FINAL REPORT

EVALUATION OF 2018 DEMAND RESPONSE DEMONSTRATION: C&I CONNECTED SOLUTIONS

National Grid and the Energy Efficiency Advisory Council

Date: April 26, 2019
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EXECUTIVE SUMMARY

DNV GL evaluated National Grid’s Connected Solutions Commercial and Industrial Demand Response Demonstration activity over the summer of 2018. This was the second study of this Demonstration; the first study concluded with a report published in 2018. The Connected Solutions Demonstration is a two year Demonstration project for demand response available to National Grid Massachusetts C&I electric customers on a G2 (General Service, Demand) or G3 (Time of Use) rate with demand of 250 kW or higher. The Demonstration provides day ahead notice and provides a per kW performance incentive without a non-performance penalty.

National Grid uses three curtailment service providers (CSPs) to sign up customers and identify demand response and demand management opportunities. National Grid administers the Demonstration and uses an AutoGrid system to dispatch notification, aggregate data, and complete the settlement process. Participation increased from 99 enrollees with 20.6 MW in enrolled capacity in the 2017 season to 276 participants with 77.7 MW in enrolled capacity in the 2018 season. The top three sectors in terms of number of participants and enrolled capacity in both seasons of the Demonstration included manufacturing, educational services, and retail trade. There were six events called in 2018. The Demonstration used a hybrid baseline to determine performance. This settlement process used the higher curtailment provided by either an additive adjusted 10 of 10 or an unadjusted 10 of 10 baseline.

As a result of their own internal improvement processes and the previous study, National Grid implemented several changes between the 2017 and 2018 campaigns. These changes are presented below.

<table>
<thead>
<tr>
<th>Change</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demand Reduction Goal</td>
<td>20 MW</td>
<td>Add 30 MW to 2017 customers (50MW total)</td>
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<tr>
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<td>Incentive based on two performance elements: $20 per kW and $0.75/kWh</td>
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</tr>
<tr>
<td>9. Notification</td>
<td>Notified day ahead by 4 p.m.</td>
<td>Notified day ahead by 1 p.m.</td>
</tr>
</tbody>
</table>

The overarching goal of this study was to assess the readiness of the Connected Solutions Demand Response Demonstration for full scale operation. This study has both impact and process research activities, summarized below.

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1 Evaluation of 2017 Demand Response Demonstration: C&I Connected Solutions National Grid and the Energy Efficiency Advisory Council Date: February 23, 2018
• **Impact:** To validate proper baseline application and impacts calculated by National Grid, examine the intersection between ISO NE market offerings and this Demonstration, and assess ex-post impacts.

• **Process:** To understand customer acceptance and experience with the intervention, the effectiveness of Demonstration changes made after the 2017 summer season, readiness of systems for larger deployment, and PA and vendor success in delivery

### Study Methods

The impact methods undertaken in this study included two primary activities. These are summarized below and include the validation of Demonstration curtailment estimates using the hybrid baseline and an ex-post regression analysis. The validation provides confirmation of the settled curtailment estimates while the ex-post analysis offers a retrospective assessment of the summer’s curtailments. Note that data completeness issues due to interval data storage system changes presented challenges to the National Grid settlement process and the study’s validation process. These issues resulted in 44 participants that did not have sufficient data for inclusion in the settlement and validation process. Furthermore, about half of the participants’ settlement values were based on load reduction estimate from fewer than 6 events.

### AutoGrid Validation

- Acquire interval data from AutoGrid
- Acquire settlement data from National Grid
- Validate Hybrid baseline (including calculations of both adjusted and unadjusted 10 of 10)

### Ex-Post Analysis

- Perform a site-level, regression based analysis including schedule and weather independent variables

The process methods undertaken in this study included four primary activities. These activities were very similar to those performed in the 2017 study with an additional interview with AutoGrid and followup surveys with 2017 enrollees (along with new 2018 enrollees). A key part of this years effort was to explore the effect of program changes since the 2017 performance season and to gather data that would be comparable over the two Demonstration years.
Conclusions

The Connected Solutions Demonstration was designed by National Grid to offer a dispatchable demand response solution for C&I customers to control their peak demand in Massachusetts and reduce system peaks. There were substantial interval data storage issues in the 2018 effort that prevented a full data-driven settlement process and validation. The Demonstration reduced load during the ICAP peak hour in 2018, an important element of Demonstration participation for many customers and critical to reducing the system peak.

As shown in Figure 1, the Demonstration exceeded the goal of 50 MW by achieving 51.3 MW of load reduction from participants with sufficient data, using the Demonstrations’s hybrid settlement baseline. However, the enrolled load from those customers was 21.6 MW higher than that achieved. The shortfall of 30% in achieving the enrolled load is similar to what was observed in the 2017 study (25%). The critical metric of performance for National Grid is achievement of Demonstration goal. Although not shown in this figure, the ex post regression analysis provides impacts that are 17% lower than the hybrid baseline, illustrating the substantial upward bias inherent in the hybrid baseline used to calculate the curtailed load.

The implications of the CSPs under- or overperforming enrolled capacity are unclear. The program was developed in response to regulatory direction. There do not appear to be direct risks, from the perspective of diminished capacity for instance, to either National Grid or ISO-NE if the program under- or overperforms. If National Grid were to perceive risk in under or overperformance, then one solution would be to build more clear penalties or incentives into the contracts with CSPs. Ultimately, the CSPs control the enrolment process and determine the amount of load reduction provided, though there are typically substantial
variations in performance from event to event. CSPs are the only party in a position to determine what level of demand reduction is realistic to respect from enrolled participants. The enrolled to actual curtailment ratio varies across CSPs and would be expected to change over time with improved program implementation and customer experience. National Grid could consider scenarios involving substantial over-subscription and shortfall and decide whether their interests are well served with the current CSP contracts.

We consider the Demonstration ready to become a full scale offering pending final changes that are recommended in this study. Once fully offered, the Connected Solutions C&I offering should continue to be regularly evaluated as part of the National Grid portfolio. This should include an early examination of whether the final changes made as a result of this study are working as intended.

A continuing need of the Demonstration’s final evolution into a full-scale offering is a clear understanding of the implications of the Demonstration in the context of ISO NE markets. The requirements that National Grid writes into contracts with CSPs will determine whether those CSPs operate in a way that takes into consideration the needs of the wider system as well as those of their customers. This study also notes that the rigid three-hour event period limits National Grids’ flexibility in multiple ways. These include the observation that there were six weeks of the summer when the highest single hour of the ISO NE load fell outside the hours between 2 p.m. and 5 p.m. If the later peak day had not occurred, the Demonstration would have missed the peak hour because of the constrained event period. Finally, although participant “gaming” of the same day adjustment to improve load reduction results was not observed in this study, the rigid window can limit the Demonstrations flexibility to mitigate this possibility.

National Grid actively managed substantial changes between the 2017 and 2018 offerings, as summarized above. In the midst of this, it maintained or increased participant satisfaction with the Demonstration overall and many of its sub-elements as illustrated in Figure 2 below.

**Figure 2: Participant and CSP Satisfaction Summary**

Other findings of this study that are supported in the main body of the report include:

- Despite improvements in recruitment, there are some signals that lead generation might be a concern moving forward. One such signal is the stark shift in how participants are learning about the program, which was primarily National Grid in the 2017 study and is CSPs in this 2018 study. This appears due to the eligibility change that allowed CSPs to leverage existing ISO NE participant
relationships in the recruitment process. If the program moves back into the mainstream C&I population (i.e., customers that are not existing ISO NE participants), National Grid may find that added attention and resources to recruitment will be needed.

- There continues to be a need for a formal mechanism for National Grid to receive sales information from the CSPs. It was further indicated that the enrollment process, while much improved over 2017, was reported to still be a little difficult to follow and confirm enrollment within.

- The 2017 enrollees that were contacted in this study were largely satisfied with the incentives received for their curtailment during the 2017 summer season (4 on a 5-point scale).

- The 2018 program included an increased incentive for participants in two towns (Bellingham and Tewksbury) to geotarget DR activity. There was a new 2018 participant enrolled from these areas, however, CSPs largely reported that there was not much time to market that area, it was difficult to implement and the coordination between National Grid and AutoGrid was not fully developed.

- There is evidence that in 2018 the three CSPs engaged in the Demonstration targeted different size (average load) and curtailment levels among the customers enrolled in the program. There is also evidence that the three CSPs tended to enroll different business types.

**Recommendations and Considerations**

DNV GL offers the following recommendations and considerations. The first two recommendations are particularly important. DNV GL notes that some of these activities may already be underway as part of National Grid’s ongoing internal efforts to improve the Demonstration based upon their own observations and experience.

**Recommendations**

1. We recommend developing a reliable data warehouse for customer interval data and confirm its gathering of data as part of normal program management checks. For the sake of redundancy, consider making it a requirement that CSPs maintain a full set of customer interval data for a set period after each season. Customers in the ISO NE markets are expected to already have this system in place.

2. We recommend National Grid develop Demonstration requirements that minimize the potential negative implications of program overlap with ISO NE activity. Allow customers to obtain ISO NE capacity supply obligations only if active energy market activity is foregone and Demonstration event days are reported as unavailable back to ISO NE.

3. We recommend that National Grid use a regression model approach to estimate impacts for annual reporting needs. The regression approach uses all data across the summer to set the most appropriate baseline that would have happened absent the curtailment.

4. We recommend the Connected Solutions C&I Program be evaluated as part of the National Grid portfolio. This should occur within two years of its operation as a program. This can include an early examination of whether the final changes made as a result of this study are working as intended, assess settled values against enrolled estimates, perform ex-post regressions as needed to support annual claimed savings estimates, and ensure program satisfaction and operation are satisfactory.
Considerations

1. National Grid should consider making customers choose between a symmetrically-adjusted 10 of 10 baselines or an unadjusted 10 of 10 baseline. The hybrid baseline minimizes customer risk but inflates apparent Demonstration load reduction.

2. National Grid should consider a flexible event window that will suit both customers and National Grid. Allowing 2- to 4-hour events within a 2-7 PM window will give National Grid more flexibility to make sure it hits the peak hour with the smallest numbers of event hours. Customers should experience more efficient use of their curtailment hours and a greater probability of hitting the system peak load hour.

3. National Grid should consider examining its process of lead generation, distribution, and enrollment for this Demonstration. The purpose of this examination would be to ensure that the process is able to garner sufficient participation levels moving forward now that participant enrollment gains from allowing existing ISO NE participants into the Demonstration have been mostly realized.

4. If continued or expanded, National Grid should consider changing its approach for geotargeting areas with special incentives or offerings by the Connected Solutions Demonstration (or program). In the future, any areas targeted should be as large as possible, given the geography sought, to provide a sufficient pool of candidates for program recruitment. In addition, National Grid should conduct a customer education component or outreach campaign in the targeted areas that will increase the probability of success of the CSP’s own outreach efforts. Finally, it should give the CSPs sufficient lead time for participants in the targeted area to get through the sales funnel.
2 DEMONSTRATION OVERVIEW AND STUDY OBJECTIVES

National Grid deployed a C&I Demand Reduction Demonstration called C&I Connected Solutions over the summers of 2017 and 2018. A study of the 2017 Demonstration effort was performed in the Fall of 2017 and is documented in a report\(^2\) that includes methods, results, conclusions and recommendations. This report provides an evaluation of the 2018 C&I Connected solution Demonstration. The overarching purpose of the combined 2017 and 2018 studies is to understand the ability of this Connected Solutions Demonstration to become a full-scale offering as part of the 2019-2021 state-wide efficiency plan.

The two year goal of the Demonstration was to enroll 50 MW of demand response curtailable load. Customers with interval meters on G-3 rates, or G-2 rates that upgraded to an interval meter were eligible for the Demonstration in both years. A 2017 requirement that customers be able to curtail a minimum of 50kW was dropped in the 2018 offering. Ninety nine accounts participated in the Demonstration in 2017, which increased to 276 in 2018. The enrolled capacity of customers increased from 20.6 MW in 2017 to 77.7 MW in 2018. Incentive payments in 2018 are based strictly on performance ($35 per kW per year), without penalties for non-performance. National Grid used a hybrid baseline to determine performance. This settlement process used the higher curtailment provided by either an additive adjusted 10 of 10 or an unadjusted 10 of 10 baseline\(^3\).

Table 1 shows the number of accounts and the level of enrolled program capacity for 2017 and 2018. Note that National Grid set 2018 enrolled load reduction to be equal to 2017 performance for 2017 enrollees that continued in the Demonstration. This was undertaken, at least in part, due to the 2017 study recommendation that steps be taken to better align the Demonstration enrolled curtailment of 20.6 MW with the final settled impact, which ranged between 14.5 and 15.9 MW.

The enrolled 2018 curtailment for all participants was 77.7 MW, which took into account an \(\sim 25\%\) underperformance assumption. However, actual curtailed load in 2017 Demonstration study events were 22-30\% lower than the enrolled curtailment value. The increased level of enrolled capacity signed into the Demonstration provided a hedge against a shortfall that would jeopardize achieving the goal of 50 MW of actual demand reduction.

### Table 1: Summary of Participating Accounts and Enrolled Capacity by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Accounts</th>
<th>Enrolled (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 (original)</td>
<td>99</td>
<td>20.6</td>
</tr>
<tr>
<td>2017 (revised)</td>
<td>97</td>
<td>16.9</td>
</tr>
<tr>
<td>2018</td>
<td>179</td>
<td>60.8</td>
</tr>
<tr>
<td>Total</td>
<td>276</td>
<td>77.7</td>
</tr>
</tbody>
</table>

Three approved curtailment service providers (IPKeys, CPower, and Enel X) marketed and sold the Demonstration along with National Grid’s commercial salesforce in 2017 and this same approach was used in 2018. These recruitment activities included visiting customer sites, explaining the Demonstration offering and helping identify curtailable loads and strategies. Events are called by 1 p.m. the day before curtailment.

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\(^3\) The 10 of 10 baseline is an average for each interval across the 10 most recent days that are eligible for inclusion in the baseline. The adjusted baseline uses the load prior to the event to which they are being applied. ISO NE uses the adjusted 10 of 10 baseline. The hybrid baseline adjustment is identical to the asymmetric-adjusted adjustment that ISO NE recently replaced with the symmetric adjustment. ISO NE changed the asymmetric adjustment because of its inherent upward bias.
is needed. All events start after 2 p.m., and end before 5 p.m. The goal of the Demonstration is to call fewer than 7 events per year, with no more than 21 total event hours called. In the summer of 2018, six events were implemented through an AutoGrid demand response management system (DRMS) that performs forecasting and dispatches notification and aggregates the interval data.

Table 2 below provides a summary of 2017 and 2018 Demonstration participating accounts and enrolled capacity by NAICS classification. Manufacturing facilities represent the most enrolled capacity in both years, with over half in 2017 and just short of 40% in 2018. Education services has the second highest enrolled capacity representing 30.8% and 21.0% of 2017 and 2018, respectively. Manufacturing is a very important business type among participating customers. A particularly interesting item is the level of enrolled capacity per manufacturing enrollee compared to levels from the next largest participating business types (educational services and retail trade). Despite being a fifth of the participants, they represent nearly 40% of enrolled capacity. Over 67% of new 2018 enrollees were from the Educational Services or Retail Trade business types. Although not shown here, examining enrollment by business type for each CSP in 2018 indicates that while each CSP enrolled a multitude of different NAICS, one showed a tendency to bring in retail trade participants while the other two brought in more manufacturing and educational services accounts.

Table 2: Summary of Enrolled Capacity by NAICS

<table>
<thead>
<tr>
<th>NAICS Classification</th>
<th>2017 Total (Original)</th>
<th>2018 Total</th>
<th>2017 Total (Original)</th>
<th>2018 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Accounts</td>
<td>Enrolled Capacity (MW)</td>
<td>Percent of Capacity</td>
<td>Number of Accounts</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>28</td>
<td>10.8</td>
<td>52.5%</td>
<td>53</td>
</tr>
<tr>
<td>Educational Services</td>
<td>31</td>
<td>6.4</td>
<td>30.8%</td>
<td>96</td>
</tr>
<tr>
<td>Utilities</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>34</td>
<td>1.6</td>
<td>7.8%</td>
<td>89</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>1</td>
<td>0.0</td>
<td>0.2%</td>
<td>6</td>
</tr>
<tr>
<td>Health Care</td>
<td>2</td>
<td>0.8</td>
<td>3.9%</td>
<td>3</td>
</tr>
<tr>
<td>Mining, Oil, Gas Extraction</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Public Administration</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Transportation, Warehouse</td>
<td>2</td>
<td>0.8</td>
<td>3.6%</td>
<td>6</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Scientific, and Technical Svcs</td>
<td>1</td>
<td>0.3</td>
<td>1.2%</td>
<td>2</td>
</tr>
<tr>
<td>Real Estate, Rental, Leasing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Arts, Entertainment, Recreation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>20.6</td>
<td>100%</td>
<td>276</td>
</tr>
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</table>

Figure 3 shows the primary changes made to the Connected Solutions DR offering for 2018. Many of the changes were geared toward making the offering more flexible in 2018, including changes to the enrollment period, allowed use of backup generation, allowed existing ISO NE participation, and removing a minimum kW enrollment requirement. The changes to the payment channel and removing the possibility of event cancellations in the 2018 offering were changes suggested as part of the 2017 study.

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4 Called events were on July 3, July 5, August 6, August 8, August 28, August 29.
2.1 Study Objectives

The primary objective of this study is to develop and execute an evaluation of the National Grid DR Demonstration project, that builds upon the findings from the previous study completed in the winter of 2017-2018. The study will include an impact and a process evaluation. The impact evaluation is designed to verify the baseline and impacts generated and provide an independent assessment of ex post impacts. There are four core research areas in the impact study:

1. What were the load reduction results for the Connected Solution Demonstration using the Demonstration’s hybrid baseline at the ISO system peak hour and across all active hours?
2. How did the Connected Solution reductions based on the hybrid baseline compare to the adjusted 10 of 10 baseline and ex post regression? What were the differences and what are the implications of those differences?
3. What were the customer experiences of the Demonstration with respect to load reduction? Were customers able to take part in the ISO NE market and Demonstration in ways that increased the value of the DR to them?
4. Explore the intersection between the Connected Solution program and ISO NE’s energy and reserves market.

The primary goal of the impact evaluation is to provide verification of the proper baseline application, settlement impacts calculated by National Grid, and assess ex-post impacts.

The objective of the process evaluation is to understand customer acceptance and experience with the DR intervention, readiness of the Demonstration for larger deployment, and PA and vendor success in delivery. We also research Demonstration changes made since the 2017 campaign and assess their effectiveness and how they were received. Participant surveys and vendor interviews are also used to gather a broad set of information on each stage of the Demonstration experience as well as specific issues of interest. These include:

<table>
<thead>
<tr>
<th>Change</th>
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</tr>
<tr>
<td>5. Backup Generation</td>
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<td>Allowed</td>
</tr>
<tr>
<td>6. Minimum Curtailment</td>
<td>50 kW</td>
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<td>Notified day ahead by 4 p.m.</td>
<td>Notified day ahead by 1 p.m.</td>
</tr>
</tbody>
</table>
1. Is there customer fatigue that sets in as events are called over time?

2. How well is the open market (three-vendor) model working as opposed to a single vendor model?

3. Are the incentives offered by National Grid sufficient? Are participants “stacking” all the revenue streams available (FCM Revenue, ICAP, demand charges) to make their curtailment as valuable as possible? If so, what role does the Demonstration-provided DR incentive play in the overall benefit to the customer?

The primary goal of the process evaluation is to understand customer acceptance and experience with the equipment and intervention, readiness of systems for larger deployment, and PA and vendor success in delivery.
3 STUDY METHODS

This section presents the impact and process study methods. These sub-sections are laid out by primary task undertaken as summarized further in the figure below.

3.1 Impact Methods

There were three tasks performed in the impact study. These were to acquire program tracking, participant load, and event performance data, verify Demonstration demand reduction calculations, and complete an ex-post regression analysis.

**DATA ACQUISITION**

DNV GL received program tracking, participant load, and event performance data for the impact analysis directly from National Grid. Beginning in October, DNV GL received four deliveries of participant load data and three deliveries of event performance data. A final dataset was delayed until the end of January due to data completeness issues.

The issue of data completeness stemmed from a change in how National Grid gathered and stored interval data. Due to a change in data gathering platforms, interval data was not regularly gathered for a period of time. Procedures to pull data from alternative sources allowed the recovery of approximately 75% of participant load data. This issue is discussed as appropriate in following sections of this report. Note that National Grid has gone back to the platform that they used previously to ensure this data collection issue does not happen again.

**SETTLEMENT VERIFICATION**

DNV GL verified National Grid’s reported load reduction estimates that participants are paid upon. This settlement baseline credits the customer with load curtailment based on what we refer to as the hybrid baseline - the larger curtailment amount estimated by an unadjusted or additive-adjusted rolling 10-of-10 baseline with a practical maximum load reduction equal to the maximum load during the 10 baseline pool days.

As noted earlier, there were data loss issues encountered in this study that required National Grid to implement data sufficiency requirements. For settlement purposes, National Grid required that no greater than 20% of 15-minute intervals may be missing during the adjustment and event period (12 PM – 1 PM, 2 PM – 5 PM, respectively) on the event day or across the 10 baseline pool days (same hours) to calculate a participant’s event load reduction. All intervals that occur during these time periods can impact the accuracy of load reduction estimates. A participant missing greater than 20% of these intervals for an event is
considered to have insufficient data to provide a valid estimate of load reduction. A participant missing less than or equal to 20% of these intervals is considered to have sufficient data to provide a valid estimate of load reduction.

Figure 4 illustrates four possible data sufficiency scenarios for a participant event. Each scenario is represented by a column and varies in the volume of missing data on the event day (upper box) and the 10 days that compose the rolling baseline (lower box) for the time periods critical to load reduction estimation: 12 PM – 1 PM (adjustment period) and beginning at 2 PM and ending at 5 PM (event period). The left-most column provides labels for the scenario column boxes, while the columns that follow to the right each represent a unique scenario. Each scenario is labelled at the top of the column. The text underneath the label indicates whether the scenario represents an event with sufficient or insufficient data to estimate the participant’s event load reduction.

For example, in Scenario 1, the participant is missing 25% of critical event day load data (red border). While the participant is not missing any critical baseline period load data (white border), the participant exceeds the data sufficiency threshold of 20% on the event day and is considered to have insufficient data to accurately estimate load reduction. In Scenario 2, the participant is not missing any event day load data, however, the participant is missing 25% of critical baseline period load data. The participant exceeds the data sufficiency threshold during the baseline period and is considered to have insufficient data to accurately estimate load reduction. In Scenario 3, the participant does not meet the data sufficiency threshold on the event day or baseline period and is considered to have insufficient data. Load reduction impacts are not calculated in Scenarios 1, 2, or 3.

In Scenario 4, the participant is missing 20% of critical event day and baseline period data. The participant does not exceed the data sufficiency threshold on the event day or baseline period and is considered to have sufficient data. For this scenario, the participant’s event load reduction is estimated and contributes to the participant’s overall performance and the Demonstration performance in aggregate.

**Figure 4: Event Data Scenarios – Data Availability (12 PM – 1 PM, 2 PM – 5 PM)**
Figure 5 shows the volume of accounts by number of data sufficient events using the 20% data sufficiency threshold, as well as more stringent thresholds of 10% and 0% missing data. For the settlement data sufficiency threshold of 20%, 118 accounts have enough data to estimate impacts for each of the 6 events, whereas, 44 accounts do not have enough data to estimate impacts for any of the 6 events.

**Figure 5: Histogram of Accounts by Data Sufficient Events**

Additionally, participant load data contained more intervals with a meter reading of 0 kWh than might typically be expected. In some instances, 0 kWh reads are adjacent to missing reads. For settlement purposes, National Grid considered all non-missing meter readings to be valid. More information on data availability and the validity of 0 kWh reads are provided in the following section.

**EX-POST REGRESSION ANALYSIS**

This report also includes a site-level, regression-based estimate of load reduction that functions as an ex-post impact analysis result. The regression-based estimates of load reduction provide a comprehensive view of load curtailment across the summer for each customer and the Demonstration in aggregate. Because the customer-level regressions have access to all data for the season and explicitly control for weather and schedule effects, the results offer an assessment of the summer’s curtailments that contrast with the rolling, settlement-type baseline results. The regression-based approach can control for weather without a same day adjustment thus avoiding the potential shortcomings associated with a same day adjustment. Another advantage of the regression approach is that, for weather-correlated loads, it facilitates ex-ante predictions of curtailments under a range of conditions⁵.

DNV GL used a regression specification that includes schedule and weather independent variables. This approach to parameterizing the hourly models recognizes the diversity of industry practice but applies a coherent, econometrically sound logic to the choice of specific structure. The model includes 24-hour load shapes for weekdays and weekends/holidays. The site-level models were run across a range of degree day bases and the optimal model selected. We tested for the inclusion of other weather variables but found limited evidence these additions improved the performance of most of the site-level models.

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⁵ While the loads taking part in the program are less likely to be weather-correlated, such loads represent a particular challenge to rolling, settlement-type baselines so it is important to have evaluation approaches that are flexible to weather.
Given the data limitations discussed earlier, another advantage of the regression-based approach is that the flexibility of the regression baseline allows estimation of load reduction in some instances when data is insufficient to estimate load reduction using the hybrid rolling-baseline. DNV GL applied National Grid’s event day data sufficiency requirement to the regression baseline. The baseline data sufficiency requirement is not applicable. For example, in the scenario analysis in the previous section (Figure 4), Scenario 2 is considered to have insufficient data to estimate load reduction using the rolling baseline approach as the data sufficiency threshold is exceeded during the baseline period. However, the regression baseline is constructed using data across the entire summer, as opposed to the 10 previous non-event, non-holiday weekdays. As such, the data sufficiency threshold is not applicable to the regression approach. Since missing event day load is less than the data sufficiency threshold, the regression approach can provide a valid estimate of load reduction in Scenario 2, whereas the rolling baseline approach cannot. Outcomes of Scenarios 1, 3, and 4 are the same for the rolling baseline and regression approaches.

Figure 6 demonstrates the quality of data for construction of a regression baseline across participants. This figure summarizes the percent of data available for summer non-holiday, non-event weekdays from 2 PM – 5 PM (event period) by account. Accounts are sorted in order of decreasing data availability. Approximately 150 of 276 accounts have at least 80% data availability and about 250 accounts have at least 40% data availability.

**Figure 6: Data Availability for Baseline Eligible Weekdays – 2 PM to 5 PM**

In initial analysis, it was clear that zero reads during the event period were affecting the load reduction estimates for some customers and events. We assessed the extent of the issue. Figure 7 demonstrates the percentage point decrease in data availability when non-event day load of 0 kWh was considered to be invalid and recoded as a missing value. Accounts remain sorted in the same order as Figure 6. As can be seen in Figure 7, when non-event day load of 0 kWh is recoded as a missing value, data availability decreases by as much as 23.9 percentage points. Apart from 5 accounts, the data availability decrease is less than or equal to 3 percentage points. Data availability is not impacted for 211 accounts, indicating that the impact of the handling of zero kWh meter reads is limited.
3.2 Process Methods

DNV GL based the findings from this process evaluation of the Connected Solution programs primarily on in-depth interviews with 23 program actors including National Grid staff, representatives of all three CSPs, a representative of AutoGrid and 17 previous and new participating customers. We completed the National Grid interview in July, the CSP interviews in August, the AutoGrid interview in September, and the participant interviews in the October-November period. The participant surveys and CSP interview guide can be found in Appendix C and D, respectively.

The process evaluation targeted two groups of participating customers: 1) thirteen customers we had interviewed for the 2017 evaluation; and 2) participants who joined the program in 2018. For the first group, we targeted all participants surveyed in 2017 and therefore had no need for a sample design. For the second group, we stratified the sample by CSP and distributed the target number of 13 interviews among them. Since two of the CSPs had many more participating customers than the third one, we assigned 11 of the 13 interviews to them. A total of six 2017 participants targeted and eleven new 2018 participants were surveyed.

Figure 8 presents the type and quantity of interviews and surveys performed and the topics of information pursued with each. The core subjects of inquiry were the same as those pursued in the 2017 study. The 2017 participant call back instrument and the interview guides had questions added to gather information on the effectiveness of changes made to the program between the first and second year of operation. These instrument elements are captured in the Program Changes portion of the figure.
**Figure 8: Matrix of Process Topics and Interviews Performed**

<table>
<thead>
<tr>
<th>Question/Topics</th>
<th>Participants 2017–11 2018–16</th>
<th>Program Manager n=1</th>
<th>Curtailment Providers n=3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Design</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenges to large scale implementation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Success of open/three vendor model</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Program Marketing, Participation and Information</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing plan and strategy, its success and ease of recruitment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How learned about pilot</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Pilot barriers and bottlenecks</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Usefulness, sufficiency of information provided</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Curtailment Impacts on Participants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differences between planned and actual curtailment activity</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Financial benefits to participation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Information received on curtailment performance</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Unintended impacts or consequences of participation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Disruptions to business/decisions on whether to curtail</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Unintended impacts or consequences of participation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Levels of fatigue experienced over time</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Influence of incentives to elicit to curtail beyond ISO commitment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Program Delivery Process</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrollment process effectiveness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Tracking data process</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Incentive payment process</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Program Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor ease of working with National Grid and vice-versa</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Effectiveness of site work to identify curtable loads</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Satisfaction overall and key elements of program experience</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Notification process efficiency and effectiveness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Success in achieving the expected level of load curtailment</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Strengths/features of the program that worked well</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Suggestions for improvement</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Program Changes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness of new incentive payment level and channel, change in cancellation rules, faster performance feedback, and fewer event hours on program experience (only asked of recalled 2017 participants)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Effectiveness of allowing backup generation, enrollment data upload process change, earlier program close date, inclusion of ISO NE participants on program experience</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect on engagement in ISO NE market outside of demonstration</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Effect of participant demo/firmographics on pilot</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
4 RESULTS

This section provides impact and process results as separate sections. This is followed by a section on overall conclusions and recommendations that draw from the findings of each series of results.

4.1 Customer Characteristics

The Connected Solutions Demonstration involved 276 participating accounts. Ninety-seven of these accounts participated in the 2017 offering; 179 additional accounts were enrolled for the 2018 offering. DNV GL received load data for 261 participants. The load data reveals basic characteristics of the participant population.

Figure 9 summarizes average load for participants by enrollment year. Each rectangle represents a participant. Accounts that enrolled in 2017 are shown on the left, while participants that enrolled in 2018 are shown on the right. The size of the rectangle represents average summer load. Additionally, average load is shown in the text (value in MW) for participants with an average greater than or equal to 0.9 MW. A green rectangle indicates an account with no negative load values; a blue rectangle indicates an account with some negative load values.

Of the 2017 enrollees, 12 accounts have an average load greater than 1 MW, while 24 of the 2018 enrollees have an average greater than 1 MW. The average summer load for 2018 enrollees is less than that for 2017 enrollees (0.53 MW and 0.79 MW, respectively), however average summer load for 2017 enrollees is similar (0.57 MW) when the participant with average load of 21.5 MW is dropped from the average. Overall, the 2018 enrollment class has a total average summer load of 89.6 MW, 16 MW larger than the 2017 enrollment class. The 2017 enrollment class has a total average summer load of 73.6 MW.

Of the 2018 enrollees, 17 participants have some negative load values, while 6 of the 2017 enrollees have instances of negative load. Negative load values are evidence of on-site generation. Participants with on-site generation may not be well-served by standard DR baselines. Accurate estimation of load reduction for DR assets with on-site generation requires incorporation of the metered generation into the baseline calculation process.

Figure 9: 2018 Average Load by Enrollment Year

<table>
<thead>
<tr>
<th>2017 (73.6 MW)</th>
<th>2018 (89.6 MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.5</td>
<td>5.1</td>
</tr>
<tr>
<td>2.7</td>
<td>3.6</td>
</tr>
<tr>
<td>2.2</td>
<td>2.5</td>
</tr>
<tr>
<td>1.6</td>
<td>2.5</td>
</tr>
<tr>
<td>6.3</td>
<td>2.2</td>
</tr>
<tr>
<td>5.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Figure 10 summarizes enrolled load reduction for participants by enrollment year. Like Figure 9, each rectangle represents a participant, while the size of the rectangle represents the participant’s enrolled load reduction for demand response events. Additionally, enrolled load reduction is shown in the text (value in MW) for participants with an expectation greater than or equal to 0.9 MW. Rectangles shown in light blue represent an enrolled load reduction greater than or equal to 50 kW, the 2017 threshold for program enrollment. Light blue indicates that the expectation is greater than the 2017 enrollment threshold of 50 kW, while green indicates that the expectation is less than 50 kW enrollment threshold. Of note, participant expectations are less than the 2017 enrollment threshold for 2017 enrollees may occur as National Grid adjusted expectations to reflect 2017 performance. The 2017 enrollment class is shown on the left and the 2018 enrollment class on the right.

In 2018, the enrollment class has a total load reduction expectation of 60.8 MW, while the 2017 enrollment class had a total load reduction expectation of 16.9 MW. Average participant expectation is larger for the 2018 enrollees than the 2017 enrollees (0.334 MW and 0.174 MW, respectively). Additionally, visual comparison of Figure 9 and Figure 10 shows that the load reduction expectation tends to be smaller in terms of average load for a 2017 enrollee than for a 2018 enrollee. The load reduction expectation was 23% of average load for the 2017 enrollment class and 68% for the 2018 enrollment class.

**Figure 10: 2018 Load Reduction Expectation by Enrollment Year**

![Figure 10: 2018 Load Reduction Expectation by Enrollment Year](image)

2017 Load Reduction Enrollment Criteria Met

- 0
- 1

Figure 11 and Figure 12 correspond with Figure 9 and Figure 10, respectively. In addition to the information shown in these figures’ analogues, participants are split into groups by CSP. Each row of rectangles represents year of enrollment; each column represents a curtailment service provider (CSP). In general, these figures show that program uptake increased relatively proportionately across CSPs from 2017 to 2018, in terms of number of accounts enrolled, average load (shown in Figure 11) and load reduction expectation (shown in Figure 12). CSP 1’s 2017 and 2018 enrollment classes are largest in terms of number of accounts, aggregate load, and aggregate enrolled load reduction. Alternatively, in terms of average participant load, CSP 1’s 2017 enrollment class was the largest (0.9 MW), while CSP 2’s 2018 enrollment class was larger than the other CSP’s enrollment classes (0.9 MW). On average, enrolled participant load reduction was 0.2 MW across CSPs in 2017. While enrolled load reduction rose to 0.4 MW in 2018 for CSP 1 and CSP 2, CSP 3 declined to 0.1 MW.
Of note, while CSP 1’s 2018 enrollment class is larger than its 2017 enrollment class in terms of number of accounts (71 and 118 accounts, respectively), average load declined from 0.9 MW to 0.4 MW. Simultaneously, the average 2017 CSP 1 participant has enrolled load reduction of 0.2 MW, whereas, a 2018 CSP 1 participant enrolled load reduction equal to 0.4 MW.

**Figure 11: 2018 Average Load by CSP and Enrollment Year**

**Figure 12: 2018 Comparison of Enrolled Load Reduction**

In addition to eliminating the load reduction expectation floor for 2018 program enrollment, National Grid added additional performance incentives for participants with sites in Bellingham and Tewksbury. A total of 3 participants in Tewksbury enrolled. One of these three was a new participant in 2018. The total load reduction expectation for these participants is 211 kW. One of the three has an average summer load of 5.3 MW, while the other two have an average load less than 1 MW.
4.2 Impact Results

There are two sections in the impact results. The first section describes the verification of National Grid’s reported load reduction estimates for which participants are paid. The second section compares results for the settlement baseline with regression-based results.

During the summer of 2018, National Grid’s demand response Demonstration, C&I Connected Solutions, called 6 curtailment events. All events were 3 hours in duration, beginning at 2 p.m. and continuing until 5 p.m. Additionally, AutoGrid, the demand response management system solution National Grid uses to forecast load and dispatch events, successfully forecast the ISO NE annual system peak hour (i.e., ICAP hour). Reduction of a customer’s ICAP tag is a marketed benefit of the Demonstration.

4.2.1 Settlement Verification

This section describes the verification of National Grid’s reported load reduction estimates. Incentives are paid to participants based on the average performed curtailment amount for all events. Table 3 presents calculation methods used to verify National Grid’s reported event performance (hybrid approach). The calculation methods deviate from standard practice in calculation of rolling baselines and estimation of load reduction. Standard hybrid baseline calculations and estimation of load reduction are shown to the right of those used for settlement verification. Note that in the absence of missing data, both sets of calculations result in identical unadjusted and adjusted baselines. Given missing data, weighting of the averages used to construct the baselines is different and can result in slightly different estimates of load reduction. Overall, the changes due to these differences were negligible.

<table>
<thead>
<tr>
<th>Parameter/Issue</th>
<th>Settlement Verification (Hybrid)</th>
<th>Standard Practice (Hybrid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted Baseline</td>
<td>Ten-day average load during three-hour event period</td>
<td>Ten-day average load by 15-minute interval</td>
</tr>
<tr>
<td>Additive Adjustment</td>
<td>Difference between average event day load and ten-day average load during adjustment period (12 PM to 1 PM)</td>
<td>Difference between event day load and ten-day average load by 15-minute interval during adjustment period (12 PM to 1 PM)</td>
</tr>
</tbody>
</table>

On average, DNV GL’s verified hybrid load reduction is ~3% less than National Grid’s reported hybrid load reduction. The majority of the difference between the reported and verified hybrid load reductions occur for three reasons.

1. National Grid manually calculated performance for two accounts with anomalies. For these accounts, the manual calculation was necessary as the automatic download of participant load data did not include the data stream for the customer’s on-site generation. In one of the final revisions to the reduction calculations, National Grid re-calculated performance to incorporate the on-site generation for this site.

2. Ten instances in which National Grid did not evaluate performance, when a participant met the data sufficiency threshold. Note that in these instances, National Grid paid the participant based upon their enrolled capacity.
3. Two instances in which National Grid reports less data availability than DNV GL.

Manual overrides (the first item above) accounts for all differences in performance estimates for the July 3rd, July 5th, and August 7th events. Accounting for manual overrides, the rest of the difference in performance estimates for the August 6th event is very small at about 100 kW (0.1 MW). For the events on August 28th and 29th, a difference of about 2 MW is attributable to instances in which National Grid did not evaluate performance despite sufficient data (the second item above). As noted earlier, all remaining discrepancies between the performance reported by National Grid and that verified by DNV GL are negligible.

Recall, the hybrid baseline credits the customer with the larger curtailment amount estimated by either the unadjusted or the additive-adjusted rolling 10-of-10 baseline with a practical maximum load reduction equal to the maximum load during the 10 baseline pool days. Table 4 compares reported and verified aggregate load reduction estimates by event and on average for accounts with sufficient data to evaluate. For each event, Table 4 contains event load, enrolled demand response from National Grid, load reduction reported by National Grid (reported hybrid reduction), and load reduction verified by DNV GL (verified hybrid reduction). Both reported and verified load reduction estimates are based on the hybrid approach and use the calculation methods indicated in the settlement verification column of Table 3. On average, the difference between the program reported reduction and verified reduction estimates are 1.8 MW. Note that both the reported and verified values are 15.9 MW and 17.7 MW lower, respectively, than the load reduction enrolled by National Grid.

Table 4: Aggregate Load Reduction Verification

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Accounts</th>
<th>Load (MW)</th>
<th>Enrolled DR (MW)</th>
<th>Reported Hybrid Reduction</th>
<th>Verified Hybrid Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, July 3</td>
<td>156</td>
<td>117.4</td>
<td>66.5</td>
<td>53.9</td>
<td>51.2</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>155</td>
<td>121.8</td>
<td>67.0</td>
<td>50.6</td>
<td>48.9</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>192</td>
<td>134.2</td>
<td>66.3</td>
<td>52.4</td>
<td>50.5</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>189</td>
<td>139.4</td>
<td>69.2</td>
<td>54.3</td>
<td>51.4</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>194</td>
<td>146.9</td>
<td>63.2</td>
<td>44.8</td>
<td>43.6</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>187</td>
<td>143.2</td>
<td>61.5</td>
<td>42.1</td>
<td>41.8</td>
</tr>
<tr>
<td>Event Average</td>
<td>179</td>
<td>133.8</td>
<td>65.6</td>
<td>49.7</td>
<td>47.9</td>
</tr>
</tbody>
</table>

For the remainder of the evaluation, the hybrid baseline, its constituent parts (unadjusted and adjusted baselines), and load reduction estimates are calculated using the standard methods described in the rightmost column of Table 3. Additionally, for settlement purposes, negative event performance at the event-level is considered equivalent to 0 and does not reduce aggregate event performance.

Table 5 compares DNV GL’s load reduction estimates used to verify National Grid’s reported performance with DNV GL’s load reduction estimates based on the hybrid approach constructed to align with standard practice. For the hybrid approach, load reduction estimates constructed using standard practices are generally 1 to 2 MW less than those used for verification of National Grid’s reported performance. Notably,

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6 The averages presented in Table 4 and Table 5 are the average of total load reduction across events and reflect all differences in load reduction estimates. These are different from Demonstration-level participant load reduction, presented in the following section. Demonstration-level participant load reduction is the sum of each participant’s average load reduction. For Demonstration-level participant load reduction, each participant receives equal weight, regardless of the number of data sufficient events. In contrast, for averages shown above, each participant receives a weight equal to the participant’s number of data sufficient events. Given complete data, the result would be independent of weighting.
on July 5th, the difference is almost 5 MW. Additionally, Table 5 compares load reduction estimates for the ISO NE annual system peak hour or ICAP hour. The ICAP hour was captured by the demand response event called on August 29th and occurred from 4 p.m. to 5 p.m. Load reduction during the ICAP hour was 41.9 MW for the hybrid approach when constructed using standard practices, 4.6 MW less than the load reduction estimate based on the hybrid approach used to verify National Grid’s reported performance.

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Accounts</th>
<th>Load (MW)</th>
<th>DR Forecast (MW)</th>
<th>Verified Hybrid Reduction</th>
<th>Evaluated Standard Hybrid Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW</td>
<td>%</td>
</tr>
<tr>
<td>Tuesday, July 3</td>
<td>156</td>
<td>117.4</td>
<td>66.5</td>
<td>51.2</td>
<td>77.0%</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>155</td>
<td>121.8</td>
<td>67.0</td>
<td>48.9</td>
<td>73.0%</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>192</td>
<td>134.2</td>
<td>66.3</td>
<td>50.5</td>
<td>76.2%</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>189</td>
<td>139.4</td>
<td>69.2</td>
<td>51.4</td>
<td>74.3%</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>194</td>
<td>146.9</td>
<td>63.2</td>
<td>43.6</td>
<td>69.0%</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>187</td>
<td>143.2</td>
<td>61.5</td>
<td>41.8</td>
<td>68.0%</td>
</tr>
<tr>
<td>Event Average</td>
<td>179</td>
<td>133.8</td>
<td>65.6</td>
<td>47.9</td>
<td>73.0%</td>
</tr>
<tr>
<td>ICAP Hour</td>
<td>187</td>
<td>138.8</td>
<td>61.5</td>
<td>46.5</td>
<td>75.7%</td>
</tr>
</tbody>
</table>

4.2.2 Load Reduction Estimates

This section compares DNV GL’s load reduction estimates from the evaluated standard hybrid approach with those from the regression approach. As noted previously, National Grid’s data sufficiency criteria and handling of meter readings (in particular, non-event load of 0 kWh considered to be valid) are applied to the following results for consistency. Calculation of the evaluated standard hybrid baseline and load reduction estimates presented in this section conform to standard practices indicated in Table 3. Differences in the results (and underlying calculations) presented here from those used to verify reported load reduction can be found in the Settlement Verification section above.

Figure 13 compares the Demonstration-level participant load reduction for the regression baseline and the evaluated standard hybrid baseline approach. The Demonstration-level participant load reduction is the sum of each participant’s average hourly load reduction (for data sufficient events). For the Demonstration-level participant load reduction, each participant receives equal weight, regardless of the number of data sufficient events. In other words, a participant with 6 data sufficient events receives the same weight as a participant with 1 data sufficient event. This is in contrast to the event averages presented in Section 4.2.1. Given the extent of missing data, the population of participants that meet data sufficiency requirements to estimate load reduction for a given event varies significantly. Due to missing data, the Demonstration-level participant load reduction is the best estimate of overall performance.
Demonstration-level load reduction for the evaluated standard hybrid approach is 51.3 MW. This is 7.4 MW greater than the regression-based estimate of 43.9 MW. While load reduction for the hybrid approach is generally greater than for the regression approach, Figure 14 demonstrates that regression-based reduction estimates can be greater for a specific event.

**Figure 14: Event Performance – Evaluated Standard Hybrid versus Regression**
Figure 14 shows load reduction estimates for the evaluated standard hybrid and regression-based approaches by event. For the July 3rd and July 5th events, total average event load reduction is greater in the regression estimate than the hybrid approach. For each of the other four events, the evaluated standard hybrid estimate is greater than the regression estimate, including a decrease of 17 MW on August 28th. The ICAP hour was captured by the demand response event called on August 29th and occurred from 4 PM to 5 PM. Load reduction during the ICAP hour was 45.6 MW for the hybrid approach and 27.3 MW for the regression approach. Table 6, later in this section, shows this information for the ISO NE annual system peak hour (i.e., ICAP hour) in more detail.

The explanation for why the regression baseline load reduction is greater than the evaluated standard hybrid baseline load reduction around July 4th helps to explain how the regression differs from the hybrid baseline. The hybrid baseline load reduction will always be higher than either of the constituent baselines alone. The regression approach will generally produce:

- higher load reduction estimates than the un-adjusted baseline to the extent that there is weather-sensitivity to control for.
- lower load reduction estimates than the adjusted baseline under typical conditions when all customers are at typical load levels prior to the event. This is because the regression weather adjustment is based on an average weather trend and event days tend to extremes within the weather distribution.

The adjusted baseline gives no load reduction credit if the customer is already shut down prior to the event as was the case for the two days around July 4th. In the case of a shut down, the adjusted baseline is likely to be the chosen approach for the hybrid. As stated above, the regression load reduction estimates will be higher than the adjusted baseline if there is weather sensitivity. Around July 4th, there were enough sites that were shut down that this relative increase for the regression baseline load reduction more than counterbalanced the potential lower load reduction estimates where the adjusted baseline was chosen.

Recall that each event has a different number of participants with sufficient data to calculate impacts. Figure 15 shows event load reduction as a percentage of forecasted demand reduction (i.e., the level National Grid enrolled) to allow for comparison of evaluable performance across events. The evaluated standard hybrid and regression-based event performance are represented by the bright blue and green bars, respectively. The number of participants with sufficient data to calculate load reduction is shown by the orange diamond. Realized load reduction varies from 60% to 75% for the hybrid approach. For the regression approach, the realization rate has a range from 36% to 80%. At the Demonstration-level (labelled as aggregate), the realization rate for the hybrid approach is 70%, while the realization rate for the regression approach is 60%.
Table 6 shows the information in Figure 14 and Figure 15 in tabular form. For each of the 6 events, Table 6 presents event load, enrolled load reduction, and load reduction estimates, in terms of MW and percent of forecasted load reduction, for the hybrid baseline and regression baselines. Additionally, Table 6 shows this information for the ISO NE annual system peak hour (i.e., ICAP hour). The ICAP hour was captured by the demand response event called on August 29th and occurred from 4 PM to 5 PM. Load reduction during the ICAP hour was 41.9 MW for the hybrid approach and 27.3 MW for the regression approach.

Table 6: Load Reduction – Comparison of Evaluated Standard Hybrid and Regression Baselines

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Accounts</th>
<th>Load MW</th>
<th>Enrolled MW</th>
<th>Hybrid Baseline</th>
<th>Regression Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MW</td>
<td>MW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Tuesday, July 3</td>
<td>156</td>
<td>117.4</td>
<td>66.5</td>
<td>50.1</td>
<td>53.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75.3%</td>
<td>80.4%</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>155</td>
<td>121.8</td>
<td>67.0</td>
<td>43.1</td>
<td>49.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64.3%</td>
<td>73.2%</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>192</td>
<td>134.2</td>
<td>66.3</td>
<td>49.2</td>
<td>42.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>74.2%</td>
<td>64.6%</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>189</td>
<td>139.4</td>
<td>69.2</td>
<td>50.0</td>
<td>37.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72.3%</td>
<td>53.7%</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>194</td>
<td>146.9</td>
<td>63.2</td>
<td>41.4</td>
<td>24.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65.5%</td>
<td>38.4%</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>187</td>
<td>143.2</td>
<td>61.5</td>
<td>39.9</td>
<td>26.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65.0%</td>
<td>43.7%</td>
</tr>
<tr>
<td>ICAP Hour</td>
<td>187</td>
<td>138.8</td>
<td>61.5</td>
<td>41.9</td>
<td>27.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>68.1%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Demonstration-Level</td>
<td>232</td>
<td>72.9</td>
<td>51.3</td>
<td>70.4%</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60.2%</td>
<td></td>
</tr>
</tbody>
</table>

The two year goal of the Demonstration was to enroll 50 MW of demand response curtailable load. Given complete data, an average of total load reduction across events would be the best estimate of overall performance. However, given the extent of missing data, the population of participants that meet data sufficiency requirements to estimate load reduction for a given event varies significantly (156 participants on July 3rd, 194 participants on August 28th). Due to missing data, the Demonstration-level participant load
reduction is the best estimate of overall performance. The Demonstration-level participant load reduction is the sum of each participant's average load reduction. As before, in the calculation of Demonstration-level participant load reduction, each participant receives equal weight, regardless of the number of data sufficient events. Ultimately, 232 of 276 participants had sufficient data to evaluate event load reduction for at least 1 event. The enrolled demand reduction for the 44 participants with insufficient data to estimate load reduction was 4.8 MW. Despite data limitations, National Grid enrolled 51.3 MW of curtailable load reduction, greater than its goal of 50 MW. Additionally, The ICAP hour was captured by the demand response event called on August 29th and occurred from 4 PM to 5 PM. Load reduction during the ICAP hour was 41.9 MW for the hybrid-approach.

4.2.3 Baseline Comparisons

Table 7 shows the composition of the evaluated standard hybrid baseline for each event. Recall, the evaluated standard hybrid approach credits the participant with the larger curtailment amount estimated by an unadjusted or additive-adjusted rolling 10-of-10 baseline. On average, the evaluated standard hybrid approach estimates load reduction with the adjusted baseline 75% of the time. This is roughly the same as observed in the 2017 study, in which 70% used the adjusted baseline. Use of the adjusted baseline indicates a degree of weather sensitivity for most customers.

**Table 7: Evaluated Standard Hybrid Baseline Composition**

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Adjusted</th>
<th>Unadjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, July 3</td>
<td>69%</td>
<td>31%</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>74%</td>
<td>26%</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>64%</td>
<td>36%</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>69%</td>
<td>31%</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>86%</td>
<td>14%</td>
</tr>
<tr>
<td>Overall</td>
<td>75%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Figure 16 is a visual representation of the first demand response event that occurred on Tuesday, July 3rd. It illustrates differences between the baseline approaches. Figure 16 shows load (orange line), the evaluated standard hybrid baseline (bright blue line), its constituent parts (unadjusted baseline as dark blue line and adjusted baselines as light blue), and the regression baseline (green line). The adjustment and event period are shaded in gray.

---

7 Given complete data, the result would be independent of weighting and the average of total load reduction across events would be equal to the Demonstration-level participant load reduction.
The unadjusted rolling 10 of 10 baseline is calculated as the average interval load across the 10 most recent non-event, non-holiday weekdays. The unadjusted baseline does not adjust to typical load for extreme conditions and will generally underestimate load for events.

In contrast, the adjusted baseline shifts the unadjusted baseline to account for extreme event conditions. The adjusted baseline is adjusted on an additive basis and is calculated as the difference between the unadjusted baseline and actual load during the adjustment period. For this Demonstration, the baseline adjustment period was from 12 p.m. to 1 p.m. The aggregate adjusted baseline across all customers is consistently greater than the unadjusted baseline across all customers. The evaluated standard hybrid approach is never less than the unadjusted or adjusted baselines because it credits the participant with the larger curtailment amount estimated by the unadjusted or adjusted baseline. The regression load shape is well above the actual load reflecting the number of shutdown customer for the days surrounding July 4th. Despite this, the regression load reduction is only marginally greater than the evaluated standard hybrid baseline.

Figure 17 illustrate the last demand response even which occurred on Wednesday, August 29th. The graph is the same as Figure 16 except that the ICAP hour on August 29th is shaded darker than the other event hours in Figure 17.
Figure 17 represents a set of baselines for a more typical day. In this case, the regression is very close to observed load just prior to the event. The adjusted baseline is a little higher than the regression because of the adjustment an hour prior to the event. The unadjusted baseline is well below observed load and well below both other baselines. The increase from the adjusted baseline to the evaluated standard hybrid baseline represents a customer whose baselines were adjusted below the unadjusted baseline. In Figure 17 that adjustment is much smaller than the same adjustment in Figure 16.

4.2.4 Performance Across Years

Figure 18 compares the Demonstration-level participant load reduction for the regression and evaluated standard hybrid approaches by enrollment year. The number of participants with at least one data sufficient event is shown as the orange dot above the bars representing evaluated standard hybrid and regression-based load reduction estimates (shown in bright blue and green, respectively). Figure 18 shows that the Demonstration was successful in enrolling more participants and achieving increased load reduction capacity between 2017 and 2018.
Figure 18: Overall Performance by Enrollment Year

Figure 19 shows performance achievement for the evaluated standard hybrid approach by enrollment year. Performance achievement is the same as Demonstration-level load reduction, except in terms of enrolled load reduction. Dark blue bars indicate participants that enrolled in 2017, while green bars indicate 2018 enrollment. The level of performance for each pair of bars is indicated on the x-axis. The proportion of the enrollment class that falls in each performance achievement bin is indicated on the y-axis. Of note, participants with no enrolled load reduction have undefined performance achievement and cannot be shown here. Six participants had no enrolled load reduction and an aggregate average load reduction of 98 kW. Figure 19 shows that 42% of the 2017 and 2018 enrollees (33 and 62 participants, respectively) reduced load during events greater than their enrolled load reduction. Sixty six percent of participants in both enrollment classes reduced load greater than or equal to 75% of their expected load reduction. Generally, performance by enrollment year is similar in proportion to the number participants by enrollment year.
Figure 20 shows Demonstration-level participant performance achievement by enrollment year for the evaluated standard hybrid and regression approaches. Bright blue bars indicate the evaluated standard hybrid approach, while green bars indicate the regression approach. Both bars occur in pairs according to enrollment year, indicated on the x-axis. Performance achievement, defined as Demonstration-level participant load reduction as a function of enrolled load reduction, is labelled on the y-axis. Using the evaluated standard hybrid approach, overall performance for 2017 enrollees was 74.6%, while overall performance for 2018 enrollees was 69.2%. The difference of 5.4 percentage points reinforces that performance was similar across enrollment year. Further, using the regression approach, overall performance for 2018 enrollees was greater than 2017 enrollees. As shown previously, load reduction for the regression approach are generally less than those for the evaluated standard hybrid approach.
4.2.5 Additional Load Reduction Estimates from Regression Approach

Table 8 presents the additional participant event load reduction for the regression approach where the evaluated standard hybrid baseline had insufficient data. Given the data limitations discussed earlier, another advantage of the regression-based approach is that the flexibility of the regression baseline allows estimation of load reduction in some instances when data is insufficient to estimate load reduction using the evaluated standard hybrid rolling-baseline. Additional load reduction estimated using the regression approach is not presented above to compare the regression and evaluated standard hybrid approaches. For each event, between 7 and 13 more accounts were able to be evaluated using the regression approach than the evaluated standard hybrid approach. On average, total event load reduction is 0.1 MW\(^8\) (1.4% of enrolled curtailment) for these events and 0.2 MW (25.3% of enrolled curtailment) for the ICAP hour. Additional impacts estimated are highly variable. Total load reduction impacts for the regression approach are presented in Table 9.

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\(^8\) The event average shown in Table 8 is weighted by the number of accounts that contribute to each event’s total load reduction and is intended to illustrate the average additional load reduction that the regression estimates per event. In contrast, the Demonstration-Level participant load reduction presented in Table 9 is weighted equally across participants with at least 1 event in which data sufficiency criteria are met. This is intended to provide an estimate of overall load reduction estimated using the regression approach.
Table 8: Additional Load Reduction - Regression Baseline

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Accounts</th>
<th>Load (MW)</th>
<th>DR Forecast (MW)</th>
<th>Regression Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, July 3</td>
<td>7</td>
<td>1.2</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37.4%</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>8</td>
<td>1.0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100.5%</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>2</td>
<td>0.6</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.9%</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>3</td>
<td>3.3</td>
<td>0.3</td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-205.6%</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>8</td>
<td>2.5</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.6%</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>13</td>
<td>4.3</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34.5%</td>
</tr>
<tr>
<td>ICAP Hour</td>
<td>13</td>
<td>4.3</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.3%</td>
</tr>
<tr>
<td>Event Average</td>
<td>7</td>
<td>2.1</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Table 9: Total Load Reduction - Regression Baseline

<table>
<thead>
<tr>
<th>2018 Event Date</th>
<th>Accounts</th>
<th>Load (MW)</th>
<th>DR Forecast (MW)</th>
<th>Regression Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, July 3</td>
<td>163</td>
<td>118.6</td>
<td>67.0</td>
<td>53.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.1%</td>
</tr>
<tr>
<td>Thursday, July 5</td>
<td>163</td>
<td>122.8</td>
<td>67.5</td>
<td>49.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>73.4%</td>
</tr>
<tr>
<td>Monday, August 6</td>
<td>194</td>
<td>134.8</td>
<td>66.6</td>
<td>42.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64.4%</td>
</tr>
<tr>
<td>Tuesday, August 7</td>
<td>192</td>
<td>142.7</td>
<td>69.5</td>
<td>36.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>52.4%</td>
</tr>
<tr>
<td>Tuesday, August 28</td>
<td>202</td>
<td>149.4</td>
<td>63.6</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38.2%</td>
</tr>
<tr>
<td>Wednesday, August 29</td>
<td>200</td>
<td>147.4</td>
<td>62.3</td>
<td>27.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43.6%</td>
</tr>
<tr>
<td>ICAP Hour</td>
<td>200</td>
<td>143.1</td>
<td>62.3</td>
<td>27.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44.2%</td>
</tr>
<tr>
<td>Demonstration-Level</td>
<td>243</td>
<td>143.1</td>
<td>62.3</td>
<td>27.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44.2%</td>
</tr>
</tbody>
</table>

4.3 Process Results

In this section of the report we provide results pertaining to DR Demonstration communication, information, and marketing/outreach (including a discussion on Demonstration drivers and barriers). Following this, we review findings related to the Demonstration enrollment process, curtailment related observations, and the experience of the stakeholders around the Demonstration financial elements. We close this section with a discussion of Demonstration satisfaction. We present participant feedback on program changes as appropriate within each section.

4.3.1 Communication and Coordination Among Demonstration Implementers and ISO NE

The program actor interviews revealed that in the second year of program implementation, there was less need for frequent communication between the program manager and the CSPs. “We don't talk to [program staff] as much anymore, because we don't need to,” said one CSP rep. One of the issues which surfaced in the 2017 evaluation – the need for more coordination between CSP sales reps and National Grid sales reps –
was less of a concern in 2018. “I think the discussion around [sales] leads with [the Program Manager] and coordination around the sales process went pretty well this year,” said one CSP representative.

### 4.3.2 Demonstration Information

According to the program actor interviews, greater familiarity with the program rules in 2018 made it less necessary for CSPs and their staff to have program training sessions. “There was much less need to have large groups on the phone for training and Q and A about nuances of the program,” commented one CSP representative. In January 2018 there was a program kickoff meeting in which both National Grid and each of the CSPs gave presentation, with National Grid and CSP sales reps in attendance. Holding a meeting of this nature was a recommendation of the 2017 study.

The CSPs said that the program information contained in the 2018 two-page flyer had improved from the 2017 version. “This year was a lot clearer as to what the program was about,” commented one of the CSP interviewee. Some of these improvements, they conceded, were due to the program features that they had not liked—such as the eligibility of customer to receive the program incentives directly—no longer being mentioned in the flyer.

However, as the 2017 evaluation had also shown, in 2018 all the CSPs primarily used their own customized materials and websites for customer education and promotion. “Our objective is to drive people to ... a landing page on our website dedicated to this program,’ explained one of the CSP reps.

We asked both the 2018 enrollees and the 2018 repeat participants how satisfied they were with the program information, using a five-point satisfaction scale where 5 indicated “very satisfied” and 1 indicated “very dissatisfied.” Figure 21 shows that, on average, the 2018 enrollees were quite satisfied with the program information (4.4 average satisfaction rating), although this satisfaction rating was lower than it had been for the 2017 enrollees.

The chart also shows that the 2018 repeat participants were, on average, less satisfied with the program information than they had been in 2017. However, it is important to note that this satisfaction rating was based on a very small sample (only three of the six 2018 repeat participants recalled the program information in the second year). Of the two repeat participants who were less-than-satisfied with the program information, one said she had to ask for some follow-up information and the other said that the program information did not explain that his company would be penalized if they curtailed load before the scheduled load control event.⁹

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⁹ While the hybrid baseline does not adjust the unadjusted baseline downward, the unadjusted baseline can still be well below the apparent consumption levels before an early shutdown, particularly for weather sensitive loads. The hybrid approach lessens the effect of an adjustment down to shutdown level but may not solve the problem completely.
4.3.3 Marketing and Outreach

The evaluation team asked the CSPs whether their marketing outreach activities had changed in 2018 compared to what they had been doing in 2017. They reported a few positive changes. One CSP representative said that knowing the Demonstration rules earlier in 2018 than they had in 2017 made it easier for them to market the program. “[This knowledge] gave us more time to position collateral and email all kinds of marketing on our website versus the year before,” he said. “The year before, we got quite a late start. We really didn’t get off the ground until March for a June program.”

This same CSP rep also said his sales staff was promoting the “stacked benefits” of participating in both the Connected Solutions program and the ISO NE DR programs much more in 2018 than they had been in 2017. A related selling point was the ability of the DR program to reduce the capacity tag for C&I customers who bought power from an ESCO under an index contract. He also credited National Grid for giving their own sales reps new “enhanced tools” for selling these stacked DR benefits.

However, another CSP representative said that promoting the stacked benefits has limitations as a marketing message because it did not apply to all customers. “It’s useful to convey, but a lot of customers don’t get any benefit from the capacity-type reductions, so it doesn’t help them out,” he said. “And then the customers that do [get dual benefits] are already going to be focused on it and already managing it pretty closely.”

One finding of the 2017 evaluation was that the National Grid sales reps sometimes provide leads for customers who turned out not to be good candidates for DR. One of the CSP reps said that in the January 2018 kickoff meeting, his company provided the National Grid sales reps with “a compilation of the experiences from the previous year … [including] “some of the nuances of identifying who is a good candidate for these programs and …. how one explores and drills down into the customer’s operations to derive some demand response benefit.”

The CSP representatives gave the program staff and National Grid sales representatives high marks for helping them with more difficult customer recruits and noted much improved coordination. “What we didn’t hesitate to do, and didn't have any problem with, is if we did run across a customer who had some reluctance talking to us for some reason,” said one CSP representative. “We would call the Grid account exec and make sure that he or she was tuned-in, make a joint call if we could … The response was good there and the administrator of the program has always been very responsive and continues to be so.”

One CSP representative also credited these improvements to a new leads tracking system which the program implemented in 2018. “I think [the program manager] set up a really good system for tracking leads presale,” he said. “…I thought that was really useful for guiding our conversations on a weekly basis, understanding which customers were in, were out.”

Despite these improvements in the sales coordination and lead tracking, the CSPs had mixed opinions as to whether National Grid sales staff improved their generation of sales leads in 2018. “I think they could do more in terms of teeing up leads,” said one CSP rep. “… They got a big group … 25, 30 folks, that’s 10 times the size of my team.” “We’ve got maybe a few more leads from National Grid this year that we were able to work on, but not a significant change from last year,” said another CSP interviewee. This CSP went on to
note that he sought more “transparency” as to how National Grid distributes its sales leads. “I don't know how leads are distributed by National Grid and the decision process for it,” he said, “But definitely we’re not getting a ton, and it seems like there's a lot of megawatts in the program.”

Despite these criticisms, this same CSP rep thought that the National Grid sales team filled a recruitment niche that the CSPs were neglecting. “I think that there's a very important lead generation function that the National Grid sales team serves in finding sort of smaller sites that maybe CSPs wouldn't generally target,” he said.

One recommendation of the 2017 evaluation was “clearer guidelines or templates for reporting sales information would benefit them and National Grid.” However, one of the CSPs we interviewed in 2018 indicated that the program had not made these changes. “One additional step, ... if [the program manager] wants to get information from our sales team on leads on a more ongoing basis and more up-to-date basis,” he said, “is coming up with a template for receiving information.”

One CSP representative said that two of the 2018 program rules changes -- 1) allowing existing ISO NE DR participants to participate in Connected Solutions; and 2) allowing customers with permitted backup generators to participate in the program – helped them recruit new customers they did not have access to in 2017. “[These rule changes] opened up the eligibility for the program and opened up a fair amount of our existing relationships, customer relationships, that we’ve had in other non-Grid programs,” he said. “We were able to pick up the phone and talk to people we already knew about an expansion of their participation in demand-side management and kick it right into here's what the National Grid program is all about.”

We asked the 2018 enrollees how they first heard about the Connected Solutions program. As Figure 22 shows, they were much more likely than the 2017 enrollees to say they heard about the program from their CSPs.

Targeting existing ISO NE participants successfully leveraged existing CSP-customer relationships. Allowing generation into the program also opened participation opportunities.
4.3.4 Demonstration Enrollment

The 2017 evaluation report recommended: “revising the process for uploading data needed as part of the enrollment process to make it more flexible and easier for CSP data submissions.” The AutoGrid representative said that his company “made some incremental changes [in the enrollment process] for this [2018] season that …. definitely made that process run a bit more smoothly.” However, he predicted a much larger change would occur between 2018 and 2019 “as we move into more of a fully Web-based approach that will kind of remove a lot of that burden in terms of preparing files.” According to the interviewees, the shorter program enrollment period in 2018, which ended at the end of May (vs. the end of June in 2017) also helped reduce the problems which could occur with last-minute enrollments.

The reaction of the CSPs to these changes in enrollment processes was mixed. One CSP was mostly positive about these changes. “The enrollment piece was smoother,” said one CSP rep. “There was still some lack of knowledge on our side to make sure we were doing what they needed us to do that needed to get cleared up….but it got cleared up early (in the process).” However, another CSP rep thought the enrollment process was still too unwieldy. “The [enrollment] form upload process is multistep, and some of the documentation is a little tricky to follow,” he said. “…So, I think, getting access to the ability to upload customers one by one would definitely be useful.” He also said that the AutoGrid portal made it difficult to confirm that customers had been successfully enrolled.

We asked the 2018 enrollees and the 2018 repeat participants how satisfied they were with the program’s enrollment process, using a five-point satisfaction scale where 5 indicated “very satisfied” and 1 indicated
“very dissatisfied.” Figure 23 shows their average satisfaction levels, as well as the satisfaction levels from last year’s survey of 2017 enrollees. The chart shows that satisfaction levels with enrollment process were high for both the 2018 enrollees and the 2018 repeat participants.

However, only three of the eleven 2018 enrollees recalled the program enrollment process. This was down significantly from last year when 12 of the 13 2017 enrollees recalled the enrollment process. It is possible that improved CSP familiarity with the enrollment process and systems in 2018, and the introduction of more user-friendly enrollment processes, meant that the CSPs did not have to ask their customers for information for enrollment as much in 2018 as they had in 2017.

4.3.5 Load Curtailment

One recommendation of the 2017 evaluation report was that the program needed to improve its forecasting of load control events, considering the two event cancellations and the missed system peak. The AutoGrid representative said that his company had taken some steps in 2018 to improve the accuracy of their forecasting. One of these was to do some new “back-casting” in 2018 (they had done some in 2017) which involved using historical ISO-NE data to develop a more accurate predictive model. “We did another round of back-casting this year just to further hone the mechanism basically to meet National Grid’s understandable goal of calling as few events as possible and yet maintaining confidence in catching the ICAP day,” he said. “What our back-casting has indicated is in every past year over the last ten years we would have caught the [system] peak.” This includes the 2018 peak which was included in the event called on August 29th.

The AutoGrid representative said that they took ISO-NE’s daily predictions of peak load and tried to determine the probability that this daily peak would be the seasonal peak based on: 1) what AutoGrid has seen in past seasons; and 2) the long-range forecast for the season. Upon National Grid’s request, in 2018 they added a method for quantifying the uncertainty of their forecasts.

We asked the CSP representatives whether the Demonstration’s load forecasting had improved in 2018. The consensus was that it had, although there was still room for improvement. One CSP representative observed that while the program’s load control events lasted from 2 to 5 PM, sometimes the system peak was from 5 to 6 PM and that some of their customers were upset for missing this higher peak. This representative recommended that the program should consider expanding its control period to a four-hour window.

Figure 24 summarizes the load-curtailment activities reported by enrollees contacted in the 2017 study as well as this 2018 study effort. Despite the changes in program rules that allowed backup generation and removed the minimum curtailment amount, the nature of activities undertaken to meet curtailment needs was largely the same in the 2018 sample as that in 2017. All reported curtailment activities taken were consistent with its curtailment plan. The common activities for reducing load both years were primarily focused on production line related controls and air conditioner shutdowns followed by lighting. Despite generation being allowed into the program, no 2018 participants surveyed indicated they used them for curtailment purposes.

CSP Representatives noted that the Demonstration’s load forecasting improved in 2018, though some peaks fell outside of the program’s load control events.
Consistent with the 2017 survey, DNV GL asked Demonstration participants a series of questions about their load curtailment experiences. The results from both years are summarized in Figure 25. Curtailment request compliance, business disruptions due to curtailment, and company issues due to frequency of events called all experienced small increases in frequency among 2018 enrollees compared to 2017 enrollees surveyed in the previous study.

The second bar series from the right reflects a substantial increase in the number of participants who had the opportunity to assess their curtailment levels after events. In the 2017 report it was noted that there were long delays in the provision of curtailment estimates after events. When asked who provided this information, nearly all 2018 enrollees indicated their curtailment provider provided it in a graphic or via portal access. This positive change between years could be driven in part by the increase in customers who also participate in ISO NE and have the metering and system in place to get more immediate feedback on performance than the 2017 enrollees.

The rightmost bar series reflects a small, but positive, reduction in employee complaints among 2018 enrollees than 2017. As stated above, this could be the result of existing ISO NE participants presenting more experience in curtailment and understanding around its effects on the company and its employees. One of the complaints reported was difficulty responding to events when they come in a series of days. There were three instances in 2018 where events were called across more than one day. The second was the increase in temperature in production areas when HVAC is curtailed.

<table>
<thead>
<tr>
<th>Curtailment Activity</th>
<th>2017</th>
<th>2018</th>
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<tbody>
<tr>
<td>Placed buildings in “unoccupied” mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put buildings in “holiday mode”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turned down air conditioning in select areas</td>
<td></td>
<td></td>
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<tr>
<td>Shut down whole processing</td>
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<td></td>
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<tr>
<td>Shut down two manufacturing islands</td>
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<tr>
<td>Shut non-essential mill machines down</td>
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<tr>
<td>Shut down kiln chambers and related fans</td>
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<tr>
<td>Shut down refrigeration compressors/motors</td>
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<tr>
<td>Shut down AC and ventilation in unocc. areas</td>
<td></td>
<td></td>
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<tr>
<td>Shut down lights, AC, Vacuum Furnaces</td>
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<td></td>
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<tr>
<td>Shut down lights, AC/Chillers</td>
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<td></td>
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<tr>
<td>Throttle back induction furnaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shut down lights, AC, process machines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shut down process equipment, HVAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turned down HVAC, lighting</td>
<td></td>
<td></td>
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<tr>
<td>Shut down processing systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turned off air conditioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turned off mechanical equipment and HVAC</td>
<td></td>
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<tr>
<td>Did not perform meaningful curtailment</td>
<td></td>
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<tr>
<td>Shut down refrigeration compressors/motors</td>
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<td>Shut down AC and ventilation in unocc. areas</td>
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<td>Shut down lights, AC, process heating</td>
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</tr>
<tr>
<td>Shut down lights, AC/Chillers</td>
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</tbody>
</table>

Figure 24: Load Curtailment Activities Reported by 2017 and 2018 Enrollees
As part of this study, National Grid is interested in understanding if curtailment fatigue sets in, and if so, is there a certain number of events where it might set in. To understand the possibility for this issue, we hypothetically asked whether participants think they would have been less willing to curtail load beyond 4 events in the 2017 study and 6 events in the current study (Figure 26). The responses received suggest that there may be an inflection point between 4 and 6 events where participants appear less willingness to curtail. There were, in fact, 6 events called in 2018.

We asked the 2018 enrollees and the 2018 repeat participants how satisfied they were with the program’s procedures for notifying their company about the curtailment event. Figure 27 shows their average satisfaction levels, as well as the satisfaction levels from last year’s survey of 2017 enrollees. It shows that the 2018 enrollees were very satisfied with the load curtailment process and were as satisfied as the 2017 enrollees had been, even though there were more load control events in 2018 compared to 2017.
The figure also shows that the 2018 repeat participants were less satisfied with the load curtailment process than they had been in 2017. Some of this may have been an effect of the smaller sample size (12 respondents in 2017 vs. only 5 in 2018). The one 2018 repeat participant who said she was dissatisfied (satisfaction rating of 2) with the load curtailment process wished that the program would provide Friday notifications for upcoming Monday events.

Another change in the 2018 program was the elimination of the program’s ability to cancel events. The 2017 program had cancelled two load control events and some of the CSPs had complained about this. “We had a handful of customers that were (in 2017)… vehemently upset when the event was cancelled,” said one CSP rep. “There are some people that do benefit greatly from being able to know that, hey, tomorrow, at 2:00 we’re going to start curtailing load. You pull the rug out from under them three hours before the event and people get upset.” “There were definitely complaints we had from customers [concerning the event cancellations], so I think that’s pretty positive that that got changed,” said another CSP interviewee.

However, this same CSP rep said that there were also some negative implications of going forward with a load control event that otherwise would have been canceled due to a change in the weather or system conditions. “The downside of not cancelling something that obviously should be is … I’m going to also get phone calls: ‘Why are we doing this today? It’s not hot enough. The load is nowhere near the peak.’ The AutoGrid representative noted that his company was “disappointed” in the decision not to allow the cancellation of events. “We had recommended event cancellation, because, … it allowed us, basically, a little more latitude,” he said. “… If we saw that it was incredibly unlikely there’d be a peak [being able to cancel] improves the program from our standpoint in that fewer events end up being called and that you still maintain the high confidence in catching the peaks.”

The 2018 program also reduced the number of allowable annual curtailment hours from 40 to 21. One CSP rep thought the impact of this change was minimal. “[This change] is pretty cosmetic. … How could you ever pull 40 [hours]? … Over a three-month period, that's a lot,” he said. However, the two other CSP interviewees, while acknowledging that the 40-hour number was unrealistic, still welcomed the rule change because it eased customer communications. “It just clears things up for the customer,” one CSP rep explained.

One interviewee suggested that reducing the annual curtailment hours to 21 could increase the urgency for more accurate load forecasting. “That also puts a little pressure, as it should be, on the prediction service that [the program] is buying,” he said. “You can't give … those [predictors] carte blanche … [so] they can
pull as many events as they want and they’re always going to hit [the system peak]. That’s not the point. The point is: call the minimum [number of events] and hit it. That’s what you’re being paid for.”

The 2017 evaluation report recommended “improvements to data availability for AutoGrid to calculate and provide event performance values to customers and vendors to confirm their performance level and as a touchpoint to foster further Demonstration engagement.”

Two of the three CSP reps said that in 2018 their customer performance data had become available in a timelier manner compared to 2017. However, the third said that this was still a problem that can damage relations with some customers. “The performance [data] thing is a problem,” said one CSP rep who was interviewed in late August 2018. “We had our first event July 3rd, and ... we're reporting on something like 30% of the data from that event at this point.... these data performance delays are not in the right direction for customer retention or customer training.”

4.3.6 Financial Incentives

The 2017 program had allowed two payment options for the program incentives: 1) the CSPs receiving the incentives based on the aggregate performance of a group of participants (with the implication that they would later share a portion of these incentives with their customers); and 2) the customers receiving the incentives directly based upon their performance (with the implication that there would be later sharing of these incentives with CSPs). The evaluation of the 2017 program had found the CSPs were unhappy with this dual payment option. They maintained that direct payment to CSPs was standard practice among similar DR programs, and that dual payment options just confused customers. Therefore, one recommendation of the 2017 program evaluation was that “National Grid should consider simplifying or choosing a single incentive payment option for participants.”

The 2018 program followed this recommendation and simplified the payment process by only allowing incentive payment to the CSPs. The CSPs supported the change to only offer payments through them, as noted in comments they provided in the figure below:

CSP Satisfaction with change in incentive payment options

- “That [incentive payment simplification] eliminated a lot of confusion in terms of just how you position the revenue with a customer and set the proper expectation.”
- Another CSP rep wondered whether any participating customers actually used that direct-to-customer incentive option, but still welcomed its elimination “just because it was confusing and would have been pretty difficult to implement.’

Another change in the incentive structure for the 2018 program was simplification of the incentive structure to just a $35/kW per year payment (the 2017 incentive structure had both a $20/kW per year capacity payment and a $0.75/kWh payment). All payments were based on average(kW) or total (kWh) performance during the season despite being referred to as capacity payments in some literature. Some CSPs had been unhappy with the old performance component of the payment because the program had called far fewer than the program cap of 20 hours per year. “So, if you’re billing this thing as a $35 a kilowatt season program, and $15 is tied up in energy, and that’s based on calling 20 hours of events, if you only call 4 hours of events, well, you don't have a $35 program, you've got a $24 program,” said one of the CSP reps.
For these reasons, the 2018 CSPs were satisfied with the new kW-only incentive structure. “To me it's about setting a proper customer expectation right up front, said one of the CSP reps. “So that was our recommendation, pay $35. It doesn't matter how many calls are made, take the energy thing off the table. The customer knows what he's going to get if he responds.”

A third change in the incentive structure of the 2018 program was the introduction of geotargeted pricing in the towns of Tewksbury and Bellingham. The program allowed customers in these towns to receive twice the normal incentives to reduce load on National Grid’s congested lines in this area. The general reaction of the CSPs to this geotargeted pricing was that while it was a good idea, it had been difficult to implement.

**Summary of CSP experience with new congestion pricing demonstration element**

- One CSP interviewee indicated there was not sufficient time to recruit from these towns (between January and May). "Unless we have somebody teed up already...on a contract in another program, the sales cycle is not a week for this kind of stuff. It's two, three, four meetings, and it's a contract discussion, and you need some time to do that”.
- One CSP representatives said the limited footprint of this congestion zone made recruitment difficult. "They're very small zones, ... I think we had one customer in Tewksbury...don't know if we had anybody in Bellingham”.
- Another CSP had a similar reaction: "They were such limited areas that it was difficult for CSPs to try and invest in targeting sales in those areas”.
- Additionally, one CSP suggested that the congested pricing strategy would be more successful if National Grid did preparatory customer education and outreach in the area before asking the CSPs to recruit there. "You've got to give some thought to what's the best way to tee it up with the customer, get the customer to be reaching out to his CSP of choice, and/or have the account exec be talking to his CSP of choice,” he said. "It's a harder for us to go cold-call in a geography that we don't know.”

The AutoGrid representative said that National Grid asked them to develop separate load forecasts for Tewksbury and Bellingham, “but at least based on experience thus far [the interview was conducted in late August 2018], those two areas are pretty coincident peaking with ISO New England overall.” Therefore, AutoGrid called their load control events for these two towns at the same time as they called events in the rest of Massachusetts. "I think that it would have been even more interesting focusing on a place that would have had a very different load profile than the rest of the state,” he said.

Since the 2018 enrollees had not yet received their incentive payments at the time we conducted the surveys, we only asked the 2018 repeat participants about the incentive payments they had received at the end of 2017. The 2018 repeat participants were generally satisfied with these 2017 payments with an average satisfaction rating of 4.0 on the five-point scale (5 of the 6 repeat participants provided ratings). Only one repeat participant was dissatisfied with the incentive payment (satisfaction rating of 2.0). She said that the payment was lower than she expected and that the methodology for calculating the final payment was “hard to understand.”

### 4.3.7 Demonstration Satisfaction

Like the 2017 evaluation, the three CSPs were asked in 2018 how satisfied they were with the enrollment process, the load curtailment notification process, and the overall Demonstration. Because the 2017 CSP interviews had occurred before the Demonstration paid out incentives, the 2018 interviews also asked the CSPs to rate their satisfaction with the 2017 incentive payment process. For all these questions, the CSPs used a five-point satisfaction scale where five equaled “very satisfied” and one equaled “very dissatisfied.” Figure 28 shows that CSP satisfaction increased from 2017 to 2018 for the overall Demonstration as well as
for the enrollment and load curtailment notification processes. The chart also shows that the average satisfaction rating for the 2017 incentive payment process was only three. Appendix A of this report provides several verbatim comments received from CSPs who offered explanations for their rating choices.

**Figure 28: CSP Demonstration Satisfaction 2017 vs. 2018**

We also asked the 2018 enrollees and the 2018 repeat participants how satisfied they had been with their CSPs, with the National Grid program staff (if they had interacted with them), and the overall Demonstration. Figure 29 shows that the 2018 enrollees had a similar level of satisfaction as their 2017 counterparts. However, the chart also shows that the 2018 repeat participants were less satisfied with the program than they had been in 2017.

We asked the 2018 repeat participants about the reasons for being less-than-satisfied (satisfaction rating of 3 or less) with their CSP and the overall program. Of the two participants who were less-than-satisfied with their CSP, one said that their CSP was not informative or transparent about the program and the other was unhappy with how the program incentives were calculated. These two participants cited similar reasons for their dissatisfaction with the overall program, including that the incentive calculation method was difficult to understand, that it appeared to punish them for curtailing earlier than the load control event, and that the incentive amounts were disappointing.

In interpreting these responses, it is important to note that since most participants said they had no interaction with the National Grid staff, and a few said they did not recall their interactions with their CSPs, the samples sizes for these satisfaction questions were lower than those for the overall program. It is also worth observing that the 2018 repeat participants (n=6) represent less than half of the 2017 enrollees (n=13) we interviewed last year.
4.3.8 Scalability

We asked the three CSP reps and the AutoGrid representative whether they anticipated any challenges for the pilot to scale up to a full-sized program. Two CSPs felt the Demonstration was largely ready to mature into a full program offering. The third CSP felt it would need to add some penalties for non-performance and some interaction with grid operator programs that might otherwise jeopardize the amount of calculated curtailed load.

CSP thoughts on readiness of demonstration to scale into full program

- Two CSPs had little to no concern about scaling the program. The other had a couple of concerns.
- “... when it becomes a real program, your regulators don't like people to just not do things and start to count on it,” he said. “So, they'll have to put a penalty in there or some kind of non-payment so it's not just: “If you shed, you make money.”
- “I think the biggest [challenge to scalability] is really the interaction with the grid operator programs and system operations.”

4.4 ISO NE Overlap Issues

The C&I Connect Solutions Demonstration takes place in territory that is served by ISO NE. Over the years, ISO NE has had various ways for Demand response resources (DRRs) to participate as supply-side resources. As of summer, 2018, ISO NE moved away from the previous DR programs structures to an integrated energy and reserves market and a capacity market.
The most common entry point for DRRs into ISO NE is to participate in the ISO NE capacity market. The capacity market has two components: a capacity supply obligation (CSO) component and a pay-for-performance (P4P) component. DRRs can participate in the capacity market in such a way that they receive a capacity payment for being available under scarcity conditions but are rarely, in fact, expected to curtail load. This approach maximizes the financial reward for the least actual curtailment effort. Alternatively, DRRs can actively participate in the energy and reserves market with or without a CSO. DRRs, like other participants, would bid in an amount of curtailment for a certain price for all hours and if their bid cleared they would be activated to provide that load curtailment.

The ways that activity in either ISO NE markets or the Demonstration could affect one another are complex. Overlapping activations during the same timeframe could negatively affect a DRR’s ability to supply load reduction and/or the ability to estimate load reduction accurately. Activity on any day should mean that the day is removed from inclusion in baseline calculations for future activity to avoid degradation of the baseline. This would not be possible to implement without complete information sharing at the customer level between the two organizations. These practical considerations do not address the wider implications of attribution and whether, where feasible, a DRR could get credit from both organizations for the same load reduction.

The potential for overlap between the Connect Solutions Demonstration and the ISO will be determined by the nature of the customers’ participation in the ISO NE markets. DRRs may participate in the capacity market in a way that will limit their actual load curtailment activity to capacity scarcity conditions which have, at least historically, not occurred during system peak conditions. A more active involvement in the energy market would increase the likelihood as prices could be high during system peak conditions.

National Grid has expressed a policy of deferring to ISO NE if there is the perceived potential for conflict on a specific afternoon. However, this does not appear feasible with the possibility of individual customers operating in the energy market.

ISO NE’s priority is maintaining an open and competitive market. They would be concerned, for instance, if a DRR was able to bid into the energy market at a lower price because they were also getting paid elsewhere for the same load reduction. It does not appear that it would be possible to manipulate the situation in this manner. The degradation of baselines has the potential to increase variation in load reduction estimates and make any particular estimate less accurate. ISO NE would also like an accurate picture of the capacity resources that are available to them. National Grid markets Connected Solutions with the promise of stacked benefits, which could include, in addition to the Connected solution payments, reduction of ICAP payments, capacity payments and, apparently, other activity in the energy market.

At this point, it is impossible to know whether there has been an actual overlap that has caused problems. In interviews with one CSP, they cited what they referred to as a “load control event” that occurred on July 5, 2018. They said that the Connected Solutions program requested load curtailment for the 2-5 PM period and then right after these customers had reduced their load, ISO NE dispatched the customers. The CSP claims that since the Connected Solutions customers were already at reduced consumption levels, they missed out on valuable incentives from the ISO NE program. The circumstances around this event are unclear as “load control events” do not occur in the current market structure, just bids clearing. This could be an example of active involvement in the energy market and points to one of the potential risks of the overlap.
One possible option would allow DRRs to have a CSO and bid into the energy market at a high enough price so as not to clear. This would limit capacity obligation-related activity to periods of capacity scarcity conditions which, as noted above, have not generally occurred during system peak conditions. In addition, DRRs would make themselves unavailable to ISO NE when the aggregator intends to participate in utility DR events. If a capacity scarcity condition arose on that day, the DRR would face penalties for not being available. However, this approach would ensure that ISO NE had an accurate understanding of the available resources and would prevent the aggregators from being double-paid by the utility and ISO NE for those hours. This strategy relies on the prior experience that capacity scarcity conditions typically do not occur during peak load periods. The two entities are effectively paying for the same resource but at different times and thus for two different grid benefits – reliability and peak shaving. This option may address the concerns for active DRRs.
5 CONCLUSIONS, RECOMMENDATIONS AND CONSIDERATIONS

This section provides the conclusions and recommendations of this study.

5.1 Conclusions

The Connected Solutions Demonstration was designed by National Grid to offer a dispatchable demand response solution for C&I customers to control their peak demand in Massachusetts and deliver system peak reductions. The Demonstration used three providers to recruit, enroll, and manage participants. Like 2017, National Grid used a DRMS platform to predict the expected peak day, dispatch day ahead event notification, and compiles power data used to calculate participant curtailment levels using a evaluated standard hybrid baseline. There were substantial interval data storage issues in the 2018 effort that prevented a full data driven settlement process and validation.

The Demonstration hit the ICAP peak in 2018, an important element of program participation for many customers. The Demonstration also exceeded their goal of 50 MW by achieving 51.3 MW of load reduction from participants with sufficient data using the program’s evaluated standard hybrid settlement baseline (i.e., it does not include 44 customers that did not have data). The ex post regression analysis provides impacts that are 17% lower than the evaluated standard hybrid baseline, illustrating the substantial upward bias inherent in the evaluated standard hybrid baseline.

The Demonstration evolved substantially between the 2017 and 2018 offerings and maintained or increased participant satisfaction with the Demonstration overall and many of its subelements. We consider the Demonstration ready to become a full scale offering pending final changes that are recommended in this study. Below we provide a recommendation regarding future evaluations of the Connected Solutions C&I Program. This should include an early examination of whether the final changes made as a result of this study are working as intended.

5.1.1 Impact Conclusions

The Connected Solutions Demonstration faced serious data issues related to the storage of customer interval data from the summer of 2018. The limitations mean that results are based on partial data and the full range of implications are effectively impossible to determine.

For settlement purposes, National Grid created a data sufficiency requirement to facilitate load reduction estimates based on available data. Most customers’ load reduction results were based on observed load reduction from between 1 and 6 events. Two hundred thirty-two customers had sufficient data to calculate empirical load reduction estimates that were validated by the study. Figure 30 shows the final summary of impacts using the evaluated standard hybrid baseline. The program achieved its goal of 50 MW. However, the enrolled load from those customers with sufficient data was 21.6 MW higher than that achieved. The shortfall of 30% in achieving the

Figure 30: Impact Summary

10 Participants without sufficient data were settled at their enrolled load reduction estimate.
enrolled load is similar to that observed in the 2017 study (25%). The critical metric of performance for National Grid is program goal achievement.

The implications of the CSPs under- or overperforming enrolled capacity are unclear. The program was developed in response to regulatory direction. There do not appear to be direct risks, from the perspective of diminished capacity for instance, to either National Grid or ISO-NE if the program under- or overperforms. If National Grid were to perceive risk in under or overperformance, then one solution would be to build more clear penalties or incentives into the contracts with CSPs. Ultimately, the CSPs control the enrolment process and determine the amount of load reduction provided, though there are typically substantial variations in performance from event to event. CSPs are the only party in a position to determine what level of demand reduction is realistic to respect from enrolled participants. The enrolled to actual curtailment ratio varies across CSPs and would be expected to change over time with improved program implementation and customer experience. National Grid could consider scenarios involving substantial over-subscription and shortfall and decide whether their interests are well served with the current CSP contracts.

Other impact findings include the following:

- The regression baseline provided estimates of load reduction at 43.9 MW. The difference between the evaluated standard hybrid baseline and the regression baseline illustrates the substantial upward bias inherent in the evaluated standard hybrid baseline. The regression baseline provides higher estimates of load reduction for the July 3rd and 5th events because many sites were shut down for the holidays. Despite this, the evaluated standard hybrid baseline load reduction average across all event days is 17% higher than the regression baseline load reduction. The evaluated standard hybrid baseline is a baseline that reduces risk considerably for customers but, in aggregate, over-estimates true load reduction.

- A clear understanding of the implications of the Demonstration in the context of ISO NE is essential for considering the scaling up of the offering. This evaluation provides background on the issue and an example of a way that Demonstration customers could act to allow both ISO NE and National Grid to meet their objectives. The requirements that National Grid writes into contracts with CSPs will determine whether those CSPs operate in a way that takes into consideration the needs of the wider system as well as those of their customers.

- The rigid three-hour event period limits National Grid’s flexibility in multiple ways. There were six weeks of the summer when the highest single hour of the ISO NE load fell outside the 2-5 PM hours. If the later peak day had not occurred, the Demonstration would have missed the peak hour because of the constrained event period. A set event period also forces a three-hour event even when it is clearly un-needed. Finally, although participant “gaming” of the same day adjustment to improve load reduction results was not observed in this study, the rigid window can limit the Demonstrations flexibility to mitigate this possibility.

5.1.2 Process Conclusions

The 2018 Connected Solutions Demonstration built off the strengths of the 2017 campaign. The 2018 effort made several incremental improvements in its operations that were well received and had their desired effect. This included revising program criteria that opened some new participant reservoirs, forecasting improvements that furthered accuracy and “hit” the ICAP peak, and improving coordination between National Grid and its three CSP partners that supported adequate levels of enrollment.
Overall, this study continues to show this Demonstration design offers a curtailment solution that is generally accepted by customers, though opportunities for improvement remain. Study findings include:

- The 2018 Demonstration maintained its previously high levels of satisfaction among Demonstration participants. Participants that enrolled in 2018 are very satisfied with their experience, as evidenced by high and stable satisfaction ratings for the Demonstration overall (4.2 on a 5-point scale), their CSP (4.0), National Grid staff (5.0), the load curtailment process (4.5), the enrollment process (4.7) and the program information received (4.4). With only one exception (program information), these ratings were the same or slightly higher than those reported by 2017 Demonstration enrollees.

- The 2017 enrollees that were contacted in this study\[1\] were largely satisfied with the incentives received for their curtailment during the 2017 summer season. They rated their satisfaction an average of 4 on a 5-point scale.

- CSPs reported moderately higher satisfaction ratings for the Demonstration overall and among many of its sub elements. There appears to be two primary reasons why CSPs are reporting higher levels of satisfaction:
  1. The Demonstration incentive was restructured in 2018. In 2018 participants no longer had the option of receiving incentives directly. While there is no evidence that any customers took advantage of this direct payment option in 2017, CSPs said that this option had caused confusion for some customers.
  2. The basis of incentive levels was simplified in 2018. In 2018, the incentive was based solely on capacity and no longer had an energy impact payment component.

- The 2018 Demonstration recruitment effort built off the Demonstration from 2017 and incorporated slightly revised marketing materials, an existing knowledgebase of the program and operations, and growth in the relationships between CSPs and National Grid. Despite this, there are some signals that lead generation might be a concern moving forward:
  1. One CSP sought more support and transparency in how National Grid leads are distributed and the number they received.
  2. Two of every three enrollees reported hearing of the Demonstration from National Grid in 2017, though only a third reported hearing of the Demonstration from National Grid in 2018 (a 50% drop) – albeit from a very small surveyed sample size. This is not entirely surprising as CSPs leveraged their ISO NE participant relationships to market the Demonstration project in 2018. Yet two of the CSPs did say that they did not get many participant leads from National Grid in 2018. In addition, if the program moves back into the mainstream C&I population, National Grid may find that added attention and resources to recruitment will be needed.
  3. The exchange of sales information from the CSPs to National Grid was reported as lacking a formal mechanism.

\[1\] Due to timing issues we were unable to ask about incentive satisfaction in the 2017 study.
4. The enrollment process, while improved, was reported to still be a little difficult to follow and confirm.

- The 2018 program included an increased incentive for participants in two towns (Bellingham and Tewksbury). This offer is a sensible expansion of the program but was regarded as largely unsuccessful by CSPs. CSPs indicated it was difficult to implement, there was not sufficient time to market those areas (or justify investing in them) and the coordination between National Grid and AutoGrid was not fully developed. There is evidence that in 2018 the three CSPs engaged in the Demonstration targeted different size (average load) and curtailment levels among the customers enrolled in the program. There is also evidence that the three CSPs tended to enroll different business types.

5.2 Recommendations and Considerations

DNV GL offers the following recommendations and considerations. Two of these recommendations are particularly important. The first is the importance of a reliable and accurate interval consumption data storage system. The second is the need to develop Demonstration requirements that will reduce issues related to overlap in activities with ISO NE. DNV GL notes that some of these activities may already be underway as part of National Grid’s ongoing internal efforts to improve the Demonstration based upon their own observations and experience.

**Recommendations**

1. We recommend developing a reliable data warehouse for customer interval data and confirm its gathering of data as part of normal program management checks. For the sake of redundancy, consider making it a requirement that CSPs maintain a full set of customer interval data for a set period after each season. Customers in the ISO NE markets are expected to already have this system in place.

2. We recommend National Grid develop Demonstration requirements that minimize the potential negative implications of program overlap with ISO NE activity. Allow customers to obtain ISO NE capacity supply obligations only if active energy market activity is foregone and Demonstration event days are reported as unavailable back to ISO NE.

3. We recommend that National Grid use a regression model approach to estimate impacts for annual reporting needs. The regression approach uses all data across the summer to set the most appropriate baseline that would have happened absent the curtailment.

4. We recommend the Connected Solutions C&I Program be evaluated as part of the National Grid portfolio. This should occur within two years of its operation as a program. This can include an early examination of whether the final changes made as a result of this study are working as intended, assess settled values against enrolled estimates, perform ex-post regressions as needed to support annual claimed savings estimates, and ensure program satisfaction and operation are satisfactory.

**Considerations**

1. National Grid should consider making customers choose between a symmetrically-adjusted 10 of 10 baselines or an unadjusted 10 of 10 baseline. The hybrid baseline minimizes customer risk but inflates apparent Demonstration load reduction.
2. National Grid should consider a flexible event window that will suit both customers and National Grid. Allowing 2- or 4-hour events within a 2-7 PM window will give National Grid more flexibility to make sure it hits the peak hour with the smallest numbers of event hours. Customers should experience more efficient use of their curtailment hours and a greater probability of hitting the system peak load hour.

3. National Grid should consider examining its process of lead generation, distribution, and enrollment for this Demonstration. The purpose of this examination would be to ensure that the process is able to garner sufficient participation levels moving forward now that participant enrollment gains from allowing existing ISO NE participants into the Demonstration have been mostly realized.

4. If continued or expanded, National Grid should consider changing its approach for geotargeting targeting congested areas with special incentives or offerings by the Connected Solutions Demonstration (or program). In the future, any areas targeted should be as large as possible, given the geography sought, to provide a sufficient pool of candidates for program recruitment. In addition, National Grid should conduct a customer education component or outreach campaign in the targeted areas that will increase the probability of success of the CSP’s own outreach efforts. Finally, it should give the CSPs enough lead time for participants in the targeted area to get through the sales funnel.
APPENDIX A. CSP SATISFACTION DETAILS

We asked the CSPs to explain their satisfaction ratings. The following are a sample of their explanations.

- **The enrollment process:**
  - (Satisfaction rating 3) “There's still some seeming disconnects. And I'm not blaming Grid, you know, because half of it, more than half of it could be on my end. But, for whatever the reason, we haven't yet achieved [where after the customer information is] loaded up you can come back ten seconds later and you got an acknowledgement and everything is hunky-dory. It just hasn't been that smooth.”
  - (Satisfaction rating 4) “So once you understand the process, it's just something you have to do to get through it, but nobody's complained as far as I know. I can't say they changed anything, but nobody is complaining, so that's a good thing. Either we got used it, or they changed something.”

- **The notification process:**
  - (Satisfaction rating 3.5) “I think there's still some room for improvement in the documentation and in the responsiveness on AutoGrid's side. At the same time, you know, we're generally able to get the answers that we want. It's just not always as straightforward as, I think, it should be for setting up new systems. ... One example in particular that stands out is the fact that these non-wires alternative zones [in Tewksbury and Bellingham] were created for this year, and it seemed like there was not a super well-developed process on National Grid's end or AutoGrid's end .... there wasn't clear sort of guidance on how to configure our systems. And our engineering team, I know, had to do a little bit of digging with AutoGrid to figure out what they needed to be doing.”
  - (Satisfaction rating 4) “Right at the start of the season, we had to reaffirm what we were doing in terms of notification, what we were getting for Grid. And then one of those included the day of confirmation. And so, Tuesday, the day of confirmation, didn't come through at the appointed hour. We waited a half hour. My dispatch desk is calling, is about to pick up the phone and call me, and then he called the AutoGrid folks first, and they said: “Oh,” and they sent the day of confirmation. So. I had my dispatch desk thinking: ‘Well, are they going to cancel for some reason?’ So that's a little glitch to the customer, but it's not a five [satisfaction rating]. .... The way I think about this, and I would like to think that AutoGrid does, you really got to be flawless in that part of it. You can sign up everybody you want, but if you're not notifying them, they're not curtailing ... Right? So, it's a big piece to this. And we're smoother, a lot smoother than we were last year, but it's one of those zero tolerance kind of things.”

- **The 2017 incentive payment process:**
  - (Satisfaction rating 2) “I don't think it was so much the payment [amount]. ... We had a lot of back and forth on the calculations of the baselines, and, therefore, the performance. We did some tweaks with National Grid as we went, and, again, this was a collaborative effort. There were two things. Data was still coming in in October for some accounts. And then, two, we had to figure out: ‘How are we going to approach the baselines, and, therefore, the subsequent calculation?’ And with our particular group of customers, we probably spent three or four weeks
back and forth with Grid to get that right. We had questions from customers: ‘When are we going to get our money? … I don’t think any of them are going to say that that was a big downside. It was clear that we needed to get it to them in the calendar year. I can’t remember when we actually got it out, but, it certainly was a November issue if not early December. … It's not their [National Grid’s] fault. It was a collaborative effort of just taking a heck of a long time to get the data together, a heck of a long time to make the calculations, and longer than any of us wanted. Did it disrupt the customer base? I don’t think so, but it was not a smooth process.”

- (Satisfaction rating 3) “I think there was just a lot of confusion around the timeline when we'd be getting payments and when we'd be able to turn payments around to customers. So, I think there was just some confusion around the deadlines that led to us having a little bit of customer confusion that we had to deal with.”

- **The overall program:**

  - (Satisfaction rating 4) “I think just for some of the issues we’ve discussed around the incentive level and some of the enrollment issues. But, in general, everything else has been extremely positive.”

  - (Satisfaction rating 4) “To give you an idea, California CBP right now is a one [satisfaction rating]. PJM capacity is a five. They pay more and they call less, so that would be a five. But that’s an emergency program. Yours is a different function, so you’re not going to be a five. They also pay more than you guys do, so probably a four.”
## APPENDIX B. PARTICIPATING CUSTOMER INTERVIEW GUIDE

**2018 Guide for Follow-Up Interviews with 2017 Participants**

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Introduction

1. [CROSS-CHECK THE 2017 CONTACT INFO WITH THE NEW 2018 INFORMATION] May I please speak with <CONTACT NAME>? [SKIP TO Q3 WHEN CONTACT GETS ON PHONE]

2. Hello, my name is _____, and I’m calling from DNV GL on behalf National Grid. Last year we interviewed you about your company’s participation in National Grid’s Connected Solutions program through [CURTAILMENT SERVICE PROVIDER]. This program pays your company rebates in return for occasionally interrupting your power. The 2018 season of this program has just completed, and we would like to get your updated feedback on this program.

Program Information, Enrollment

3. In 2018, National Grid updated information on how the Connected Solution program works. Do you recall receiving this updated program information?

4. [IF Q3= YES] Using a five-point scale where 5 equals very satisfied and 1 equals very dissatisfied, how satisfied were you with this information in terms of explaining to you how this program works?
   a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

5. Do you recall any interactions with [CSP]? They are a contractor that is helping National Grid deliver this program?
   a. [IF YES] What were the nature of these interactions?

6. Do you recall the process for getting your company enrolled in this program?
   a. [IF YES] Using a five-point scale where 5 equals very satisfied and 1 equals very dissatisfied, how satisfied were you with this enrollment process?
      a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?
      b. information in terms of explaining to you how this program works?

7. Did your company face any barriers or difficulties in participating in this program?
   a. [IF YES] What were these?

8. The main goal of this program is to pay customers to reduce their power consumption at times when electricity use on power grid reaches its highest levels. Did anybody provide advice to your company on the best ways to reduce your power consumption during these periods of peak electricity usage?
   a. [IF YES] Who provided this advice?
   b. [IF YES] What kind of advice did they provide you?

9. Besides this National Grid Connected Solutions program, has your company participated in any other load curtailment or demand response programs?
   a. [IF YES] What other programs? [PROBE FOR NATURE OF THEIR PARTICIPATION IN THESE PROGRAMS]
   b. [IF YES, AND THEY PARTICIPATED IN AN ISO NE PROGRAM] Were you able to actively participate in both programs to maximize incentives received for your curtailment capability?
c. [IF YES TO 9B] How was your experience participating in both programs? [PROBE FOR WHETHER PARTICIPATING IN BOTH PROGRAMS WAS ECONOMICALLY BETTER OR MORE FEASIBLE THAN ONLY ONE]

The Control Events, Incentive Payments

10. Do you recall the National Grid Connected Solutions program notifying your company that it had to reduce its electric power consumption? [IF THEY ARE UNSURE, MENTION THAT THE NOTIFICATION MIGHT HAVE COME FROM AUTOGRID, A CONTRACTOR WORKING FOR NATIONAL GRID]

a. [IF YES] Who notified you?

b. [IF YES] Approximately when did you receive this notification?

c. [IF YES] Did your company reduce its power consumption in response to this notification?
   i. [IF NO] Why not?

11. [IF THEY RECALL RECEIVING NOTIFICATION (Q10= YES)] Using that same five-point satisfaction scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the program procedures for notifying your company that it had to reduce its power consumption?

a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

12. [IF THEY INDICATED THAT THEY HAD REDUCED THEIR POWER CONSUMPTION IN RESPONSE TO THE PROGRAM NOTIFICATION (Q10C= YES)]

a. How did your company reduce its electric power consumption in response to the program? [PROBE FOR SPECIFIC ACTIONS TAKEN, THE TIMING OF THESE ACTIONS, AND WHETHER THE CUSTOMER MADE USE OF BACKUP GENERATION OR OTHER SUPPLEMENTARY SOURCES OF POWER]

b. Were the ways that your company reduced its electric power consumption what it originally planned to do before receiving the notification?
   i. [IF NO] How was it different?

c. Did your company encounter any technical difficulties in trying to comply with the program’s request to reduce your power consumption?
   i. [IF YES] What were they?

d. Were there any serious disruptions to your company’s productivity or operations when it responded to the program’s request to reduce power consumption?
   i. [IF YES] What were they?

e. Were you aware of any complaints or concerns raised by your company’s employees in response to the reduced power consumption? [IF NECESSARY PROBE FOR INSTANCES OF TEMPERATURE-RELATED DISCOMFORT, ETC.]
   i. [IF YES] What were they?
f. [IF INTERVIEW IS FIELD AFTER END OF SEPTEMBER] The program called 6 load curtailment events over the course of the program. Did the frequency of these events cause any issues with your company?

i. [IF YES] What were these issues?

g. [ALL RESPONDENTS] If the program had called more than 6 load curtailment events, would your company have been less willing to curtail its load for these additional events than it had been for the previous events?

i. [IF YES] What were these issues?

h. [IF THEY RECALLED RECEIVING ADVICE ON HOW TO REDUCE THEIR POWER CONSUMPTION (THEY GAVE A RESPONSE TO Q8A AND Q8B)] You said earlier that [CSP/National Grid] provided you with advice on how to reduce your power consumption. Did you follow this advice when choosing to reduce your electric power consumption?

i. [IF NO] Why not?

i. After you responded to the program’s request for you to reduce your power consumption, did you receive any information on how much power you were able to reduce?

i. [IF YES] Who provided this information?

ii. [IF YES] What was the nature of this information?

iii. [IF YES] What did this information say about how your company performed during these load control events?

iv. [IF YES] Did this information tell you what your incentive payments were likely to be for this level of consumption?

j. One change in the program design from last year is that participants can use backup generation to help them curtail their load. Does your company have backup generation?

i. [IF YES] Did your company use its backup generation to help it reduce load as part of this program?

k. Last October your company received an incentive payment from the National Grid Connected Solutions program. Do you recall receiving this information?

i. [IF YES] Did the incentive amount meet your expectations?

   1. [IF NO] Why not?

ii. [IF YES] Did you think the incentive payment was fair given the level of curtailment you provided and the challenges of curtailing this load?

   1. [IF NO] Why not?

iii. [IF YES] Using that same five-point satisfaction scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the program’s incentive payments?

   1. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

l. Another change in the program design from last year is the way the incentives are calculated. Last year part of the program incentive was a performance payment which was
paid out depending on how many hours the customer curtailed over the season. This year’s program no longer has this performance payment. Before I mentioned it, were you aware of this change in the program incentives?

i. [IF YES] What do you think about this change?

**Program Satisfaction, Suggestions for Program Improvements**

We’re almost done. Just some final program satisfaction questions

13. [IF THEY RECALLED INTERACTIONS WITH THEIR CSP (Q9=YES)] You mentioned earlier that you had some interactions with [CSP]. Using that same five-point satisfaction scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the overall performance of [CSP]?

   a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

14. During your participation in the program, did you have any interactions with the National Grid staff?

   a. [IF YES] What were the nature of these interactions?

   b. [IF YES] How satisfied were you with the overall performance of the National Grid program staff? [REPEAT THE SCALE, IF NEEDED]

      i. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

15. What would be your level of satisfaction with the National Grid Connected Solutions Program overall, considering all the various aspects of the program we already discussed? [REPEAT THE SCALE, IF NEEDED]

   a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

16. [IF 2018 PROGRAM SATISFACTION RATING IS DIFFERENT THAN 2017 LEVEL] Last year you gave the program a satisfaction rating of Y and this year you’re giving it a satisfaction rating of Z. What factors influenced you to change your program satisfaction ratings from 2017 to 2018?

17. What suggestions do you have for improving this program?
Guide for Participants Joining in 2018

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Introduction

18. [IF WE HAVE CONTACT INFO] May I please speak with <CONTACT NAME>1>? [SKIP TO Q3 WHEN CONTACT GETS ON PHONE]

19. [IF WE DO NOT HAVE CONTACT INFO] Hello, my name is _____, and I’m calling from DNV GL on behalf National Grid. According to our records, your company recently participated in National Grid’s Connected Solutions program through [CURTAILMENT SERVICE PROVIDER]. This program pays your company rebates in return for occasionally asking you to decrease your energy use. Who at your company would be most knowledgeable about your participation in this National Grid program? [RECORD NAME AND CONTACT INFO OF PROGRAM-FAMILIAR CONTACT, AND SKIP TO Q3 WHEN YOU GET PROGRAM-FAMILIAR CONTACT ON THE PHONE]

20. Hello, my name is _____, and I’m calling from DNV GL on behalf National Grid. According to our records, your company recently participated in National Grid’s Connected Solutions program through [CURTAILMENT SERVICE PROVIDER]. This program pays your company rebates in return for occasionally asking you to decrease your energy use. I would like to ask you some questions about your participation in this program that will help National Grid improve this program going forward.

Sources of First Information, Drivers of Participation, Program Information, Enrollment

21. How do you first hear about this Connected Solutions program from National Grid?

22. What was your company’s main reason for getting involved with this program?

23. Were there any other reasons?
   a. [IF YES] What were these other reasons?

24. How did you learn about how this program worked? [IF THEY JUST MENTION A PROGRAM ACTOR – E.G., NATIONAL GRID OR THEIR CSP – PROBE FOR WHAT TYPES OF INFORMATION THEY RECEIVED AND WHAT FORM IT TOOK - E.G., WEBSITE VS. HARD COPY, PROGRAM FLYER, NGRID SALES REP]

25. Using a five-point scale where 5 equals very satisfied and 1 equals very dissatisfied, how satisfied were you with this information in terms of explaining to you how this program works?
   b. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

26. Do you recall the process for getting your company enrolled in this program?
   b. [IF YES] Using a five-point scale where 5 equals very satisfied and 1 equals very dissatisfied, how satisfied were you with this enrollment process?
      a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

27. [CSP] is the contractor that is helping National Grid deliver this program and would have enrolled your company into the program. Besides the enrollment process, have you had any other interactions with [CSP]?
   b. [IF YES] What were the nature of these interactions?

28. Did your company face any barriers or difficulties in trying to join this program?
29. The main goal of this program is to pay customers to reduce their power consumption at times when
electricity use on power grid reaches its highest levels. Did anybody provide advice to your company
on the best ways to reduce your power consumption during these periods of peak electricity usage?

c. [IF YES] Who provided this advice?
d. [IF YES] What kind of advice did they provide you?

30. Did National Grid or [CSP] provide you with any data showing your company’s electric power
consumption levels that might help you participate in this program?

a. [IF YES] Who provided this power consumption data?
b. [IF YES] What kind of power consumption data did they provide you?

31. Besides this National Grid Connected Solutions program, has your company participated in any other
load curtailment or demand response programs?

d. [IF YES] What other programs? [PROBE FOR NATURE OF THEIR PARTICIPATION IN THESE
PROGRAMS]
e. [IF YES, THEY PARTICIPATED IN AN ISO NE PROGRAM] Were you able to actively participate
in both programs to maximize incentives received for your curtailment capability?
f. [IF YES TO 14] How was your experience participating in both programs? [PROBE FOR
WHETHER PARTICIPATING IN BOTH PROGRAMS WAS ECONOMICALLY BETTER OR MORE
FEASIBLE THAN ONLY ONE]

The Control Events, Incentive Payments

32. Do you recall National Grid Connected Solutions program notifying your company that it had to
reduce its electric power consumption? [IF THEY ARE UNSURE, MENTION THAT THE NOTIFICATION
MIGHT HAVE COME FROM AUTOGRID, A CONTRACTOR WORKING FOR NATIONAL GRID]

a. [IF YES] Who notified you?
b. [IF YES] Approximately when did you receive this notification?
c. [IF YES] Did your company reduce its power consumption in response to this notification?
   i. [IF NO] Why not?

33. [IF THEY RECALL RECEIVING NOTIFICATION (Q13=YES)] Using that same five-point satisfaction
scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the program procedures for
notifying your company that it had to reduce its power consumption?

b. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

34. [IF THEY INDICATED THAT THEY HAD REDUCED THEIR POWER CONSUMPTION IN RESPONSE TO
THE PROGRAM NOTIFICATION (Q15C=YES)]

a. How did your company reduce its electric power consumption in response to the program?
   [PROBE FOR SPECIFIC ACTIONS TAKEN, THE TIMING OF THESE ACTIONS, AND WHETHER
THE CUSTOMER MADE USE OF BACKUP GENERATION OR OTHER SUPPLEMENTARY SOURCES OF POWER]

b. Were the ways that your company reduced its electric power consumption what it originally planned to do before receiving the notification?
   i. [IF NO] How was it different?

c. Did your company encounter any technical difficulties in trying to comply with the program’s request to reduce your power consumption?
   i. [IF YES] What were they?

d. Were there any serious disruptions to your company’s productivity or operations when it responded to the program’s request to reduce power consumption?
   i. [IF YES] What were they?

e. Were you aware of any complaints or concerns raised by your company’s employees in response to the reduced power consumption? [IF NECESSARY PROBE FOR INSTANCES OF TEMPERATURE-RELATED DISCOMFORT, ETC.]
   i. [IF YES] What were they?

f. [IF INTERVIEW IS FIELDING AFTER END OF SEPTEMBER] The program called 6 load curtailment events over the course of the program. Did the frequency of these events cause any issues with your company?
   i. [IF YES] What were these issues?

g. [ALL RESPONDENTS] If the program had called more than the X load curtailment events, would your company have been less willing to curtail its load for these additional events than it had been for the previous events?
   i. [IF YES] What were these issues?

h. [IF THEY RECALLED RECEIVING ADVICE ON HOW TO REDUCE THEIR POWER CONSUMPTION (THEY GAVE A RESPONSE TO Q11A AND Q11B)] You said earlier that [CSP/National Grid] provided you with advice on how to reduce your power consumption. Did you follow this advice when choosing to reduce your electric power consumption?
   i. [IF NO] Why not?

i. After you responded to the program’s request for you to curtail your power consumption, did you receive any information on how much power you were able to reduce?
   i. [IF YES] Who provided this information?
   ii. [IF YES] What was the nature of this information?
   iii. [IF YES] What did this information say about how your company performed during these load control events?
   iv. [IF YES] Did this information tell you what your incentive payments were likely to be for this level of consumption?
j. [IF INTERVIEWS TAKE PLACE IN OCTOBER AFTER PAYMENT OF PROGRAM INCENTIVES AND PARTICIPANT HAS BEEN IDENTIFIED AS SCHEDULED FOR PAYMENT] Has your company received its incentive payment for the Connected Solutions program?
   i. [IF YES] Did the incentive amount meet your expectations?
      1. [IF NO] Why not?
   ii. [IF YES] Did you think the incentive payment was fair given the level of curtailment you provided and the challenges of curtailing this load?
      1. [IF NO] Why not?
   iii. [IF YES] Using that same five-point satisfaction scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the program's incentive payments?
      1. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

k. [IF THEY INDICATED EARLIER IN RESPONSE TO Q14 THAT THEY ARE ALSO PARTICIPATING IN THE ISO NEW ENGLAND DR PROGRAM] You told us earlier that your company is also participating in an ISO New England demand response program. Did your participation in this ISO New England program have any influence in your decision to also participate in this National Grid Connected Solutions program?
   i. [IF YES] How did it influence it?
   ii. [IF NO] Why not?
   iii. [IF NOT ALREADY MENTIONED] Did your participation in this National Grid Connected Solutions program influence you to reduce your electric power consumption more often than you would have if you only participated in the ISO New England DR program?
      1. [IF YES] To what extent? [TRY TO GET THEM TO QUANTIFY THE INCREMENTAL LOAD REDUCTION, IF POSSIBLE]

Program Satisfaction, Suggestions for Program Improvements
We're almost done. Just some final program satisfaction questions and a couple of questions about what your company/organization does/

35. [IF THEY RECALLED INTERACTIONS WITH THEIR CSP (Q10=YES)] You mentioned earlier that you had some interactions with [CSP]. Using that same five-point satisfaction scale [REPEAT THE SCALE, IF NEEDED], how satisfied were you with the overall performance of [CSP]?
   b. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

36. During your participation in the program, did you have any interactions with the National Grid staff?
   a. [IF YES] What were the nature of these interactions?
   b. [IF YES] How satisfied were you with the overall performance of the National Grid program staff? [REPEAT THE SCALE, IF NEEDED]
      i. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?
37. What would be your level of satisfaction with the National Grid Connected Solutions Program overall, considering all the various aspects of the program we already discussed? [REPEAT THE SCALE, IF NEEDED]
   
a. [IF SATISFACTION RATING OF 3 OR LESS] Why do you say that?

38. What suggestions do you have for improving this program?

39. If this program were to mature into a larger offering, what suggestions would you have for improving the design or delivery of it?

**Firmographics**
Lastly just a couple of questions about your company/organization?

40. What is the principal activity of your organization at this location? [CHOOSE ONE. IF RESPONDENT TELLS YOU MULTIPLE, ASK THEM WHICH ONE BEST DESCRIBES THE MAIN ACTIVITY AT THIS LOCATION.]

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41. At this location, does your organization [READ UNBRACKETED LIST]

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<th>Own all the space it occupies</th>
<th>Lease all the space it occupies?</th>
<th>Or own some and lease some of the space it occupies?</th>
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42. Are any of your energy costs included in your normal lease payment?

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## APPENDIX C. CURTAILMENT SERVICE PROVIDER INTERVIEW GUIDE

Curtailment Service Provider
Interview Guide

### Interview Tracking Information

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### Call Tracking

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<th>Notes/result/actions: (Who spoke to, new contact info, when to call back, etc.)</th>
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Introduction

Thanks for agreeing to participate in this interview. As we discussed earlier via email, the objectives of this interview are to find out how National Grid’s Connected Solutions program is working, what could be done to make it better, and what it would take to make this pilot program a full-scale program.

Program Design, Management

43. Before we get into the details, at a high level, what are your general impressions of the design of this program, both positive and negative?

44. Last year you said that you communicated with National Grid [REPEAT NATURE, FREQUENCY, AND MEANS OF COMMUNICATION FROM 2017 INTERVIEW]. Has the nature of your communications with National Grid changed since then?
   a. [IF YES] How has it changed?

45. Have there been any challenges in your communications with National Grid so far in 2018?
   a. [IF YES] What were these challenges?

46. Last year you said that you communicated with Autogrid [REPEAT NATURE, FREQUENCY, AND MEANS OF COMMUNICATION FROM 2017 INTERVIEW]. Has the nature of your communications with Autogrid changed since then?
   a. [IF YES] How has it changed?

47. Have there been any challenges in your communications with Autogrid so far in 2018?
   a. [IF YES] What were these challenges?

48. When you recruit a new customer into the Connected Solutions program, what customer information do you share with National Grid?
   a. How about with Autogrid

49. Have there been any challenges in sharing or managing this customer information with either National Grid or with Autogrid?
   a. [IF YES] What were these challenges?

50. The 2018 Connected Solutions program has some changes in program design from the 2017 program? I’m going to mention a few of them. For each one I mention, please let me know your reaction to it and what impact, if any, it has on your company’s ability to recruit and retain customers in the Connected Solutions program?
   a. Changing the incentive structure from both capacity and energy payments, to just capacity payments
   b. Removing the rule that allowed participating customers to have the program incentive payment go to them instead of to the CSP
c. No longer allowing the program to cancel load control events

d. Allowing customers to have and use backup generation

e. Allowing former ISO NE participants into the program

f. Removing the 50kW minimum curtailment requirement

g. Shortening the curtailment period from 11 AM – 5 PM in the 2017 program to 2 PM – 5PM in the 2018 program

h. Reducing the maximum curtailment hours from 40 hours to 20 hours

i. Cutting off program enrollment at 5/31 vs/ 6/30 for the 2017 program

j. Paying higher incentive payments for customers in the Lowell and Nantucket areas

Program marketing/information, participation, barriers

51. The 2018 program made updates to the program flyers and website. Do you think the program information that participants currently receive is adequate for helping them understand how the program works and what their responsibilities are as participants?

   a. Why do you say that?

52. Do you think that program's marketing messages are the right ones to encourage customers to join the program?

   a. [IF NO] What alternative marketing messages should the program be using?

53. One of the recommendations from last year's program evaluation was that National Grid do more customer education to better familiarize them with the Connected Solutions program. Have you noticed any additional customer education efforts in the 2018 program?

   a. [IF YES] What customer education activities have you noticed?

54. Last year you described your standard practice for recruiting new customers into the program [DESCRIBE THEIR 2017 RESPONSE IF NEEDED]. In 2018 have you made any changes in how you recruit these customers? [IF NOT MENTIONED, PROBE FOR:

   a. HOW THEY FIND C&I CUSTOMERS WHO WOULD BE GOOD CANDIDATES FOR THE PROGRAM

   b. WHAT KIND OF MARKETING MESSAGES THEY USE TO RECRUIT THESE CUSTOMERS

   c. WHAT INFORMATION THEY PROVIDE ABOUT HOW THE PROGRAM WORKS, THE INCENTIVE LEVELS

   d. WHAT SORTS OF SITE VISITS THEY MAY DO AND WHAT THINGS THEY LOOK FOR WHEN THEY ARE ONSITE

   e. WHAT KIND OF ADVICE THEY PROVIDE CUSTOMERS ON HOW TO CURTAIL THEIR LOAD
f. WHAT SORTS OF ENERGY CONSUMPTION INFORMATION THEY COLLECT FROM THE CUSTOMERS TO DETERMINE THEIR SUITABILITY FOR THE PROGRAM, OR AS BASELINE INFORMATION]

55. Do you think the current balance between your company’s program marketing/outreach responsibilities and those of National Grid is the right balance?
   a. Why do you say that?

56. Have you been satisfied with your level of program recruitment?
   a. Why do you say that?

57. Do you think the resources devoted to marketing and outreach for this program are adequate for achieving program objectives?
   a. Why do you say that?

58. What do you think are the greatest barriers to the C&I customers participating in this program?

59. What would be some ways to help mitigate these program participation barriers?

60. In 2017 some of the CSPs thought the process for communicating and sharing sales leads between National Grid and the CSPs could be improved. Has the 2018 program made any improvements in this area?
   a. Why do you say that?

Program delivery

61. In 2017 some of the CSPs thought the program’s options for uploading customer data were not very user-friendly. Has the 2018 program made any improvements in this area?
   a. Why do you say that?

62. Using a five-point scale, where five equals “very satisfied” and one indicates “very dissatisfied”, how satisfied have you been with this program enrollment process?
   b. Why do you say that?

63. In 2018 have you made any changes in terms of how you notify customers of an upcoming load control event?
   c. [IF YES] What changes have you made?

64. Using this same five-point satisfaction scale [REPEAT SCALE IF NEEDED], how satisfied have you been with this control event notification process?
   d. Why do you say that?

65. Last year all the CSPs said that it took too long for them to get information about how their customers had performed in the load control events. In 2018, has the program made any improvements in this area?
   e. [IF YES] What improvements have been made?
66. Last year some of the CSPs said that the program wasn’t very accurate in forecasting when peak loads would occur. In 2018, has the program made any improvements in this area?

   f. [IF YES] What improvements have been made?

67. Last year we interviewed you before your customers received their incentive payments in October. Using this same five-point satisfaction scale [REPEAT SCALE IF NEEDED], how satisfied were you with the 2017 incentive payment process?

   a. Why do you say that?

68. In 2018 the program made it easier for customers to participate in both the ISO NE and Connected Solutions DR programs.

69. For those of your customers who are participating in both these programs, do you think that the incentives from the National Grid Connected Solutions program are encouraging them to curtail more often than they would be if they participated in the ISO New England demand response programs only?

70. Have your customers who participate in both the ISO NE and Connected Solutions DR programs been able to take advantage of the “stacked benefits” that are available for participation in multiple DR programs?

   a. Why do you say that?

**Impact of the load curtailment on program participants**

71. Do you think the program’s current incentive levels are adequate for compensating participants for any inconvenience stemming from the load curtailments?

   a. Why do you say that?

72. Have there been any indications (e.g., customer complaints, program drop-outs) that program participants are dissatisfied with the load control event(s)?

   a. [IF YES] What are these indications?

   b. [IF YES] What is the relative frequency of these complaints/dropouts?

**Summing up**

73. Using this same five-point satisfaction scale [REPEAT SCALE IF NEEDED], how satisfied have you been with this National Grid Connected Solutions as a whole? Why do you say that?

74. What aspects of the program have gone well?

75. What aspects of the program have gone less well?

76. Based on your experience with the pilot so far, what do you think would be the challenges of making this a full-scale program?

77. If you could do it over again, what changes would you make in the design or delivery of this program?
About DNV GL

DNV GL is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.