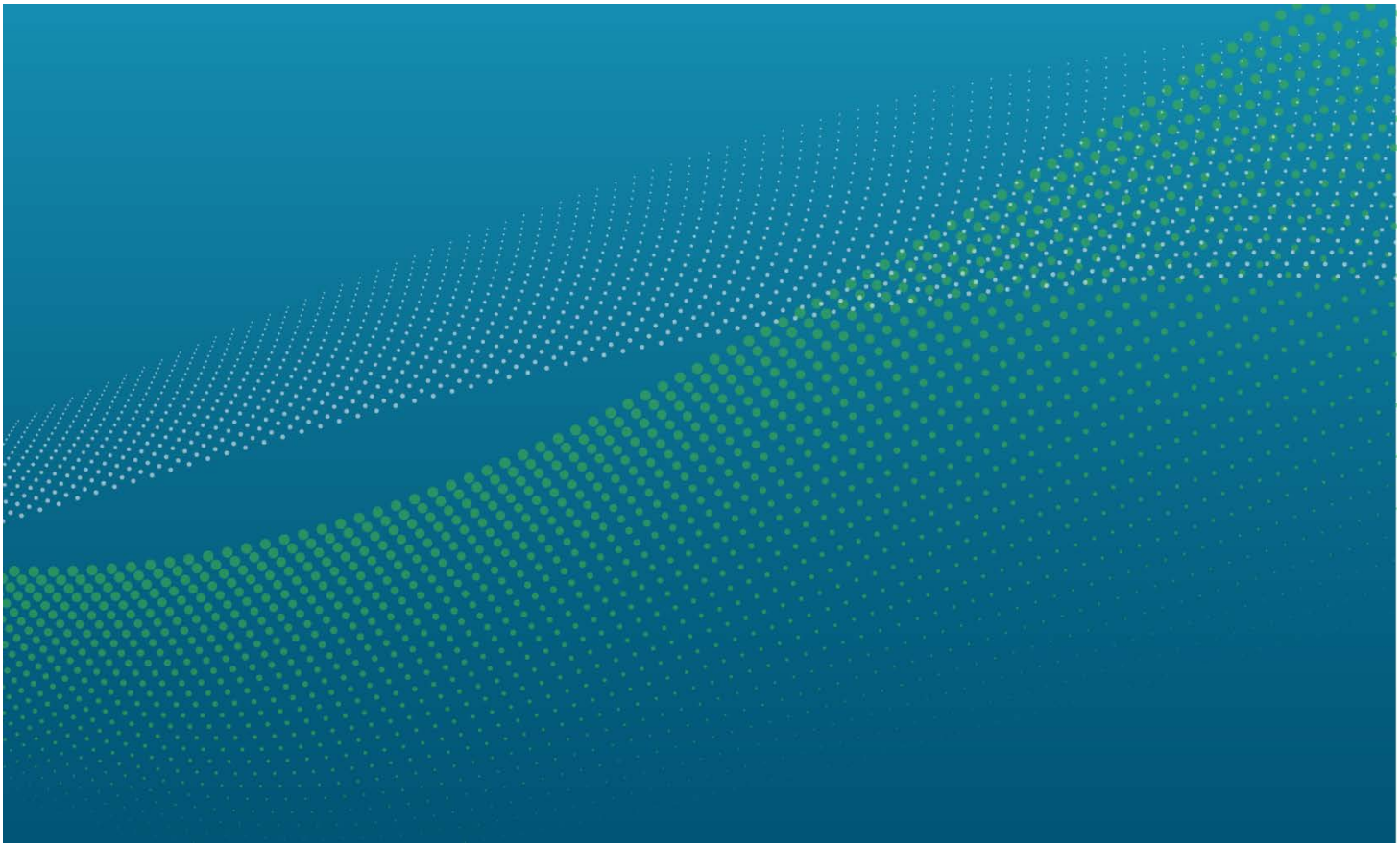

“Peak Response Program”: A 2018 Demand Response Capability Initiative

EFFICIENCY VERMONT REPORT

Jason Lenihan
Efficiency Vermont
October 4, 2019

Efficiency Vermont

Table of Contents

Introduction

Testing the Value of Combining Energy Efficiency with Demand Response
Vermont Energy Investment Corporation (VEIC), the organization that operates Efficiency Vermont, is a next-door neighbor to and customer of the Burlington Electric Department (BED). That municipal utility asked VEIC, as a customer, to participate in their Defeat the Peak[1] program. The 2018 pilot would help test the efficacy of combining both "demand response" and energy efficiency practices in reducing energy use on the hottest and coldest days of the year. As part of its demand response research and development (R&D), Efficiency Vermont joined the pilot initiative by engaging VEIC office occupants and attempting to measure savings of peak events.

Demand response and energy efficiency practices are classically separate functions in energy systems. They are delivered through separate operations and are valued under separate evaluation methods. BED and Efficiency Vermont were both interested in seeing the extent to which combining them in a disciplined way would affect ratepayer, energy system, and environmental benefits. BED already had launched its "Defeat the Peak" demand response program for customers in 2017, making it relatively easy to track additional benefits from a pilot that coordinated both functions.

Given VEIC's mission to act with urgency to enhance the benefits of clean energy use, the organization welcomed the invitation. Efficiency Vermont welcomed the opportunity to assess how efficiency program technical expertise could be utilized for demand response programming. Efficiency Vermont staff began to utilize the facility at which they are located to carry out peak reduction programming. The research and R&D team of Efficiency Vermont staff carried out peak reduction measures, when signaled by BED, monitored performance and reported results.

Specific Aims

The primary objective of the R&D pilot was to test the extent to which a single, medium-sized customer could shed and shift load during the summer peak season. The objective of "Defeat the Peak" has been to lower utility expenses by reducing transmission costs during periods of congestion on the regional power system (i.e., "Peak periods").

A reported 15 percent of BED's annual budget was used in 2017 to pay for the extra costs of maintaining reliability of supply during peak events in that year.[2] The

[1] See "Defeat the Peak": https://www.burlingtonelectric.com/peak.
[2] Kanarick, Mike, 2017. "Burlington Electric Launches Defeat the Peak Program." Burlington: Burlington Electric Department. June 22. https://www.burlingtonelectric.com/news/111

regional transmission organization (grid operator) for Vermont is ISO New England, which determines the days and hours of peak events, whether summer or winter. ISO New England's announcements of peak events trigger distribution utilities like BED to signal participating customers to reduce their draw (demand) on electricity supply for a set number of hours and occasionally during a sequence of days. Knowing peak hours enables utilities to base their rates on the amount of electricity needed to supply enough power on peak demand days so that the utilities do not have to purchase additional (and costlier) supply. In Vermont, a state with a baseload supply of electricity that comes from mostly clean sources, buying additional supply at peak means purchasing from less-clean fuel sources and at higher prices.

Efficiency Vermont recognized that it would likely learn several important lessons from the pilot. It also hoped that any lessons learned could enhance BED's "Defeat the Peak" program and result in a subsequent Efficiency Vermont offering for the state's other utilities and large customers. This aspiration is based on the recognition that effective delivery of energy supply and effective delivery of energy efficiency services each has its own time and locational value—and that demand response programs can provide great additional value to ratepayers and utility programs alike.

Methods

Efficiency Vermont created an in-house campaign at its Burlington headquarters to manage the employee experience for peak season and events. Each Burlington-based employee received a "seasonal peak" announcement, preparing them with a list of measures they could undertake during peak hours. The list described measures they could take at their desks, in meeting rooms, in general office spaces, and at home. The approach leveraged Efficiency Vermont's experience in implementing programs and services focused on reducing energy use through customer behavior change.[3] The project team asked participants to change their behaviors, and applied building controls by changing peak lighting settings to be more energy efficient, and by setting back temperatures on the HVAC system during peak events.

[3] Since 2015, the Vermont Public Utility Commission has approved residential customer behavior pilots and initiatives, and continuous energy improvement projects in the commercial and industrial sector. The results of these and earlier projects have been substantially reported in the literature. See, for example: Lange, Nicholas, 2014. "The REAL Problem with Behavioral Savings (and what we can do about it)". Presentation at the 2014 Behavior, Energy & Climate Change Conference (BECC), convened by American Council for an Energy-Efficient Economy, Berkeley Energy & Climate Institute (University of California at Berkeley), and Precourt Energy Efficiency Center (Stanford University), https://beccconference.org/wp-content/uploads/2014/12/presentation_Lange.pdf; Palchak, Elizabeth, 2017. "Casting a Wide Net: What We Know Now About Behavioral Strategies and Energy Use." Presentation at 2017 BECC; and Baker, Greg, 2019. "The Call for Energy Efficiency at Work." Blogpost athttp://www.veic.org/media-room/insights/insights/2019/05/29/the-call-for-energy-efficiency-at-work.

The project team created periodic communications to round out the campaign. These involved "day before peak" announcements, "morning of peak event" reminders, "peak event starting" notifications, and "peak event results." To enhance awareness of the start of the peak, and to drive positive results, the team facilitated early awareness through communications and events.

The project team analyzed the AMI data from the building to determine the effects of the combined efforts. The analysis began with a baseline containing data on similar historical days (non-weekend, non-holiday, hot days). The team then built visualizations to easily demonstrate the extent to which the addition of demand response practices to an energy-efficient building were able to shift load from peak periods.

Analysis and Results

The summer of 2018 was hot, and July was officially the hottest month ever recorded in Burlington, Vermont.[4] These conditions made the VEIC building—and BED's electricity supply—ripe for peak management. BED called six system peak events in 2018, and with each, Efficiency Vermont observed distinctly different results in overall energy use and load. There are many factors contributing to the varied results showing some successful and some less impactful performance.

On the sixth event of the year, the project team determined that optimal peak event management begins the night before, when an occupant needs to pull window blinds to prevent early-morning solar heating. Generally speaking, in the summer months, blocking the sun's warming effect inside the building after business hours means less energy is required to cool the building the next day. This practice resulted in reduced overall kWh consumption during peak days.

The project team also determined that combining behavior methods and equipment controls as demand response measures is essential to successful peak management.

Figure 1 and Figure 2 offer data and insights on the first and last of the six peak days experienced in 2018.

[4] Murray, Elizabeth, 2018. "July Was Officially Burlington's Hottest Month Ever," *Burlington Free Press,* August 1. https://www.burlingtonfreepress.com/story/news/local/2018/08/01/july-officially-burlingtons-hottest-month-ever/877915002/.

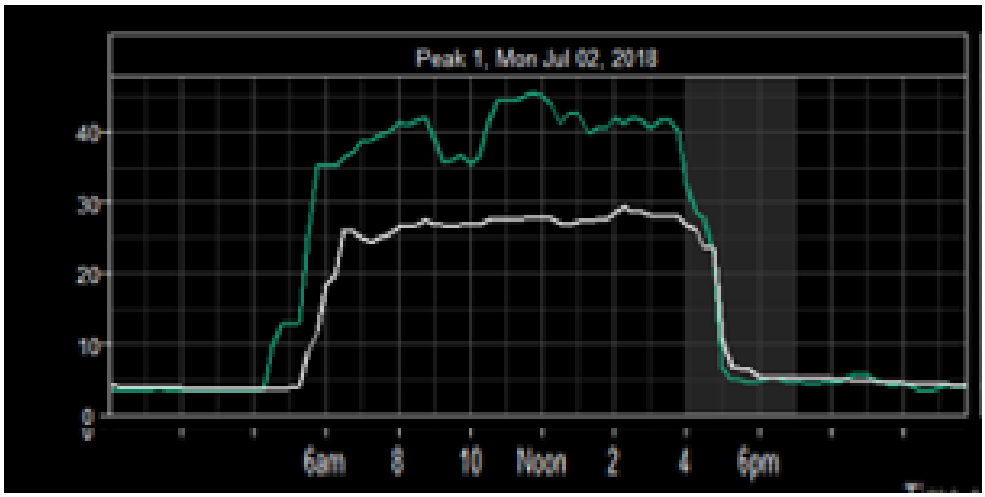

Figure 1. Data visualization of peak day energy consumption at VEIC, first summer peak day of 2018: July 2, from 4:00 to 7:00 p.m.

The green line in **Figure 1** indicates energy use on the peak day in kWh, beginning at midnight. The white line indicates average peak from historically similar days. The gray area denotes the peak period, beginning at 4 p.m. and ending at 7 p.m.

It is important to note that the green line is significantly higher than the historical white one, indicating greater consumption for that July 2018 day. However, there is no significant shift in the amount of energy consumed during the peak hours, since the peak line does not show lower consumption at the beginning of the peak period when compared to the average days.

On this first peak event, the building had not been prepared to handle the peak. Further, Efficiency Vermont's peak response practices were not in place. We can see a general increase in energy use on this day, and little to no shift from previous performance, especially during the 3-hour peak period. The project team used lighting controls but did not apply HVAC controls. Efficiency Vermont did, however, use behavior-change strategies, including an office social to engage the occupants, and provide awareness of peak events and activities.

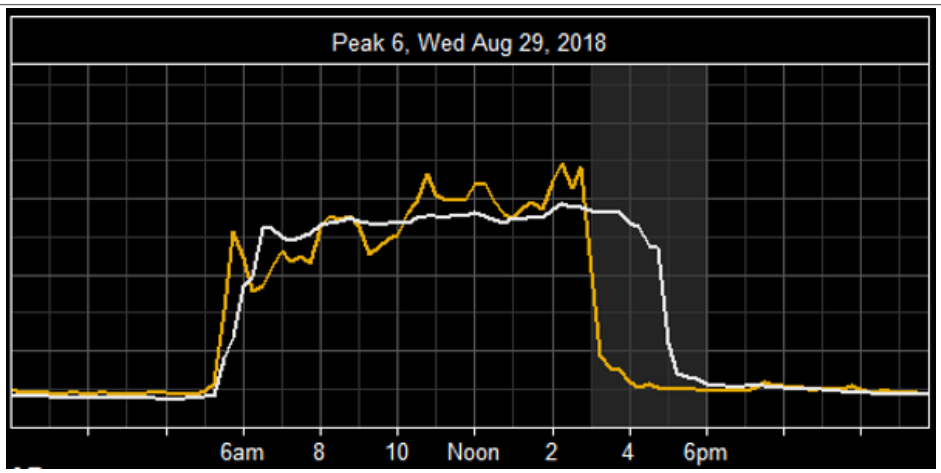

Figure 2. Data visualization of the sixth peak event, August 29, 2018, from 3:00 to 6:00 p.m., after VEIC put into place more demand response strategies.

The yellow line in **Figure 2** indicates energy use on August 29, the sixth and final summer peak day of the year. The white line shows average historical energy use for similar days. Again, the gray area denotes the peak period on that day, beginning at 3:00 p.m. and ending at 6:00 p.m.

During the peak event, the yellow line is at or below the historical energy use for similar days. The shift in the amount of energy consumed on that peak day is significant in two ways; the peak line notably begins sooner than the peak shape for average days, and drops off earlier, and more quickly and decisively, throughout the three-hour peak period.

Efficiency Vermont purposely changed the VEIC office occupants' behaviors to include building preparation on the evening prior to the peak day. The organization had also fine-tuned its building energy systems to the point of being able to use less energy throughout the day, and less during the peak hours. The team successfully used lighting and HVAC controls, along with behavior changes, during the peak.

Conclusions

Shifting load effectively is possible via a combination of demand response and energy efficiency practices. This pilot project demonstrated that it is possible to manage energy consumption in commercial office buildings during peak hours and peak days, using relevant behavior change and judiciously adjusting building controls. Being successful at these strategies can also be difficult.

Seasonal planning is the key to achieving success. Responding effectively to peak events requires coordination and planning. Demand response also requires timely action. Because commercial building operators frequently do not have much time to react to a signal from their distribution utilities, they must find ways to plan ahead, seasonally. It is also important to have backup plans in place. Peaks do not typically

occur on holidays, but they can happen while a program team member or building operator trained in reducing energy use on peak days is out of the facility.

Enlisting the support of building occupants is important. The improved performance of the VEIC building on the sixth peak day was the result of a coordinated effort among occupants and building operators—because they had all been primed to get ready for peak events.

Documenting appropriate and relevant steps takes the guesswork out of good building management practices on peak days. Creating a list of effective activities to undertake on peak days is an important element for success. Spending time *prior to* peak season to create the peak activities list is a must. It is a good practice, too, to solicit employee input on those activities, to ensure that energy use in all parts of the building are considered, and employees are engaged.

Testing and testing again. Planning for a peak event should include tests of operations with building operators and software managers or vendors. Even temporary failures in HVAC system settings, or lighting settings, can significantly impede energy use reductions during peak periods. Such failures can introduce or exacerbate occupant dissatisfaction if workspaces are too hot or cold, or if lighting is not working correctly.

Explaining peak impacts so that everyone can understand. ISO New England peaks and the effects of reducing demand during the peak are both difficult to explain to occupants who are not familiar with energy systems. Easy-to-understand language about why peak demand management is essential. Even at VEIC, which has an energy-attuned staff, it is difficult to change behaviors. Thus, reminders of the steps to take, at a minimum, are important—especially when accompanied by a general orientation about peak management.

Sharing results reinforces future good practices. Sharing results in a timely and effective manner is important for reinforcement of peak management actions. Sharing results involves good data science systems and practices.

The time value of energy. Organizations need to understand that energy saved involves not just reducing use generally, but also deliberately timing energy use reductions. Understanding the time value of energy is important for companies, as much as it is for the regulated energy industry.[5]

[5] To date, *investment* language for energy efficiency and other demand-side management strategies has been relevant for customers, just as is the concept of *paying for peak performance*. However, the true and positive effects of peak management have traditionally eluded comprehensive evaluation—and subsequent appropriate valuing. Demonstrating the impacts in terms of $0.15 / kWh leaves little customer incentive to reduce demand (measured in kW, not the kWh of consumption). Appropriately valuing the kW reductions can provide customer motivation to change practices, while making peak management strategies and outcomes easier to comprehend.

What the project showed. Efficiency Vermont now knows that, in terms of effective peak management, optimal, if not maximum, results are achieved when behaviors are modified, and all of the other lessons presented here are operationalized.

2019 Activities

Efficiency Vermont has expanded the menu of communications to staff for 2019 management of peak events and will increase the activities list incorporating feedback from employees in the VEIC office.

Efficiency Vermont intends to engage in a pilot program with the blockchain energy rewards platform Omega Grid[6] to provide commensurate value to the energy saved during peak periods. Omega Grid and BED have together provided a local market that uses incentives to motivate customers to reduce loads in response to dynamic pricing. The goal of the planned program is to reduce BED's peak charges on the monthly Vermont and annual New England peak load hours. Using the platform, BED will reward customers with tokens for their energy reduction contributions, worth 70 percent of the realized benefits.

Efficiency Vermont has begun working with Omega Grid to obtain the knowledge necessary to ask customers (via surveys) to become program participants. By becoming participants, customers would be able to create their own comprehensive peak activities list, maximizing their reductions of energy consumption during peak periods.

Assuming the initial work in the first half of 2019 and with a more seasoned "Defeat the Peak" campaign in place, Efficiency Vermont plans to bring this experience to distribution utility partners and their large customers. At the outset, Efficiency Vermont plans to test a few customers with AMI data by the end of 2019. The outcomes of this exploration are expected to be, for each participating customer account:

- Creation of a seasonal peak management package
- Seasonal announcements
- Employee surveys / interviews
- Peak management activities list
- Menu of communications (day-before-peak announcements, morning-of-peak-event reminders, peak-event-starting notifications, and peak-event results)
- Savings analysis services

A final report will be developed capturing 2019 lessons learned.

[6] This blockchain platform helps utilities calculate, deliver, and earn rewards for clean energy practices. See https://www.omegagrid.com/.