



## **Oracle Comments in Response to the IESO Staff Proposal on Alternative Baselines for Residential Demand Response in the DR Auction**

Oracle is pleased to submit the following comments in response to the IESO Staff Proposal on Residential Demand Response Alternative Baselines (Staff Proposal) that was presented at the September 30 meeting of the Demand Response Working Group (DRWG). As an implementer of behavioral demand response (BDR) and behavioral energy efficiency (BEE) for residential consumers in Ontario and elsewhere, Oracle has deep experience with design and evaluation of programs using randomized controlled trials (RCT). We hope these comments and recommendations will be useful to the IESO as it refines its approach to accurately measuring the load reduction from residential Hourly Demand Response (HDR) resources in the DR Auction.

These comments are structured into three sections. The first section re-emphasizes our preference for the RCT methodology as the most accurate and robust methodology to estimate load reduction from residential DR programs. The second section identifies three issues related to the Staff Proposal that would create new barriers to residential DR participation in the DR auction. Specifically, these issues include: the same day adjustment mechanism, contributor consent and participation agreements, and eligibility for multi-unit residential customers. The third section recommends RCT design principles related to the construction and size of treatment and control groups necessary to deliver accurate estimates of load reduction.

### **RCTs are the Best Methodology for Evaluating Residential DR**

Oracle applauds the IESO for selecting the RCT methodology as an alternative baseline for residential DR. The RCT methodology provides the highest level of statistical accuracy in evaluating residential DR programs without being overly burdensome for the evaluation entity. As discussed in our previous comments, the RCT methodology is already used to evaluate the energy impact of residential programs in multiple markets and jurisdictions for both behavior-based EE and DR, as well as conventional DLC programs. The IESO should approve an RCT-type evaluation methodology for residential DR programs for the December 2016 DR Auction.

The Staff Proposal for RCT is a significant step forward for evaluating residential DR, but there remain a few significant issues that should be corrected prior to implementation. These issues are identified in the following section along with Oracle's recommendations for how these issues could be resolved.

### **Issue 1: The Same Day Adjustment Unnecessarily Penalizes Pre-Curtailment and Creates New Barriers to Residential DR Participation in the IESO DR Auction**

DR resource performance should be assessed based on curtailment during the activation period. The same-day adjustment mechanism shifts the emphasis of performance from the activation period to the hours immediately preceding the activation period. The same-day adjustment does not improve the accuracy of an RCT evaluation design. Additionally, the same-day adjustment mechanism unnecessarily penalizes pre-curtailment, which could result in the disqualification of some residential programs, including behavioral demand response (BDR). Finally, the same-day adjustment mechanism potentially rewards "pre-consumption", which creates opportunities for gaming.

The same-day adjustment mechanism is not necessary to get an accurate estimate of DR load impact because the unadjusted RCT is already reflecting event-day conditions. The control and treatment group energy consumption will be identical but for the DR intervention in the treatment group. For this reason, the control group will act as an unbiased baseline against which the treatment group's load reduction can be measured. This unbiased control group baseline allows for unbiased estimates of treatment group load reduction, regardless of whatever else may be happening over the course of the day (e.g., heatwave, thunderstorm, Stanley Cup Finals, etc.). Any difference observed between the treatment and control group consumption during the activation period is attributable to the DR program intervention. The inclusion of a same-day adjustment actually biases the estimate of DR load reduction by making baseline adjustments for load variation that is solely attributable to the DR intervention.

HDR resource compliance should be assessed based on resource curtailment during the 4-hour activation period--i.e., the difference between actual usage and what usage would have been in the absence of the DR program intervention, which is reflected by the control group consumption. A DR resource should be compliant with dispatch signals if consumption during the activation period is at a level that is less than what would otherwise have occurred in the absence of the DR intervention. The addition of the in-day adjustment mechanism shifts the focus of compliance from actual curtailment during the activation period to the curtailment that occurs in the hour preceding activation. A DR resource that takes load off the grid in response to an activation period is providing capacity value for the IESO, regardless of the timing or duration of the curtailment ramp.

Pre-curtailment creates an economic benefit for the market, although this benefit is not valued through the HDR program. HDR resources are dispatched when hourly energy prices are high, usually due to high demand relative to available supply. If a resource pre-curtails, it removes load from the system in advance of a period of high energy prices, and as a result may have the effect of lowering the energy market clearing price. It's conceivable that an HDR resource in pre-curtailment may actually have the effect of reducing the energy market clearing price to such an extent that DR activation is no longer required. Clearly, voluntary pre-curtailment has some value to the grid that is not compensated through the HDR program. Instead, the same-day adjustment mechanism would penalize pre-curtailment by derating the energy provided by the HDR resource during the curtailment period.

The same-day adjustment mechanism creates a new barrier to market participation for certain residential DR technologies, including BDR. Whereas DLC programs can "flip a switch" to curtail load relatively quickly, behavior-based programs (like BDR) curtail load through the aggregation of behavioral modifications from tens or hundreds of thousands of residential participants. Rather than flipping on all at once, these behavioral changes come on gradually in the lead-up to the activation period and achieve maximum sustained curtailment during the hours of the activation period. At the end of the activation period, the curtailment gradually attenuates as customer behavior reverts to normal. Because BDR has a gradual ramp-up and ramp-down of curtailment, it is negatively affected by the same-day adjustment mechanism. Based on the hourly curtailment data from the 2015 BDR pilot at Hydro Ottawa, the same-day adjustment factor could result in a 46% derating of BDR capacity value. Such a derating would considerably impair the economics of BDR participation in the IESO DR Auction.

Just as a same-day adjustment mechanism penalizes pre-curtailment, it can also reward “pre-consumption”–or consumption in excess of what is normal. This makes the adjustment mechanism vulnerable to gaming. For example, a DR provider could theoretically increase energy consumption in the hours preceding DR activation in order to receive a more favorable adjustment factor and be compensated for delivering more MWs of curtailment than what it really produced. Between the penalization of pre-curtailment and the rewarding of pre-consumption, it is clear that the same-day adjustment is too sensitive and introduces perverse incentives for DR participant behavior.

The same-day adjustment mechanism is a solution in search of a problem. The same-day adjustment mechanism does not add to the accuracy of the RCT design, it unnecessarily penalizes pre-curtailment, and it creates opportunities for gaming through pre-consumption. For these reasons, the same-day adjustment mechanism should be dropped from the RCT evaluation methodology for residential DR.

### **Issue 2: Requirement for Contributor Consent and Participation Agreements Prevents LDCs from Deploying BDR on an Opt-Out Basis to their Own Customers**

The requirement that residential DR aggregators must submit contributor consent and participation agreements would unnecessarily preclude LDCs from administering BDR programs on an opt-out basis. There is ample precedent in Ontario for LDCs to run opt-out programs for BDR and behavioral energy efficiency (BEE). Instead of a uniform requirement for contributor consent agreements and participation agreements, DR providers should have flexibility to provide alternate documentation to verify that they have the ability to call upon the constituent contributors to deliver load reduction when dispatched. In the case of an LDC deploying an opt-out BDR program, this documentation could verify that the contributors are served by the LDC and that the LDC has the ability to send communications and collect the energy consumption data for the contributors.

Oracle partners with LDCs to implement BDR programs with an opt-out enrollment design. In an opt-out enrollment design, eligible customers are randomly assigned to either a treatment group or a control group. Treatment group households receive BDR messages but are allowed to opt out of the messages, and the control group households do not receive behavioral messaging and are not allowed to opt in.

In BDR programs, customers curtail load in response to behavioral messaging delivered through digital channels (phone, email, and text message). Unlike direct load control (DLC) programs, a BDR program does not require an enabling device to be installed at the customer premises. To implement a BDR program on an opt-out basis, the BDR program administrator must have access to customer energy usage data and the ability to send BDR-related communications. The LDCs that Oracle partners with to deploy BDR programs have both the consumption data and the ability to communicate with their LDC customers. Therefore, LDCs are able to implement opt-out behavioral programs.

There is significant precedent for LDCs to implement opt-out program design for BDR and behavioral energy efficiency (BEE) in Ontario, including opt-out behavioral CDM programs approved by the IESO. In the summer of 2015, Opower partnered with Hydro Ottawa and the Ontario Ministry of Energy to pilot a BDR program with an opt-out design and a 52,711

household treatment group. Additionally, the IESO has approved opt-out BEE programs at Hydro One and PowerStream as part of their respective CDM portfolios. Outside Ontario, Oracle has administered opt-out BDR and BEE programs to residential customers in Alberta, Nova Scotia, and 36 U.S. states.

The requirement that residential DR aggregators must submit contributor consent and participation agreements would unnecessarily preclude LDCs from administering BDR programs on an opt-out basis. Instead of contributor consent and participation agreements, the LDC should only need to demonstrate that the residential customer participants meet eligibility requirements (e.g., requirements for metering, zonal location, etc.) and are served by the LDC. This is consistent with the precedent for LDCs to implement opt-out behavior-based programs in Ontario.

### **Issue 3: Multi-Unit Residential Customers Should be Eligible to Participate in the DR Auction so long as They Are Individually Metered**

Multi-unit residential customers should be eligible to participate as part of an aggregated DR resource provided that each unit is individually metered. From a measurement perspective, there is no problem with combining residential customers from single-unit and multi-unit buildings into a single HDR resource with RCT program design. This is because a properly designed RCT will randomize participants into treatment and control group that are well-balanced along energy usage characteristics. This means that the control group will act as an unbiased proxy for the counterfactual energy consumption of the treatment group regardless of the dwelling type of individual participants. Therefore, there is no reason to exclude customers that live in individually-metered, multi-unit buildings.

Multi-unit residential customers that are master-metered--i.e., where a single meter measures energy consumption for the entire building--should be excluded from using the residential RCT methodology at this time. The load from master-metered customers cannot be disaggregated to the individual unit level, which prevents attribution of curtailment using an RCT. This is different than for individually-metered customers, where load for a single unit is recorded by a single meter

### **Determining the Size of Control and Treatment Groups**

The size of the control and treatment groups must be carefully considered in the design of an RCT program. If the control group is too small, the program evaluator may be unable to detect the program impact at a desired level of statistical precision. If the control group is too large, the program may be sacrificing customers that could have otherwise have been in the treatment group and delivering valuable curtailment services. Determination of the minimum control group size is achieved through a statistical power analysis.

Factors that go into the statistical power analysis of minimum control group size include:

- Desired level of statistical precision (e.g., confidence interval)
  - The 95% confidence level is generally used in the evaluation of BDR and BEE programs.
  - Oracle believes that the 95% confidence level provides the appropriate tradeoff between statistical precision and confidence.
- Expected magnitude of treatment effect

- Programs with small average treatment effect require larger control groups to measure treatment effect at the desired level of statistical precision. For example, a BDR program with 3% average load impact will require a larger control group than a thermostat cycling program with a 15% average load impact.
- Whether the hypothesis testing will be one-sided or two-sided
  - One-sided hypothesis testing requires a smaller control group than two-sided hypothesis testing.
  - For the purposes of DR compliance with IESO dispatch signal, a one-sided hypothesis test is sufficient

In general, larger control groups are necessary to detect the treatment effect at a greater statistical precision and with a smaller confidence interval around the point estimate. As the detection threshold becomes smaller (i.e., as the desired confidence interval narrows), additional households must be added to the control group to maintain the same level of statistical precision.

It is important to note that the control and treatment groups need not be identical in size, and that doing so may result in a control group that is larger than strictly necessary to achieve the desired level of statistical precision. If the control group is oversized, there are customers who could have provided curtailment as part of the treatment group who are instead sequestered from the program as part of the control group, which results in a lower potential MW reduction.

The BDR pilot that Opower implemented in partnership with Hydro Ottawa provides one example of the ratio of treatment and control group customers in a typical RCT program. For the Hydro Ottawa BDR pilot, the ratio was 52,711 treatment households (67%) to 25,659 control household (33%), which was sufficient to detect an average 3.2% load reduction with a  $\pm 18.4\%$  relative precision at a 95% confidence interval. In this case, the sizing of the control group was influenced by the number of treatment households, the average load reduction per household, and the desired level of statistical confidence.

Further documentation on how statistical power analysis is used to calculate the number of households needed in the study population to get a precise estimate, see Chapter 4 of Duflo, Glennerster, and Kremer (2007).

### **Conclusion**

Oracle appreciates the opportunity to respond to the Staff Proposal on alternative baselines for residential DR and appreciates the IESO Staff's sincere efforts to identify and remove barriers to residential DR participation in the IESO DR Auction. We look forward to continued engagement in the IESO DR Working Group.