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Comments on Scope for 2020 Load Management Rule Making

Additional submitted attachment is included below.

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Reascend LLC appreciates the opportunity to submit these comments on the scope of the 2020 Load Management Rulemaking Docket 19-OIR-01. The author of these comments has 44 years of experience in the energy industry including the creation of a utility's demand-side resource plan, and more than 27 years implementing load management and AMI projects while employed at an electric utility. He is the recipient of a 2019 PLMA award, and provided Testimony on standards to House Science & Technology Committee on Technological Innovation, July 1, 2010.

To keep the following comments short the author provides these comments more or less as fact without supporting analysis based on previous work and experience, but the author will be gladly provide detailed analysis to support any claims or questions.

New Planning Tools Required (to achieve a least cost resource plan with a grid supplied by 100% renewable energy)

For the last 40 years resource planning has been dominated by Monte Carlo analysis to meet requirements for energy and power. However storage, at some level, adds a 3rd requirement to serve windless nights in December. What model today will determine the optimum amount of battery storage required? I'll argue that our industry needs to apply the methods of operations research to answer this question, and so I urge the CEC as an outcome of the rulemaking to commission the national labs or your state universities to develop tools that develop least cost resources portfolios.

Load Management Required for an Energy-Constrained System

Let me detail a bit more of generation outcomes for output in December because it will help illustrate a number of points. Using PV Watts data for Anaheim CA, I found that the worst case, consecutive 4-day average solar output will only achieve 25% of the average daily output over the year in the scenario of a 1-in-2 year minimum. An average winter day produces about 70% of the annual average.

Using gross estimations I'll examine the average winter day output first. If the average daily electric usage in December is 70% of the annual average usage, the properly sized batteries (ignoring losses) could take the excess output (in a resource portfolio of 100% solar PV) produced by day to serve the 14 hours of darkness beginning at 5p through 7a. In this system the average day solar output will be nearly 3 times average system load between 9a and 2p so this implies the battery system will need to be about 30GW with about 6 hours of storage to get through the dark hours. These are calculations based on the assumption of an <u>average</u> CA peak December load of 22GW, and a 15GWa daily energy consumption. The peak output in winter from the PV panels will be 50 GW and generate 15GWa of output

What are the implications?

The battery is 70% of the cost; the marginal cost to additional capacity is about $250 per kW. So the primary constraint is the quantity of battery storage needed.

Load management needs to be able to control all storage both utility and customer-owned units.

If most EV charging can occur by day then the increased energy demand can be met by adding more solar generation without the need to add more stationary battery storage.

Now consider a modest "worst case" scenario where average solar output over 4 days solar is only 25% of annual average day. (Lucky California, neighbor states to the North won't even get 10% and will have to serve near-peak load on those same days.)

What are the implications?

What you discover is that you need backup generation, or overbuild renewable generation to a level 3X above the numbers described above which lead to throwing away about 75% of renewable generation.

What you come to realize is that you want the solution that mother nature evolved for northern land plants and animals 600 million years ago. That is you need to store energy excess from summer in the form of liquids or solids (but note our CCCTS need liquid fuels) in order to get thru the cold dark days of winter. Batteries will not be economic for these worse case scenarios.

So add to list of needs in the outcome of this rulemaking the need to work with the universities and the oil companies to develop a liquid fuel that you can synthesize from excess solar power in spring and summer and fall.

As you think through a realistic end-state resource portfolio, you realize more clearly the need for new planning tools as stated above.

Marginal Cost for Storage

Once you have a model that determines the optimum about of storage, you will have a cost basis not based on avoiding building peaking plants but an outright need for storage as independent constraint. This will marginal cost is critical as an input to load management. Now instead of trying to justify load shifting based savings from the delta of on-peak and off-peal prices you develop and incentive based on the capital cost building unnecessary storage. This opens the door to creative thermal storage solutions and industrial loads that you have not listed. For example, the making cement uses a lot of natural gas. This could enable cement manufacturers switch to electricity when it is in excess production. The energy cost will below that of gas during these hours, but the avoided batteries needed in summer will give them the capital incentive they need to pay for the new equipment.

Control Paradigms

Price-to-devices is a desirable outcome for all traditional mass market loads, but not EVs or stationary batteries at or behind the meter. The total amount of energy that can be shifted either less than an hour (to deal with irregularity of solar and wind output) or more than 6 hours (to create a battery equivalent) is limited compared to the storage described above. But since load shifting is much cheaper than storage we want to get as much of it as possible, and this is more about making it easy for customers and ultimately the equipment manufacturers. A 24-hour price forecast that can be broadcast and updated every hour is all that is needed. The required electric battery storage will be more than enough to deal with all variation within an hour.

Charging and discharging of batteries (EV and Stationary) requires much more though. Since when these batteries charge and has almost no impact on customer lifestyle, their control system will be triggered, coincidently, by even small price changes. These 7 to 10 kW devices operating coincidently on a single transformer will certainly lead to overloading. Until pilots can determine effective ways to control these devices by prices and amelioration by group assignments and/or control of charge/discharge rate by percent, direct load control will be needed to protect distribution components.

Making Flexible Loads Cost Effective

The key is CTA-2045 interface on major appliances sold beginning with electric water heaters, EVSEs, battery inverters, and HVAC equipment that cannot be controlled by conventional thermostats. E.g. high-efficiency heat pumps and A/C units that use variable speed motors.

I intend to participate in future discussion as to why this is so important, but a few reasons stated with minimal explanation.

CTA-2045 is the enabler of all communication protocols and makes appliances future proof so they can support any communication protocol available today and any one created in the future

Communications between two humans or two machines requires a minimum of two communication standards: at least one physical media the connects the two entities and one command language. So for example two English speaking people will talk and listen using the physical media of sound waves, and they will format sentences in English as the language. Or, these same two people could choose to convey the same information using the media of text on paper and use the exact same English content. Note that if you want to communicate with someone that speaks the language of Spanish, you can facilitate with Google translate. Commuters are good at translation, especially in the case of a demand response language like IEEE 2030.5 or OpenADR that have very limited vocabularies.

In humans, the regardless of the physical media used to communicate; our central nervous system is the common receptor of all of these media. CTA-2045 is a port that connects to the appliances digital brain. In this way is access to the nervous system (the digital bus) of the appliance. Like our nervous system this port can receive messages on any physical media and this is determined by the communication module that gets plugged in by the customer. So the physical media can be Wi-Fi, ZigBee, a 4G mobile tower, Ethernet, Bluetooth, etc. The communication module of the future could have a library of every demand response language created to include: both open standards like IEEE 2030.5, OpenADR, BACNet, but also proprietary commands of any appliance maker, if they choose to share them.

The important take away is that the port supports OpenADR over Wi-Fi, but it can also support OpenADR over the 4G mobile networks for the 20% of Americans that don't have a Wi-Fi in their home, of the 10 to 20% of Americans that have Wi-Fi but don't know how to connect devices to their home system.

Note that the current approach of appliances controlled via the manufacturers "cloud" is only available on more expensive high-feature appliances so this discriminates against low income household and/or renters. If a socket requirement is on all manufactures and all appliances then these DR ready appliances become available to all on a non-discriminatory basis.

A CTA-2045 port on the appliance means control is accessible to any customer, any entrepreneur, and service provider without the need to go through the manufacturers cloud. This approach often requires legal contracts and is subject to the OEM changing the access protocol or choosing to drop a product. This open approach is what we expect with apps on phones or computers and it allow 3rd parties to innovate. As we focus more on resiliency, open access to appliances means a home control system can operate efficiently during periods when power or internet access is lost.

Later after the value of a CTA-2045 on the large appliances is proven the cost will drop due to volume and it will be cost effective to add to pool pumps, electric dryers, dishwashers, and refrigerator/freezers.