Integration of Demand Response Controls into Energy Efficiency Retrofits

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My name is Mary Ann Piette from Lawrence Berkeley National Laboratory. Marco Bertone is helping me to make sure we're going to make sure that there's no technical difficulties. We want to make sure that people can see and hear, and my slides advanced properly. I'm going to be talking about energy efficiency and demand response integration. And I'm with Lawrence Berkeley National Laboratory and the demand response Research Center. I want to thank the California Public Utilities Commission for inviting me to get the presentation today, I'll be talking about how energy efficiency and demand response are related and the relevance to the emerging programs in California. So, before I get started, are there any technical difficulties we think we're people can hear for under underway. Okay, I'm going to cover a background to today's presentation, I'll talk about how energy efficiency and demand response are linked. I'll talk about the California demand response potential study, and then review the programs in California, and talk about summary and future directions. And then we'll have time for Q&A. I may not be able to answer all the questions that come up. But the purpose of this presentation is to help the utilities and the contractors, and the stakeholders understand how energy efficiency and demand response are linked.

The background of today's presentation is this as part of the Public Utilities Commission activities to explore joint demand response and energy efficiency by integrating funding and program implementation in a limited matter. So, the question we are talking about today is related to how controls can be integrated and conducting necessary studies. So, in specific, we're talking about an application, A 1701. O 13, which is last April 14 scoping memo, and we're exploring the coordination between energy efficiency and demand response portfolio.

To talk a little about the electric grid in California and the history of our demand response programs. During the last few decades, California has been looking at the issue of demand response needs on hot summer days. So, for many years, we were very interested in the concept of how to reduce the peak demand on a hot summer day. And on the upper right hand, you'll see from back in 2006, we had a time where we had a needle peak, and from 45 to 50 gigawatts was less than 1% of the hours. And so, if we could use less electricity, during those top hours, the whole system can be more cost effective. We didn't need as much transmission and distribution and capacity. And the concept of demand response was focused on hot summer day. There are still many programs that are focused on hot summer day demand response. If we use demand response, appropriately, it can make electricity more affordable, and improve the grid reliability, but also considering the reduction of peak demand during peak hours, where the grid is constrained, as well as locally. So, there may be areas in California that are distribution constrained. And there's value of demand response. In more recent years, as we've moved towards

more renewables on the electric grid, there's a strong interest in the addressing the duck curve, which many of you have seen before. And shown here on the bottom right. The duck curve is a result of the fact that we have excess solar in the middle of the day, and then a high ramp at the end of the day. And that is causing an hour where we actually have too much supply and over generation and negative prices on the grid, as well as that steep ramp. And it's very difficult to maintain the system when there's a big change in load over those hours. That's historically an important issue in the spring. But we see ducks in the next 10 years occurring and every month. So, California is exploring what kinds of technologies might provide shift as well as the shed. And there's been work to think about energy efficiency and how it's linked to the traditional demand response as well as the emerging demand response. That's the subject of today's webinar. And these are challenges in the electric grid that these programs are designed to address.

I want to spend a few minutes talking about demand response. And how are related to energy efficiency. Using this graphic. On the very left, the concept of energy efficiency means you're getting the most service out of out of every kilowatt hour. So that means that the lumens per watt and the watts per CFM and the COP of the heat pump or the COP of the air conditioner are as efficient as they can be to provide energy and electricity in an efficient way. Typically, we think about that on and kind of an annual scale. And we care about reducing total energy use. As we move to the right, we're thinking not only about reducing total energy use, but when we use energy. And that is the most important thing of today's presentation is the concept of how we use electricity and the hourly load shapes. So, we had time of use energy and in commercial tariffs for many years, and we're now seeing it emerging in residential tariffs. So, we care not just about how much we use, but when we use it, and a customer can change their electric load shapes in order to use less energy when the prices are high. To further to the right, we care about the daily peak load we may have peak demand charges. And up facility manager may look at the time that they're peaking and reduce the demand charge which is common in commercial, large commercial tariffs. Then we have different timescales of demand response. And one of the common timescales is day ahead demand response, many of the critical peak pricing programs and peak day pricing is day ahead and will be told the day ahead of an event that tomorrow at two o'clock is a demand response time and we can prepare so we might pre-cool the building. And then real time we're very fast mad response might have five minutes ahead or 10 minutes ahead timescale and on the bottom picture that shows the controls and the telemetry. So, when we control a load, we need to have that granularity and that measurement. For today's presentation. All of that telemetry is provided by the advanced meters. For some of the faster DR programs the CAISO so requires four second telemetry, but that's not really the subject of today's presentation. We're talking about timescales, where the hourly meters and 15-minute meters that are available through AMI provide the measurement of the DR. And the service levels are often changed during DR events. We've done a lot of work in commercial buildings and many buildings are over cooled in the summer. And when you start changing the set points, we might actually find that people are more comfortable. So, we had an example of some IKEA's where they started changing the temperature for demand response events. And they said, Hey, we can do this every day. And then we call it retro commissioning. So, it's very important to understand the link between how a building is operating, how well is it commissioned? How well are the set points under control? And doing that first, before we do the demand response. So, we make sure

that every code out there as efficient as it can be before we start instigating the DR events. So that's a very important thing that sometimes we will try something for DR And it may migrate to the left and be considered in energy efficiency of value. So that's why this is a continuum of activity. And a facility manager is able to understand how efficient the building is operating, as well as whether or not the demand response events are being controlled. With a baseline of energy efficiency. At the foundation.

I show a graphic here that has three different bullets, demand response enabled variable frequency drives, commercial HVAC systems are responsive technologies that can provide DR services. I'll talk about that in a moment. Residential HVAC. One of the most common ends uses with used for air conditioning is a residential AC loads for demand response. And then automated control devices, smart thermostats and energy management systems. These are really things that initially were designed for energy efficiency, but because we can dynamically control set points, many smart thermostats and commercial building energy management systems can also be used for demand response by controlling HVAC dynamically. And that can include pre-cooling, and and changing setup points. So, it is very common to run the building perhaps at 70 degrees during a typical day. And then during a demand response day, let the building float up to 75. And depending on how much glass and the commissioning and the mass, it may be that people don't notice if there's some pre-cooling, and sometimes we're changing set points, but the ventilation levels stay the same with variable air volume systems. So, depending on the type of HVAC systems, these technologies can provide changes and electric loads that the customers are comfortable with. And as mentioned earlier, many buildings are already over cool. So, it is useful to explore how well a building stone set points are managed. And consider whether or not the building is a candidate for demand response and the technologies that are installed to provide both EE and DR activities. Variable frequency drives are an important technology because they tend to be able to modulate a supply fan or a pump sometime to allow the building to have levels of control beyond just audit off. And really that's one of the valuable attributes of HVAC systems. Some of the more advanced controls, as I mentioned, can provide energy efficiency as well as demand response. And variable frequency drives allow the fans to be reset during less demanding times. So, the V ft is actually turning down a supply fan during times where the air conditioning load is is not at full throttle. So, there's some variability and control there. The next slide is a little bit of a deeper dive on examples of measures that support energy efficiency and demand or response. And this is actually a control system at UC Berkeley. Here I have the concept that an automated DR Ready energy management system can be required in the building codes and installed so there's many of the vendors that currently offer energy management and control for large buildings can easily integrate open ADR and I'll explain what open ADR is in a moment. But these systems have hardware and software that take signals from the DR automation system, the ADR automated DR technologies, and commercial buildings are one of the most important sources of DR And in the commercial sector. These are known as building automation systems, energy management systems, or energy management and control systems. And most of these are cases where we reset the zone temperature. And the facility manager has a schema like this.

A lot of the demand response around the United States is currently manual. But in California, we've been working with commercial building owners for more than 10 years. To help them install and use automated demand response technologies. We also use the word semi-automated in the case where

they're not receiving a signal, but they've preprogrammed a demand response mode. So, for a variable air volume system, they may reset the zone temperature from 70 to 74. And the system continues to provide the baseline ventilation for the system. And the chillers are automatically set to let the temperature rise while the ventilation system is providing normal HVAC services. So, these systems are fully automated. And a facility manager is able to not even be at the building or remotely and the building is automatically changing its electric loads in order to provide these services for demand response. Another technology that has been evaluated for demand response is network lighting controls. Advanced network lighting controls are evolving to use wireless communications, embedded sensors, data analytics, and controls that can optimize the building system in real time. These technologies often have occupancy sensing directly in the ballast, they sometimes have their own power measurement. And they're very configurable. So, as we move from our incandescent to fluorescent LEDs to network LEDs these technologies and offer a variety of new services. So, one of the most important things that we think about as we think about energy efficiency and demand response is what are the other benefits streams that are associated with these technologies, because the non-energy benefits can be very significant. So, as we move towards modern office buildings that have variable occupancy, we can have lighting needs tailored to the individuals. And these technologies are of interest for facility managers. But they also provide energy efficiency as well as demand response. And this particular picture, you can see there's a lot of, of glass. So, this facility may have day lighting, and the day lighting may actually cause the lights not even to be on during the afternoon. So, the how much demand response we get from a lighting system, just like in HVAC system is going to depend on how the building is configured for normal operations, and then how its configured for demand response. But it's very common to change the light level by 10 to 20%. And for people not to notice, if they do notice, they can actually probably participate in some kind of communication with the facility manager. But in general, these lights are very configurable. And we can use both test lighting and overhead lighting to achieve a 10 to 20% reduction in total lighting power and have very little impact on the occupants. So, these technologies can be installed for a variety of reasons to upgrade the building and provide both energy efficiency and demand response services.

I'm going to talk a little about open automated demand response. This is a technology that began development over 15 years ago, the technology development was funded by the California Energy Commission. And the concept was, could we send prices to devices and could we send signals to buildings to allow them to automatically respond to some kind of utility signal that would automate a change in the electric load shape by interacting with the building controls such as the lighting or the HVAC system. Open ADR was published in 2006, what is known as open ADR 1.0. And open ADR 2.0 was developed in 2009 as a standard that was supported by nest through the smart grid standards. And the open ADR Alliance was formed, and open ADR 2.0 is a national consensus standards true standards development organization. And it is supported by the open ADR alliance that does certification and testing. So, to comply with open ADR, a facility manager or building owner needs to install devices that have been certified. Normally, these are certified virtual end nodes or clients. The control system is sitting in the building and it's able to receive signals from San Diego Gas and Electric, PG&E or SoCal Edison. Because those utilities have servers that communicate every minute of the year, the devices communicating through an open Application Programming Interface. And the technology is monitored

to ensure that the communication is robust. During a demand response event, the signals change, and the facility automatically changes the lighting loads or the electric loads from the HPC. And these systems can respond. In the case of large commercial buildings, these virtual end nodes are often on site. And in the case of residential, they tend to be cloud based. Virtual end nodes and many smart thermostats support the use of the open ADR protocol.

To open ADR is available for use through the utility programs. And I'll go through at the end which programs have ADR incentives, and which do not. And the electric utilities have active programs that work with customers to provide incentives for the ADR technology. It is also required in many elements of the building codes. And there is an open ADR symposium next weekend in San Francisco, San Francisco at the PG&E Energy Center. And we are working closely with the open ADR lines to ensure that this technology is robust and cost effective. And it is one of the main sources of automation, and a standard to facilitate the automation of demand response events. Now I'm going to talk a little about DR services on different time scales. And in California, we have completed a study about the potential for demand response. In the state of California. We had a variety of different services grid services that we explored. And we wanted to understand what capability exists in buildings and industrial facilities. So, we looked at homes, we looked at commercial buildings, we looked at industrial process. And we had four grid services that have different timescales of load shaping, we had shape, which is load shaping demand response, which is based on retail tariffs, I'll talk a little about that we had shift, which is a very new service. And that's related to the duck curve problem. The duck curve problem is one where we're changing the way we use energy. Traditionally, low prices were in the middle of the night. But with the renewable over generation and the duck curve, we're exploring prices where the lowest price might be in the middle of the day. So, we actually want to consume more in those times, and then use less around dinnertime when the neck of the duck is ramping up. Shed is the traditional demand response. And it's a notch out of a hot summer day. I'll show you a picture of that. But that is the traditional four-hour event, where we send some sort of signal to automate. And then shimmy is the very fast modulation, I will not be talking much about the shimmy service. But as we have more renewables on the electric grid, as in the past and moving forward, there's a need to firm up the the electricity supply. And we have regulation services that are fast acting loads, often their energy neutral to go up and down. And buildings and other demand side loads can often provide those services as well. But they're not the main focus of the DR EE integration today. But it's something to be aware of for the future. So, we're going to talk a little about this concept of load shaping, we are moving towards a time where we are offering time of use pricing throughout the utility service territory for all customer types. And we're changing the windows. So, it's very important to know this peak time is changing, it used to be like two to six. And now it's more like five to nine five to 10, four to 10. So that's a big change in California, for people to understand those are the high price times. So, we want to be able to create technology, where a homeowner or a commercial building can program their control system. And do this every day, not just on demand response days. So, this time of use scheduling is a very important part of our goals for the integration of energy efficiency and demand response. And it's kind of in between the two, some can think about it as time value of energy efficiency. So, controls that have this time of use capabilities are an important technology to try to use to minimize customer bills. And as I mentioned here, it says

accomplishing shed and shift with prices and behavioral demand response. So, we want customers to understand how to use less during that peak price time.

Two other pictures here, I have the shed service and the shift service. So, on the left is a typical electric load shape. This is actually the statewide load shape of 36 gigawatts 36,000 megawatts, and we're taking a notch out of the system load in order to reduce the need for that those peak hours where the system is constraint capacity constraint, it could be locally constrained. And the traditional demand response is is what we call shedding. On the right is this new concept of shifting. The California Public Utilities Commission has an active program with a load shift working group that has proposed a number of pilots to try to define and deploy shift in order to help flatten the electric loads and minimize the ramp and to better utilize the solar in the mid-day. And again, that's becoming a year-round issue, historically been most important in the spring. But we're also seeing it in other months, definitely winter and fall as well as some summer months. In the demand response potential study, there were over 40 different measures that were evaluated. And these are demand response measures, not energy efficiency measures. But we also tried to model as co benefits associated with the energy efficiency. So, at the top, you'll see we modeled electric batteries and plug in and electric vehicle we modeled behind the meter batteries. In residential, the two key loads were air conditioning and pool pumps, and commercial we modeled HVAC and lighting with a special emphasis on refrigerated warehouses that have been shown to be very successful in demand response programs, and industrial we modeled process facilities, agricultural pumping data centers and wastewater and pumping. Each of these measures have different levels of automation. So, we considered behavioral manual demand response, as well as automated an open ADR ADR type automation, that these technologies were very important in thinking about what does it cost to install the technology? And then how do you run it in a DR event, and how what is available from each of the sectors. So that study was published a couple years ago, and we're in the process of updating the study. To include a deeper dive in shift technologies, we're looking at thermal storage, electrification, redoing the battery and the EV models. So, we're in the process of revising the demand response potential study with a deep dive the shift technologies. But these technologies, many of them also provide energy efficiency. In fact, each of them in the residential and commercial building sector of pool pump. Here, it's listed as direct load control. But some of the advanced vs variable frequency drives on the pumps can also offer energy efficiency. That's one of the key aspects of this concept is the link between the technologies that provide basic energy efficiency and control as well as demand response abilities. Now I'm going to just talk a little about the co-benefits of energy efficiency and DR. As I've said several times, already, some technologies, most technologies benefit both energy efficiency and demand response. And I mentioned the concept that DR enabled lighting can be more efficient, advanced than standard lighting. So, as we move comply with our building codes, and install new technologies, we're getting both EE and DR. We're getting EE benefits and DR capabilities in order for the DR capabilities to be realized we have to participate in a DR program. And I'll go through those in a moment. So, the basic idea here is that, in the DR potential study, we modeled co benefits. So, we attributed we bought down the first cost of the technology, the tracking alpha value derived from these value streams. So, it so the way to think about it is if it costs so much per square foot to install an energy management system, we said some percent of that first cost is going to be available

from the energy efficiency savings. And we were able to model some of the EE and DR co-benefits in the DRF potential study.

Now I wanted to share this electric load shape for four different regions of the United States. This is the summer residential air conditioning load, which peaks when California is electric system peaks. So, we have this late day peak and see around 6pm. The green curve there is California. What's remarkable is where's this is similar in other states. So, when you install a more energy efficient air conditioner, you're reducing energy at those peak times.

Marco Bertone

Can we do the sound check. They said they lost the audio.

Mary Ann Piette

Oh, they lost audio. Should we go to we try to chat?

Marco Bertone

Okay, they say audio is fine.

Mary Ann Piette

Audio okay?

Marco Bertone

Only one.

Mary Ann Piette

Sorry, I hope everybody can hear. We have 347 people online.

Okay, so let's see, I didn't need to go back here and still here.

Did you change the slide? Yeah, we're gonna have to, we're gonna have to do it again. There we go. Okay, so back to the air conditioner, load shake story. This is a story about when you put in better

insulation in your walls and change your windows and your your, your cooling load goes down. That helps us at these peak times. So, when we're retrofitting homes to put in more efficient air conditioners, you can see we're going to reduce that electric load shape for the average home. And that's a good thing. That's an example where an energy efficiency investment is going to change the electric load shape it's going to help that duck curve. So, these are important to understand and how we use electricity and and how it's different now and, in the future, compared to what we've done in the past. Now I'm going to go through two slides that give you an overview of the California investor owned utility program dispense DR programs and rates. On this first table at the top is time of use rates. The utilities have time of use rates that vary by winter and summer. We call these loads modifying. And that is similar to this concept of shape that I mentioned earlier. So residential and non-residential customers, IOU customers have tariffs, where the time that cost of electricity changes during the day. These are not auto DR incentive programs. But these are the basic programs available through the utility territories. The second row is peek day pricing or critical peak pricing. PG&E and SoCal Edison offer programs where customers receive a reduced rate during summer months, and higher prices or rates during CPP events. Now this is revenue neutral to the class average. So, for the average customer, your price doesn't go up or down, your bill doesn't go up or down. But if you're picky, you're going to have to shed and some customers save money doing nothing. So, it's worth looking at whether or not a load shape is how how it can be performed to minimize costs. For CPP, PDP This is also a load modifying rate because it is focused on the retail tariff. It is available to residential and non-residential customers and it is eligible for the auto DR incentives. So, there's many technologies in this category that provides energy efficiency to the customer, as well as the DR capabilities. San Diego Gas and Electric has a critical peak pricing rate that is a commodity tariff that provides customers with an opportunity to manage their loads by reducing load during high cut price periods or shifting from load from the highest price period to the lower price period. So here, they're making the point that this is this is allowing some shifting. So, it's an it's these these tariffs in general, if you can pre-cool the building before that high price time, then you can you can shift low. And that's a non-residential tariff, also available for the ADR incentive. SoCal Edison has a real time pricing tariff. It has hourly rates that are based on time of day season and temperature that is a temperature triggered RTP it is available for res and non-res customers. And it's also a load modifying tariff is also available for the ADR incentives.

Here's a longer list of the programs, all three utilities have base interruptible programs. These are considered reliability programs. So, I'm going to switch back and see under program type all these four our load modifying programs. This top one offered by all three IOU the base interruptible program is a reliability program, which means that it gets called when there's reliability issues on the grid. So, the customers can reduce their use directly or through an aggregator and their energy demand is established by firm service level. So, this is not a shed with a baseline. But the electricity use is reduced to meet a target that the customer negotiates with utility. And you can see that the notification of the event varies a 20 minutes 30 minutes and 15 minute or 30-minute notification. So, the facility has to drop load within 15 to 30 minutes, and it is not an ADR program. The next one is the agricultural and pumping interruptible program by SoCal Edison. This is a utility direct low control program where devices which is installed with the customer premise. This is also not an ADR program. But it's an it's a reliability program for for Ag and Ag and pumping customers. And it's also this one and the one above it

is available for IOUs CCA and direct access customers. So that's the first time I've mentioned that. There are Community Choice aggregators that these first two programs can participate in not of the load shaping on the previous page are CCA. But direct access customers can participate in these programs as well as CCA.

The next one is the air conditioner cycling program.

Both PG&E and Edison have utility direct load-controlled programs, where a device or switches installed at a customer's premise. These devices receive signals directly from the utility. They are not ADR or open ADR signals. They are a proprietary custom system that the utilities have developed to interact with air conditioners. And those are available to res and non-res customers. As well as IOU, CCA, and direct access customers. The Smart Energy thermostat programmed by SoCal Edison uses a customer registered the thermostat which can be controlled to a certain temperature during an DR event. So, this one is like the air conditioner cycling the Smart Energy Program is that at a price Response Program, the AC one above was price response or reliability. This one is price response, Edison Smart Energy thermostat program, residential customers only and there is a thermostat incentive program. So many of you have heard of the bring your own thermostat type of programs. And this one is similar to that. San Diego Gas and Electric has the AC saver day ahead program. This is also open to residential and commercial customers with programmable thermostats. This is a low shed economic and summer liability program. And customers non-res and res, IOUs, CCA, and direct access. There's not an ADR incentive. The AC saver day of switch program by San Diego Gas and Electric is open to res and commercial with a switch device on their system that's similar to the AC cycling programs that PG&E and Edison had, since his load shedding economic and reliability available to res and non-res. And it's also not an ADR so it's not using that open protocol and direct control. Now capacity bidding, the capacity bidding program or CBP is available from PG&E, for Southern California Edison, non-res only and for San Diego Gas and Electric non-res only. This program allows third parties to bid load into the DR capacity each month. So, this is Edison and San Diego offer a major October, whereas Edison offers their program year-round January through December. So, this is a price Response Program for res and commercial. And again, IOUs, CCA, and direct access of all three it does offer ADR incentives for capacity bidding. And then the very bottom one is the DRAM the DR, Demand Response Auction Mechanism Pilot, this is a third-party program offered by aggregators and into the CAISO market. Excuse me. It is a resource adequacy program under a standard agreement in a non-non-negotiable purchase agreement. It is a price Response Program. And it's also reliability program. Excuse me. So, the res non-res customers are are can be participate. IOUs, CCAs, and direct access customers. So, on the very far right, the proxy DR program, proxy demand response does operate ADR incentives. But the reliability demand response resource does not. So, we have RDRR and PDR. Those are the two different kinds of activities.

So, I'm going to my final slide.

Want to just remind you what we've been talking about. And the picture is to think about a building today and where we're headed. Traditionally, we've been very concerned with the lighting and the envelope and the HVAC and the plug alone. But now we're starting to monitor things like security, and productivity and health. We have EVs coming into the behind the meter loads, we're trying to integrate

buildings as part of a campus and with the grid. So, we're moving from the history of Static Energy Efficiency to dynamic energy management. And that can be a very synergistic opportunity to look at technologies. So, we want to be able to understand how to integrate demand side management technologies to help achieve a low carbon grid in California. I'm not sure how we're going to manage the 300 people what the Q&A is, I should say, type their questions and maybe.

Marco Bertone

A few did

Mary Ann Piette

I'm not sure I'm going to be able to answer them, but I'll give it a shot. So, let's just read the first one.

Marco Bertone

So, one is asking to share how non-energy benefits are incorporated in cost effectiveness tests.

Mary Ann Piette

I'm going to CC the answer to that one.

Marco Bertone

So, the second one is about this, some more information about the the study where we can find this.

Mary Ann Piette

drrc.ldl.gov. So, demand response research center.ldl.gov. There's also a link at the CPUC site that we can we can send out to the participants

Marco Bertone

Another related question is how they can get in touch for updated for the updated version of this study? Is there some website or update? there will be in the future?

Mary Ann Piette

That's right. It's not it's not out yet. But we will be publishing the results in the near future.

Marco Bertone

Another one asks also about the potential study if there's been some investigation, how much bill how many buildings have need to go through DR to and load shift to actually a progressive curve?

Mary Ann Piette

Right. Good question. In general, the way we modeled the demand response was we explored what was considered cost effective. We didn't instead of we didn't figure out how much we need, we looked at how much is available, because one of the big questions is how much storage we need versus how much customer DR We need. And we actually model both. So, a different price point. The storage becomes very competitive. In general, if we can do it through the utility tariffs that on that first slide, I'll go back to this slide here. The question about how much DR we need is, is a little bit related to how much we can get from responses to these dynamic tariffs and the load modifying DR That comes from everybody who has those tariffs. So, if we can get people to respond to their TOU rate, that will be one of the most cost-effective ways for us to handle the duck curve. To to, again, use more in the middle the day and less around dinnertime. And we're going to need to continue to look at the incentives and the behavioral response.

Marco Bertone

There's a new series of questions just came in. One is about the manufacturers flight train, and there's some concern about warranties being avoided. Do we have experience with this right?

Mary Ann Piette

So many people will express concern that we may be cycling a compressor too often. That is actually not the case, because we're doing things on timescales, where we're not really modulating the compressor up and down, does not that modulate or shimmy service. These services are more like a time of use control or a demand response event. And we have not seen any concern. Changing a compressor on the timescale says this kind of technology is is automating.

Marco Bertone

There's another one, which is I think interesting about the challenges and obstacles to integrating EMVR and they're asking their move technological or more bureaucratic process. Let us maybe have some different programs such

Mary Ann Piette

Yeah, that's a really good question. It's certainly the case that we historically have had very siloed EE programs and DR programs, which is challenged the on the on the regulatory side. However, the demand response is new for many people. So, there's a lot of education needed, which is one of the reasons for this webinar. So, we believe that people really need to understand their hourly load shapes, and how their load shapes compare with their tariffs, that is the most important thing to do is to understand their current load shape, and what flexibility exists in their own shape. So, there's definitely control and automation challenges there.

Marco Bertone

And as a specific one is about with the family customers, and they have this up either in overspent or,

Mary Ann Piette

yeah, that's an interesting one. So, I believe it depends a little bit on how big that building is, whether it gets categorized as residential or commercial, but in most cases, most apartment buildings are residential.

Marco Bertone

This was the new one. This is interesting. How do you separate EE from DR benefits when they're all together?

Mary Ann Piette

Well, that's that's one of the challenges for sure. So, if we think about this, think about it in terms of baseline, if you have an electric load shape, and a monthly bill, and we start to install a technology that has both energy efficiency and demand response, then we expect the load shape to change every day. And that's kind of an EE and a load shape change, DR tends to be discrete events. So, for our demand response event, will have a more energy efficient load shape than before the devices installed. But during the DR, we should still see a drop from the regular EE load shape. So, so that's really, it's really

taking an electric load shape, making you more efficient, and then showing the dispatch ability of a demand response

Marco Bertone

there’re still new ones. One interesting one, in my my opinion is this one, they're asking if there's a specific order that we saw in different studies in like more effective demand response applications, if in terms of cost.

Mary Ann Piette

Yeah, the most cost-effective DR is the one where the owner or the facility manager is paying attention to it. So so, one of the issues about both energy efficiency demand response in the control topic is whether the savings persist, because you can program, and retro commissioned a building. But unless you check it over time, the savings may not persist, or the demand response control strategies may erode, and you need to make sure they're programmed correctly. So that's the most important thing in this space, which is different than just changing a light bulb or putting in a more efficient air conditioner. The controls matter, and the sequence of operations matter, and the set points matter.

Marco Bertone

There's another one about EV, EV charging alone versus EV combined with other form of storage data meter if we have experienced or that's relevant. Or associate, again, add these standalone EVs and the fact of those four, or DR or EV combined with other thoughts memories. Yeah.

Mary Ann Piette

So, So the most important thing for EV is that we charge them at the right time. So, for most people, it's easy to protect your home, you're going to be on an EV tariff. And the EV tariff is trying to keep you off of that five to nine peak time. So, they're going to want you to charge later in the day. If you also have a behind the meter battery. That's an interesting one, which I haven't thought about as much EVs at the workplace. We charged them in the middle of the day, typically. And that's of course, very, very good for the duck curve problem, where we want to use more electricity during the middle of the day, EVs are one of the most important new loads, because they will make the curve worse if we let everybody charge when they get home. But if we can charge them at work, it's a much better load. Honestly.

Marco Bertone

The This is the kind of connected question about time excuse rates for EVs. And those if we know those are available in California.

Mary Ann Piette

Yeah, they are. Yeah, I mean, it again that tends to be the residential. I'm not as familiar with the commercial.

Marco Bertone

They only have residentials EV programs, no commercial.

Mary Ann Piette

Yeah. Although SoCal Edison has automated DR Fleet program. So, Carl Visa helps run that program. And there are special programs for fleet EVs separate from the residential and custom residential commercial building owners.

Marco Bertone

There's a set of new interesting one. This one is I guess, one of her favorite M&V methods for DR.

Mary Ann Piette

Yes. So, M&V method for DR Have to do with different baselines. There's been a lot of work on baselines. Typically, you look at the 10, previous days before the DR event, the non-weekend, non-holiday non-DR days. And then you say the highest three out of the last 10 or the 10 previous day load shapes or do some sort of weather regression. So, there's ongoing work on the way to do the settlement and baselines for demand response. But I should also emphasize, if you're on the time of use rate or critical peak price rate or the Edison RTP rate, there's no baseline needed, because the settlements in the bill itself.

Marco Bertone

Another question, about the you know, growing in other technologies is growing, which is a pump water heater. And what's the potential of those and alone and integrate with other systems?

Mary Ann Piette

Yeah, good question. There's a lot of work by NRDC, the Natural Resources Defense Council and others about what are called grid interactive heat pump water heaters. California doesn't have a lot of electric water heaters. But there are new new groups exploring electrification of space, heat and water heat. And in the case of those loads, if we don't do anything about them, they also will make the duck curve worse, because people will charge their water heater in the morning in the afternoon. But a grid interactive, one can be programmed to charge at some time and discharge it others so that we can make the electric load shape more favorable to the type of problems that we've been talking about. So, it's a really good question. There's not a lot of experience with controls on those heat pumps. But stay tuned. And NRDC is definitely looking at it as well as many other groups and F3 as well.

Marco Bertone

Theres a set questions I get from people and people on the phone who don't necessarily have access to the whole webcast. They are asking if we're recording if the recording will be will be available.

Mary Ann Piette

yes, we will, we will send it to the PUC to post on their website. So, the demand response proceeding site, we will send it to a Jean Lamming and analog group at the CPUC.

Marco Bertone

This set of questions on different flavors of cost effectiveness of these measures again, and if the combination of EE and DR makes each component their synergies right.

Mary Ann Piette

Well, yeah, I'm actually on unable to comment a lot on the regulatory cost effectiveness, metrics.

Marco Bertone

There's another question about heat pumps talking about if there's any rule on incentivizing fuel switching in California?

Mary Ann Piette

I don't know, I know, there's an electrification proceeding. But I'm not sure exactly the details of it.

Marco Bertone

covered most of the recent ones? Let me check a second. There’re several questions on approval and policy questions that are probably

Mary Ann Piette

Yeah, so I, unfortunately, I'm not in a position to answer some of the regulatory policy questions. I've been focusing mostly on the technology characterization and the EE DR integration. Marco let's just take one more, if you find one. I want to thank everybody for joining. We really appreciate your attention to this topic. We hope this has been useful. And we will work with the CPUC to try to publish the list of questions and get the answers out.

Marco Bertone

So, one interesting one is about smart thermostats. And the effect of those when somebody also has EVs and storage. Yeah. And if this can be some interaction that is actually penalizing utilities or grid, meaning that Yeah,

Mary Ann Piette

yeah, so that's a good question. And I actually don't have much experience, but I'm certainly aware. I mean, I should say that a lot of people with photovoltaics, if they have storage, they're trying to charge charge their batteries. So that the duck curve exists because as the sun goes down, loads are still high. And if you have your own battery, then you can use the battery during the dinner time hour. So, it's five to nine periods in order to to run your air conditioner with your own battery. So, so that is kind of a customer optimization. And we'll probably start to see more of that as people with EVs, install their own behind the meter batteries. So that's up to the customer. And and I'm sure there's control algorithms from some of those vendors that offer technology to help minimize your bills.

I think we'll wrap it up. I really appreciate everybody joining today's call. Hope it's been useful to you and thank you so much for for joining