and Jim Grevatt, "Energy Efficiency as a T&D Resource: Lessons from Recent U.S. Efforts to Use Geographically Targeted Efficiency Programs to Defer T&D Investments," Northeast Energy Efficiency Partnerships, 2015, http://www.neep.org/sites/default/files/products/EMV-Forum-Geo-Targeting_Final_2015-01-20.pdf.

5 Ibid.

high energy efficiency potential and provide them with actionable recommendations for upgrades.[6] While questions have been raised about the demonstration project's performance, it reveals an emerging interest among utilities to conduct geo-targeting for energy efficiency and demand response using whole-building data.

Supporting Resilience through Coordinated Emergency Planning and Response

Traditionally, cities have tracked tax parcels or deed addresses that may differ from street addresses, and utilities have tracked customer accounts or premises that may differ from buildings. Many cities that implement benchmarking and transparency policies have implemented a unique, numerical building identifier (unique building ID) to support data management. The unique building ID provides an opportunity for both cities and utilities to link multiple datasets while ensuring they are speaking about the same physical building.

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This unique building ID may benefit energy utilities in several ways as they plan for and respond to natural and human-caused disasters, often coordinating with local emergency services (fire, police, health, water) and regional mutual aid networks in the process.[7] For example, the unique building ID could be tied to information about whether particular buildings are essential facilities to create a common understanding between utilities and emergency services as to priority for restoring power, water, and other functions. It could also be used to provide information about whether buildings have backup generators or particular types of equipment, helping ensure the safety of field crews, and it could be used to transfer information quickly between field crews when utilities rely on mutual aid for support.

The U.S. Department of Energy is currently leading an initiative to develop a universal unique building ID (UBID) that could be generated and used by multiple entities in a coordinated fashion. The research draws on other industries' practices with regard to unique identifiers, including the International Standard Book Number (ISBN) and the Vehicle Identification Number (VIN). The proposed methodology allows multiple parties to independently derive the same unique ID for a given building, eliminating the need to have a central authority that is responsible for maintaining the complete universe of building ID values. The data that cities are collecting about building systems, as well as the work utilities are doing to map meters, could be used to create more complete views of buildings, supporting resilience through more effective planning for and response to natural disasters.

6 DNV GL, "The Changing EM&V Paradigm: A Review of Key Trends and New Industry Developments, and Their Implications on Current and Future EM&V Practices", Northeast Energy Efficiency Partnerships, 2015, http://www.neep.org/sites/default/files/resources/NEEP-DNV%20GL%20EMV%202.0.pdf.

7 "Understanding the Electric Power Industry's Response and Restoration Process," Edison Electric Institute, 2016, http://www.eei.org/issuesandpolicy/electricreliability/mutualassistance/documents/ma_101final.pdf.

Serving Customers Proactively

Where the process of benchmarking creates the opportunity for utilities to look at whole-building data internally, it can support customer service offerings by which they notify customers of proactive maintenance opportunities. For commercial and multifamily buildings, utilities can preemptively notify building owners of issues that could otherwise negatively affect their tenants.

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In one case in a Western U.S. state, a small business tenant experienced high demand charges because of a malfunctioning piece of HVAC equipment. Moreover, according to the terms of their electric rates, the tenant's demand charges were to remain high for 12 months because of a "ratchet" provision that charges customers based on the higher of a set demand charge or a proportion of their largest monthly demand.[8] In other words, the equipment malfunction cost the tenant a significant amount of money. If the building owner was able to benchmark, they could have identified and corrected the error earlier. Moreover, better analytics could have allowed the utility to identify and even proactively reach out to the building owner or tenant to fix the problem. Information about building energy systems collected by cities could help utilities provide even more accurate recommendations. In addition to improving customer relationships, addressing these sorts of issues proactively has the added benefit of contributing to the utility's financial stability and preventing irregularities in distribution planning or cost allocation.

8 Second Supplemental Comments of Western Resource Advocates, filed in Docket 14R-0394EG (Colorado Public Utilities Commission, November 7, 2014).

Identifying Early Signals of Building Stock Change to Enable More Precise Load Forecasting

Whole-building data for commercial and multifamily customers could allow for more precise load forecasts, especially when overlaid with geospatial data for where these customers are currently located, and where they may be located in the future, in consultation with city planners. Utilities forecast load to understand what package of resources they may need to acquire in the future to maintain service to customers and to ensure reliability. Forecasting occurs on a range of time scales, from 15-minute and day-ahead forecasts necessary to balance grid reliability on an ongoing basis, to 10- to 20-year forecasts that assess the utility's long-term need to build or purchase supply from generating units.

Traditional load forecasting involves a high-level econometric approach that assesses historical energy usage and customer numbers, anticipated economic and demographic changes, and trends related to per-customer usage, which may be impacted by federal efficiency standards. Often, projections are based on per-customer (per-meter) assessments over customer classes such as "residential" or "industrial." A significant recent analysis found that under this traditional approach, utilities have tended to overestimate load growth, leading to over-procurement of energy resources.[9]

Looking at energy usage at a more granular level, including where and how buildings use energy, may provide opportunities to refine utilities' ability to forecast future growth and avoid over-procurement of energy resources in future years.

In recent years, growing uncertainty associated with long-term investments in resources such as coal, coupled with changing load-growth projections and increased computational power, have combined to transition load forecasting from a single-point exercise to a probabilistic exercise that considers scenarios and risk. Looking at energy usage at a more granular level, including where and how buildings use energy, may provide opportunities to refine utilities' ability to forecast future growth and avoid over-procurement of energy resources in future years.

Designing New Rate Structures on a Building Basis

The ability to view energy usage and energy performance at a building level could lead to the development of new rate structures. Regulated energy utilities operate in a "cost of service" regime in which they design rates for customers based on the assessed cost to serve that particular "class" of similar customers; residents, small businesses, and certain types of manufacturers may be separated into their own classes. Rates are often designed around the

9 Juan Pablo et al., "Load Forecasting in Electric Utility Integrated Resource Planning," Ernest Orlando Lawrence Berkeley National Laboratory, 2016, https://emp.lbl.gov/sites/default/files/lbnl-1006395.pdf.

number of meters and types of usage patterns for customers within that class. Looking at rates on a building basis could create interesting alternatives.

Currently, a single building may have submetered commercial tenants who are each billed separately based on their respective individual peak demands.[10] However, from a building perspective, the building may have a high load factor, reflecting that tenants with peaks that differ from each other actually create a relatively consistent load profile over time. This is desirable to utilities because it means that customers' energy needs are consistent and predictable, and would not require them to change operations to meet irregular peaks in demand. Accordingly, utilities could design rates that incentivize tenants to work together to manage energy in certain ways that create benefits for their neighborhood (such as deferring upgrades) or for the larger system (by flattening peaks).

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Traditional rate design does not contemplate this level of granularity. However, particularly as building energy management becomes more sophisticated, tenants could work together to create uniform building energy usage profiles that match what utilities need—for example, pushing certain types of usage to night hours when wind is prevalent or making usage relatively consistent throughout the day to produce a high load factor. Utilities could develop rate designs or demand response programs that incentivize tenants working together to optimize the entire building in particular ways.

Supporting Research and Data Reporting Efforts

When utilities map meters to create whole-building energy usage data in response to city policies, this effort could produce benefits for research and development. For example, it could better position utilities to respond to requests from the Energy Information Administration (EIA) to fulfill the Commercial Buildings Energy Consumption Survey (CBECS).

To produce the CBECS, EIA collects a statistically representative sample of commercial buildings nationwide to assess energy consumption by commercial buildings by source, end use, type, size, age, and region.[11] For the 2012 CBECS, EIA developed an assessment of the

10 Utilities have different billing practices around demand rates, but often charge commercial tenants based on their maximum demand within a month, usually based on 60-minute intervals.

11 The EPA uses the CBECS results to develop the 1–100 ENERGY STAR score produced by Portfolio Managerfor a range of building types. "Updated to ENERGY STAR score with CBECS data," ENERGY STAR, https://www.energystar.gov/buildings/facility-owners-managers/existing-buildings/use-portfolio-manager/update-energy-star-scores-cbecs.

total commercial building population for 2012 and sorted it into subgroups for sampling.[12] It then requested energy usage information and other building characteristics, first attempting to interview a respondent on the behalf of the building, and then going directly to the energy supplier for the building in the event the respondent could not provide full data.[13] EIA goes through multiple steps to obtain and validate the data it receives from building owners, their representatives, and suppliers, and sometimes is unable to obtain data from a particular building.[14] CBECS includes buildings with multiple uses and can include buildings with multiple meters or multiple tenants that need to be aggregated.

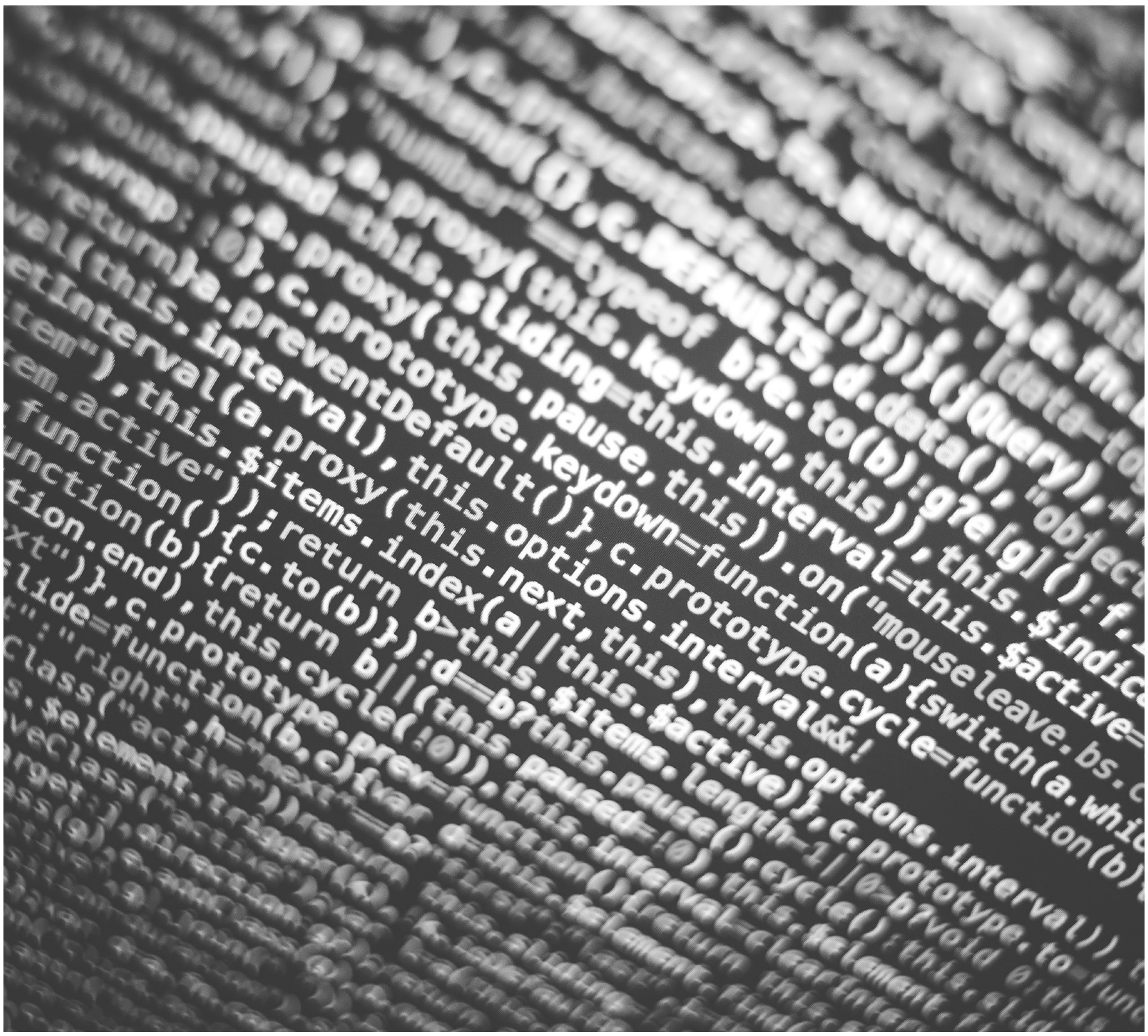
Where utilities are able to produce whole-building energy usage data on request, EIA could conduct a more extensive sample more cost-effectively, which could increase the usefulness of surveys such as CBECS. Accuracy for CBECS is important because, among other benefits, it provides the foundation for ENERGY STAR Portfolio Manager, the most common platform used in collecting benchmarking data, to make comparisons between similar buildings. The availability of this type of data for research could similarly support efforts by state energy offices or public utility commissions to evaluate building energy usage as part of assessing the benefits of energy code

12 "How Were Buildings Selected for the 2012 CBECS?" U.S. Energy Information Administration, https://www.eia.gov/consumption/commercial/reports/2012/methodology/sampling.php

13 "How Was Energy Usage Information Collected in the 2012 CBECS?" U.S. Energy Information Administration, https://www.eia.gov/consumption/commercial/reports/2012/methodology/usage.php

14 "How Was the 2012 CBECS Buildings Survey Conducted?" U.S. Energy Information Administration, https://www.eia.gov/consumption/commercial/reports/2012/methodology/conducted.php

compliance or recommending energy code updates. For utilities, these sorts of studies could inform discussions with regulators about whether energy code compliance and adoption can be integrated into regulated energy efficiency programs. Realizing these benefits would, however, require significant effort to develop consistent ways to map meters and format data across utilities, as well as implementing regulatory regimes that enable the use of energy data for research purposes while continuing to protect customer privacy.



Realizing the Benefits of City Building Datasets

Using city building datasets in the ways discussed above requires utilities to take several key steps from an organizational perspective. This report provides three examples of how utilities can position themselves to leverage the data from cities' building energy performance policies. The complementary *Putting Data to Work* tool, "Implementation Guide for Program Administrators: How Utilities and Cities Can Use Building Energy Data to Improve Energy Efficiency," includes additional recommendations tailored to setting up an energy efficiency program that leverages building energy data.

Increasing Collaboration and Efficiency by Developing Cross-Functional Teams

Leveraging building energy data associated with city policies to enhance energy efficiency programs and create other internal and external operational efficiencies requires utilities to develop new types of teams. Utilities may need to bring together staff from energy efficiency, information technology (IT), the legal department, customer service representatives, and distribution engineering. For example, when Con Edison began its Building Efficiency Marketplace pilot, it established teams from across the organization, including marketing, account executives, engineering, information resources, and energy efficiency program administrators.[15] Similarly, when evaluating the role of behind-the-meter solutions in meeting customer energy needs, the Sacramento Municipal Utility District emphasized the need to connect utility departments who may not have collaborated in the past, ranging from transmission and distribution planners to program designers and implementers.[16]

Incorporating Data into Information Technology Planning

Utilities are constantly exploring new software offerings based on changing needs related to cybersecurity and analytics. In order to realize the opportunities this report describes—including more effective energy efficiency program targeting, improved disaster planning and coordination, and more granular distribution management and load forecasting—utilities must begin to incorporate them when they analyze business practices and implement new software. Some utilities have been challenged even to map meters based on existing technology, and at least one municipal utility opted to undergo an extensive billing system upgrade in order to consistently produce whole-building data. The use cases reflected here may require integration of data across multiple utility systems, as well as the ability to share and receive data from cities and customers. Utilities should begin considering these future use cases as part of their IT planning sooner rather than later in order to lay the foundation for the availability of data.

Engaging Productively with Cities that are Developing Building Performance Policies

Utilities and cities have different and complementary strengths. Where they can align their interests and collaborate, they increase their ability to reach building owners who may have large opportunities to save energy or who may provide housing for tenants who have been underrepresented in energy efficiency programs. Some of these opportunities are explored in specific case studies for the *Putting Data to Work* case studies "Successful Partnerships to Accelerate Efficiency: NYC Retrofit Accelerator" and "Increasing Customer Engagement with Data: District of Columbia Sustainable Energy Utility."

However, cities and utilities are often on course to clash with regard to building performance policies, particularly where cities require building owners to take certain energy actions, such as undergoing energy audits. This is in part because regulated utilities must justify to their regulators that customers saved energy because of the utility's offerings, not because of local requirements. Where cities institute requirements, utilities may express concerns that they cannot provide rebates or incentives for customers to participate. Some utilities have solved this issue by

15 "Implementation Plan for the Building Efficiency Marketplace," Con Edison, Nov. 20, 2015).

16 "Beyond the Meter: Planning the Distributed Energy Future Vol. II: A Case Study of Integrated DER Planning by Sacramento Municipal Utility District (2017)," Black & Veatch & SEPA, https://sepapower.org/resource/beyond-meter-planning-distributed-energy-future-volume-ii/

considering benchmarking-related initiatives, such as the development of IT systems that generate whole-building data, to be a marketing expense that provides the foundation for customers to use energy efficiency services in the future. An emerging option is to treat utility support for benchmarking and transparency ordinances like utility support for energy code compliance or above-code adoption, which a growing number of state regulatory authorities are recognizing as a valid source of energy savings.[17] In other words, solutions likely exist within current regulatory structures that can be translated for this newer application.

Conclusion

State and local governments across the U.S. are exploring opportunities to increase energy efficiency and transparency in the built environment through voluntary and mandatory programs impacting commercial and multifamily buildings. The data these programs generate—and the efforts energy utilities must take internally to produce data to support them—create new opportunities for utilities. Data about building energy usage, performance, characteristics, equipment, and ownership can be used by utilities to provide better services to their customers and to realize operational efficiencies, ranging from distribution planning to load forecasting. Moreover, it may enhance research efforts at the state and national level. By building cross-functional teams, incorporating new use cases into their IT planning, and cooperating with cities, utilities can unleash these new benefits in the coming years.

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17 Christopher Wagner et al., "Leveraging State Energy Office-Utility Partnerships to Advance Building Energy Codes," National Association of State Energy Officials, 2012, https://www.naseo.org/data/sites/1/documents/publications/NASEO_Report_Leveraging_SEO-Utility_Partnerships_on_Building_Energy_Codes.pdf.

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