Comments of Residential Demand Response Stakeholders Following the DRWG Meeting of May 30, 2016

July 13, 2016

Who We Are

These comments are submitted jointly by a group comprised of EnergyHub (a subsidiary of Alarm.com), Nest Labs (a division of Google), Opower, and WeatherBug Home (a service of Earth Networks Inc.). Collectively, we have experience in many states and provinces and worked with many utilities on demand response programs. We have worked in a variety of regulatory and market regimes including Texas's Electric Reliability Council (ERCOT) in Texas, California's Demand Response Auction Mechanism (DRAM), PJM and others.

Executive Summary

EnergyHub, Nest Labs, Opower, and WeatherBug Home thank you for the opportunity to follow up on our participation in the IESO's Demand Response Working Group (DRWG) meeting by providing additional comments. We each look forward to working with the staff and stakeholders of the IESO to develop opportunities for the inclusion of residential load resources in the Ontario market. We believe residential demand response is an important and underutilized resource in Ontario. Reflecting the general discussion at the May 30 meeting, which was comprehensive, yet high-level, we would like to follow up with a more thorough discussion of our shared position.

In these comments, we explain the capabilities of residential demand response and identify changes to the current IESO DR auction structure that are necessary to encourage residential participation. Residential loads simply do not have the characteristics of large residential industrial loads, which have formed the basis for the current IESO demand response market structure. Residential demand response loads are weather sensitive, and should be appreciated for their distinct advantages and the contributions they can provide. We note that an explicitly weather-sensitive program for residential demand response (such as the Weather Sensitive Load element of the Emergency Response Service in ERCOT) is the most appropriate program structure for residential demand response. We suggest the following alterations to the current two season IESO DR auction as a possible approach for the IESO.

In the table below, we outline the specific barriers to entry for residential demand response in the IESO demand response market, as currently structured, as well as actionable solutions to these problems. The left-most column identifies the section in these comments where the particular issue is discussed.

Section	Barrier to entry	Suggested Solution
Adopt pay for performance approach	IESO payment structure does not compliment the weather sensitive attributes of residential loads.	Utilize a payment structure that pays DR providers for their average performance over the commitment period (for tests and/or events).
Alternative baseline methodologies and	Baselines must be appropriate to market design	Consider alternative methodologies, as appropriate to

approaches		market design, including control groups, firm service levels, and like-day matching.
Simple customer registration	The current system requires coordination with multiple utilities	Allow demand response providers to manage customer enrollment and registration while minimizing information and steps required of customers. Ensure any and all customer forms can be signed digitally.
Automate meter data access	Data must be obtained directly from each of the 70+ LDCs.	Create a centralized digital repository of customer meter data that can be accessed by verified demand response providers, or at least a commonly adopted, simple, standardized process to be followed by each LDC
Change meter data granularity requirement	DR auction rules require 5 minute meter data, granularity that is not currently provided by residential AMI.	Accommodate the native meter read frequency of residential meters in program design or allow longer intervals to be broken down.
Accommodate dynamic populations	Residential aggregations include many customers and each must be individually uploaded and removed from the IESO database.	Update the IT system of the IESO to allow for bulk registration and enrollment of customers. Ensure resources do not go "offline" when accounts are added and removed.
Automate standby and dispatch signals	Current notification of dispatch requires market participants to login each day to check in they have been scheduled for standby and/or activation.	Automate dispatch signals
Include activation hours and quantity of MWs in standby notification	DR providers do not know which hours they will likely dispatched and how many MW of DR will be dispatched, which reduces potential effectiveness.	Standby notification should include which four-hour periods the DR resource can expect to be activated and how many MWs will be activated.

Introduction

It is very important that we convey that residential loads simply do not have the characteristics of large industrial loads. The profiles of residential HVAC and heating systems, which represent the largest points of consumption in typical homes, will reflect changes in weather as much or more than human activity patterns. For residential customers, space cooling and heating constitute the largest discretionary load and this cooling and heating load is highly correlated with temperature and other weather characteristics. Therefore, when it is hot, for example, household energy consumption increases, and more load is available to be reduced. On mild days there may be little demand response resource to draw upon. This variability does not mean the resource has no value, because this same pattern of demand tends to dominate the overall demand of the grid as well. Because residential space cooling and heating loads drive the peak demand on the larger system, aggregations of weather sensitive demand response capacity are a logical means to moderate that very tendency.

A number of alternative approaches are possible to incorporate such variable resources, but choosing one that provides participating loads and the IESO transparency and access to the capacity of the resource when it is needed the most, is a key to developing a successful program.

Changes to Current Market Structure to Facilitate Residential DR Participation

(1) Include Pay for Performance Option

One approach to incorporating residential load participation (and that of other weather sensitive loads) is the accurate and precise measurement of load reductions in response to IESO dispatch, whether for tests or actual system events, and then payment for the actual performance on average across the commitment period (e.g., summer or winter). ERCOT chose this methodology for the Weather Sensitive Loads component of its Emergency Response Service. Larger loads must demonstrate a weather sensitive load profile, but residential load aggregations are accepted as weather sensitive loads by default. DR market participants bid their expected available capacity based on days when the probability for a resource adequacy event related to peak demand is most likely to occur (when temperatures are over 35 degrees Celsius, for example). While ERCOT recognizes that the aggregations will not provide this much load reduction on a cool day (like the 25 degree Celsius day that can occur in early June or late September), accepting such bids allows ERCOT to know what these aggregations are capable of when they are needed the most.[1]

[1] Before the adoption of the Weather Sensitive Loads program, aggregators wishing to participate in the Emergency Response Service, had to bid the lowest, predictable load reduction capacity for the entire four month

ERCOT avoids scheduling test events on cool days when residential DR predictably has less load available to curtail. However, actual events can happen for a variety of reasons and may fall on a cooler day, or in off-peak hours, so aggregators accept that their net payment could be for an average capacity below its bid capacity. It is most important to note that the program design dictates that payments may be reduced for various performance parameters, but does not penalize participants for reflecting the natural variable character of the resource type.[2]

(2) Allow Alternative Baseline Methodologies

As noted above, the "pay-for-performance" approach adopted by ERCOT assumes the accurate measurement of residential load drops, and alters the payment to residential aggregations based on actual performance (which is recognized, varies predictably with weather). There are a variety of ways to obtain accurate reading of residential load movements, especially in larger aggregations. The customer baseline methodology used by the IESO DR Auction—high 15 of 20 with same-day adjustment—was developed to be predictive of commercial, industrial, and institutional loads during DR events, however, and will often not be predictive of residential loads. This is because residential loads are highly weather sensitive. Indeed, the summer peak in the IESO region is driven to a large extent by these weather-sensitive residential loads—specifically residential air conditioning that peaks during hot summer afternoons. The weather sensitivity of residential loads means that baseline methodologies that predict usage based on non-dispatch days can significantly underestimate the load curtailment from residential DR.

Any baseline relying on a selection of "high x of the preceding y days" for comparison purposes has problems in that it creates a baseline that is downwardly biased for weather dependent loads such as residential air-conditioning. This type of baseline methodology was designed for the large industrial and commercial loads that were the first wave of demand response to enter wholesale markets. Recent experience, however, shows that these baselines routinely underestimate the actual load response of residential loads. A series of cool days followed by a heat wave can even result in the calculation that a substantial reduction in demand was actually an increase in demand (relative to such a baseline) during an event, and therefore unfairly lead to penalties. Some markets using these baselines allow for a "day-of" adjustment that can greatly improve the accuracy of a "high x of the preceding y days" baseline, but depending on how it is implemented may not entirely make up for the downward bias inherent in this type of baseline. California for example allows up to a 20% "same-day" adjustment, but it is insufficient

summer contract period, which you can see from the chart on page 1, would be the point on the very left end of each curve for each daily window, half or less of the real capacity available on most peak days.

[2] In addition to reduced payments for actual average performance for all tests and emergency events, the ISO requires that Weather Sensitive Load Resources achieve a percentage of their bid performance, and that they achieve a set percentage of their total number of projected participants or receive payment reductions.

to overcome the bias because experience shows adjustments of as much as 300% would be required to capture actual load reductions from extreme weather events.

Same-day adjustments can bias baseline estimates for residential programs that include pre-cooling or for which customers begin curtailment in the hours prior to the event period. With any “same-day” adjustment, you still want to allow customers to be able to pre-cool their homes before the activation time without unfairly biasing the baseline. There is a simple solution however. That is not to use the hours immediately before activation for inclusion in the “day-of” adjustment. That way the accuracy of the “X of Y” methodology can be substantially improved while allowing customers to improve their performance and equally importantly, their perceived experience. Finally, there is little worry that people will pre-cool for more than an hour beforehand because that would waste energy which customers still have to pay for and actually decrease their perceived experience.

Another example would be a behavioral demand response (BDR) program in which customers begin load curtailment in the hours prior to the activation period by taking actions such as raising their thermostat setpoints in the morning prior to leaving for work. These behaviors result in a reduction in customer usage in the hours preceding the activation period and will result in a same-day adjustment with a negative bias, which underestimates the load curtailment from that BDR program during the DR event period. Both pre-cooling and pre-curtailment are perfectly legitimate curtailment behaviors for residential DR participants, but mean that the same-day adjustment mechanism be designed to accommodate these behaviors.

Other ISOs recognize the weather sensitivity of residential customers and have developed measurement and verification (M&V) methodologies that account for weather sensitive load much better than baselines that use an X of Y previous days methodology. The most satisfactory and fair representations of residential load response can be obtained by a “like-day matching” baseline or randomized control trial baseline method, both of which are used by ERCOT. Under the “like-day” approach ERCOT searches for a couple of days that best resemble the day of the current event and its preceding day on a couple of key characteristics (i.e. day of week, temperature, time of day). This is superior to any baseline relying on a selection of “high x of the preceding y days,” or even a “high X of Y days,” for evaluation purposes. These latter baseline methodologies were designed for the large industrial and commercial loads that were the first wave of demand response to enter wholesale markets. Recent experience, however, shows that these routinely under represent the actual load response of residential loads. Some markets using these baselines allow for a “day-of” adjustment. California for example allows a 20% adjustment, but experience shows adjustments of as much as 300% would be required to capture actual load reductions from extreme weather events. A series of cool days followed by a heat wave can even result in the calculation that a substantial reduction in demand was actually an increase in demand (relative to such a baseline) during an event, and therefore unfairly lead to penalties.

Under the randomized control trial (RCT) baseline approach, eligible customers are randomly assigned to either a treatment group or a control group. This random allocation can either occur as part of the DR program design—in which case the treatment and control groups are static for the duration of the program—or the random allocation could change for each DR event—in which case the treatment and control groups are dynamic subsets of the program participants. [3] The load reduction during a DR event is estimated by evaluating the difference in energy usage between the treatment group and the control group. The RCT methodology has the benefit of estimating residential load reduction with a high degree of statistical precision and accuracy. Various quasi-experimental methods, such as propensity score matching, can also be used to estimate residential load reduction.[4]In this approach, a synthetic control group is selected from non-participants that exhibit characteristics similar to those of the participant population. The propensity score matching method has some benefits of not reducing the number of participants eligible to participate in each DR event. (Attached is a presentation of the ERCOT ISO staff, on the various baselines applicable in ERCOT.)

If the IESO is unable due to other constraints on program design to adopt a pay for performance type compensation scheme as described in Section (1) above, an alternative baseline may be appropriate.

This second general approach is based upon the proposition that the value of such load resources is their capacity to limit their impact on total demand when system adequacy is challenged by weather-driven peak demand. That is, while the load response available on any given day still varies according to weather conditions, an aggregation of such participants can guarantee not to exceed a pre-established maximum level of demand. This approach is often therefore referred to as a “drop-to” baseline, rather than a “drop-by” baseline. Adoption of this approach is quite simple from the standpoint of performance validation.

The “drop to” methodology works well for the incorporation of weather sensitive loads into wholesale capacity markets, especially where the market construct generally requires a fixed bid over a period of time—whether for the next whole day or the next four to six months—which might encompass a wide variety of weather conditions. For example, the PJM Interconnect currently allows seasonal resources like weather sensitive loads to participate in its forward capacity market if they can successfully drop to a Firm Service Level (FSL), guaranteeing that PJM can rely on that load resource to not further exacerbate the system’s resource adequacy.[5] The capacity contributed is considered to be the

[3] Whether static or dynamic, the energy usage profile of the control group should be statistically similar to the treatment group in order to deliver unbiased results.
[4] RCT and quasi-experimental methods are discussed in the U.S. Department of Energy’s “Uniform Methods Project”, available: http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf
[5] This Seasonal Resource (Base Capacity) program could be eliminated by the PJM transition to an annual Capacity Performance market, which various parties point out could cost the market between $3 and $7 billion annually, or more. Stakeholders are currently endeavoring to find an avenue to reincorporate seasonal weather sensitive loads

difference between the customers' aggregated average peak load contribution and their FSL specified in the aggregator's bid. While this may underestimate actual contribution on any given event day, it is a construct that has been used to accommodate weather sensitive and other variable load resources.

(3) Simple Customer Enrollment and Registration

A key point to embrace with respect to incorporation of aggregations of small loads is that the marginal benefit of any one load participating is relatively small. The IESO will need to help facilitate the participation of such aggregations so that the effort to enroll and register customers is relatively small. The aggregation of many thousands of small customers is in part enabled by emerging digital and communications technologies that allow residential DR providers to offer customers engaging mobile app driven options with easy enrollment and participation that deliver more comfort and increased efficiency from the cloud, with very little effort.

Our companies have successfully worked with multiple utilities in the United States and Canada to make enrollment easy. Residential DR providers host (cloud-based) demand response software platforms that most of their utility partners use to manage enrollment and event dispatch. Utilities (and potentially ISOs) use these platforms to import participant information, create discrete dispatch groups, monitor device availability, schedule dispatch events, forecast capacity and generate performance reports. These same platforms can be integrated with utility or ISO systems to access resource data and to easily verify customer registrations.

Our experience shows that elaborate multi-step customer approval processes will dramatically reduce customer enrollment and increase the cost of residential demand response aggregations. EnergyHub has published a white paper citing their experience in Texas and California: In Texas, where enrollment in the ERCOT program can be done in a batch process without a separate authentication of customer approval from the ISO or the utility, Energy Hub finds 42% of their customers enroll in demand response, while in California, where a multi-signature form must be approved, customers are led through multiple online steps, and multiple data exchanges are required, only 3% is achieved.[6]

(4) Automate Meter Data Access

The process for obtaining access to customer meter data, in order to allow demonstration of performance and execute settlement, must similarly require very low effort by, or on behalf of, each

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into the new market design, but it will be challenging, and may ultimately require the reinstitution of the Base Capacity product. Furthermore numerous stakeholders have appealed the PJM abandonment of seasonal resources to the courts. The fact that the IESO has a two season capacity market, could allow differing levels of capacity to be bid into the Summer and Winter, easily permitting weather sensitive products to be incorporated using an FSL baseline for each season.

[6] EnergyHub. "Why are less than 3% of eligible Californians signing up from DRAM?" Available: http://www.energyhub.com/blog/optimizing-demand-response-enrollment

individual customer. Residential participation requires relatively easy access to large numbers of customers' meter data through an automated programming interface to the IESO's meter data repository or that of each participating utility. Creating a frictionless meter-data platform is also the key to making these aggregations cost effective and flexible resources for utilities, and grid or wholesale market operators. Create a centralized digital repository of customer meter data that can be accessed by verified demand response providers, or at least a commonly adopted, simple, standardized process to be followed by each LDC.

(5) Change Meter Data Granularity Requirement

The DR Auction rules require that DR market participants submit measurement data using 5-minute usage intervals. This is problematic because most residential customers in Ontario have AMI meters that only collect usage data at 15-minute or 60-minute intervals. The IESO DR auction must accommodate the meter read frequency of residential AMI if the residential sector is to participate. The province has invested hundreds of millions of dollars to deploy AMI meters to mass market customers with the promise that these meters would facilitate customer participation in demand response and other load management programs. It is critical that this investment not be wasted due to issues with meter read frequency.

We recommend that the IESO accept measurement data submissions using the native read frequency of the AMI meters affiliated with the DR resources. In the case of residential AMI, this could be a 15-minute, 30-minute, or 60-minute read frequency. For the purposes of standardized data reporting, the DR market participant could report the value of a single meter read as the interval value for each 5-minute period within the meter read frequency. For example, if an aggregated DR resource is composed of residential customers with 15-minute interval data, the DR aggregator should be allowed to report a single value for each of the three 5-minute intervals within the 15-minute consumption interval.

Both PJM and MISO accommodate meter data from residential DR resources at the meter read frequency most commonly captured by residential AMI: 60 minute intervals. The IESO could changes its program design to be satisfied by hourly compliance data.

In addition to meter data, devices like connected thermostats can pair aggregate runtime data with average energy consumption in shorter increments for evaluation when needed. It may also be possible to implement statistical sampling for aggregations which allow for the upgrade for a much smaller number of smart meters on the existing network.

(6) Accommodate Dynamic Populations

Another feature of small load aggregations is that they are relatively dynamic. Aggregators must engage in relatively constant marketing, recruiting, and registration of customers, and at the same time, experience churn, as some customers leave the program for a variety of reasons. A residential or small customer demand response program must make provisions for the number of customers in a resource to expand and contract, and for replacement of original participants over time. A system should be developed to ensure the bulk registration of customers as well as to allow for frequent additions and subtractions to aggregations. ERCOT and CAISO allow DR market participants to add and drop customers on a monthly basis during the commitment period.

(7) Include Activation Hours in Standby Notification

If possible, standby notifications should identify which four-hour period the DR resource could expect to be activated and the capacity that those resources should expect to deliver during the activation period. By including potential activation hours and energy commitments in the standby notification, the DR market participant would better prepare its resource portfolio to comply with IESO directions when and if the DR resource is activated. This increased certainty about activation hours would not only benefit residential DR resource, but would also benefit commercial and industrial DR resources by allowing for the advanced scheduling for DR curtailment activities in preparation for a potential activation.

(8) Automate Dispatch Signals

The IESO should automate signals for standby notifications and activation notifications, as opposed to the current method that requires market participants to login each day to check if they have been scheduled for standby and/or activation. Signal automation would improve communication between the IESO and market participants, reduce the chance of a missed notification, and maximize the amount of time that DR market participants have to respond to standby notifications and activation notifications.

(9) Reduce the Minimum Size of DR Aggregation to 100 kW

The RDRSG agree that the minimum aggregation size to participate should be less than 1 MW. Even 1 MW of capacity could require over 2,000 customers. The division of the Ontario province into multiple zones makes it even more challenging to aggregate 1 MW of residential capacity.

Summary and Recommendations

Our message is simply that the more the IESO can understand and accept the nature of the residential load resources, and the manner in which they are created, the more successfully it can design appropriate program parameters to incorporate these resources cost effectively. Our general recommendations are:

(1) The IESO should either adopt:
   a) The ERCOT Weather Sensitive Loads market design, including its more accurate baseline methodology options, particularly Matching Pairs or Control Group approaches in one form or another, together with a Pay-for-Performance compensation system that allows for variable payments, but does not penalize residential loads for behaving as expected; or

b) A program construct built upon the current IESO two-season capacity construct, allowing residential loads and other weather sensitive loads to offer different peak capacities in each season, and be evaluated for meeting a firm service level baseline metric.

(2) The Market design chosen should incorporate the following features:

- Simple, frictionless customer registration and bulk, automated enrollment in demand response aggregations by demand response providers;
- Simple access to bulk downloads of registered customer meter data for any aggregator through APIs, preferably from the ISO data depository, or at least through a commonly adopted standard API);
- Create a centralized digital repository of customer meter data that can be accessed by verified demand response providers;
- DR Market Participants should be able to capture energy usage data at the native meter read granularity, which is typically 60 minutes for residential and small commercial customers, for validation and settlement;
- Allows participant Adds and Drops during each season, to permit small customer aggregators to continue their marketing and registration initiatives in the market;
- Include potential activation hours and MW of DR in the standby notification;
- Automated dispatch signals; and
- Reduces minimum aggregation size from 1 MW to 100 kW per zone.

Thank you again for this opportunity to offer our comments about the design of successful residential and weather sensitive load resource demand response programs or markets. We appreciate the commitment of the IESO staff to identify and remove barriers to the participation of residential DR in the IESO DR auction. The active engagement of EnergyHub, Nest Labs, Opower, WeatherBug, and other residential DR providers in this stakeholder process demonstrates the level significant interest and indicates the considerable potential for residential DR to deliver DR services to the IESO system. We look forward to working with the IESO in the coming months through the Demand Response Working Group to further develop specific solutions to these market barriers.