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July 26, 2016

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1200 W. Washington Street
Phoenix, AZ 85007

Arizona Corporation Commission
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JUL 26 2016

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RE: APS 2016 DSM Implementation Plan
Docket No. E-01345A-15-0182

Dear Commissioner Burns,

Attached please find Arizona Public Service Company's Response to your request during the July 12, 2016 Open Meeting regarding information on Demand Response with Smart Thermostats.

Information on Demand Response with Smart Thermostats
Prepared for Commissioner Burns - 7/26/16

At the July 12, 2016 Open Meeting approving APS's 2016 DSM Implementation Plan, Commissioner Burns requested information from APS about a residential demand response program concept that he understands is being implemented by some co-op utilities in other parts of the country to reduce system demand. The concept is for the utility to rotate the cycling of residential customers' air conditioners on and off in groups. The result is that no one group has their air conditioner cycled off for more than a short period of time, but the utility benefits from the sustained load reduction during the peak demand period.
APS is aware of this program concept and of similar programs being run by other utilities. The potential impact of these types of programs is very specific to local climate, housing stock, and customer participation levels. Experience in other markets has shown that it typically takes many years of program marketing and customer education to build up significant program participation levels.
The information below: 1) discusses some key findings from other residential DR programs, 2) sets a common understanding of where APS currently is with regard to smart thermostats, 3) outlines the demand response capabilities of those smart thermostats, 4) lists some important considerations for this program concept in Arizona, and 5) outlines conclusions and next steps.

1) **Other Utility Residential DR Programs**

- Residential demand response programs began in the 1970's and they have evolved significantly in recent years. Until recently, most DR programs relied on direct load control (DLC) switches that simply turned off an HVAC unit, water heater, or other appliance in response to a peak demand event. These programs provided peak demand savings but they often suffered from low customer engagement, low participant satisfaction, frequent overrides and high levels of customer drop outs due to comfort issues. In addition, it was difficult to accurately determine whether all customers were participating in an event and what level of peak demand savings impacts were being delivered.
- Today most DR programs are being launched using smart thermostats as the preferred control technology. This technology enables better customer engagement and interaction with DR events through mobile apps and other interfaces while it helps overcome comfort challenges by pre-cooling homes prior to events. And these thermostats offer detailed data for each event to help utilities accurately assess program peak demand savings impacts. They can also facilitate very flexible implementation where participants can be divided into different cohort groups during each DR event – providing the ability to target locational DR events and stagger AC cycling strategically to maintain participant comfort while better meeting flexible utility resource needs.
- In addition to direct load control switches and smart thermostat enabled programs, there are also new DR program opportunities such as Behavioral Demand Response, which engages customers with peak demand savings tips prior to events and then use interval utility meter data to provide feedback on customer performance afterwards. APS is launching a residential behavioral demand response program this summer which was recently approved by the ACC in the 2016 DSM Implementation Plan.
- Currently the largest residential demand response program in the country is the Duke Energy Florida program. This program has been deployed and marketed over decades and it has grown to over 400,000 participating customers (out of a total customer base of 1.7 million) representing over 650 MW of peak demand savings potential. The Duke Energy Florida program is currently transitioning from a direct load control switch to a smart thermostat enabled program.
- Recently both the Bonneville Power Administration and the New Hampshire Electric Co-Op announced new residential demand response pilot programs. These programs are both using smart thermostat technologies that enable flexible deployment of DR where air conditioners can be cycled among different participant cohort groups for each DR event.
- The peak demand savings impacts of residential smart thermostats are highly dependent on climate conditions. Since southern Nevada experiences similar extreme summer heat conditions to Arizona's desert climate, we have provided program results of the NV Energy residential smart thermostat enabled demand response program as an example of the potential demand response capabilities from residential DR in a similar service territory to APS.
    - For each DR event, NV Energy sends signals to smart thermostats to conduct pre-cooling of participating homes up to 2 hours prior to an event, and then signals

thermostats to turn up at the start of a DR event. Each DR event lasts 2 hours in duration. Based on measured savings from DR events in summer 2013, the average demand savings per participating was approximately 1.9 kW per household during the first hour of a DR event, and 1.2 kW per household for the second hour of an event.

- Based on participation from 23,000 households and the hourly impacts experienced in Nevada, total demand response capacity for NV Energy from the program is approximately 43.7 MWs in the first hour of an event and 27.6 MWs in the second hour of an event.
- The system impact results reported by NV Energy, while expected to be somewhat similar for APS because of the similar climate conditions, may not be completely generalizable to APS because of differences in housing mix and customer propensities to participate.

2) <u>Energy Efficiency Savings from Smart Thermostats</u>

APS is currently working to include smart thermostats in its 2016 DSM portfolio for the energy efficiency savings they produce.

- The ACC's recent Decision to approve the APS 2016 DSM Plan at the July open meeting approved smart thermostats as an energy efficiency measure in the APS DSM portfolio.
- Smart thermostats provide cost effective energy and peak demand savings by improving the efficiency and operation of residential and small commercial HVAC systems.
- Smart thermostats can be easily programmed to align with a customer's rate schedule so it can optimize the efficiency, comfort, and bill savings for the customer. In some cases, the thermostats can actually learn the behavior of the homeowner over time and adjust accordingly to maximize the savings without compromising comfort.
- Market estimates indicate that somewhere between 40,000 and 60,000 smart thermostats have already been purchased and installed in the APS service territory.
- APS estimates savings of 548 kWh per year and 0.18 kW of peak demand reduction per home as a result of the energy efficiency features of smart thermostats, including technology that automatically adjusts thermostat settings and optimizes HVAC operation by learning users' patterns over time. This is before considering any impacts of the utility cycling the air conditioners through the smart thermostats.
- In addition to these EE savings, smart thermostats also provide capabilities for additional peak demand reductions from demand response as noted below.

3) <u>Residential Smart Thermostat Demand Response Capabilities</u>

- APS anticipates that it may utilize residential smart thermostats in a future demand response program. As stated in the APS 2016 DSM Plan, "In addition to their significant energy savings features, smart thermostats also offer capabilities for smart grid enabled automated demand response (ADR) where thermostat settings can be automatically adjusted based on rate signals. Although APS has no plans to utilize these thermostats in a demand response (DR) capacity at this time, they are DR enabled. Encouraging their deployment will allow APS to build a DR ready infrastructure that can be leveraged as needed in the future, offering significant additional benefits to smart thermostat deployment that is not being included in the current benefit/cost results".

- Utilizing smart thermostats for demand response can either be through voluntary control of the thermostat by the customer, direct control of the thermostat by the utility, or automated control where the thermostat directly responds to rate signals from the utility meter based on pre-programmed user settings. Voluntary control by the customer provides flexibility for customer participation, but also makes the load reduction less certain for the utility. Direct control of the thermostat by the utility offers more certainty about the load reduction, but it can make the program less desirable for some customers. Automated DR is designed to optimize results with enabling technology that makes participation in DR events convenient, comfortable and seamless for customers. This is an emerging approach that is being studied as part of the APS Solar Innovation Study pilot.
- As a result, the level of customer participation in a smart thermostat demand response program depends on who controls the thermostat and how it is controlled.

4) <u>DR Program Considerations for Arizona</u>

- Frequent and/or long duration DR events can cause participant fatigue and dissatisfaction with a DR program, so it is a resource that must be used judiciously.
- To address these issues, a utility may choose to cycle participants so that not all thermostats are called at every event, or that participation during an event is staggered to extend the total event duration. This helps provide more flexibility, but it comes with additional costs because more participants need to be enrolled to achieve the needed capacity savings.
- Not all APS residential customers would participate in an air conditioner cycling program because of the following potential barriers:
    - Not all residential households have air conditioning, particularly high country customers
    - Many residential households live in rental properties which are typically less likely to participate in a program
    - Not all residential households have smart thermostats or any other means of controlling the cycling of the air conditioner
    - Not all residential households will want to have their air conditioner controlled during the hot summer months, even if for only a brief time.
    - It would not be appropriate to control the air conditioning operation for some groups of customers, such as medical monitoring customers and other vulnerable populations.
- Up until this time, the most successful residential DR program in the country, Duke Energy Florida, has achieved participation from less than 1/3 of its residential customers in a program that has been operating for decades. Therefore, the expectation for an APS program would be for participation and impacts to start small and build over time. As participation grows over time, participants could be divided into varying cohort groups depending on the resource needs and objectives of each DR event.

5) <u>Next Steps / Conclusions</u>

- APS solicited proposals for smart thermostat enabled demand response in the recent All Source RFP. In the RFP, APS encouraged bidders to consider opportunities for leveraging

existing smart thermostats within the APS territory for future demand response capacity. APS is currently evaluating responses.

- Residential demand response using smart thermostats might be a viable program concept in Arizona. However, further study is necessary to determine the load reduction potential depending on whether the thermostat is controlled by the customer or directly by the utility and depending on estimates of how many customers would participate. APS will continue to evaluate these options and their load reduction potential.
- APS is continually evaluating many potential options for delivering peak load reduction and demand response to residential customers. The other options include offerings such as, whole home load management, HVAC thermal storage, and control of appliances such as water heaters and pool pumps. Many of these measures are included the APS 2017 DSM Implementation Plan filing within the proposed Energy and Demand Education pilot and the Load Management Technologies pilot.
- After considering all of these options, APS will recommend additional residential demand response as appropriate in a future DSM Implementation Plan.

If you have any questions, please contact me at (602)250-3341.

Sincerely,

Debra On for

Kerri A. Carnes

KC/ks