SMART METER-ENABLED COMMERCIAL ENERGY EFFICIENCY

A sample of programs and approaches

May 21, 2019

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WHAT IS SMART METER-ENABLED ENERGY EFFICIENCY?

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1. NEW OPPORTUNITIES: New, previously unidentified savings found using smart meter data. Examples include remote audits and using artificial intelligence to optimize building automation systems.

2. PROGRAM ENHANCEMENTS: The use of smart meter data to improve existing program designs by increasing savings and decreasing costs. Examples include using smart meter data to validate savings or for designing targeted program marketing strategies.

A WIDE RANGE OF SOLUTIONS ARE BEING IMPLEMENTED

1. Remote audits
2. Commissioning
   - Monitoring-based persistence commissioning
   - Real-time energy management
3. Grid-interactive efficient buildings
4. Building information modeling
5. Pay-for-performance

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REMOTE AUDITS

OVERVIEW

- Uses software to screen population of applicable commercial buildings for savings potential.
- Identifies building-specific retrofit and operational measure opportunities and communicates these opportunities to customers.
- Can increase the volume of buildings audited at lower cost than on-site physical audits.

RISKS AND CHALLENGES

Accuracy: Remote audits can be less accurate as on-site audits

- Accuracy can be improved by comparing the results of remote on-site to physical audits

Data privacy: The right to opt-in or opt-out should be clearly communicated to customers.

VALUE PROPOSITION

Remote audits are an economic solution to scaling-up building energy audits.

- Increase utility access to building energy performance data available for program design and targeting.
- Provide low-cost alternative to on-site audits

U.S. DOD COMPLIANCE WITH EISA 2007: OVERVIEW

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IMPLEMENTING ENTITY:

FirstFuel

LOCATION:

100 Department of Defense (DOD) buildings across 11 demonstration sites

YEARS ACTIVE:

2012 to 2014

Source: U.S. DOD, 2014

DESCRIPTION OF MODEL:

FirstFuel helped the U.S. Department of Defense comply with the EISA 2007 mandate to conduct energy audits on 25% of covered facilities annually. 15-minute historical energy use data and building images from Google Earth were used to conduct remote energy audits.

Sources: FirstFuel, 2014; U.S. DOD, 2014

U.S. DOD COMPLIANCE WITH EISA 2007: RESULTS

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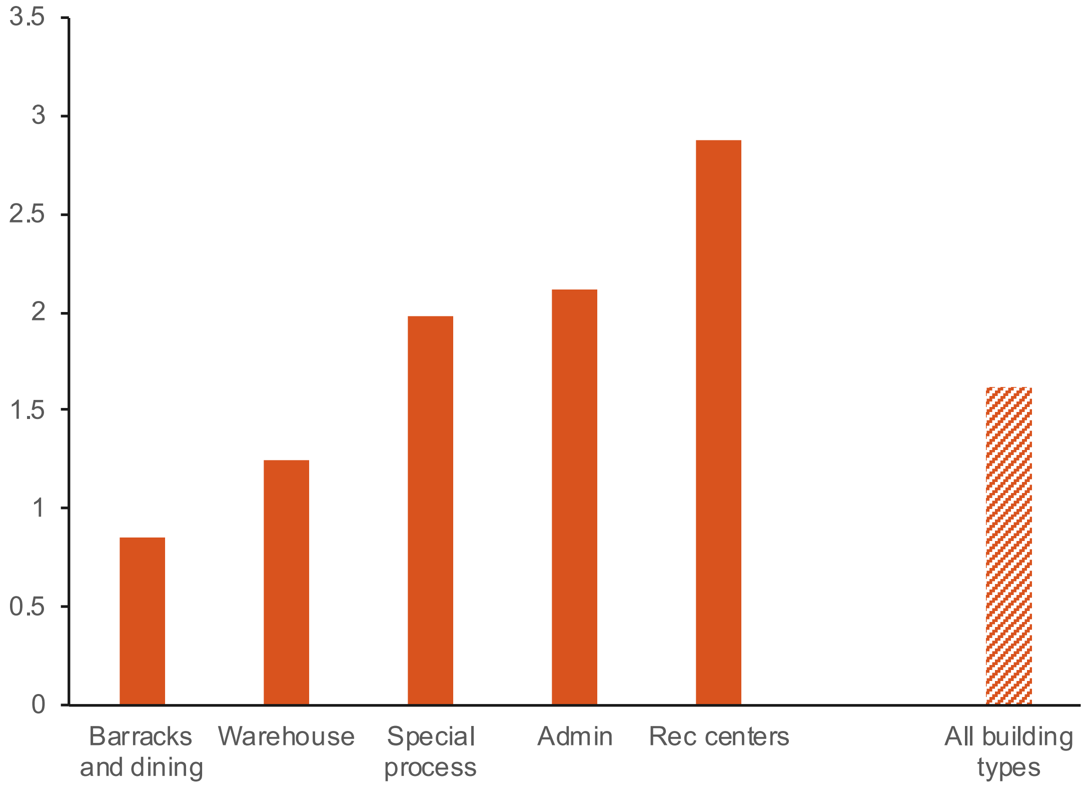
CHALLENGES ENCOUNTERED:

- Remote audits were difficult or impossible for buildings with less than a year of interval meter data, that were wholly or partially unoccupied, or that had low energy use.

RESULTS:

- 8.6 million kWh in potential energy savings, equivalent to a 14% reduction in energy spending at a cost of $0.12/sqft, or less.
- Independent building auditor conducted ASHRAE Level 2 onsite audits at 16 of the buildings to validate results.
  - Remote audits found 61%-85% of the measures found during the onsite audits, but also found a number of measures *not* found during the onsite audits.
  - In total, the remote audits identified 16%-37% more potential savings than the on-site audits.

Average kWh savings per sqft



Source: Adapted from U.S. DOD, 2014

Sources: FirstFuel, 2014; U.S. DOD, 2014

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ADVANCES IN COMMISSIONING

OVERVIEW

New hardware and software have enabled advances in building commissioning.

1 MONITORING-BASED PERSISTENCE COMMISSIONING

Builds on traditional retro-commissioning with:

- Sub-metering
- Fault detection and diagnostics
- Direct digital controls

2 REAL-TIME ENERGY MANAGEMENT

Builds on monitoring-based persistence commissioning with:

- Cloud-based data storage
- IoT sensors
- Real-time data collection and analysis

MONITORING-BASED PERSISTENCE COMMISSIONING

OVERVIEW

- Monitoring-based Persistence Commissioning (MBPCx) builds on RCx with continuous monitoring mechanisms (such as: end-use metering), with building operator training, and through installation of retrofit measures in addition to O&M measures traditionally performed by RCx programs.
- Addresses the issue of RCx savings persistence, which is known to decline after initial implementation.

RISKS AND CHALLENGES

- Identifying candidate buildings with the right BAS
  - Only 14% of the building stock has a BAS
- Finding willing building owners and operators
- Finding qualified vendors

VALUE PROPOSITION

- Can benefit utilities by increasing cumulative savings from building commissioning and retrofits.
- Continuous data collection helps mitigate evaluation risk.
- Benefits customers through long-term energy and costs savings and through building operator training.

Sources: FirstFuel, 2014; U.S. DOD, 2014

PG&E'S MBPCX PILOT: OVERVIEW

IMPLEMENTING ENTITY:

Enovity

LOCATION:

Northern California

YEARS ACTIVE:

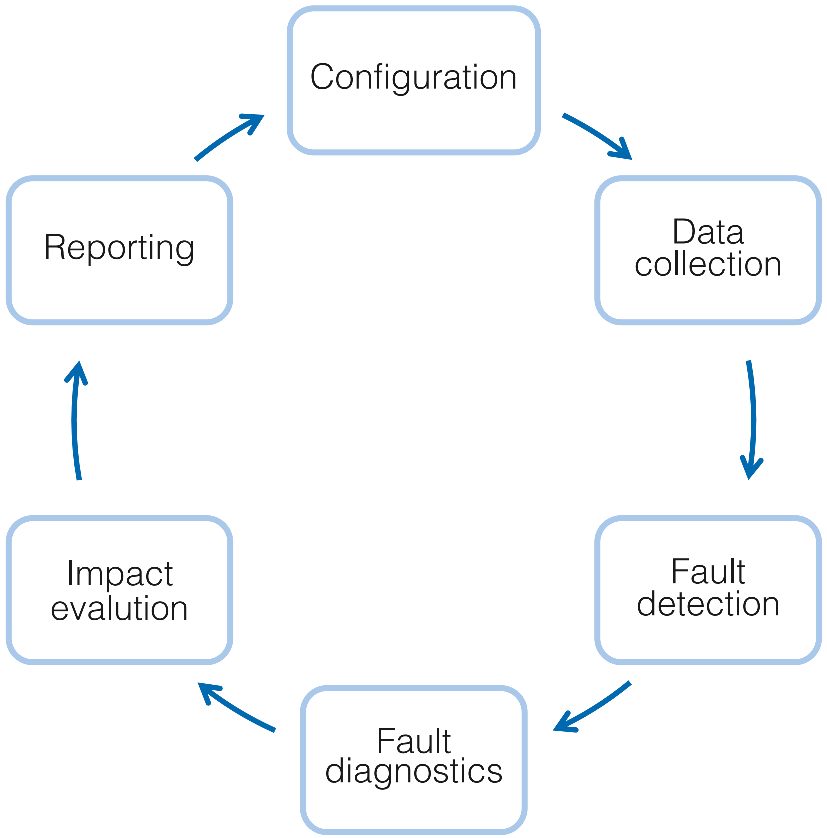
2006 to 2008

DESCRIPTION OF MODEL:

The MBPCx pilot provided technical services to help large commercial customers find and correct sub-optimal building energy performance issues as they occurred.

Enovity installed end-use metering for continuous monitoring, and used fault detection and diagnostic tools (FDD) to ensure savings persistence and find performance gaps.

STEPS TO FAULT DETECTION AND DIAGNOSTIC TOOL USE FOR MBPCX



Source: Adapted from Hjortland, 2012

Sources: Enovity, 2008; PG&E, 2010; PG&E, 2014; SBW 2010; Hjortland, 2012

PG&E'S MBPCX PILOT: RESULTS

CHALLENGES ENCOUNTERED:

Identifying candidate buildings with robust BAS; Finding building owners with available funds and willing O&M staff.

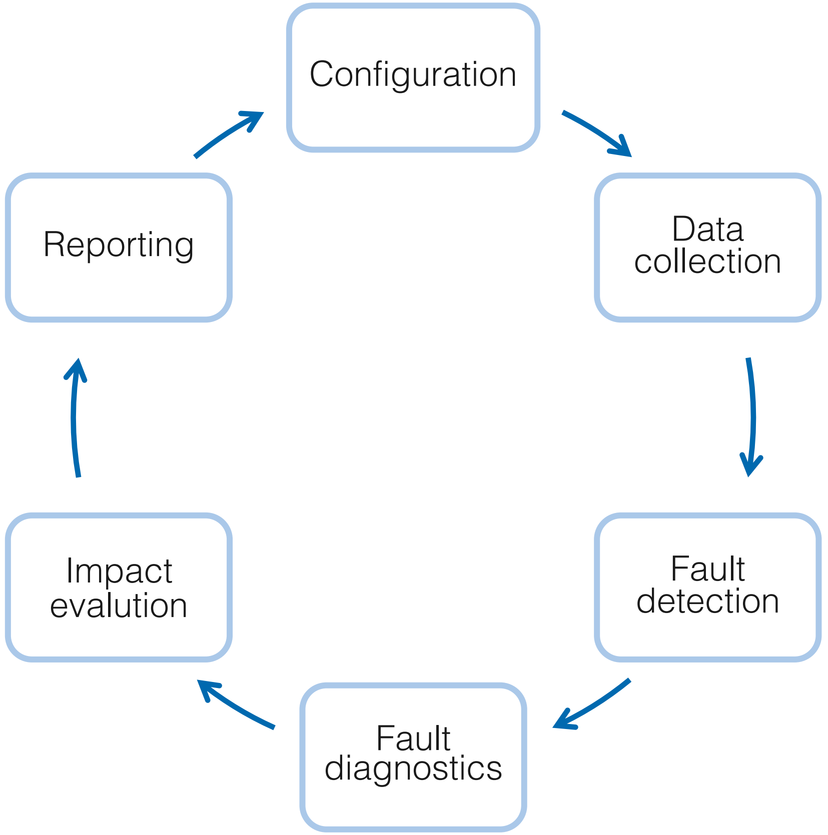
RESULTS:

- Net savings of 2,500 MWh and 55,000 Therms.
- Net-to-gross ratio of 0.93.

NEXT STEPS:

The program advanced out the pilot phase in 2010, but was closed in 2014.

STEPS TO FAULT DETECTION AND DIAGNOSTIC TOOL USE FOR MBPCX



Sources: Enovity, 2008; PG&E, 2010; PG&E, 2014; SBW 2010; Hjortland, 2012

REAL-TIME ENERGY MANAGEMENT

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OVERVIEW

- Real-time Energy Management (RTEM) is the Internet of Things (IoT) applied to building automation.
- RTEM systems continuously collect live building energy performance data through a cloud-based or on-site platform and analyze it to identify building energy optimization opportunities. Sensors, meters, and other equipment, along with data analytics and information services, show how a building or facility is performing at any point, in real time.
- RTEM addresses the “efficiency gap” between predicted performance of “efficient” buildings and actual performance, which frequently frustrates real estate developers, owners, and operators.

RISKS AND CHALLENGES

- Cybersecurity: Many building engineers and operators lack data security expertise. Therefore, BAS can have long-standing unresolved cybersecurity issues.
- Adequate vendor market size

VALUE PROPOSITION

- Commercial customers: Lower operating and energy costs, and smarter buildings with greater marketability.
- Industrial customers: Improves the bottom line by limiting energy use while maintaining productivity.
- All customers: Enables centralized utility usage tracking (electric, gas, steam, water) in the building, allowing for one-stop management of total energy consumption and spending.

Sources: Blue Pillar, 2018; Senseware, 2018; Aquacore, 2018; NRDC, 2013 NYSERDA, 2018

NYSERDA'S RTEM PROGRAM: OVERVIEW

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IMPLEMENTING ENTITY:

NYSERDA

LOCATION:

New York State

YEARS ACTIVE:

2016 to present

Source: NYSERDA, 2018a

DESCRIPTION OF MODEL:

RTEM is funded by NY's Clean Energy Fund, a 10-year, $5.3 billion clean energy initiative. RTEM's $12 million annual budget includes $5.7 in incentives for industrial RTEM projects, $830,000 for multifamily, and $6 million for commercial.

NYSERDA pays up to 30% of RTEM expenses, including rolling any hardware costs to a three-year agreement, eliminating customer up-front expenses.

Sources: NYSERDA, 2018a; NYSERDA, 2018b; BuildingIQ, 2018; Energy Manager Today, 2017

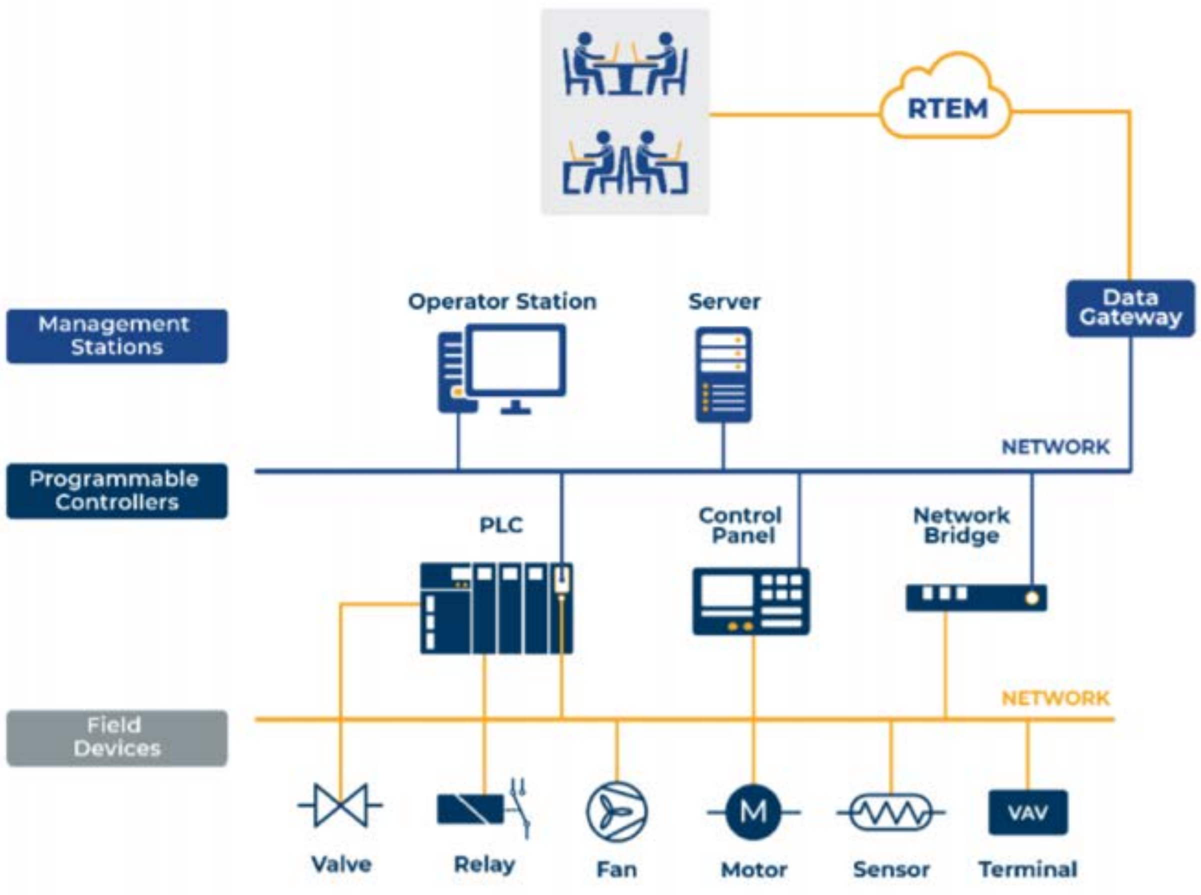
RTEM CASE STUDY

NYSERDA'S RTEM PROGRAM : RESULTS

RESULTS:

- Buildings receiving RTEM: 165 (+60 in pipeline)
- Average annual MWh savings/building: 840
- Average annual (MMBtu) gas savings/building: 366
- Average annual energy bill savings/building: $115K
- Buildings in pipeline: 60
- Projects are generally smaller and less costly than expected, but early analysis of actual project data indicates that overall plan benefits will be met, and ROI may be more favorable than forecasted.

NEXT STEPS: RTEM is funded through 2024



Source: NYSERDA, 2018a

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GRID-INTERACTIVE EFFICIENT BUILDINGS

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OVERVIEW

- U.S. DOE's Building Technologies Office (BTO) is conducting Grid-interactive Efficient Buildings (GEB) research to understand the potential of connected devices to save energy in the buildings sector and create new markets with transactive energy.
- Key goal of BTO's research is to develop and test technologies and practices that create a two-way interaction between buildings and the electric system; increased connectivity enables buildings to be more responsive to electric grid conditions, helping avert system stress and enhancing reliability.

RISKS AND CHALLENGES

- Cyber-secure transaction-based energy systems help facilitate GEB transactions is a key challenge.
- Seamless communication between building devices and systems, regardless of manufacturer, is still under development.
- Lack of ability to transact energy-related services with other buildings or entities impedes financial motivation to engage robustly with distributed renewable energy and storage.
- Lack of awareness.

VALUE PROPOSITION

- GEB could allow utilities to better use buildings as a grid resource, e.g., avoiding substation construction.
- Customers could not only benefit from energy savings, but from new sources of revenue created by transactive energy.

Source: U.S. DOE BTO, 2017

TRANSACTIVE CONTROLS: OVERVIEW

IMPLEMENTING ENTITY:

Pacific Northwest National Laboratories (PNNL)

LOCATION:

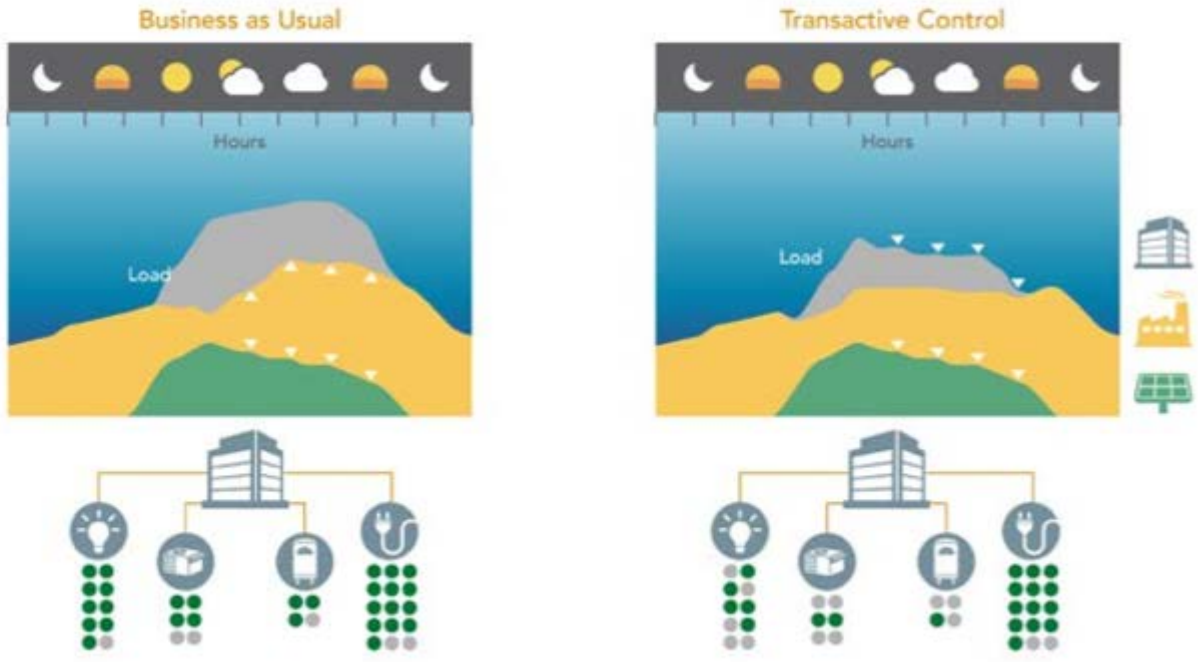
Richland, Washington

YEARS ACTIVE:

2015 to 2019

DESCRIPTION OF RESEARCH:

Project is evaluating transactive control (TC) technologies as viable solutions for coordinating responsive building loads and distributed energy resources, benefiting energy efficiency and power grid reliability objectives.



Source: U.S. DOE PNNL, 2018b

Source: U.S. DOE PNNL, 2018a; U.S. DOE PNNL, 2018b

TRANSACTIVE CONTROLS: RESULTS

CHALLENGES ENCOUNTERED:

Building operations staff are concerned about cyber security of building controls infrastructure and are hesitant to install new hardware and software on their networks.

RESULTS:

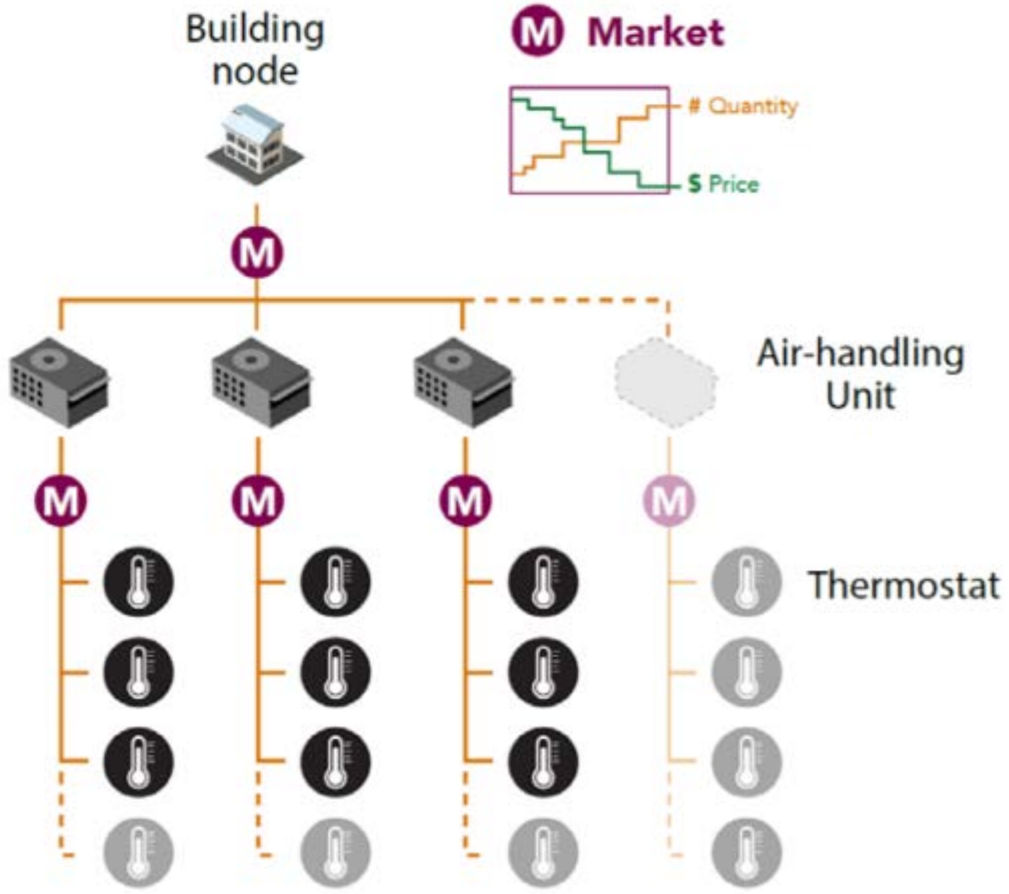
Developed and successfully tested new technologies, including:

- Automated Fault Detection and Diagnostics (AFDD),
- Automated Identification of RetroCommissioning or Re-tuning™ measures (AIRCx),
- Intelligent Load Control (ILC), and
- Transactive Control and Coordination (TCC).

NEXT STEPS:

Validation of technology and services at distribution scale

TCC CREATES MARKETS WITHIN DIFFERENT BUILDING ZONES AND DEVICES AS PART OF AN AUTOMATED, REAL-TIME PROCESS



Source: U.S. DOE PNNL, 2018c

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BUILDING INFORMATION MODELING

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OVERVIEW

- Building Information Modeling (BIM) is an increasing popular approach to designing new – and improving existing – buildings through modeling all the physical and functional characteristics of a facility, including energy use.
- Shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life-cycle.
- Helps mitigate building construction time and cost overruns and ensure actual performance mirrors planned performance by solving problems associated with ineffective exchange of facility information.

RISKS AND CHALLENGES

- Legal: There is a lack of determination of ownership of BIM data and the need to protect it through copyright laws and other legal channels.
- Technical: As cost, schedule, sustainability and other dimensions are added to BIM, responsibility for proper technological interface among different programs becomes challenging.

VALUE PROPOSITION

- Helps building project teams better evaluate long-term energy performance before construction or renovation.
- One study showed 75% of BIM users report a positive ROI, shorter project life cycles, and savings on paperwork and material costs.

AUSTIN ENERGY INTEGRATED MODELING INCENTIVE PROGRAM

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IMPLEMENTING ENTITY:

Austin Energy

LOCATION:

Austin, Texas

YEARS ACTIVE:

2016 to present

DESCRIPTION OF MODEL:

The Integrated Modeling Incentive program rewards building owners who incorporate energy modeling and virtual design beginning early in the design process through post-occupancy verification. Participants select a qualified energy consultant to guide the process.

The team uses EDAPT, a web-service, developed by the U.S. Department of Energy to track projects, manage data, automate quality control checks, and produce reports generated with OpenStudio® simulation results.

Program participation contributes to requirements for Austin Energy Green Building ratings and LEED certifications.

Sources: Austin Energy, 2018a; Austin Energy, 2018b; Austin Energy 2018c

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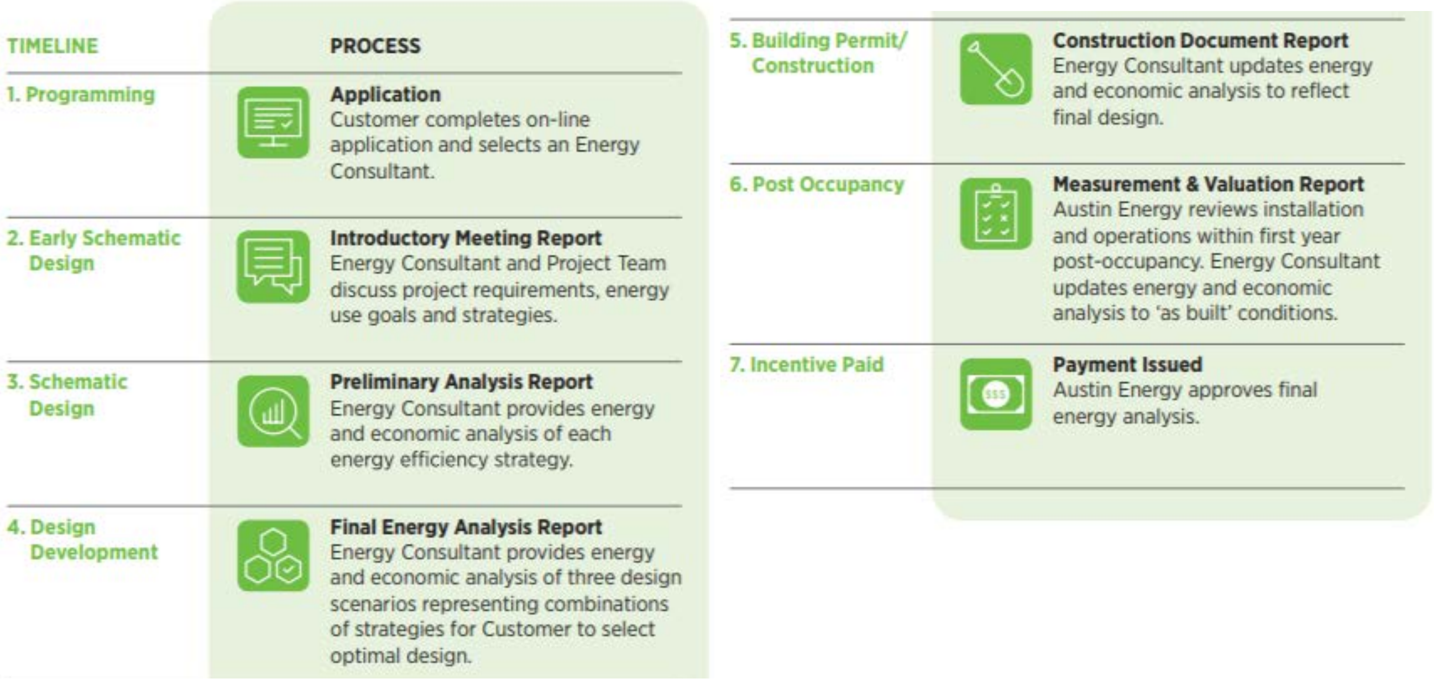
RESULTS:

In its 3rd quarter progress report for FY 2018, Austin Energy reported that the program:

- Registered eight new commercial, multifamily and governmental projects totaling over 812,000 square feet;
- Approved five new qualified Energy Consultants for a total of 27 consultants from 18 firms, and;
- Conducted advanced training for nine qualified Energy Consultants.



TIMELINE	PROCESS
1. Programming	**Application** Customer completes on-line application and selects an Energy Consultant.
2. Early Schematic Design	**Introductory Meeting Report** Energy Consultant and Project Team discuss project requirements, energy use goals and strategies.
3. Schematic Design	**Preliminary Analysis Report** Energy Consultant provides energy and economic analysis of each energy efficiency strategy.
4. Design Development	**Final Energy Analysis Report** Energy Consultant provides energy and economic analysis of three design scenarios representing combinations of strategies for Customer to select optimal design.
5. Building Permit/ Construction	**Construction Document Report** Energy Consultant updates energy and economic analysis to reflect final design.
6. Post Occupancy	**Measurement & Valuation Report** Austin Energy reviews installation and operations within first year post-occupancy. Energy Consultant updates energy and economic analysis to 'as built' conditions.
7. Incentive Paid	**Payment Issued** Austin Energy approves final energy analysis.

Source: Austin Energy, 2018a

Sources: Austin Energy 2018b

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PAY-FOR-PERFORMANCE PROGRAMS

OVERVIEW

- Pay-for-performance (P4P) Programs pay customers on an ongoing basis for meter-based energy efficiency savings, as opposed to a one-time payment for prescriptive or custom projects.
- Savings calculated using pre- and post-project energy meter data address issues of precision inherent to traditional prescriptive and custom incentive payments. The cash flow from energy savings can be used to finance the EE investment.
- Best practices of P4P programs reward deeper savings through incentives that are tiered by savings amount or higher-saving measures, minimum conservation requirements, or requirements for multi-measure projects.

RISKS AND CHALLENGES

- P4P programs shift performance risk from the program administrator (e.g., the utility) to the entity responsible for installing and maintaining the energy-savings measures (e.g., ESCOs or the program implementer).
- The long-term nature of P4P may not align with short-term (annual) energy savings goals and incentives required by state policy.

VALUE PROPOSITION

- Helps utilities meet energy savings targets and grid resource needs, while facilitating growth in the energy services market.
- Customers can benefit from whole building improvements that save energy and money over the long-run, and from lower administrative burden and more project flexibility than in traditional programs.

Sources: NRDC, 2017; JRC, 2018

P4P CASE STUDY

SEATTLE CITY LIGHT DEEP RETROFIT

IMPLEMENTING ENTITY:

Seattle City Light (SCL)

LOCATION:

Seattle, Washington

YEARS ACTIVE:

2013 to present

DESCRIPTION OF MODEL:

- Deep Retrofit, which began as a 3-year P4P pilot, offers commercial property owners and operators incentive payments over time for verified energy savings.
- P4P pays a set incentive amount for the total energy saved at the electric meter, rather than separate incentives for different measures, allowing for more flexible and creative projects than traditional prescriptive or custom offerings.

Eligibility requirements include:

- 50,000 sqft+ of conditioned space;
- Access to building-level energy use data at hourly or 15-minute intervals;
- One year of stable building energy use; and
- Savings from planned capital equipment improvements (HVAC, lighting, envelope, etc.) must equal at least 15% of building baseline electric use.

Source: Seattle City Light, 2018

P4P CASE STUDY:

SEATTLE CITY LIGHT DEEP RETROFIT

INCENTIVE STRUCTURES:

There are two incentive structures:

- A 3-year performance period, which pays $0.08/kWh on *cumulative* savings at the end of each year, and
- A 5-year option, which pays $0.18/kWh on *incremental* savings achieved year-over-year for each year of the performance period, with the baseline "resetting" each year. Projects with deeper energy savings are eligible for a bonus incentive when cumulative savings reach greater than 15% of the initial baseline.

RESULTS:

SCL reports P4P participants save 15-20% on their annual energy bills.

Source: Seattle City Light, 2018

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thank you

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