

# Metered Energy Data Display

## A GUIDE FOR BUILDING DESIGNERS

### Energy Display Systems

Energy data display systems are software platforms that compile metered data into actionable visual information. Seattle Energy Code requires the installation and commissioning of energy display systems in new commercial construction and additions, greater than 20,000 square feet, to enable better energy management. These code requirements, as well as the intended use of the system, should be considered in both the electrical design and the selection, installation and commissioning of the metered energy display system.

**Reference the 2015 Seattle Energy Code for complete description of requirements:**

<http://www.seattle.gov/dpd/codesrules/codes/energy/overview/>

### Electrical Design Considerations

#### Code Requirements

**(Section C409.2) Energy source metering.** Buildings shall have a meter at each source, including electrical energy, gas and liquid fuel supply energy (natural gas, fuel oil, propane, other), district energy (district steam, district chilled water, district hot water, other), and site-generated renewable energy.

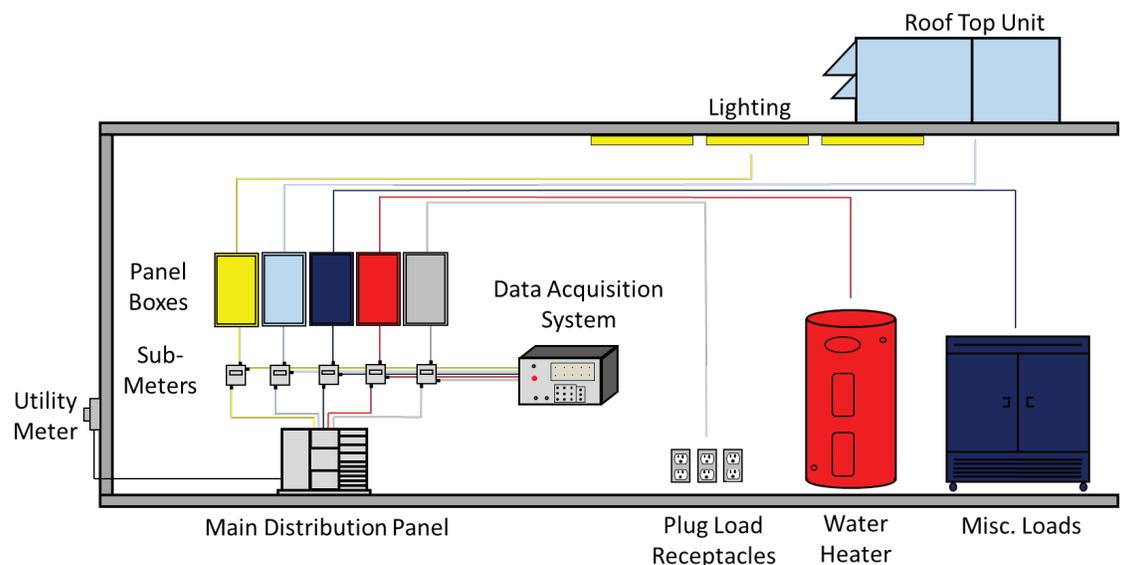
**(Section C409.3) End-use metering.** Meters shall be provided to collect energy use data for each end-use, defined as lighting, heating, ventilation and air conditioning (HVAC), plug load (e.g. water heating and process loads (e.g. refrigeration, laundry, industrial equipment)).

Not more than 10 percent of total connected load of any end-use is permitted to be excluded from that end-use data collection. Not more than 10 percent of total of total connected load of any end-use is permitted to consist of loads not part of that category.

Multiple meters may be used for any end-use category, provided the data acquisition system totals all of the energy used by that category.

#### Sub-metering and data acquisition design configuration

*The number of sub-meters installed can be determined by the design team, provided the data acquisition system accurately totals all energy used by each end-use category.*



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### Energy Display Selection Considerations

Energy displays systems may be integrated with the building control system (BCS) or installed as stand-alone meter data display systems. When selecting, installing and commissioning the sub-metering system and associated energy display, the following code requirements, design options, and operator needs should be considered.

	Code Requirements	Options*	Considerations
<b>Energy Display System Vendor Options</b> (Seattle Energy Code Section C409.4.3, C409.4.2)	<ul style="list-style-type: none"> <li>Simultaneously view current consumption rate for each whole building energy source and the average and peak hourly consumption values for any day, week month or year</li> <li>Provide weather-normalizing data in the comparison time periods</li> <li>Facilitate the use of energy use trends and identification of anomalies</li> <li>Support at least hourly data intervals and data storage for 36 months</li> </ul>	<ul style="list-style-type: none"> <li><b>Standard software products</b> are typically purchased with a one-time fee, are licensed according to number of installations, and include limited support with no additional services</li> <li><b>Application Service Providers (ASP)</b> offer solutions in which the ASP owns, operates, and maintains the software and servers for web-based applications that are usually priced according to monthly/annual fees</li> <li><b>Turnkey solution providers</b> offer fully-packaged solutions that include pre-installed software, hardware and accessories in a single 'bundle'</li> </ul>	<ul style="list-style-type: none"> <li>Pricing and licensing are usually per site and per user, can be subscription-based or one-time fee, and are often tied to the support services included</li> <li>Bundled or optional services can include data and IT management and customizability for user interface and analytics</li> <li>For buildings with a BCS, BCS providers may include an analytics package (turnkey solution), or include the option of a third party package on top of the BCS (ASP)</li> <li>Servers can be hosted on-site or remotely by energy data display company (commonly known as software as a service, or SaaS)</li> </ul>
<b>Commissioning of Metering and Display System</b> (Seattle Energy Code Section C408.6, C409.4.1)	<ul style="list-style-type: none"> <li>Metering system devices and components work properly under low and high load conditions</li> <li>Metered data is delivered in a format compatible with data collection system</li> <li>Energy display is accessible to building operation and management personnel</li> </ul>	<ul style="list-style-type: none"> <li>Failure to commission sub-metering and energy display systems correctly is a common pitfall in their effective use. Suggestions for optimizing the commissioning process include:                             <ul style="list-style-type: none"> <li>Providing clear mapping of electrical design (what is being metered) to commissioning team</li> <li>Ensuring sub-meters are communicating as intended to data acquisition system</li> <li>Ensuring that all of the metering, data collection and display system work in a fully integrated way, and that one party takes responsibility for all integration and functioning</li> </ul> </li> </ul>	

\*Granderson, J., Piette, M.A., Ghatikar, G., Price, P. (2009, June). Preliminary Findings from an Analysis of Building Energy Information System Technologies. Retrieved from <https://cbs.lbl.gov/sites/all/files/2224e.pdf>

To meet the intent of the code, energy data display systems should be used to help better manage building energy use. Potential uses of energy display systems include:

- Tracking energy use and identifying inefficiencies
- Benchmarking building performance and identifying areas for improvement
- Performing measurement and verification to track energy savings projects
- Automating utility bill analysis and estimating the cost of each energy end-use
- Incorporating data quality verification to self-diagnose any errors with the system

A description of each these functions, along with example visuals, is provided on subsequent pages.

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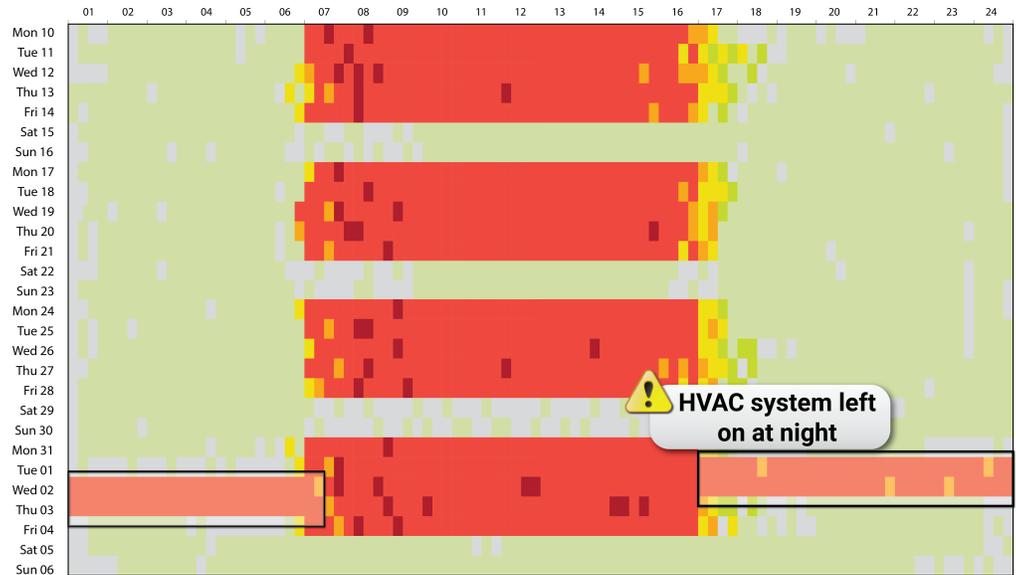
### Energy Display System Uses and Visuals



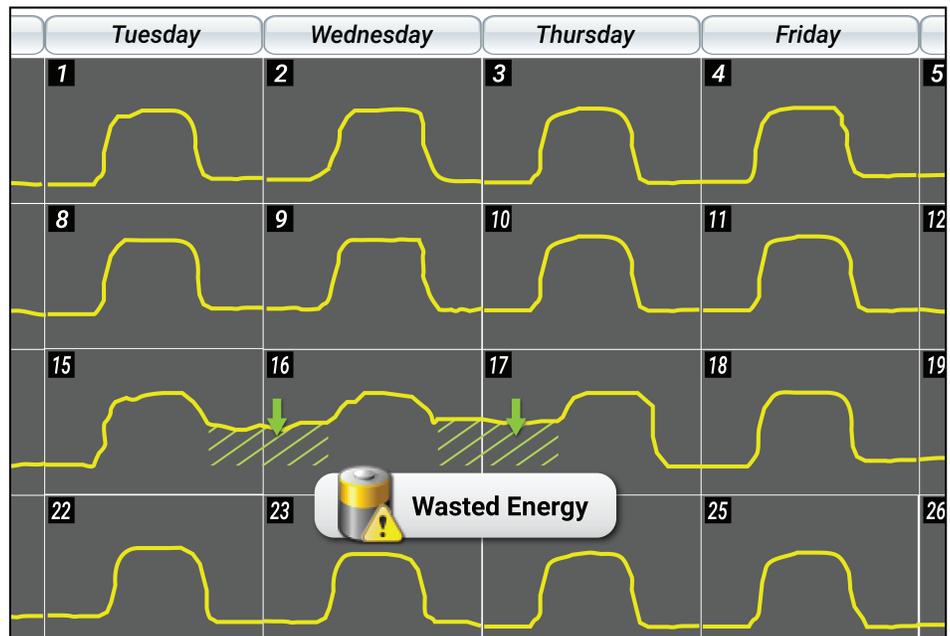
#### TRACKING ENERGY USE



**Heat Map** identifying a building's HVAC system operating at full capacity overnight.



**Calendar View** of lighting sub-meter showing an abnormal profile on the 16th, likely indicating main office lighting was left on overnight.



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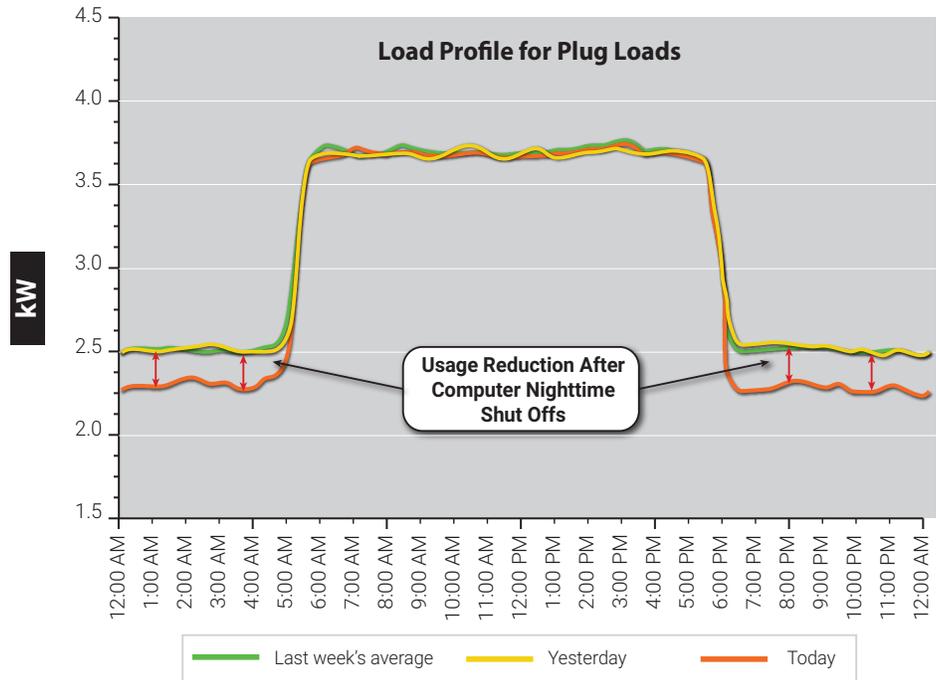
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### Energy Display System Uses and Visuals (Cont.)

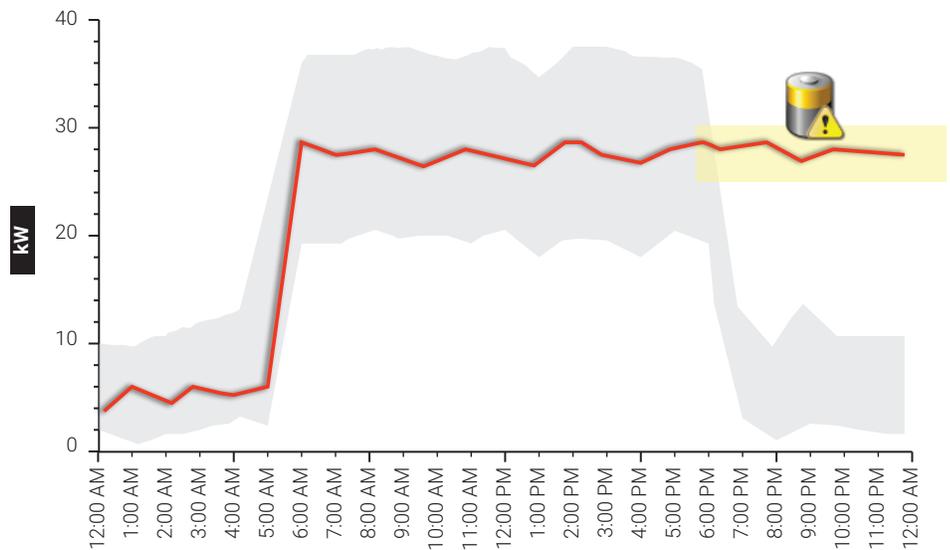


#### TRACKING ENERGY USE

**Overlay** showing a reduction in today's plug load power draw overnight compared to yesterday and last week's average after a nighttime shut down of all personal computers was implemented.



**Trend Analytics** delivering a notification that the building's lighting system is operating outside the expected profile.



#### • Notifications •

Excessive lighting energy usage detected after 7pm

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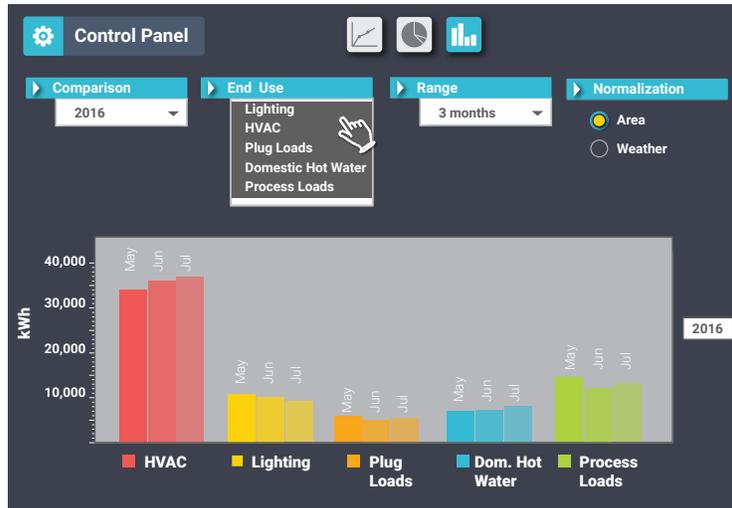
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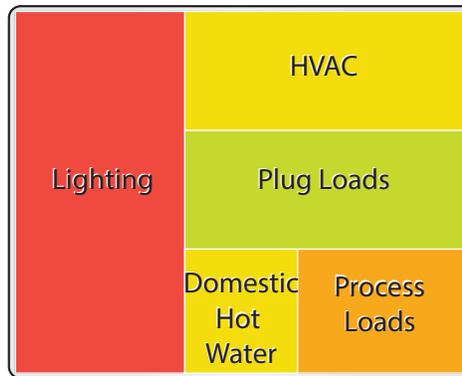


#### BENCHMARKING BUILDING ENERGY PERFORMANCE

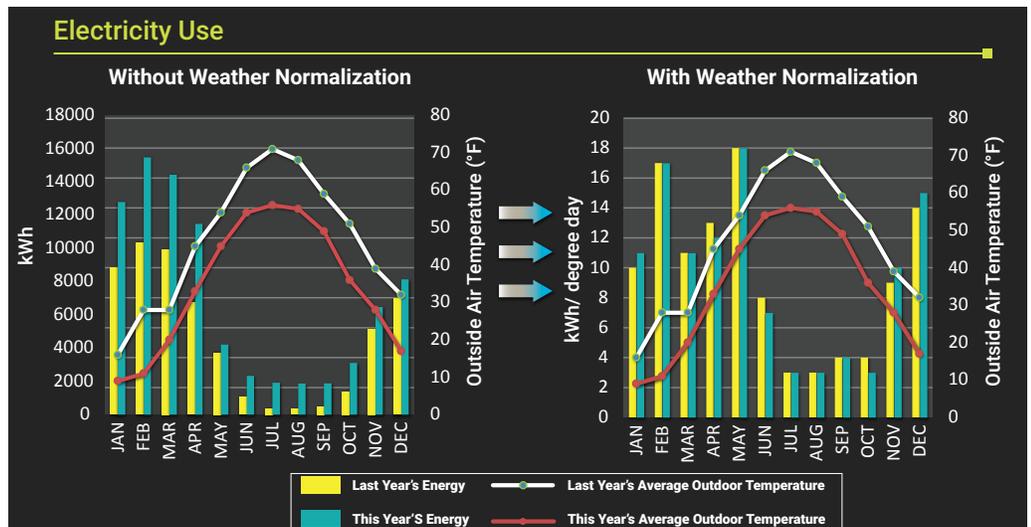
**Benchmarking**  
comparing energy use for each end use category over three months.



**Sub-Meter Portfolio View** showing lighting as the major energy contributor to the overall building load yesterday (relative size of rectangle) and showing an increase in lighting energy consumption between yesterday and last week (red color).



**Normalization**  
removing the impact of weather for benchmarking against last year's performance.



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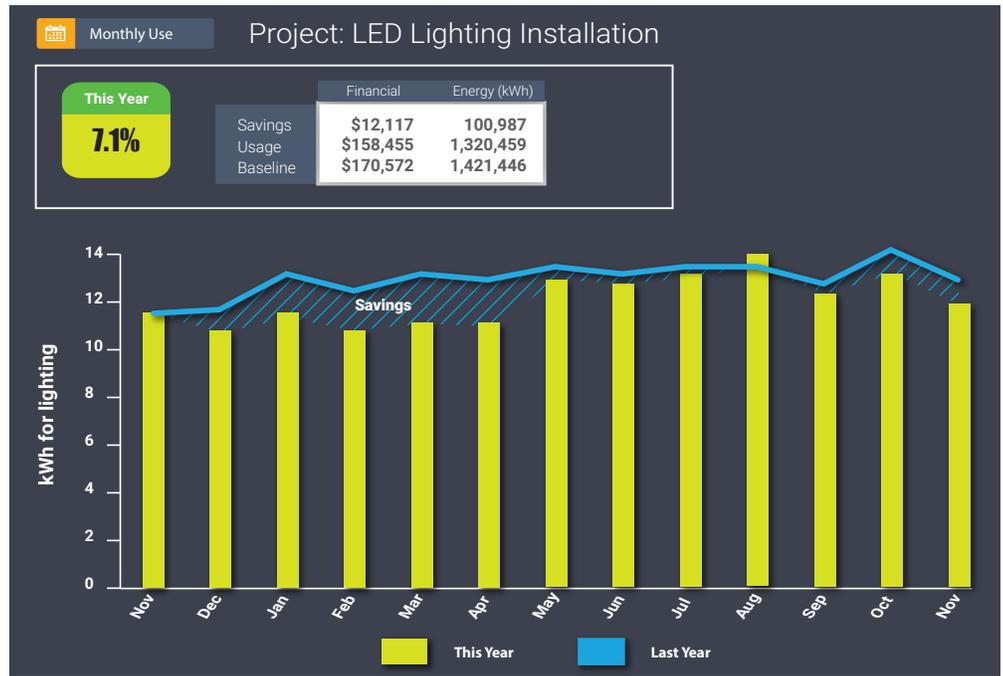
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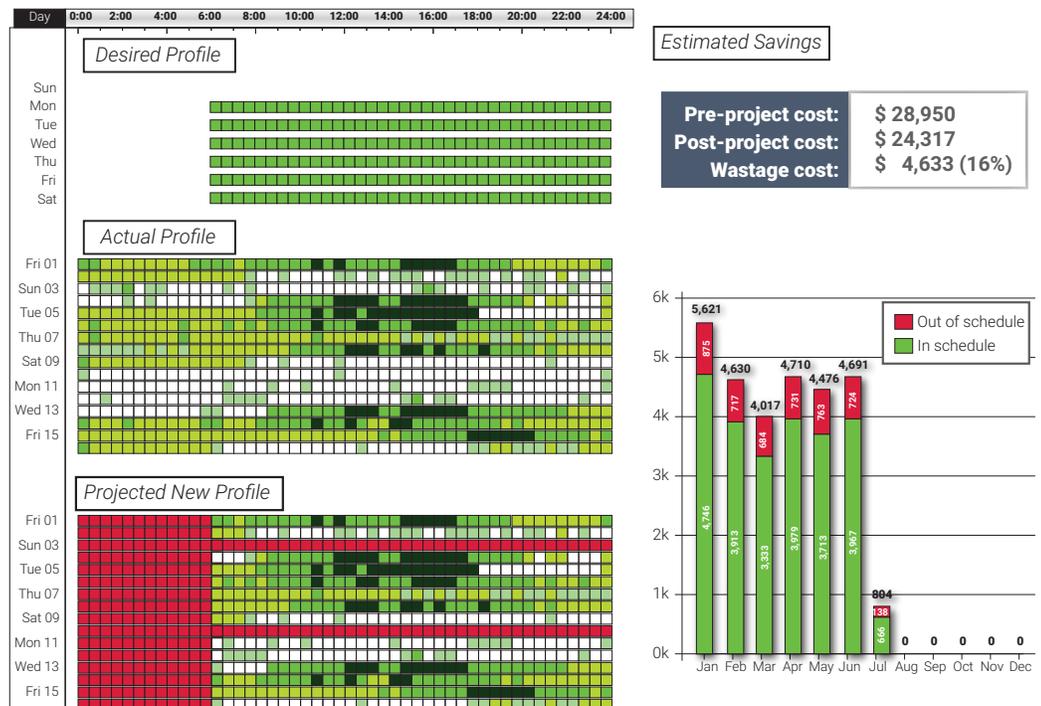
#### MEASUREMENT AND VERIFICATION (M&V)

**Project Tracking**  
 comparing lighting energy use before and after replacing all lights with light emitting diodes (LEDs).



**Energy Savings Estimation** allowing a user to input a desired profile for plug loads based on a conservation measure (e.g. nighttime computer shutdown).

Project: Computer Nighttime Shut Down





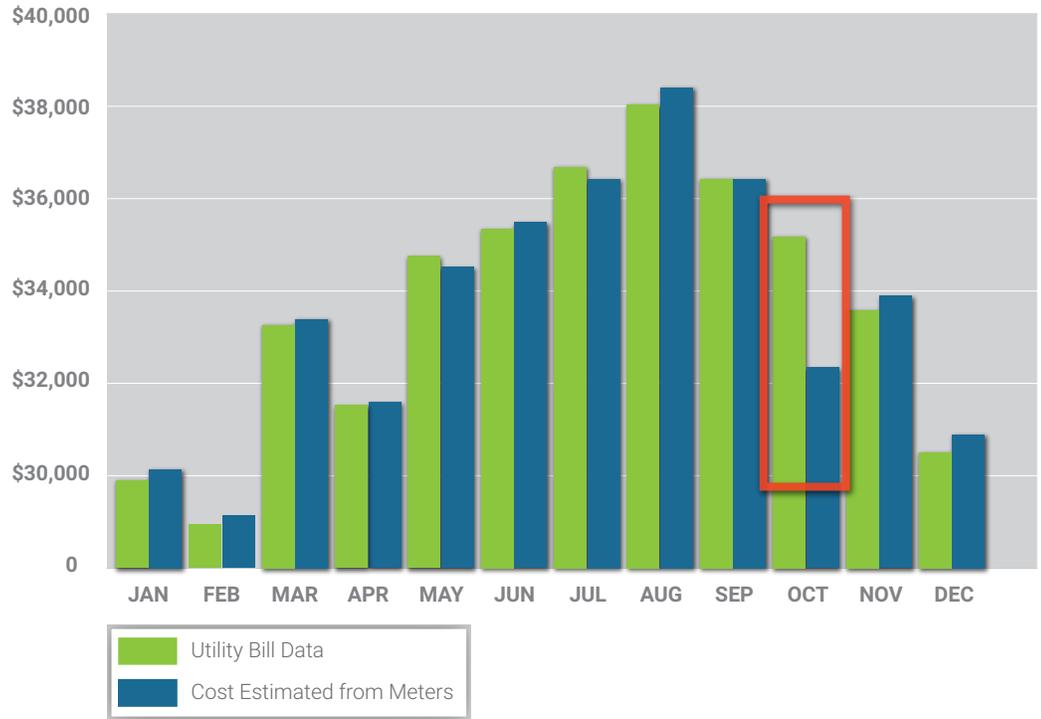
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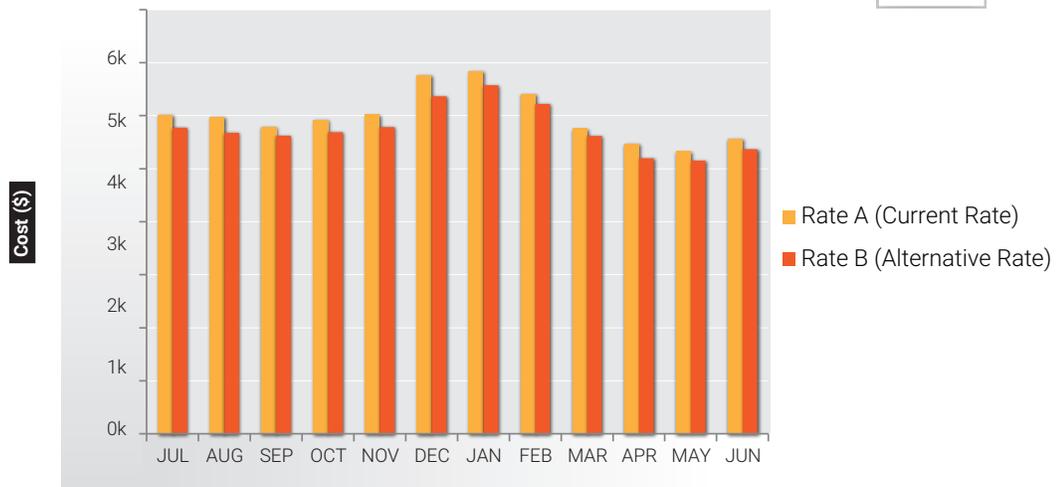
#### UTILITY BILL ANALYSIS

**Utility Bill Validation** showing a comparison of the building energy costs estimated from the metered data and the actual utility bills.



**“What if?” Utility Bill Analysis** comparing the building’s energy costs using the current rate structure to the costs if another rate structure was used.

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
<b>RATE A</b>	\$ 6,012	\$ 5,975	\$ 5,794	\$ 5,924	\$ 6,023	\$ 6,772	\$ 6,845	\$ 6,413	\$ 5,763	\$ 5,469	\$ 5,327	\$ 5,568	<b>\$ 71,885</b>
<b>RATE B</b>	\$ 5,772	\$ 5,676	\$ 5,620	\$ 5,687	\$ 5,782	\$ 6,366	\$ 6,571	\$ 6,221	\$ 5,619	\$ 5,196	\$ 5,151	\$ 5,368	<b>\$ 69,028</b>
													<b>-3.9%</b>



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### Energy Display System Uses and Visuals (Cont.)



#### DATA QUALITY VERIFICATION



**Alarms and Notifications** warning a user of uncharacteristic data spikes indicating likely metering errors.

