

New Product Development: How to Keep the DSM Product Pipeline Flowing

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ABSTRACT

DSM portfolio administrators face a common challenge: as energy baselines change and some energy efficiency technologies near full saturation, there is a need to develop cost-effective technologies and approaches that will help utilities achieve their energy goals. This challenge is driven by increasing efficiency standards for lighting and other technologies, but also by evolving regulatory goals and changing customer expectations.

To maintain a pipeline of emerging technologies and services for an energy efficiency portfolio, many utilities have embraced approaches to product development common in other industries. These approaches focus on starting with an understanding of customers' problems and then developing services that directly address those problems. This is a shift from the traditional DSM program design, which started with a promising technology (e.g., CFLs) and then tried to convince customers to adopt it. Understanding how customers use technologies and manage their energy consumption is key to developing customer-centric approaches that can encourage them to adopt those technologies while addressing other operational concerns.

This paper summarizes how various utilities are developing this understanding of customers' needs to inform their product development process. This includes studies that focus on the technical feasibility of emerging technologies and advanced market research methodologies that map out the universe of energy management within a facility or household. Using these results, utilities can develop approaches to address specific customer problems through program design and improve the reach of their efforts, ultimately increasing their ability to achieve savings goals and reduce GHG emissions.

Introduction

Over the last several decades, the effective delivery of energy efficiency in the United States has achieved significant results and remains a key component of any clean energy or carbon neutrality strategy. Whether the goal is reducing energy burden, reducing greenhouse gas emissions, or increasing grid resiliency, investments in energy efficiency to lower overall energy consumption and demand have achieved significant results. In most clean energy strategies, energy efficiency efforts remain first in the loading order as a more cost-effective resources than renewable generation or energy storage solutions.

Utility-administered demand side management (DSM) programs are an important part of this effort. Utilities in the United States have long offered some variety of energy efficiency programs to help their customers reduce and manage their energy costs through financial and technical assistance. In general, these programs are overseen by state regulators and, depending on jurisdiction, can have a variety of goals, penalties, and incentives associated with achieving

certain levels of performance. For many years, program administrators were able to rely on “low-hanging fruit” to achieve these goals (e.g., residential lighting). However, as energy baselines change and some energy efficiency technologies near full saturation, utility DSM program administrators continue to seek out and develop innovative ways to both achieve their regulatory targets and help reduce energy consumption (and subsequent emissions). As such, there is a need to promote cost-effective technologies and services that both save energy and solve market problems. And while this challenge is driven by increasing efficiency standards for lighting and other technologies, it’s compounded by evolving regulatory goals and changing customer expectations.

To maintain a pipeline of emerging technologies and services for an energy efficiency portfolio, many utilities have embraced approaches to product development common in other industries. These approaches focus on starting with an understanding of customers’ problems and then developing services that directly address those problems. This is a shift from the traditional DSM program design, which started with a promising technology (e.g., CFLs) and then tried to convince customers to adopt it. Understanding how customers use technologies and manage their energy consumption is key to developing customer-centric approaches that can encourage them to adopt those technologies while addressing other operational concerns.

This paper explores three case studies in how various utilities are encouraging the development of new technologies and services that help address customers’ problems and cost-effectively increase the energy efficiency of homes and businesses across the United States. This includes both market-driven approaches that rely on manufacturers and developers to develop new technologies and “outside-in” approaches that focus on exploring the barriers faced by customers and market actors and then designing solutions to address these barriers. These methods validate the technical performance of new technologies (i.e., technical assessments) and explore the universe of energy management within a facility or household to identify market problems. Using results from both frameworks, utilities can develop approaches to address specific customer needs through program design. This will improve the reach of their efforts and ultimately increase their ability to achieve savings goals and reduce GHG emissions.

In the next section, we review examples of approaches that focus on the technical assessment of emerging technologies. We then review examples that use an “outside-in” product development approach.

Technical Assessment of Emerging Technologies

An important component of utility DSM program delivery is verifying and quantifying the incremental energy efficiency of a specific technology when compared to previous, less-efficient technologies. A simple example of this type of assessment would be comparing incandescent lighting to LED lighting. The technical performance of LED lighting in building retrofits is straightforward. The reduced power consumption of LED bulbs for equivalent lighting performance provides reductions in electricity consumption with no further intervention on the part of contractors, homeowners, or facility managers.

However, more complex technologies may require greater scrutiny in real-world settings. For example, in California, the Emerging Technology Programs evaluated small wall-mounted Heat Pump Water Heaters and their ability to efficiently provide domestic hot water. While these units are currently commercially available in Europe, they have not been tested under operating conditions in the US. Similarly, as the incremental advancements in efficiency decrease at the end-use level, there remain opportunities to achieve building efficiency by focusing on technologies that enhance systems (e.g., energy management systems, networked lighting controls). However, these systems-level approaches require additional measurement and verification in real-world settings to assess their performance. Another example from the California Emerging Technology Program includes the assessment of Zero Net-Energy (ZNE) construction of multifamily buildings through the coordinated design and implementation of energy-efficient building systems.

There are numerous organizations across the United States that focus on accelerating the adoption of energy-efficient technologies through this type of technical assessment. Example organizations include:

- National laboratories funded by the Department of Energy such as Lawrence Berkeley National Labs, Pacific Northwest National Laboratory, National Renewable Energy Laboratory, Oak Ridge National Laboratory.
- State or regional collaboratives such as the New York State Energy Research and Development Authority, the Northwest Energy Efficiency Alliance, and the Bonneville Power Authority.
- Industry groups such as the Electric Power Research Institute and the Gas Technologies Institute.

Given our focus on utility-run DSM programs, this paper explores two emerging technologies programs run by investor-owned utilities (IOUs). This includes the emerging technology program at Commonwealth Edison (ComEd) in Illinois and the California Emerging Technologies Program (run by Southern California Edison on behalf of the California IOUs). ComEd's Emerging Technology program seeks to identify and validate innovative ways to increase the energy efficiency in customers' homes and buildings across northern Illinois through a public solicitation process. Similarly, the California Emerging Technologies Program (ETP) seeks to bring innovative new technologies and approaches to the market through a similar method overseen by the Emerging Technologies Coordinating Council (ETCC).

Case Study #1. ComEd Emerging Technology

The ComEd Emerging Technology program is “a dedicated innovation team, charged with identifying new customer energy savings opportunities.”¹ This team develops and fields pilot projects to test and bring to market new energy efficient technologies and innovative methods for customer engagement. This program, recognized nationally as an effective emerging tech incubator, has won industry awards, and made vital contributions to the ComEd DSM portfolio. As of the writing of this paper in February 2022, the ComEd program has reviewed 301 proposals from third-party vendors, completed 35 pilot projects, and worked with 61

¹ <https://comedemergingtech.com/>

partners. Per the Q4 2020 portfolio summary, the portfolio includes a wide variety of projects in three categories:

- **Validating New Technologies for Energy Savings.** These projects are technical assessments that aim to test the effectiveness of specific technologies. Example projects include insulating shades in commercial buildings, liquid-cooled server racks, and efficient elevator systems.
- **Increasing Market Adoption Through Innovative Program Design.** These projects are focused on developing new ways to engage customers in energy efficiency activities. This includes market transformation programs like the ENERGY STAR® Retail Products Platform as well outreach strategies like the BIT Building Neighborhood effort that leverages new building standards as the basis for a workforce training program that improves the energy efficiency of multi-family buildings in income-eligible communities.
- **Thinking “Outside the Box” for Future Opportunities.** These projects provide additional opportunities to the ComEd team, exploring edge-case opportunities that, while beneficial, do not neatly fall into the two categories above. This includes projects such as assessing the non-energy benefits of improved ventilation in low-income homes and research exploring opportunities with various energy efficiency market actors (e.g., indoor agricultural operators, managers of municipal water systems).

Importantly, the ComEd Emerging Tech program (currently overseen by CLEAResult) has an open but rigorous application process. ComEd encourages vendors to submit proposals regarding their innovative product or service, providing a proposal template² to facilitate the application process. These proposals include information necessary concept evaluation including:

- A description of the idea and its applicability to the ComEd market
- The theory behind potential energy savings and how the technology improves upon the current state
- A description of how the vendor will demonstrate the effectiveness of the concept through research, measurement, and verification
- A detailed project plan, including tasks, milestones, and budget

Once proposals are submitted, the ComEd team reviews them, based on a variety of criteria, to determine whether the concept is worthy of greater investment by the Emerging Tech program. Example criteria include questions such as:

- Is the idea novel and new?
- Will the idea likely lead to additional energy efficiency savings?
- Will the idea likely be adopted by customers?
- How much potential market is there for the idea?
- Does the idea have potential to be cost-effectively implemented?

² https://comedemergingtech.com/images/documents/3/ComEd_Emerging_Technologies_Proposal_Template.docx

- Is the idea likely to be successfully implemented as described in the proposal, based on the experience and expertise of the vendor, the available budget, and the feasibility of the M&V plan?

In summary, the ComEd approach to the development of emerging technologies leverages the highly competitive and rapidly growing clean energy market. It creates an open and transparent process by which vendors can propose unique solutions and, if successful, receive support from ComEd to accelerate the delivery of those products to ComEd's customers.

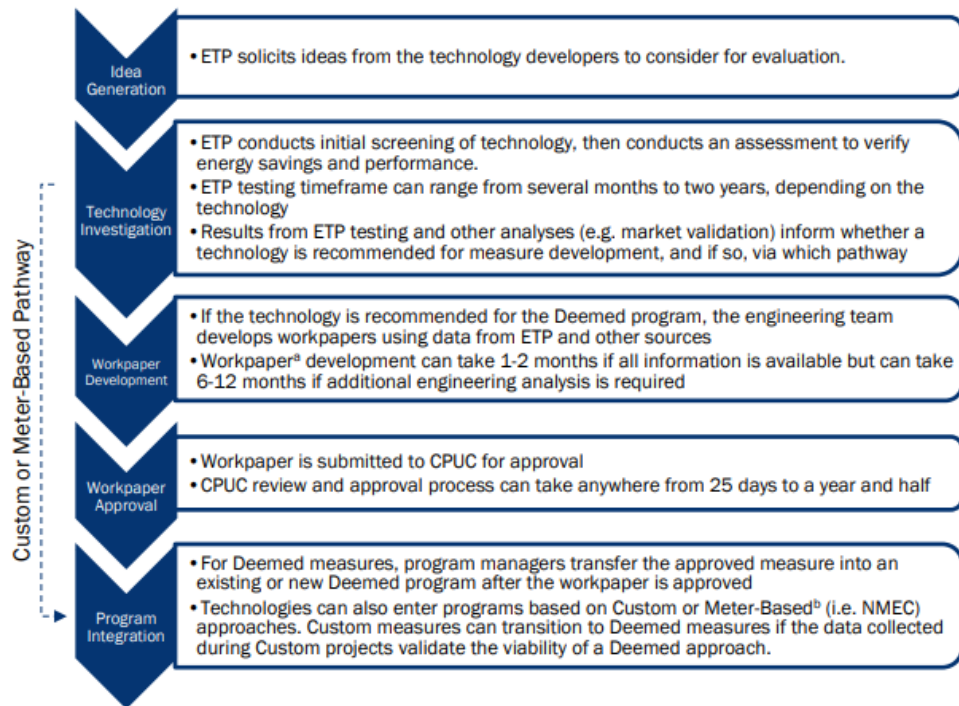
Case Study #2. California Emerging Tech Program Example

Similar to ComEd, California's Emerging Technology Program (ETP) seeks to identify and accelerate new technologies for inclusion in the California energy efficiency portfolio, again fulfilling the important role of feeding the energy efficiency pipeline. Established in 2009, the ETP framework is a market-driven approach that has completed 263 projects across 53 vendors, with 72 active projects active.³ Currently, Southern California Edison (SCE) oversees the electric emerging tech program for all California IOUs while Southern California Gas (SoCalGas) oversees the natural gas emerging tech program (historically, each IOU administered their own implementation).

The ETP operates in a similar way to ComEd's program but on a larger scale. The program solicits concepts from the marketplace, screens these concepts for viability, and then tests their performance. Given the complex nature of DSM program delivery in California, if concepts prove successful, the ETP then develops workpapers for review and approval by the California Public Utilities Commission (CPUC). Once approved, these concepts are then integrated in the overall DSM portfolio. The figure below illustrates this process from solicitation to integration.

³ Per the ETP website <https://ca-etp.com/>

Figure 1. ETP Concept Development Process



Source: Emerging Technologies Program Handoff Process Evaluation, Guidehouse and Opinion Dynamics. October 2020.

Though the ETP design has evolved since its inception, it has remained very impactful. Per a recent evaluation by Opinion Dynamics, the ETP has contributed:

- Over one million ETP measures in the DSM Portfolio
- Over 7 billion evaluated net lifetime kWh, nearly 1 million kW, and 54 million evaluated net lifetime therms.
- On average, 8% of Portfolio kWh savings and 2% of positive therms savings

Case Study #3. “Outside-in” Product Development

Consumers Energy, the largest IOU in Michigan, also pursues emerging technologies and innovative approaches to energy efficiency as part of its delivery of DSM programs. While Consumers Energy maintains technology assessment portals similar to those at ComEd and in California, it also conducts forward-looking market research (while the ComEd and California emerging tech programs include research studies, they are generally focused on specific technologies and markets). This research is designed to identify customers’ unmet or underserved needs, both broadly and specifically related to their energy consumption. This includes panel studies of customers and market actors, studies with “non-participants” (i.e., customers that have not participated in energy efficiency programs), and studies with the general population of customers.

One such study used advanced market research methodologies to map out the universe of energy management within the general population of commercial and industrial (C&I) customer facilities. In 2018, Consumers Energy commissioned TRC and Strategyn to conduct research

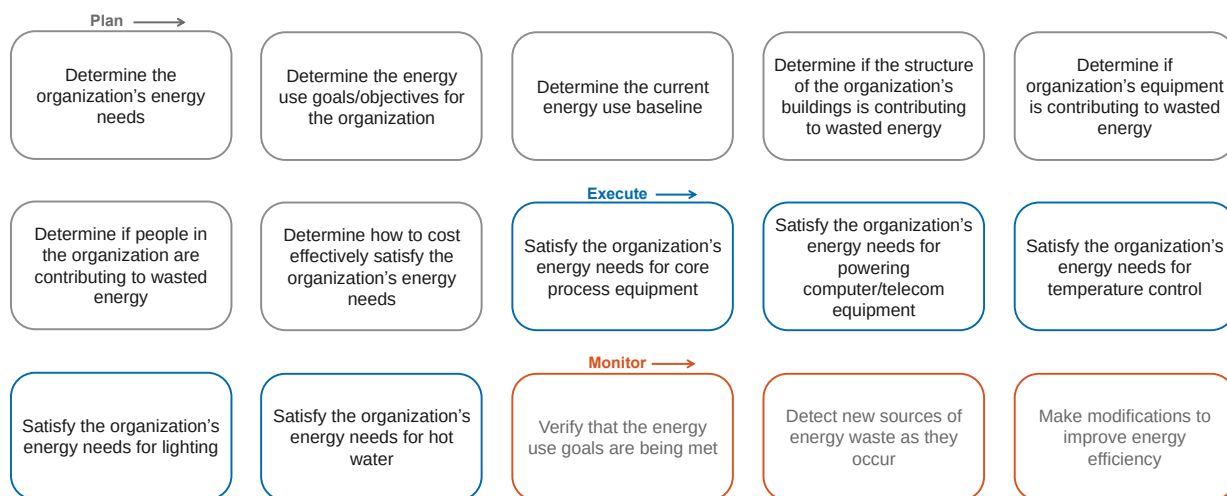
with C&I customers to better understand the underlying problems that businesses have when trying to manage the energy use at their facilities. These critical customer problems or “underserved needs,” were defined as business needs that customers rated “high” in importance but reported low satisfaction with their ability to address those needs. Consumers Energy wanted to better understand these problems to help inform the optimization of existing energy efficiency solutions as well as to inform the design of new products and services. This study included the following research questions:

- What steps do businesses take when managing energy use and demand at their facilities?
- Within each of these steps, what are customers’ desired outcomes?
- Which of these outcomes are most important to customers but also not being satisfactorily met (i.e., what are customers’ most pressing underserved needs or problems)?
- Finally, how should Consumers Energy engage C&I customers to address these underserved needs and maximize the value of DSM products and services?

To address the four research questions above, Consumers Energy used Strategyn’s Outcome-Driven Innovation® (ODI) methodology to focus on the “underlying process” that customers are trying to execute while using a product or service, focusing on the primary steps or “jobs” that customers are trying to get done and the outcomes they want from doing those jobs. In this instance, that focus was on how organizations go about satisfying their facilities’ energy needs (of which *thinking about energy efficiency* is only a small component).

First, Strategyn conducted in-depth interviews to populate a comprehensive list of all 15 steps that business owners and energy managers are trying to accomplish to satisfy the energy needs of their organizations. The 15 steps fall into three primary stages: 1) Planning, which contains seven steps (2) Executing, which contains five steps, and (3) Monitoring, which contains three steps. The complete job map is illustrated below. This approach ensures that when assessing “unmet needs,” the study has a comprehensive view of the entire universe of potential needs. That is, at a very granular level, this map documents all the individual steps that an organization would need to satisfy their energy needs (of which *improving energy efficiency* is only a small component). The intent behind this map is to ensure that Consumers Energy has a complete understanding of every step in that process so that when developing new interventions and service offerings, product developers can target specific areas that are in most need of support.

Figure 2. Job Map for Satisfying Energy Needs



For each step of the job map, customers measure their success by determining how well they are meeting several “desired outcomes.” For example, outcomes for the job step “determine the organization’s energy needs” include:

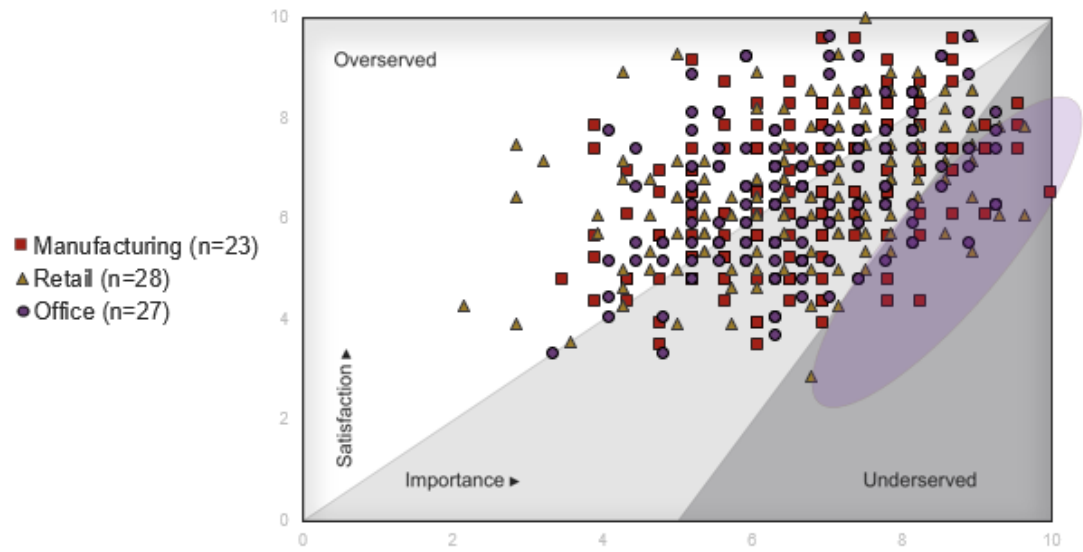
- Minimize the time it takes to determine how energy costs impact the organization’s profitability.
- Minimize the time it takes to determine how much energy is needed to power each building.

As part of this study, after documenting 164 outcomes across the 15 job steps, Strategyn then measured through a survey with a sample of representative business customers how important each outcome was, and the extent to which customers are satisfied with their ability to accomplish that outcome. Again, underserved needs or “customer problems” are defined as outcomes that were important but were not being satisfactorily met.

Using this quantitative data, the study was then able to isolate underserved aspects of the “Managing Energy Use” job for commercial building owners and facility managers. In the figure below, each point represents an outcome, with average importance shown on the x-axis and average satisfaction shown on the y-axis. Consumers Energy identified 44 underserved needs (in the purple ellipse) for three different segments of customers (manufacturing, retail, and office). Examples of these needs included:

- Need to determine how much energy is being used to power each area of a customer’s facility.
- Need to determine which energy efficiency improvements to start first.

Figure 3. Steps for Managing Energy Use



Once Consumers Energy determined which needs were underserved, it mapped each one to Consumers Energy’s current energy efficiency offerings to understand alignment with existing products and services and identify gaps where additional opportunities might exist. To optimize its energy efficiency portfolio and improve program participation, Consumers Energy uses these data to tailor and refine existing program offerings and related marketing messaging. It can then develop new programs and services to address any remaining gaps. Working with TRC, the Consumers Energy team followed the stepwise process described below:

- **Position existing offerings that align best with underserved needs:** Leverage underserved needs to communicate the value proposition of existing programs/services.
- **Improve existing offerings:** Leverage underserved needs to drive innovation efforts and improve existing programs, focusing on the common underserved needs across multiple customer types, where feasible, to address multiple needs with one solution. This allow will Consumers Energy to focus on the greatest value for all customer types for the least amount of effort.
- **Identify gaps in the portfolio:** Leverage underserved needs to identify potential gaps in DSM program offerings. Use these underserved needs to develop new programs and services allows Consumers Energy to engage a broader set of customers.
- **Continuous improvement:** Continue to address underserved needs over time by having the teams conduct ideation sessions to identify concepts, features, partnering opportunities, etc. This effort is supported by fielding follow-on surveys for each customer type to measure effectiveness of solutions created.

Similarly, TRC is currently conducting on behalf of Consumers Energy a study designed to take an “outside-in” approach to new product development and emerging technologies. The objective of the study is to understand C&I customers’ operational challenges (not just those

related to satisfying energy needs) within their organization to drive the development of new and engaging energy efficiency pilot products and services, as well as encourage greater participation in existing programs. It includes a qualitative component (focus groups and in-depth interviews) to identify the types of challenges faced by business customers in managing their business. The themes that arise from the qualitative research will then be quantified with a large customer survey. While this research is still in the data collection phase, preliminary themes from the qualitative research include:

- Supply chain issues relevant in the COVID era
- Hiring challenges during the “Great Resignation”
- Customer demand issues during the Boom/Bust cycles of COVID lockdowns and re-opening.

Typically, business customers view the utility bill as something they cannot control, with an “it is what it is” attitude. Again, this perception presents an opportunity to provide customers with education on how to increase their building’s energy efficiency through both capital improvements and adjustments to its operation.

Conclusion

The opportunity for energy efficiency to support broad decarbonization goals is immense and it remains the least cost resource as part of any clean energy plan. As program administrators continue to acquire every last “negawatt”, these two complimentary approaches to emerging technologies and pilot program development are both needed.

Programs such as the ETP in California and the ComEd Emerging Tech portfolio are needed to identify and vet innovative technologies created by vendors across the marketplace. And the cutting-edge market research commissioned by Consumers Energy to spur new product development within its teams is needed to help understand how to package those technologies and get them to the broadest set of customers possible. And while what works in Michigan may not always work in California, creating national platforms to share lessons learned and to discuss the successes of others will improve the ability of all involved to achieve their clean energy goals. The challenge, based on our review of emerging technology programs today, is aggregating all the data into actionable improvements for program administrators given the wide variation in regulations that govern DSM program delivery at the state level. Greater understanding of these challenges by national organizations would increase uptake of emerging technologies as part of energy efficiency program delivery.

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