Meta-Analysis of the Regulated Price Plan Pilots: Output Data Sheets

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Introduction to the Output Data Sheets

This document acts as an appendix to Guidehouse's main report to the Ontario Energy Board (OEB) of its meta-analysis of the Regulated Price Plan (RPP) pilots deployed by four Ontario Local Distribution Companies (LDCs). That report is intended as a stand-alone document and may be read as such. This document – the Output Data Sheets (ODS) – is intended for readers particularly interested in understanding in detail the findings of Guidehouse's in-depth review of the pilot evaluation reports or the treatment-group specific scoring of the seven metrics used in the meta-analysis study.

This introduction is divided into three sections:

1. **How to Use the ODS.** A brief outline of the recommended manner in which this document should be used.
2. **What is Included in the ODS.** A summary of the different data fields included in the ODS.
3. **The Treatment Groups Characterized in the ODS.** A list of the treatment groups characterized in the ODS.

How to Use the ODS

The ODS is a supplementary document to Guidehouse's main report and represents the key information summarized in the main report and used to drive Guidehouse's recommendations. It is intended as a reference document to provide interested readers with additional detail on specific aspects of each of the treatment groups evaluated, and not as a narrative document to be read from start to finish. Importantly, analyses - findings, conclusions, and recommendations - have been concentrated in the accompanying report.

For example, readers particularly interested in Guidehouse's scoring of the Cost Minimizing metric and the analysis that drives that scoring may wish to consult that section of the ODS for each of the treatment groups of most interest. Readers interested in obtaining a more detailed description of, for example, the non-price treatments applied to the Oshawa Seasonal TOU with CPP treatment group may wish to review the detailed summary of that group. There is one ODS for each treatment group reviewed, and each of these ODS have been developed to be reviewed independently. As such, a linear progression through them may seem, in some cases, repetitive.

For example, the description of some elements of the London Hydro RT-Only treatment will be reproduced nearly exactly in the ODS for the London Hydro CPP and CPP/RT treatment group. This approach, though repetitive in a report document, is important for allowing each ODS to stand on its own, in a manner analogous to that which may be observed in energy efficiency Technical Reference Manuals (TRMs), which detail key inputs and assumptions used to derive prescriptive (deemed) savings for energy efficiency measures.

Much of the information included in the ODS is derived from the evaluations of each of the pilots conducted by each proponent LDC's technical contractor. These may be found online here:

https://www.oeb.ca/industry/policy-initiatives-and-consultations/regulated-price-plan-rpp

The evaluation reports are referred to often in the material below. In some cases, these are supplemented by other associated reporting documents. To avoid repeated citations cluttering the ODS, the citations for the evaluation reports are provided immediately below:

Alectra's final report

Alectra Utilities with its partner BEworks, *Regulated Price Plan Pilot – Final Report*, August 31, 2020

https://www.oeb.ca/sites/default/files/Alectra-RPP-roadmap-12-Month-Report-20200831.pdf

Other relevant Alectra reports:

Analysis of focus group findings:

> Ipsos Public Affairs on behalf of Alectra Utilities, *Advantage Power Pricing (APP) Qualitative Research Report*, October 2018

Interim process evaluation report:

> BEworks on behalf of Alectra Utilities, *Process Evaluation of the Regulated Pricing Pilot: Behavioural Diagnostics Session,* undated.

The draft 17-month report providing analysis of the five-month Dynamic pilot extension:

> Alectra with its partner BEworks, *Regulated Price Plan Pilot – Dynamic Pricing Final Report*, September 2020

CustomerFirst

Guidehouse (formerly Navigant) prepared for CustomerFirst, *CustomerFirst Regulated Price Plan Pilot Program: Final Report*, July 21, 2020

https://www.oeb.ca/sites/default/files/CustomerFirst-RPP-Pilot-Final-Evaluation-Report-20200721.pdf

Oshawa PUC's final report

Publicis.Sapient on behalf of Oshawa Power, *RPP Pilot Program – Final Results Report*, August 24th, 2020

https://www.oeb.ca/sites/default/files/OshawaPUC-RPP-Pilot-Final-Results-Report-20200824.pdf

London Hydro's final report

Guidehouse (formerly Navigant) on behalf of London Hydro, *Regulated Price Plan Roadmap Pilot Program Final Impact Evaluation*, April 21, 2020

https://www.oeb.ca/sites/default/files/LondonHydro-RPP-Pilot-Final-Evaluation-Report-20200421.pdf

What is Included in the ODS

Each ODS is divided into four main sections:

- **Treatment Group Summary.** This section summarizes – at a high level – some of the key features of each treatment group as well as the results of Guidehouse's meta-analysis – the scores set for each of the metrics of interest.
- **Treatment Detailed Description.** This section provides additional descriptive detail relevant to the treatment group, for example describing the functionality of enabling and informational technologies, providing a more detailed description of the LDC's customer engagement strategy in deploying the pilot, etc.
- **Pilot Report Findings.** This section summarizes the key findings relevant to the given treatment group, as recorded in that utility's evaluation report. In some cases, these key findings reflect Guidehouse's interpretation of the results reported for that treatment group, based both on its review of the evaluation reports and the context provided by Guidehouse's review of all the reports together.

- **Evaluation Metric Scoring.** This section of each ODS provides the results of Guidehouse's analysis in each of the seven metrics examined:
    - Cost Recovery
    - Cost Reflectiveness
    - Cost Minimizing
    - Predictable
    - Comprehensibility
    - Opportunities for Bill Savings
    - Ease of Implementation

  Note that before consulting these sections of the ODS, the reader should review the description of these metrics in the main report.

The Treatment Groups Characterized in the ODS

Altogether there are 10 treatment groups characterized in the ODS. They are:

1. Alectra Enhanced TOU
2. Alectra Dynamic (New and Legacy)
3. Alectra Overnight
4. CustomerFirst Enhanced TOU
5. CustomerFirst Seasonal TOU
6. London Hydro CPP and CPP/RT
7. London Hydro RT-Only
8. Oshawa Super-Peak
9. Oshawa Seasonal TOU with CPP
10. Oshawa Information Only

Alectra Enhanced TOU

Treatment Group Summary

Treatment Name	Enhanced TOU
LDC	Alectra
Period of Analysis	2018-05-01 through 2019-04-30[1]
Sample Size	~2,700 (Enhanced Pricing), + ~2,700 (Enhanced Pricing and Nudge Reports)[2]
Enrolment Type	Opt-Out

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

Provision of a monthly shadow bill and "Nudge" report (to half of pilot group and half of control group) which communicates: bill cost savings (or increases) as a result of pricing pilot participation, personalized tips for achieving energy savings goal, and provides personal benchmarking feedback to track on-peak consumption behaviour from month-to-month.

Customer Engagement

- **Recruitment:** random automatic selection – pilot design is *opt-out*, not opt-in; notified customers of participation through an official letter;
- **Retention:** online portal, letters, call-centre, e-mail, energy reduction pledge campaign (with incentive for making pledges), and survey participation incentives;

Price Treatments

- Larger On- to Off-Peak price differential (4:1) relative to status quo TOU pricing (2:1). On-Peak price set at 17.5 cents/kWh.
- Larger Mid- to Off-Peak price differential (3:1) relative to status quo TOU pricing (1.6:1). Mid-Peak price set at 13.2 cents/kWh.

Technology Treatments

Smart thermostats. Smart thermostats were not deployed as part of this pilot treatment group, though participants that registered their Energate or Nest thermostat[3] could receive automatic A/C curtailment during On-Peak periods. The technical contractor estimated technology impacts by comparing registered and unregistered participants' pilot-period consumption with a univariate regression. Fewer than 150 of the over 5,000 participants registered their thermostat.

[1] This is the "unprotected" period, the pilot period in which participants were billed according to the Enhanced TOU rates. The "protected" period, in which participants continued to be billed according to the status quo TOU rates began in November 2017 and ended at the end of April 2018. It should further be noted that the bill impact of Enhanced TOU prices were lagged by one billing period as they were applied as debits or credits on participant bills. See "Price Treatments" in the Treatment Detailed Description section below.
[2] Participant numbers include those that completed the pilot and were included in the final evaluation. Population presented does not include participants in the Control group, which accounted for ~3,000 participants.
[3] Honeywell and Ecobee devices could also be registered, but did not deliver any automatic curtailment.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	4	*Very little under- or over-collection relative to the RPA. Deviation in revenue collection is likely statistical noise.*
Short-Term Cost Reflectiveness	3	*This rate treatment is the 4th most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	3	*This rate treatment is the 4th most reflective long-term cost-reflective series.*
Cost Minimizing	2	*No statistically significant impacts mean this treatment delivers no system benefits.*
Predictability	4	*Treatment involves price periods and seasonal changes consistent with current customer expectations.*
Comprehensible	4	*Three price periods, consistent and regular, and 58% of participants claimed comprehension.*
Opportunities for Bill Savings – Realized	2	*Consumer bills increase slightly in summer but see larger decrease in winter*
Estimated Bill Savings Opportunities	1	*Consumer bills are estimated to increase due to the treatment; 2nd largest bill increase of treatments analysed.*
Ease of Implementation	5	*Requires only changes of prices for existing TOU period definitions, equivalent to changing status quo prices. Opt-out treatment reduces complexity; no enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

Provision of a monthly shadow bill and nudge report to pilot participants.

- **Shadow Bill**. Each participant received a monthly shadow bill. This was mailed in hard copy each billing period under a separate envelope from the actual TOU bill. The shadow bill compares the customer's total cost of electricity in the given billing period under status quo TOU rates with their total cost under the Enhanced TOU rate. The difference between these values (a debit or a credit) is applied to the participant's next bill.[4]
- **Nudge Report**. Half of the Enhanced participants were randomly allocated to receive a monthly "Nudge" report with their shadow bill. The report provided customers with feedback on their On-Peak electricity consumption in the prior billing period, relative to a household historical benchmark and provided personalized tips for saving energy. Note: Nudge reports were also provided to a random sample of half of the control participants.
  In addition to the approximately 2,700 participants that received nudge reports, approximately 3,000 control customers were also provided with nudge reports in order to allow the technical contractor to evaluate the impact of this treatment in isolation of the price treatment.
- **Energy Pledge.** For three months in the summer period (June through August 2018), nudge reports encouraged participants to take a "pledge" to reduce On-Peak consumption in exchange for a $5 bill credit incentive. Only 54 participants (about 2.5% of those that received the nudge reports) enrolled in the pledge.

Customer Engagement

Recruitment began August 1, 2017 and Enhanced TOU participants were randomly and automatically enrolled into the pilot. Seven thousand customers were initially enrolled in this rate (half receiving nudge reports, half not). Data cleaning and opt-outs resulted in a final analysis sample size of approximately 5,400 participants.

The automatic enrolment of customers in the Enhanced TOU pilot caused dissatisfaction for some customers, though participant attrition was relatively low (see below).

Enhanced TOU focus group analysis indicates that there was some confusion in the Enhanced TOU group about how the pilot rates worked a) because of the similarities to regular TOU pricing – in particular, the rate design graphic and b) because they were automatically added to the pilot and not opt-ins, and so were generally less informed about the program.

[4] Each participant's bill is the sum of the given billing period's charges under the status quo TOU rate and the debit or credit carried forward from the previous month's shadow bill – the difference between their status quo TOU cost and the Enhanced TOU cost in the previous month.

Alectra staff interviewed by Guidehouse, indicated that they believed that having the option to opt-out and a transitional risk-free period, wherein customers could try the new rates, was helpful in making customers feel confident that they were not committing to a rate that may end up costing more.

- **Recruitment**
  - *Official letter.* Mailed out an official letter to notify customers of their participation.
- **Retention**

  Online portal. Allows customers to view their usage online. The portal included the price schedule, graphical representation of daily and monthly usage by period, average daily temperature, program details and FAQs.
  Many customers were unaware this portal existed, while others were confused about whether it is separate from Alectra MyAccount portal (per the focus group analysis). The process evaluation presentation indicates that the purpose of the portal and how it can be used by customers to change consumption behaviour is not communicated upfront.
  - It is unclear the degree to which this portal was used by participants, and whether it delivered any value. It is referenced only once in the final evaluation report.
  - *Letters*. Accompanied the shadow bills and Nudge reports. Informed customers of any program updates, customer care centre hotline and e-mail addresses, the availability of the online portal, any billing adjustments or issues, etc. The process evaluation report identified that the lack of visual aid on the letters may have reduced attention capture and comprehension.
  - *E-mail blasts.* Used to offer customers incentives / bill credits in exchange for completing customer surveys. E-mails also included support channel hotline and e-mail. The process evaluation report mentioned that low personalization may reduce the perceived relevancy and lead customers to ignore the message.
  - *Support channels.* Customer care and support channels through e-mail and call-centre. Call centre services for the pilot were provided by a third-party vendor, meaning that when participants called Alectra's standard customer support line, inquiries regarding the pilot had to be diverted to this second call centre. The report notes that gaps in the knowledge overlap between the two call centres resulted in some customer inconvenience (and likely some customer frustration). This is echoed in the findings of the focus group analysis.
  - *Pledge campaign.* The initial cycles of nudge reports (June to August 2018) included a monetary offer whereby customers were asked to take a pledge to reduce their usage during On-Peak periods in return for a $5 credit on their next bill. Fifty-four Enhanced participants responded to the pledge and were eligible for the $5 incentive.

Price Treatments

Pricing Period	Commodity Rate (cents/kWh)	
	Standard RPP Consumers	Enhanced TOU Participants
Off-Peak 7 pm to 7 am, on weekdays 24 hours on weekends and holidays.	6.5	4.4
Mid-Peak 7am to 11am and 5pm to 7pm, summer weekdays 11am to 5pm, winter weekdays	9.4	13.2
On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 7pm, winter weekdays	13.2	17.5 (17.6)[5]

Note that Enhanced participants were not billed directly for their consumption under the Enhanced TOU rates. Rather, each month participants would receive *two* bills: their official Alectra bill (which they were required to pay each month as usual) and a shadow bill. The shadow bill provided a comparison of electricity costs incurred in the given billing month by the customer under both the Enhanced and the status quo rates. It then displayed the difference (either a savings or an increase). This difference was then carried forward to the next month's official bill as either a bill credit or debit.

Put another way, the financial consequences of the pilot differ somewhat from what would be experienced under a full deployment of the rate in that they are lagged by one month.

[5] On-Peak rate from May 2018 to October 2018 is 17.6 cents per kWh

Technology Treatments

Smart thermostats. Smart thermostats were not deployed as part of this pilot treatment group, though participants that registered their Energate or Nest thermostat[6] could receive automatic A/C curtailment during On-Peak periods. The technical contractor estimated technology impacts by comparing registered and unregistered participants' pilot-period consumption with a univariate regression. Fewer than 150 of the over 5,000 participants registered their thermostat.

This analysis found that participants with registered smart thermostats had a statistically significant lower demand during all TOU periods, winter and summer, as well as statistically significantly lower overall consumption. These results should be used with caution. The proportion of participants with the technology is very small suggesting that differences between the two groups may be largely a result of selection. This is reinforced by the magnitude of the estimated seasonal conservation (11% reduction in consumption in the summer, 12% reduction in the winter), given that most participants with central heat (and thus likely to own a smart thermostat) use natural gas for space heating. .

Participant Attrition

- **Enhanced TOU.** Of the 3,500 participants recruited to this group, 295, or approximately 8.5% opted out of the pilot, and an additional 429 participants moved away (and thus exited the pilot). Overall attrition for this treatment group was approximately 21%.
- **Enhanced TOU with nudge report.** Of the 3,500 participants recruited to this group, 287, or approximately 8% opted out of the pilot, and an additional 439 participants moved away (and thus exitd the pilot). Overall attrition for this treatment group was approximately 21%.
- **Enhanced TOU control group with nudge report.** Of the 3,500 participants recruited to this group, 82, or approximately 2.3% opted out of the pilot.

Pilot Report Findings

Price Treatment Key Findings

- The technical consultant's evaluation report found that there is no evidence that the Enhanced TOU pricing offered as part of the pilot is an effective means of reducing participant demand during the On-Peak period.
- None of the estimated demand impacts, by TOU period or by season, is statistically significant. This means that the hypothesis that the price plan left demand unaffected cannot be rejected at the 90% confidence level.
- The technical contractor estimated a daily own-price elasticity of -0.133 and a substitution elasticity between On-Peak and weekday overnight Off-Peak of -0.019.
- According to the focus group analysis of pilot participants, participants in the Enhanced TOU group were much less enthusiastic about the pilot than participants included in other price treatments. Participants that were dissatisfied with the level of realized bill savings identified that finding out more about the program was not a topic that warranted much effort given the other demands on participants' time.
- The same focus group analysis further found that:
    - Participant electricity bill savings did not meet expectations, and participants dissatisfied with their credit indicated that the amount of effort they felt they had expended did not "*seem worthwhile as compared to the savings*" they realized.
    - Participants that did not observe reductions in their bill that "*feel substantive*" indicated that they did not feel the pilot is worthwhile.

Non-Price Treatment Key Findings

- **Nudge Reports.** The Nudge reports were found to deliver modest, but statistically significant impacts in winter and in summer during some TOU periods. No statistically significant interaction was estimated between the price treatment and the Nudge reports (i.e., the average response to the Nudge report was the same for participants subject to the Enhanced TOU price plan as it was for those subject to the status quo TOU price plan).

[6] Honeywell and Ecobee devices could also be registered, but did not deliver any automatic curtailment.

- *Summer*. Nudge reports deliver a statistically significant -0.013 kW impact[7] (1.1%) during the On-Peak period.. Impacts in all other TOU periods, and for the summer season as a whole, were not statistically significant.
- *Winter*. Nudge reports deliver a statistically significant -0.008 kW impact (0.8%) during the On-Peak period, and an impact of -0.014 kW (1.6%) during the Mid-Peak period. Winter conservation impacts are not statistically significant.

- **Smart Thermostats**. The technical consultant estimated the impact of the smart thermostat simply by comparing the relevant period (e.g., On-Peak, Mid-Peak, etc.) demand across pilot participants during the pilot period with a univariate regression. No controls have been applied to account for the fact that smart thermostat registration is possible only for smart thermostat owners, and that smart thermostat owners are much less likely than non-smart thermostat owners (in the Alectra PowerStream service territory) to use electric heat, and more likely than non-smart thermostat owners to have central air-conditioning. Guidehouse recommends using caution in applying these estimated impacts.
  - *Summer*:
    - In the On-Peak, Mid-Peak, and Off-Peak periods of the pilot, the estimated impact of smart thermostat registration is presented as a statistically significant reduction of 0.144 (12.5%), 0.114 kW (10.6%), and 0.07 kW (7%), respectively.
    - The average demand of the ~150 participants with registered smart thermostats was approximately 0.11 kW (10.1%) less than that of the ~2,700 to 3,500 (sample size varies over time) participants without a registered smart thermostat.
  - *Winter:*
    - In the On-Peak, Mid-Peak, and Off-Peak periods of the pilot, the estimated impact of smart thermostat registration is presented as a statistically significant reduction of 0.128 (13.5%), 0.122 kW (14.2%), and 0.09 kW (10%), respectively.
    - The average demand of the ~150 participants with registered smart thermostats was approximately 0.115 kW (12.5%) less than that of the ~2,700 to 3,500 (sample size varies over time) participants without a registered smart thermostat.[8]
- **Pledges**. Only a trivial number of Enhanced pricing participants made an energy pledge – less than 2% of the participants that received a nudge report. The evaluation reports that participants that made a pledge had, on average, lower On-Peak demand than those that did not make a pledge. No indication is provided of the statistical significance of this estimate, and the report explicitly declines to make a causal link between the act of making a pledge and reduced demand.

Evaluation Metric Scoring

Cost Recovery	**4**
How effectively have the price plans recovered [embedded commodity] costs?	
The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[9] After making the adjustments for the Ontario Fair Hydro Plan (OFHP)	

[7] A negative estimated impact is a demand reduction. A positive estimated impact, unless referred to explicitly as a "savings" or "reduction", indicates an increase in demand.

[8] Note that although exact figures are not available, most of Alectra's PowerStream service territory customers have access to a natural gas connection. The very modest differences between average summer (average ~1 kW) and winter demand (average ~0.9 kW) also suggest that a large majority of Enhanced pricing participants and controls use natural gas as their primary space-heating fuel. The estimated impacts provided for smart thermostats should be treated with caution.

[9] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

Act, the average commodity price falls to $0.082/kWh.[10] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [11]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Enhanced TOU	$0.0812	$0.0813	-1%	-0.9%
Control[12]	N/A	N/A	N/A	N/A

Based on the evaluation report, it appears as though the price treatment is slightly under-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP. So small is the under-collection, in fact, that it may be that this is difference is simply the result of statisitical noise and forecast uncertainty.

In this case, the magnitude of the difference is so small that – given the inherent uncertainty associated with applying this sample out to a wider roll-out of a provincial rate – no adjustment to the core price-setting assumption (revenue neutrality under the assumption of no behaviour change) would be required unless participant response changed, and participants began responding to the rate by delivering statistically significant changes in demand.

Short-Term Cost Reflectiveness — 3

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This rate treatment is the 4th most reflective *short-term cost-reflective* series out of 10 and has been given a score of 3.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the short-term system cost than the status quo TOU. A positive value indicates that is more reflective of short-term system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-36%	-45%	-39%

The RMSE of this price series is 39% larger than that of the status quo price series, indicating that it is **less** reflective of short-term supply cost than the status quo price series.

[10] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf

[11] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

[12] Alectra's technical consultant did not provide figures for control group revenue adequacy in the evaluation report. Given the results of the analysis, and the comparison of mean pilot-period demand by period, however, it seems unlikely that the average revenue per kWh for the control group was statistically significantly different from that of the Enhanced TOU treatment group

Long-Term Cost Reflectiveness	**3**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the 4th most reflective *long-term cost-reflective* series out of 10 and has been given a score of 3.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
5%	-0.5%	2%

The RMSE of this price series is 2% smaller than that of the status quo price series, indicating that it is **more** reflective of long-term supply cost than the status quo price series.

Cost Minimizing	**2**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost Energy Benefits ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$0	$0	$1,005	0.00

Over the deployment period, the NPV of system benefits for the Alectra Enhanced TOU price plan, for a single participant enrolling at the start, is projected to be $0.

There are no significant coincident peak impacts to provide avoided capacity benefits, and no statistically significant price-related impacts on TOU period consumption. For the same period, the unit costs are estimated to be $222, excluding fixed costs for the utility incurred for all participants. For Alectra's treatments, decreases in recruitment/marketing costs relative to opt-in treatments were reported as a fixed recurring cost.

Piloted fixed costs that could not be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment. Costs are largely driven by customer communications, specifically the implementation of nudge reports.

Due to the lack of benefits for this treatment, the benefit / cost ratio is zero, regardless of costs.

Key Scaling Assumptions

Maximum Possible Market Share

Based on the proportion of the population residing in single-family households, the maximum possible market share assumed for this price treatment is 75%.

Achievable Market Share

For opt-out price treatments, Guidehouse assumed that 100% of the maximum market share (75%) is eligible for enrolment in the program. To account for annual program attrition rates (8%), the achievable market share is reduced in year 0 to 69%. Each year, the incremental provincial population (from population growth) is enrolled in the program.

Predictability	**4**

To what degree are prices predictable?

The Alectra Enhanced TOU treatment involves modifications to existing prices but does not alter the period definitions. No CPP events or variable peak pricing are involved. Price periods and seasonal changes in the Enhanced TOU treatment are consistent with current consumer expectations.

Changing prices for existing TOU periods is equivalent to changing status quo prices, as they are on an annual basis. Prices are regularly scheduled, and that schedule is the same as that of the status quo TOU price periods. The Enhanced TOU treatment, similar to current pricing, features fewer price periods per day than other treatments being evaluated.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
4	2

Comprehensible	**4**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

58% of participants indicated in the customer survey that remembering the new pricing plan structure was easy. Further, the price treatment has three rate periods which were consistent and regular.As discussed in the Customer Engagement section, Alectra had multiple customer support channels available to help customers understand the rate. Alectra also used a linear visual depiction of the rate, which has been shown to be more comprehensible compared to the status quo TOU circular "dial" diagram. The bill and shadow bill also showed the usage by price period, along with a comparison of the cost or savings.

Based on the above factors, the Enhanced treatment rated a score of ***4***, indicating that the price structure was reasonably comprehensible.

Realized Opportunity for Bill Savings	**2**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%)	-0.3%	0.9%
Bill Savings ($)	-$0.3	$0.4

The Alectra Enhanced treatment delivered the 7th highest summer bill savings, and the 3rd highest winter bill savings, of the 10 treatment groups analysed.

The treatment delivered an average of 0.3% monthly bill savings, resulting in a score of 2, none or minimal savings compared to other treatments.

Monthly bill savings during the winter offset the slight increase consumer's experienced on their summer bills. In both cases, the magnitude of absolute savings was small.[13] Bill savings were not, as part of the evaluation report, tested for statistical significance.

Potential Opportunity for Bill Savings	**1**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	-$0.9

The Alectra Enhanced treatment delivers the 9th highest estimated monthly bill savings opportunity through the pilot period (May 2018 to April 2019), of the 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill increase of $0.9, resulting in a score of 1, due to it delivering negative bill savings.

[13] In Alectra's evaluation report, percentage bill savings and absolute bill savings are calculated as the average of each respective metric across a six-month period. Participants experienced a range in bill savings, both positive and negative, resulting in an average bill savings that is relatively small.

Ease of Implementation	**5**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Enhanced TOU treatment involves the implementation of a price plan with price changes to existing TOU periods. As the definitions of the TOU periods do not change, the price changes for this treatment are equivalent to updates to status quo TOU prices as a result of the annual price-setting.

As this pricing structure involves only the changing of status quo pricing and does not alter period definitions or include other complexities (e.g., CPP events or variable peak pricing), this treatment would cause only slight disruptions to normal business operations, would require minimal consumer guidance.

The Enhanced TOU treatment is an opt-out treatment – opt-out treatments do not present the same recruitment challenges as opt-in treatments. Further, the treatment did not require any enabling technology installation.

Customer engagement efforts were less intensive for this treatment than others; engagement efforts included email blasts and an internal call centre, but no in-person events or focus groups.

For the above reasons, the Enhanced TOU treatment receives a score of **5.**

Alectra Dynamic (New and Legacy)

Treatment Group Summary

Treatment Name	Dynamic
LDC	Alectra
Period of Analysis	Legacy Dynamic: 2015-05-01 through 2019-09-30[14] Dynamic (New Participants): 2018-05-01 through 2019-09-30[15]
Sample Size	~700 (Dynamic – New Participants), ~1,500 (Dynamic – Legacy)[16]
Enrolment Type	Opt-In

NB: Legacy Dynamic participants were recruited long before the group of approximately 700 participants recruited for this pilot. These participants, due to their composition, their length of program tenure, and the evaluation exigencies are not a suitable comparison to the other pilots for the evaluation metrics or core results, though the difference in attrition is notable and is addressed below. All other sections of this ODS, unless explicitly noted, focus only on the findings associated with the participants recruited as part of this pilot.

The new participants of the Dynamic treatment group were also subject to the program treatment for five months longer than the participants of all other treatment groups. Discussion of these impacts is presented below in the "Pilot Report Findings", but these extended impacts are not *included in the calculation of the metrics. As the purpose of these metrics is to allow a quantitative comparison across pilots, it would be inappropriate to include the results of the final 5 months in calculating these metrics.*

Summary Description of Treatments Applied

Informational Treatments
Enabling Information
Provision of a monthly shadow bill and nudge report (to half of pilot group and half of control group) which communicates: bill cost savings (or increases) as a result of pricing pilot participation, personalized tips for achieving energy savings goal, and provides personal benchmarking feedback to track on-peak consumption behaviour from month-to-month.
Customer Engagement
• **Recruitment:** targeted engagement only (no mass market) – pilot is an opt-in; email, direct mail, brochures; website • **Retention:** online portal, letters, call-centre, e-mail, energy reduction pledge campaign (with incentive for making pledges), and survey participation incentives
Price Treatments
• Variable peak price from 3pm to 9pm that will either be Low (2:1, ~10 cents/kWh) , Medium (4:1, ~20 cents/kWh), High (8:1, ~40 cents/kWh), or CPP (10:1, ~50 cents/kWh) depending on system conditions. The price on any given day is communicated via email or text message on the previous day. • Critical Peak Periods (CPP) – maximum of 6 summer (summer of 2018) and 6 winter, lasting 4 hours each. A minimum of two hours notice is given before a CPP event. In the summer of 2019, new Dynamic participants were randomly allocated to two groups, one of which was subject to 6 summer CPP events, the other of which was subject to 9 summer CPP events.
Technology Treatments
Smart thermostats. Some participants (approximately 70) obtained Energate thermostats directly from Alectra – these were automatically registered. Other participants with existing EcoBee, Honeywell, or Nest thermostats could register their thermostats to receive automatic HVAC curtailment during the daily peak

[14] The "unprotected" period – the period in which bill protection is removed – began 2018-05-01.
[15] This is the "unprotected" period, the pilot period in which participants were billed according to the Dynamic prices. The "protected" period, in which participants continued to be billed according to the status quo TOU rates began in November 2017 and ended at the end of April 2018. Note that the Dynamic treatment group was extended for an additional five months (to the end of the summer of 2019). To ensure comparability of results with those of the other pilots, which were all complete by May 2019, only the results from the first 12 months are reported here. Impacts reported in the additional five months of the pilot extension are discussed in the main report body.
[16] Includes legacy participants recruited no later than May 4th, 2016, or, as they are referred to in the evaluation report: Registration Bin 1 and Registration Bin 2. Only 55 legacy participants were enrolled after June 1, 2016 and were not included in the evaluation.

period periods. The technical contractor estimated technology impacts by comparing registered and unregistered participants' pilot-period consumption with a univariate regression. Approximately 160 of the over 700 participants registered their thermostat.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	2	*This rate under-collects by 4.1%. It seems likely that this under-collection is due to the substantial estimated participant behaviour changes..*
Short-Term Cost Reflectiveness	1	*This rate treatment is the least reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	5	*This rate treatment is the most reflective of long-term costs.*
Cost Minimizing	1	*2nd largest per-participant benefits of all treatments considered. Majority of benefits are for avoided capacity due to CPP events.*
Predictability	1	*Treatment involves Variable Peak Pricing, where peak pricing is determined according to system conditions. This treatment is the least predicable, as the prices experienced by customers is determined daily.*
Comprehensible	2	*Three varying On-Peak prices plus CPP events introduced some element of inconsistency and irregularity in terms of timing. 64% of participants claimed comprehension.*
Opportunities for Bill Savings – Realized	4	*Moderately-sized bill savings available in both the summer and winter seasons*
Estimated Bill Savings Opportunities	5	*Estimated to deliver the highest bill savings of all treatments analysed.*
Ease of Implementation	1	*Treatment requires changes to both prices and period definitions, as well as the implementation of CPP events and a variable peak pricing period. Opt-in treatment requires significant recruitment efforts; installation/maintenance of enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

Provision of a monthly shadow bill and nudge report to pilot participants.

- **Shadow Bill**. Each participant received a monthly shadow bill. This is mailed in hard copy each billing period under a separate envelope from the actual TOU bill. The shadow bill compares the customer's total cost of electricity in the given billing period under status quo TOU rates with their total cost under the Dynamic TOU rate. The difference between these values (a debit or a credit) is applied to the participant's next bill.[17]
- **Nudge Report**. Half of the Dynamic participants were randomly allocated to receive a monthly "nudge" report with their shadow bill. The report provided customers with feedback on their On-Peak electricity consumption in the prior billing period relative to a household historical benchmark and provided personalized tips for saving energy. Note: nudge reports were also provided to a random sample of half of the control participants.
- **Energy Pledge.** For three months in the summer period (June through August 2018), nudge reports encouraged participants to take a "pledge" to reduce On-Peak consumption in exchange for a $5 bill credit incentive. Only 24 participants (about 7% of those that received the nudge reports) enrolled in the pledge.

Customer Engagement

Recruitment began October 1, 2017 for the Dynamic group and customers had to opt-in to the pilot. 770 were initially enrolled in this rate (half receiving nudge reports, half not). Data cleaning and opt-outs resulted in a final analysis sample size of approximately 700 participants.

[17] Each participant's bill is the sum of the given billing period's charges under the status quo TOU rate and the debit or credit carried forward from the previous month's shadow bill – the difference between their status quo TOU cost and the Dynamic TOU cost in the previous month.

Alectra staff interviewed by Guidehouse, indicated that they believed that having the option to opt-out and a transitional risk-free period, wherein customers could try the new rates, was helpful in making customers feel confident that they were not committing to a rate that may end up costing more.

- **Recruitment**
  - *Email.* E-mail to customers contained a direct link to the website for signing up. Alectra indicated during the interview that e-mail was most successful recruiting channel, especially from a cost-effectiveness perspective.
  - *Direct mail out and brochures.* Mailed out marketing materials to provide detailed information and encourage participation in the pilots. The process evaluation report reveals that the brochures presented too much information and could be framed better from the customer's perspective. The direct mailer compared different rate plans and was price-focused, rather than lifestyle focused.
  - *Website.* Provided program overview, price plans, FAQs, an overview of tools available for customers, and registration link. The process evaluation report indicates that while all information was readily available, it was difficult to parse through the amount of information presented to customers. Tangible benefits of the program were not highlighted upfront.
  - *Social media.* Alectra indicated that social media was not very effective.
- **Retention**

  Online portal. Allows customers to view their usage online. The portal included the price schedule, graphical representation of daily and monthly usage by period, average daily temperature, program details and FAQs.
  Many customers were unaware this portal existed, while others were confused about whether it is separate from Alectra MyAccount portal (per the focus group analysis). The process evaluation presentation indicates that the purpose of the portal and how it can be used by customers to change consumption behaviour is not communicated upfront.
  It is unclear the degree to which this portal was used by participants, and whether it delivered any value. It is referenced only twice in the evaluation report.
  - *Letters*. Accompany the shadow bills and nudge reports. Inform customers of any program updates, customer care centre hotline and e-mail, availability of the online portal, any billing adjustments or issues etc. The process evaluation report identified that the lack of visual aid on the letters may reduce attention capture and comprehension.
  - *E-mail blasts.* Used to offer customers incentives / bill credits in exchange for completing customer surveys and/or registering any existing thermostats or obtaining an Energate thermostat free of charge. E-mails also included support channel hotline and e-mail. The process evaluation report mentioned that low personalization may reduce the perceived relevancy and lead customers to ignore the message.
  - *Support channels.* Customer care and support channels through e-mail and call-centre. Call centre services for the pilot were provided by a third-party vendor, meaning that when participants called Alectra's standard customer support line, inquiries regarding the pilot had to be diverted to this second call centre. The report notes that gaps in the knowledge overlap between the two call centres resulted in some customer inconvenience (and likely some customer frustration). This is echoed in the findings of the focus group analysis.
  - *Daily pricing e-mails or texts.* Emails or texts sent to participants daily with details on daily pricing
  - *Pledge campaign.* The initial cycles of nudge reports (June to August 2018) included a monetary offer whereby customers were asked to take a pledge to reduce their usage during On-Peak periods in return for a $5 credit on their next bill. Twenty-four Dynamic participants responded to the pledge and were eligible for the $5 incentive.

Price Treatments

Pricing Period	Commodity Cost (cents/kWh)	
	Standard RPP Consumers	Variable Peak Pricing Consumers
Status Quo Off-Peak 7 pm to 7 am, on weekdays 24 hours on weekends and holidays.	6.5	N/A
Dynamic Off-Peak Weekdays: 12am-3pm and 9pm-12am Weekends: all day	N/A	4.9
Status Quo Mid-Peak 7am to 11am and 5pm to 7pm, summer weekdays 11am to 5pm, winter weekdays	9.4	N/A
Status Quo On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 7pm, winter weekdays	13.2	N/A
Dynamic Low On-Peak ~50% of Weekdays: 3pm-9pm	N/A	10.0
Dynamic Medium On-Peak ~30% of Weekdays: 3pm-9pm	N/A	19.9
Dynamic High On-Peak ~20% of Weekdays: 3pm-9pm	N/A	39.8
Dynamic Critical Peak Price On the top six system peak days in summer and winter respectively, each event lasting four hours. Start time of events determined by peak demand hour of event day.	N/A	49.8

Note that the proportion of days allocated to the High-, Medium- or Low-price period provided above are the assumed proportions used for rate-setting purposes and assume perfect foresight. The actually observed distribution differed slightly from that used for price-setting. The maximum observed deviation between percentage of days planned for and percentage of days called occurred in the winter, for Medium price days: the goal was for 30% of eligible days to be Medium price whereas only 27% of eligible days were in fact Medium price days.

Technology Treatments

Smart thermostats. Some participants (approximately 70) obtained Energate thermostats directly from Alectra – these were automatically registered with Alectra for automatic curtailment during the daily peak period or critical peak pricing events.

Other participants with existing Ecobee or Nest thermostats[18] could register their thermostats to receive automatic A/C curtailment during the daily peak period periods. The specifics vary by device:

- **Energate.** Participants identify a "comfort setting" for the device. The device then adjusts the thermostat set-point as a function of the comfort setting and the price signal sent by Alectra (Critical, High, Medium, Low). Of the 683 participants included in the summer 2018 analysis, 72 had registered Energate thermostats. Of the 428 participants included in the summer 2019 analysis, 43 had registered Energate thermostats.
- **Ecobee.** Participants with registered devices had their A/C units cycled[19] during peak price periods, as a function of the price. Cycling ranged from 50% (Low price periods) to as high as 80% (Critical peak events). Of the 683 participants included in the summer analysis, 31 had registered Ecobee thermostats. Of the 428 participants included in the summer 2019 analysis, 18 had registered Ecobee thermostats.

[18] Honeywell devices were eligible to participate and be registered, though none were.
[19] "Cycling" is a standard approach for residential A/C direct load control. Cycling levels are typically presented as percentages representing the maximum allowable run-time for the A/C compressor in a given hour. E.g., with 50% cycling, the thermostat will only allow the A/C compressor to run at most 30 minutes out of every hour.

Nest. Participants with registered devices had their A/C units cycled[20] during Critical peak periods, but not during the standard price (High, Medium, Low) peak period. Of the 683 participants included in the summer analysis, 53 had registered Nest thermostats. Of the 428 participants included in the summer 2019 analysis, 22 had registered Nest thermostats.

Impacts from the technology treatment were estimated by the technical contractor by comparing participants with registered devices to those without registered devices during the program period with a univariate regression. The reported impacts should be used with caution.

Participant Attrition

- **Dynamic.** Of the 385 participants recruited to this group, 59, or approximately 15.3% opted out of the pilot by the end of the initial 12-month period. An additional 17 participants (4.4%) moved out in the pilot period. Between the end of the initial 12-month period and the end of the extended 17-month period, an additional 7 participants opted out and an additional 13 participants moved out. Altogether 205 participants were included in the analysis of the summer of 2019.
- **Dynamic with Nudge report.** Of the 385 participants recruited to this group, 67, or approximately 17.4% opted out of the pilot. An additional 10 participants (2.6%) moved out in the pilot period. Between the end of the initial 12-month period and the end of the extended 17-month period, an additional 9 participants opted out and an additional 7 participants moved out. Altogether 223 participants were included in the analysis of the summer of 2019.
- **Dynamic control group with Nudge report.** Of the 385 participants recruited to this group, 5, or approximately 1.3% opted out of the pilot. An additional 28 participants (7.3%) moved out in the pilot period. Between the end of the initial 12-month period and the end of the extended 17-month period, an additional 4 participants opted out and an additional 13 participants moved out. Altogether 322 participants were included in the analysis of the summer of 2019.
- **Legacy Dynamic.** Of the 1,489 participants from Registration Bin 1 and 2 recruited to this group, 82, or approximately 5.5% opted out of the pilot. An additional 141 participants (9.4%) moved out in the pilot period.

Pilot Report Findings

Price Treatment Key Findings – Daily Pricing

- The technical contractor's evaluation report estimated statistically significant reductions during the variable pricing period (3pm to 9pm) for *all* price levels (Low, Medium, High) during the initial 12-month period, but no statistically significant impacts during the Off-Peak period. The impact of the Low price period in the five-month extended period was also found not to be statistically significant.
- **Summer 2018**:
  - High Price (20% of days[21]). A 0.26 kW (13%) reduction.
  - Medium Price (28% of days). A 0.186 kW (11.2%) reduction.
  - Low Price (52% of days). A 0.069 kW (6.3%) reduction
- Summer 2019:
  - High Price[22] (24% of days). A 0.15 kW (8.5%) reduction.
  - Medium Price (36% of days). A 0.115 kW (8.8%) reduction.
  - Low Price (40% of days). A 0.045 kW (4.5%) reduction. This impact is not statistically significant.
- **Winter[23]**:
  - High Price (22% of days). A 0.122 kW (10.6%) reduction.
  - Medium Price (27% of days). A 0.085 kW (7.7%) reduction.

[20] Curtailment was implemented via Nest's "Rush Hour Rewards" program. Google's support website indicates that "*cooling is turned off at specific times to minimize the use of your system during peak energy demand*" suggesting that curtailment is delivered via cycling, but no additional detail regarding the aggressiveness of the cycling strategy is provided.
Google Nest Help, *How Nest thermostats work with Rush Hour Rewards*, accessed September 2020 https://support.google.com/googlenest/answer/9749812?hl=en&visit_id=637382752155230121-375951719&rd=1

[21] Percentage of seasonal non-holiday weekdays where the given price was applied during the variable peak period from 3pm to 9pm, prevailing time.

[22] The evaluation report identifies a slightly different percentage of days as being High for the group subject to 6 as opposed to 9 CPP events in the extended period of summer 2019 with the group subject to 9 CPP events subject to one more Medium day and one less High day than the group subject to 6 CPP events.

[23] Winter impacts are those derived from the models estimated by Alectra's technical contractor where the dependent variable is the difference between average unprotected pilot period demand and pre-pilot period demand. This is the case for all winter impacts unless otherwise explicitly noted.

- Low Price (51% of days). A 0.069 kW (6.6%) reduction.

- The evaluation report indicates that despite statistically significant reductions in all non-Off-Peak periods[24], the winter conservation impact is not statistically significant. The summer conservation impact is reported as an average statistically significant reduction of 0.024 kW (2.4%), while the year-round conservation impact is reported to be a statistically significant 0.026 kW (2.1%) reduction.[25]
- The key finding of the 5-month extension to the period of analysis is that variable peak period response fell considerably in the second summer to which participants were subject to it.
- The technical contractor estimated a daily own-price elasticity of -0.151 and a substitution elasticity between On-Peak and Off-Peak of -0.054.

Price Treatment Key Findings – Critical Peak Event Pricing

- The estimated impacts on all critical peak events (winter and summer) were statistically significant.
- **Summer 2018**: the average estimated impact during critical peak events was between 0.282 kW (13.9%) and 0.407 kW (24.1%), with an average across events of 0.354 kW (17.2%).
- **Winter**: the average estimated impact during critical peak events was between 0.094 kW (8.1%) and 0.32 kW (20.3%), with an average across events of 0.168 kW (12.9%).
- **Summer 2018**:
  - 6 Event Group: the average estimated impact during critical peak events was between (a statistically non-significant) 0.07 kW (6.6%) and 0.496 kW (21.6%), with an average across the 6 events of 0.367 kW (19%).
  - 9 Event Group: the average estimated impact during critical peak events was between (a statistically non-significant) 0.06 kW (5.6%) and 0.436 kW (23%), with an average across the 9 events of 0.349 kW (18.8%).
- The key finding of the 5-month extension to the period of analysis is that critical peak period response does not seem to vary materially whether participants are subject to 6 or to 9 events, and that critical peak response *improved* in the summer of 2019 compared to the summer of 2018. This is in direct contrast to the variable peak response which diminished considerably. The evaluation report presents no hypothesis for the directional difference in these behavioural changes.

Note that these results all combine a mix of purely behavioural response and response enabled by smart thermostats registered by participants with Alectra to deliver automatic curtailment during critical price periods.

Non-Price Treatment Key Findings

- **Nudge Reports.** Overall, the Nudge reports appear to have been ineffective in impacting demand. Nearly all Nudge effects were statistically non-significant. The only exceptions were during two Critical peak events (one in summer, one in winter), however, the average incremental impact of the Nudge reports across Critical peak price events was not statistically significant.
- **Smart Thermostats**.
  The technical consultant estimated the impact of the smart thermostat simply by comparing the relevant period (e.g., High, Medium, etc.) demand across pilot participants during the pilot period with a univariate regression. No controls have been applied to account for the fact that smart thermostat registration is possible only for smart thermostat owners, and that smart thermostat owners are much less likely than non-smart thermostat owners (in the Alectra PowerStream service territory) to use electric heat, and more likely than non-smart thermostat owners to have central air-conditioning. Guidehouse recommends using caution in applying these estimated impacts.
  - *Summer 2018 – Variable Peak Period (3pm – 9pm)*.:
    - None of the estimated incremental impacts of thermostat registration on participant demand during any price period is statistically significant.
  - *Summer 2018 – Critical Peak Events*
    - The incremental impact of thermostat registration was statistically significant for two summer events, but not, on average, across all events. The estimated incremental impacts of the smart thermostat on the two CPP days on which the estimate was statistically significant were 0.23 kW (10.6%) and 0.18 kW (13.3%).
  - *Winter– Variable Peak Period (3pm – 9pm)*:

[24] The winter Off-Peak impact estimate was a statistically non-significant average increase of 0.001 kW, or 0.1%.
[25] These conservation impacts may be flawed – the estimated annual effect should be some weighted average of the summer and winter effects and so should not therefore be higher than the maximum of those two values.

- The evaluation reports a statistically significant incremental impact on reductions from smart thermostat registrations in *all* price periods, including the discounted Off-Peak period.
- Estimated impacts are remarkably consistent across events and do not seem much affected by the period price (the estimated kW reduction during the Off-Peak is identical to that in the Medium-priced peak periods).
  - High: 0.145 kW (13.7%)
  - Medium: 0.11 kW (10.6%)
  - Low: 0.11 kW (10.8%)
  - Off-Peak: 0.11 kW (12.2%)

o *Winter – Critical Peak Events*

- The estimated average impact across Critical peak is a statistically significant reduction of 0.145 kW (12.3%). Estimated reductions range between 0.07 kW (5.6%, not statistically significant), and 0.22 kW (19.5%).
  .

o *Summer 2019 – Variable Peak Period (3pm – 9pm)*.:

- None of the estimated incremental impacts of thermostat registration on participant demand during any price period is statistically significant.

o *Summer 2019 – Critical Peak Events*

- The incremental impact of thermostat registration was statistically significant for three summer events, but not, on average, across all events. The estimated incremental impacts of the smart thermostat on the three CPP days on which the estimate was statistically significant were 0.348 kW (18.3%), 0.457 kW (24.5%), and 0.387 kW (24.7%).

o As suggested above, the analysis that drives these results may be affected by selection or model specification issues. The results above are generally inconsistent with what would normally be expected of thermostat curtailment deployed to a group of program participants with central A/C and natural gas fired space heat. Examples from other jurisdictions and a more detailed discussion may be found in the body of the main report.

- **Pledges**. Only a very small number of Dynamic pricing participants made an energy pledge – approximately 7% of the participants that received a Nudge report. The evaluation report does not present any impacts of the pledge as statistically significant.

Evaluation Metric Scoring

Cost Recovery	**2**
How effectively have the price plans recovered [embedded commodity] costs?	

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[26] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[27] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [28]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU

[26] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf
[27] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf
[28] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

Dynamic	$0.0786	$0.0816	-4.1%	-0.5%
Control[29]	N/A	N/A	N/A	N/A

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour – is materially under-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP. The average revenue collected from this treatment group is approximately 4.1% less than required to deliver the provincial average RPP cost.

This under-collection has two[30] identifiable elements: behavioural, and rate-structural.

- **Behavioural.** The top row of the right-most column indicates the percentage under-collection due to the changes in behaviour. If participants had paid the status quo TOU rate, but still changed their behaviour as they did in response to the pilot price plan, then on average Alectra would have under-collected by only 0.5%. This suggests that either participants did not make any really significant changes in behaviour, or that their behavioural changes were off-setting. Given that statistically significant impacts were estimated for all non-Off-Peak periods in the first twelve months of this pilot, it must be the latter – the mix of response by period, and the manner in which the APP period crosses the status quo On-Peak, Mid-Peak and Off-Peak periods results in no net change in revenue, assuming the observed behaviour took place under the status quo price plan.
- **Rate-Structural.** The total under-collection is 4.1%. Given the uncertainty associated with the behavioural under collection it is unclear how much of this under-collection can be ascribed to the pricing structure and how much to participant response to the dynamic price signals.

Historically, the approach to setting prices in Ontario has followed the principle that changes in rate structure must be revenue neutral to the provincial average, *assuming no changes in behaviour*. The question of cost-recovery addressed above identifies to what degree this is a reasonable and sustainable approach to price-setting for a wider deployment of the piloted rate.

In this case, the magnitude of the difference is material. The under-collection is of sufficient magnitude that should this price plan be considered for wider deployment, some consideration should be given for adjusting the price-setting approach to account for some change in participant behaviour, as well as the difference in the underlying load profile of the consumers that self-select into this price plan, compared to the average RPP consumer (the profile of which is used to set prices).

Short-Term Cost Reflectiveness	**1**
Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?	

This rate treatment is the least reflective *short-term cost-reflective* series out of 10 and thus has been given a score of 1.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the

[29] Alectra's technical consultant did not provide figures for control group revenue adequacy in the evaluation report.
[30] No assessment of jurisdictional under- or over-collection is possible as no value for average revenue is provided for control customers. Given the results of the Enhanced TOU rate treatment, it seems likely that the jurisdictional under- or over-collection is sufficiently small to not be a major concern.

charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-182%	-143%	-158%

The RMSE of this price series is 158% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**5**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the most reflective *long-term cost-reflective* series out of 10 and has been given a score of 5.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
25%	-56%	6%

The RMSE of this price series is 6% smaller than that of the status quo price series, indicating that it is **more** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	**4**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$4	$87	$281	0.32

Over the deployment period, the NPV of system benefits for the Alectra Dynamic price plan, for a single participant enrolling at the start, is projected to be $325.

For the same period, the unit costs are estimated to be $406, excluding fixed costs for the utility incurred for all participants. Piloted fixed costs that could not be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment. For Alectra's treatments, increases in recruitment/marketing costs over opt-out treatments were reported as a fixed recurring cost.

Based on the assumptions below, the estimated benefit/cost ratio of this rate treatment, accounting for changes assumed to the treatment group design for full deployment makes it the 2nd- most cost-effective treatment group out of the 10 considered.

The table below summarizes scaling factors applied by Guidehouse to the pilot costs provided by Alectra, for the purposes of defining the fixed and variable costs of a wider roll-out.

Cost Category	**Aggregate Scaling Factor**	**Description**
Overhead	10%	Substantial effort was required to set up the program; less was required once it was operational. These operational tasks would generally be covered through existing staff if it were run as a separate price plan, though presumably some extra effort would be required if multiple billing approaches needed to be supported
Communication	80%	Most costs are unaffected by provincial deployment, although no risk-free periods per customer are assumed at provincial deployment, reducing the required communications budget.
Technology	100%	Bulk-purchased technology and deployment could realize economies of scale, or program design could obviate these costs. For example, the cost of technology such as thermostats could potentially be covered through other programs at scale. These reductions have not been considered for this analysis.

Key Scaling Assumptions

Maximum Possible Market Share

The maximum possible market share for the Alectra Dynamic rate is based on actual enrolment values for the Oklahoma Gas & Electric 'Smart Hours' program, a very similar critical peak pricing treatment.[31] As of 2016, approximately 15% of residential customers were enrolled in this program.

Achievable Market Share

For opt-in price treatments, Guidehouse estimated annual enrolment using an S-shaped diffusion curve, consistent with those used in the 2019 Conservation Achievable Potential Study.

Predictability	**1**

To what degree are prices predictable?

The Alectra Dynamic treatment involves the modification of pricing and period definitions from status quo, CPP events, and variable peak pricing. Both variable peak pricing and CPP events are determined according to system conditions. This treatment is the least predicable relative to treatments without variable peak pricing or CPP events only, due to the increased number of different prices experienced by customers.

Customers were subject to 12 CPP events, receiving 24 hours' notice prior to the event. CPP events are inherently dependent on system conditions and are therefore less predictable.

For variable peak pricing, customers are notified the day prior regarding the on-peak price in the given day. The price varies between three on-peak prices; this increased level of complexity further reduces predictability for consumers.

Comprehensible	**2**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

64% of participants indicated in the customer survey that remembering the new pricing plan structure was easy. Further, the price treatment has three variable Peak price periods in addition to an Off-Peak period and CPP. As discussed in the Customer Engagement section, Alectra had multiple customer support channels available to help customers understand the rate. Alectra also used a linear visual depiction of the rate, which is more comprehensible compared to the status quo TOU "clock" diagram. The bill and shadow bill also showed the usage by price period, along with a comparison of the cost or savings.

Based on the above factors, the Dynamic treatment rated a score of **2**, indicating that the price plan was the least comprehensible relative to other price plans.

[31]Oklahoma Gas & Electric. *2016 Oklahoma Demand Programs Annual Report* https://www.occeweb.com/PU/EnergyEfficiency/2016OGE_DemandProgramsAnnualReport.pdf

Realized Opportunity for Bill Savings	**4**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%)	3.9%	5.4%
Bill Savings ($)	$0.3	$2.7

The Alectra Dynamic treatment had the 2nd highest summer monthly bill savings, and the 2nd highest winter bill savings, of the 10 treatment groups. The Alectra Dynamic treatment delivered an average of 4.6% bill savings, resulting in a score of 4, moderate bill savings compared with other treatments.

Over two summer months (July and August), the Alectra Dynamic treatment saw large increases in customer bills, with bills increasing 23.1% and 16.7% respectively. All CPP events for the Dynamic treatment occur in July and August. All remaining summer months delivered bill savings to customers. The average monthly bill savings for the entire season are positive, but small in magnitude. This suggests that customers are accruing bill savings for months which do not contain CPP events (i.e. are responding to the variable peak pricing), but these savings are offset during months with CPP events.

Potential Opportunity for Bill Savings	**5**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$6.9

The Alectra Dynamic treatment delivers the highest estimated monthly bill savings opportunity through the pilot period (May 2018 to April 2019), of all 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill savings of $6.9, resulting in a score of 5, monthly bill savings exceeding $5.

Ease of Implementation	**1**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Alectra Dynamic treatment involves the implementation of variable peak pricing, CPP events, and the modification of existing status quo period definitions.

There was a wide range of perceived costs among LDCs for implementing price and/or TOU period definition changes. Many respondents did not believe this would pose significant time or cost challenges (<$100,000 and ~3-6 months), while others reported larger challenges (>$1,000,000 and > 6 months). The majority of respondents indicated additional required systems enhancements, e.g., the MDM/R and Operational Data Store, including customer interaction channels, bill printing, how rate switching would be handled, and additional customer education and support.

The inclusion of CPP events further increases the complexity of this price plan. LDC survey respondents reported substantially increased cost estimates for the price plans with CPP events relative to those without. While several still feel this is a <$100,000 endeavour, this cost is not consistent with our expectations of the level of complexity and required effort. Conversely, the two largest utilities, who utilize market leading CIS platforms (SAP and Oracle), indicated >$1,000,000 potential cost. The implementation of variable peak pricing is expected to be similar to implementing CPP events, due to the dynamic nature of the prices and the need to send appropriate signals to customers.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. This treatment involved the installation of hardware, which was a substantial effort for pilot proponents, who spent resources on hardware selection and ensuring that devices were functioning correctly. Pilot proponents expressed that the deployment of hardware may be streamlined at scale - for example, including relying on existing programs for Smart Thermostats, or relying on self-installation of hardware.

For the above reasons, the Dynamic treatment receives a score of **1.**

Alectra Overnight

Treatment Group Summary

Treatment Name	Overnight
LDC	Alectra
Period of Analysis	2018-05-01 through 2019-04-30[32]
Sample Size	~300
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

Provision of a monthly shadow bill which communicate bill cost savings (or increases) as a result of pricing pilot participation.

Customer Engagement

- **Recruitment:** targeted engagement only (no mass market) – pilot is an opt-in; email, direct mail, brochures; website
- **Retention:** online portal, letters, call-centre, e-mail, and survey participation incentives

Price Treatments

- An additional "Super" Off-Peak lower-priced period from 12am to 6am all year round, coupled with higher Mid- and On-peak rates
  - $0.065/kWh and $0.02/kWh for Off-Peak and Overnight Off-Peak, respectively
  - $0.092/kWh for Mid-Peak
  - $0.184/kWh for On-Peak

Technology Treatments

Smart thermostats. Smart thermostats were not deployed as part of this pilot treatment group, though participants that registered their Energate or Nest thermostat[33] could receive automatic A/C curtailment during On-Peak periods.

[32] This is the "unprotected" period, the pilot period in which participants were billed according to the Overnight rates. The "protected" period, in which participants continued to be billed according to the status quo TOU rates began in November 2017 and ended at the end of April 2018. It should further be noted that the bill impact of Overnight prices was lagged by one billing period as they were applied as debits or credits on participant bills. See "Price Treatments" in the Treatment Detailed Description section below.

[33] Honeywell and Ecobee devices could also be registered but did not deliver any automatic curtailment.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	1	*On average the rate under-collects RPA by 15%. The combined effect of the increased consumption in the lowest priced periods and the substantial drop in the price of the lowest price periods means that revenues collected by this price plan are much lower than the RPA..*
Short-Term Cost Reflectiveness	2	*This rate treatment is the 7th most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	3	*This rate treatment is the 6th most reflective long-term cost-reflective series.*
Cost Minimizing	1	*Negative avoided energy benefits due to increased overnight consumption that were greater than the avoided capacity benefit.*
Predictability	3	*Treatment involves additional price periods in each day, which customers must be aware of. Due to the additional number of periods, Customers experience more frequent price changes.*
Comprehensible	4	*Addition of an overnight period results in a total of four rate periods. Timing is consistent and regular, and 58% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	5	*Largest available bill savings of all treatments analysed, in both summer and winter seasons*
Estimated Bill Savings Opportunities	5	*Second largest estimated bill savings of all treatments analysed.*
Ease of Implementation	4	*Treatment requires changes to both prices and period definitions. Some period definitions may require some regulatory updates to ensure compliance. Opt-in treatment requires significant recruitment efforts; no enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

Shadow Bill. Each participant received a monthly shadow bill. This is mailed in hard copy each billing period under a separate envelope from the actual TOU bill. The shadow bill compares the customer's total cost of electricity in the given billing period under status quo TOU rates with their total cost under the Overnight TOU rate. The difference between these values (a debit or a credit) is applied to the participant's next bill.[34]

Customer Engagement

Recruitment began October 1, 2017 for the Overnight group. The uptake for this pilot treatment was low, which led to an extension of the recruitment period that lasted up until the start of the treatment period in May 2018. Altogether 440 participants were recruited, 366 for the initial summer period, and an additional 74 as part of the extended recruitment period that participated in the winter months.

Alectra staff indicated in an interview with Guidehouse to support this analysis that they believed that having the option to opt-out and a transitional risk-free period, wherein customers can try the new rates, would be helpful in making customers feel confident that they were not committing to a rate that may end up costing more.

- **Recruitment**
  - *Email.* E-mail to customers contained a direct link to the website for signing up. Alectra indicated during the interview that e-mail was most successful, especially from a cost-effectiveness perspective.
  - *Direct mail out and brochures.* Mailed out marketing materials to provide detailed information and encourage participation in the pilots. The process evaluation report revealed

[34] Each participant's bill is the sum of the given billing period's charges under the status quo TOU rate and the debit or credit carried forward from the previous month's shadow bill – the difference between their status quo TOU cost and the Dynamic TOU cost in the previous month.

that the brochures presented too much information and could be framed better from the customer's perspective. The direct mailer compared different rate plans and was price-focused, rather than lifestyle focused.
    - *Website.* Provided program overview, rate plans, FAQs, an overview of tools available for customers, and registration link. The process evaluation report indicated that while all information was readily available, it was difficult to parse through process the amount of information presented to customers. Tangible benefits of the program were not highlighted upfront.
    - *Social media.* Alectra indicated that social media was not very effective.
    - *Targeted marketing*. Alectra tried to promote the Overnight plan to EV owners (via auto dealerships) and shift workers (via employers).
- **Retention**
    - *Online portal.* Allows customers to view their usage online. The portal included the price schedule, graphical representation of daily and monthly usage by period, average daily temperature, program details and FAQs.
      Many customers were unaware this portal existed, while others were confused about whether it is separate from Alectra MyAccount portal.
      The process evaluation report indicated that the purpose of the portal and how it can be used by customers to change consumption behaviour is not communicated upfront. It is unclear the degree to which this portal was used by participants, and whether it delivered any value. It is referenced only twice in the evaluation report
    - *Support channels.* Customer care and support channels through e-mail and call-centre. Call centre services for the pilot were provided by a third-party vendor, meaning that when participants called Alectra's standard customer support line, inquiries regarding the pilot had to be diverted to this second call centre. The report notes that gaps in the knowledge overlap between the two call centres resulted in some customer inconvenience (and likely some customer frustration).

Price Treatments

Pricing Period	Commodity Rate (cents/kWh)	
	Standard RPP Consumers	Low Overnight Participants
Overnight Off-Peak 12 am to 6 am	N/A	2.0
Status Quo Off-Peak Summer: Weekdays: 6am – 7am and 7pm – 12am Weekends: 6am – 12am Winter: Weekdays: 6am – 7am and 7pm – 12am Weekends: 6am – 12am	6.5	N/A
Overnight Off-Peak Same as status quo. Where status quo and Overnight Off-Peak conflict, Off-Peak takes precedence	N/A	6.5
Mid-Peak Summer: Weekdays: 7am – 11am and 5pm – 7pm Winter: Weekdays: 11am – 5pm	9.4	9.2
On-Peak Summer: Weekdays: 11am – 5pm Winter: Weekdays: 7am – 11am and 5pm – 7pm	13.2	18.4

Technology Treatments

Smart thermostats. Smart thermostats were not deployed as part of this pilot treatment group, though participants that registered their Energate or Nest thermostat[35] could receive automatic A/C curtailment during On-Peak or Mid-Peak periods. The technical contractor estimated technology impacts by comparing registered and unregistered participants' pilot-period consumption with a univariate regression. Fifty-one participants registered Energate or Nest devices. An additional 21 registered Ecobee thermostats.

[35] Honeywell and Ecobee devices could also be registered but did not deliver any automatic curtailment.

Participant Attrition

Of the 440 participants recruited to this group in both the initial (366) and extended six-month (74) recruitment period, 41, or approximately 10% opted out of the pilot. An additional 10 participants (2.2%) moved out in the pilot period.

Pilot Report Findings

Price Treatment Key Findings

- **The price treatment provoked large, statistically significant changes in behaviour.** The technical contractor's evaluation report found that that participant summer demand shifted according to the pricing design, with statistically significant increases in demand during the Overnight Off-Peak and Off-Peak periods partially offset by reductions in demand during the On-Peak and Mid-Peak period. In contrast, in the winter, offsetting demand reductions during the On-Peak and Mid-Peak periods were not statistically significant and Overnight Off-Peak and Off-Peak increases in consumption were substantially greater than in the summer.
- **The target population (EV owners) were very positive about the price plan.** This price plan was designed to target EV owners and (to a lesser extent) shift workers. Despite the recruitment difficulties (perhaps owing to the relatively small proportion of the population that own EVs) the analysis of focus group findings indicates that EV-owning participants were "very pleased" with the pilot. Altogether 43% of participants owned an EV at the time of the pilot.
- **Summer:**
    - Average On-Peak and Mid-Peak demand fell by a statistically significant 0.1 kW (9.6%) and 0.082 kW (8.1%), respectively.
    - Average Off-Peak demand (i.e., all status quo Off-Peak periods except the period between midnight and 6am) increased by a statistically significant 0.058 kW (4.8%)
    - Average Overnight Off-Peak demand increased by a statistically significant 0.345 kW – an increase in average demand in this period by approximately 45%
    - Average overall summer demand was estimated to have increased by 0.056 kW per participant, approximately 5.3%.
- **Winter:**
    - No statistically significant change in On-Peak and Mid-Peak demand.
    - Average Off-Peak demand (i.e., all status quo Off-Peak periods except the period between midnight and 6am) increased by a statistically significant 0.153 kW (16.2%)
    - Average Overnight Off-Peak demand increased by a statistically significant 0.51 kW – an increase in average demand in this period by approximately 73.3%
    - Average overall winter demand was estimated to have increased by 0.165 kW per participant, approximately 19.6%.
- The technical contractor estimated a daily own-price elasticity of -0.291 and a substitution elasticity between On-Peak and Off-Peak of -0.23.
    -

Non-Price Treatment Key Findings

Smart Thermostats. The technical consultant estimated the impact of the smart thermostat simply by comparing the relevant period (e.g., On-Peak, Mid-Peak, etc.) demand across pilot participants during the pilot period with a univariate regression. No controls have been applied to account for the fact that smart thermostat registration is possible only for smart thermostat owners, and that smart thermostat ownership may be generally correlated with other exogenous variables that also affect demand (e.g., A/C ownership, home size, heating system type, etc.).

- *Summer*:
    - In the On-Peak, Mid-Peak, and Off-Peak periods of the pilot, the estimated impact of smart thermostat registration is presented as a statistically significant *increased* demand of 0.134 (14.7%), 0.158 kW (17.7%), and 0.256 kW (21.3%), respectively.
    - The average demand of the ~65 participants with registered smart thermostats was approximately 0.205 kW (20.5%) less than that of the ~300 to 370 (sample size varies over time) participants without a registered smart thermostat.
- *Winter:* no statistically significant impacts reported.

Evaluation Metric Scoring

Cost Recovery	**1**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[36] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[37] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [38]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Overnight	$0.0697	$0.0772	-15%	-5.9%
Control[39]	N/A	N/A	N/A	N/A

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour – is substantially under-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP. The average revenue collected from this treatment group is approximately 15% less than required to deliver the provincial average RPP cost.

This under-collection has two[40] identifiable elements: behavioural, and rate-structural.

- **Behavioural.** The top row of the right-most column indicates the percentage under-collection due to the changes in behaviour. If participants had paid the status quo TOU rate, but still changed their behaviour as they did in response to the pilot price plan, then on average Alectra would have under-collected by 5.9%. This is one indication of the very substantial impact that this rate had on overall participant consumption.
- **Rate-Structural.** The total under-collection is 15%. Subtracting the behavioural under-collection (5.9%) and assuming that there is no jurisdictional under- or over-collection, this results in a rate-structural under-collection of approximately 9%. This under-collection indicates that the imposition of this rate, absent any changes in behaviour and, again, assuming no jurisdictional over- or under-collection, would result in an under-collection if participants subjected to this rate made no changes in their behaviour. This suggests that the provincial load profile used to set pilot prices differs substantially from the status quo load profile of participants – unsurprising given that 43% of participants own or lease electric vehicles.

Historically, the approach to setting prices in Ontario has followed the principle that changes in rate structure must be revenue neutral to the provincial average, *assuming no changes in behaviour*. The question of cost-recovery addressed above identifies to what degree this is a reasonable and sustainable approach to price-setting for a wider deployment of the piloted rate.

[36] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

[37] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf

[38] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

[39] Alectra's technical consultant did not provide figures for control group revenue adequacy in the evaluation report.

[40] No assessment of jurisdictional under- or over-collection is possible as no value for average revenue is provided for control customers. Given the results of the Enhanced TOU rate treatment, it seems likely that the jurisdictional under- or over-collection is sufficiently small to not be a major concern.

Cost Recovery	**1**

How effectively have the price plans recovered [embedded commodity] costs?

In this case, the magnitude of the difference is substantial. The under-collection is of sufficient magnitude that should this rate be considered for wider deployment, and adoption beyond pilot levels was expected (e.g., more than 1 – 2% of the given population), some consideration should be given for adjusting the price-setting approach to account for some change in participant behaviour, as well as the difference in the underlying load profile of the consumers that self-select into this price plan, compared to the average RPP consumer (the profile of which is used to set prices).

Short-Term Cost Reflectiveness	**2**

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This rate treatment is the 7th most reflective *short-term cost-reflective* series out of 10 and has been given a score of 2.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-52%	-56%	-53%

The RMSE of this price series is 53% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**3**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the 6th most reflective *long-term cost-reflective* series out of 10 and has been given a score of 3.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
5%	0.4%	2%

The RMSE of this price series is 2% smaller than that of the status quo price series, indicating that it is **more** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	**1**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
-$35	$32	$163	0.00

Over the deployment period, the NPV of system benefits for the Alectra Overnight price plan, for a single participant enrolling at the start, is projected to be -$14. There is a per-participant benefit to avoided capacity of $134, but a per-participant cost for avoided energy consumption of $149, as unit impacts resulted in increased consumption. For the same period, the unit costs are estimated to be $227, excluding fixed costs for the utility incurred for all participants. For Alectra's treatments, increases in recruitment/marketing costs over opt-out treatments were reported as a fixed recurring cost.

Fixed costs that cannot be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment.

The negative benefits of this treatment are associated with increased energy consumption that offset the capacity and energy benefits of the treatment. The lack of benefits for this treatment makes it the least cost-effective treatment group out of the 10 considered. There are no scaling factors that could be applied to the pilot costs to achieve cost-effective results, as the benefits are not positive.

Key Uncertainties
Where is the additional demand coming from?

If, prior to pilot participation, EV charging is being done away from the home during the day (e.g., public or workplace charging), benefits may be understated. If electric space-heating is displacing natural gas consumption overnight, failure to account for natural gas avoided costs may result in benefits being understated. See main report for a more detailed discussion of these possibilities.

Key Scaling Assumptions

Maximum Possible Market Share

The Alectra Overnight pilot treatment is targeted at participant's that own an electric vehicle. The maximum potential market share is therefore the proportion of population in Ontario that owns an electric vehicle. Guidehouse Research's Q4 report on electric vehicle market data provides an estimate of electric vehicle population by province and year. Using this forecast, Guidehouse estimated a maximum possible market share of 12.1% in 2035.

Achievable Market Share

Guidehouse's assumption is that all eligible customers would enrol in this program, maintaining the market share at 12.1%. For opt-in price treatments, Guidehouse estimated annual enrolment using a standard S-shaped diffusion curve.

Predictability	**3**

To what degree are prices predictable?

The Alectra Overnight treatment includes the modification of pricing and period definitions from status quo. The treatment involves the creation of a Super-Off-peak rate, and pricing variations for Mid- and On-Peak rates. The addition of a fourth period inherently adds complexity to the pricing structure (and makes prices less predictable).

The Alectra Overnight treatment includes the most price period changes per day of any treatment being evaluated, with 6 individual changes per day. This number of changes decreases price predictability for consumers. Of note, the shift from 'Overnight Off-Peak' to 'Off-Peak' at 6:00 AM lasts for only one hour. Rapid changes in TOU periods increases complexity greatly.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
6	2

Comprehensible	**4**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

58% of participants indicated in the customer survey that remembering the new pricing plan structure was easy. Further, the price treatment has four periods compared to and is consistent and regular in terms of timing. As discussed in the Customer Engagement section, Alectra had multiple customer support channels available to help customers understand the rate. Alectra also used a linear visual depiction of the rate, which is more comprehensible compared to the status quo TOU "clock" diagram. The bill and shadow bill also showed the usage by price period, along with a comparison of the cost or savings.

Based on the above factors, the Overnight treatment rated a score of **4**, indicating that the price structure was reasonably comprehensible.

Realized Opportunity for Bill Savings	**5**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%)	9.0%	8.3%
Bill Savings ($)	$5.6	$6.9

The Alectra Overnight treatment had the highest summer monthly bill savings, and the highest winter monthly bill savings, of the 10 treatment groups. The treatment delivered an average of 8.6% bill savings, resulting in a score of 5, high savings compared to other treatments. Of all treatments evaluated, this treatment was most effective at delivering bill savings.

Potential Opportunity for Bill Savings	**5**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$5.1

The Alectra Overnight treatment delivers the second highest estimated monthly bill savings opportunity through the pilot period (May 2018 to April 2019), of all 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill savings of $5.1, resulting in a score of 5, monthly bill savings exceeding $5.

Ease of Implementation	**4**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Alectra Overnight treatment involves the implementation of a price plan with pricing and period definition changes from the status quo TOU. Deviations from status quo pricing include the addition of a "super" Off-Peak period and changes to the Mid- and On-peak rates.

There was a wide range of perceived costs among LDCs for implementing price and/or TOU period definition changes. Many respondents did not believe this would pose significant time or cost challenges (<$100,000 and ~3-6 months), while others reported larger challenges (>$1,000,000 and > 6 months). The majority of respondents indicated additional required systems enhancements, i.e. the MDM/R and Operational Data Store including customer interaction channels, bill printing, how rate switching would be handled, and additional customer education and support.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. The installation/maintenance of enabling technology was not required for this treatment.

This treatment had lesser customer engagement than other treatments – an internal call centre was established, as well as an online portal.

For the above reasons, the Overnight treatment receives a score of **4.**

Note: The definitions of the Off-Peak in this treatment do not meet the requirements stipulated in O. Reg. 95/05 §6(1)4. Specifically, the off-peak period begins no later than 7 p.m. on every weekday and ends, no earlier than 7 a.m. on the next day if the next day is a weekday, or no earlier than 12 a.m. on the next day if the next day is Saturday, Sunday or a holiday.

CustomerFirst Enhanced TOU

Treatment Group Summary

Treatment Name	Enhanced Time-of-Use
LDC	CustomerFirst (Greater Sudbury Hydro, North Bay Hydro Distribution, PUC Services)
Period of Analysis	2018-10-01 through 2019-08-31
Sample Size	~680
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

None provided.

Customer Engagement

- **Recruitment:** two-thirds of each utility's customer base were provided with brochures to encourage enrolment, offer of free smart thermostat (either at prior to start or following completion of pilot). No mass market engagement possible in order to enable the pilot's experimental design.
- **Retention:** two participant online surveys, third-party (CustomerFirst) call centre support, e-mail

Price Treatments

- Larger On- to Off-Peak price differential (3:1) relative to status quo TOU pricing (2:1)
- Larger Mid- to Off-Peak price differential (1.6:1) relative to status quo TOU pricing (1.4:1)

Technology Treatments

Thermostats. Half of participants that enrol are provided with a smart thermostat at the beginning of the pilot. The remaining half are provided with the smart thermostat at the end of the pilot. Allocation to both groups is randomly assigned.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	5	*Virtually no under- or over-collection relative to the RPA. Deviation in revenue collection is likely statistical noise..*
Short-Term Cost Reflectiveness	3	*This rate treatment is the 4th most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	3	*This rate treatment is the 4th most reflective long-term cost-reflective series.*
Cost Minimizing	1	*No statistically significant impacts, benefits are non-existent*
Predictability	3	*Treatment involves price periods and seasonal changes consistent with current customer expectations.*
Comprehensible	4	*Three price periods and consistent and regular timing. 62% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	1	*This treatment resulted in slight bill increases for consumers in both the summer and winter seasons.*
Estimated Bill Savings Opportunities	2	*This treatment is estimated to deliver moderate consumer savings; the 6th highest of treatments analysed.*
Ease of Implementation	3	*Treatment requires only changes of prices for existing TOU period definitions, equivalent to changing status quo prices. Opt-in treatment requires significant recruitment efforts; installation/maintenance of enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

None provided.

Customer Engagement

- **Recruitment:**
  - Two-thirds of each utility's customer base provided with brochures to encourage enrolment, mailed separately from bills
  - Offer of free smart thermostat (either at prior to start or following completion of pilot).
  - The brochure had a website link and a phone number for customers to register for the pilot
  - No mass market engagement possible in order to enable the pilot's experimental design – pilot was designed as a random encouragement design (RED) and required that encouragement to enrol (i.e., advertising) be presented only to a randomly selected group of customers.
  - The process evaluation notes that LDC representatives believed that the recruitment timeframe was too short, especially when coupled with the limited marketing efforts. Due to lower than expected enrolment, a second round of recruitment was conducted to the same set of customers using the same brochure.
- **Retention:**
  - Two participant online surveys.
  - Utility websites provide no mention of the pilot to ensure validity of experimental design.
  - CustomerFirst provided call-centre services to support this pilot (rather than support being provided directly by the utilities themselves). The process evaluation notes that customers were confused by being directed away from their utility's call centre to the dedicated CustomerFirst call centre.[41] Call centre staff was limited to one person handing the calls and addressing participants' issues.
  - Email was also available for participants to send in questions.

Price Treatments

Pricing Period	Commodity Rate (cents/kWh)	
	Standard RPP Consumers	Enhanced TOU Participants
Off-Peak 7 pm to 7 am, on weekdays 24 hours on weekends and holidays.	6.5	6.0
Mid-Peak 7am to 11am and 5pm to 7pm, summer weekdays 11am to 5pm, winter weekdays	9.4	9.4
On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 7pm, winter weekdays	13.2	17.5 (17.6)[42]

Technology Treatments

Thermostats. Half of participants that enrol were provided with a smart thermostat at the beginning of the pilot. The remaining half were provided with the smart thermostat at the end of the pilot. Allocation to both groups is randomly assigned.

Although the evaluation report does not identify it explicitly, it seems likely that a high proportion (relative to the provincial average) of CustomerFirst participants use electricity as their primary space-heating fuel. This assumption is driven by the utilities' location, and the frequency with which utility staff, in the process evaluation interviews, identify space-heating as a concern for the ability of participants to respond to prices.

[41] This echoes findings of the Alectra focus group analysis that found a third-party call centre increased customer frustration and confusion.
[42] On-Peak rate from May 2018 to October 2018

Since homes that depend on electric baseboard heating typically require multiple thermostats (often one per room), it is possible that baseboard electric heating participants would derive less benefit from a smart thermostat than participants with centrally heated homes (potentially a reason for the lacklustre enrolment figures). This might also lead to some selection issues – for example the offer of a smart thermostat may have resulted in participants being disproportionately equipped with central heating systems compared to the average for the utility.

Participant Attrition
Of the 529 participants recruited to this group, 52, or approximately 10% opted out of the pilot.

Pilot Report Findings

Price Treatment Key Findings

None of the estimated impacts were found to be statistically significant. The technical contractor concluded that participants had not, on average, made any real change in behaviour for three reasons:

- Limited discretionary consumption.
- The price plan was insufficiently different from the status quo (there was no novelty to adapt to).
- The financial benefit of even very significant changes in behaviour are, under this price plan, trivially small.

The technical contractor estimated daily own-price elasticities of:

- -0.032 for price-only participants in the summer
- +0.012 for price-only participants in the winter
- -0.007 for price and thermostat participants in the summer
- +0.01 for price and thermostat participants in the winter.

None of these estimates is statistically significant.

The technical contractor estimated inter-period elasticities of substitution (between On-Peak and Off-Peak periods) of:

- -0.057 for price-only participants in the summer
- -0.044 for price-only participants in the winter
- -0.07 for price and thermostat participants in the summer
- -0.041 for price and thermostat participants in the winter.

All these results are statistically significant.

Non-Price Treatment Key Findings

The technical contractor did not estimate the incremental impact of thermostat ownership on consumption. Though impacts were estimated separately for the “Rate-Only” and “Rate and Enabling Technology [thermostat]” groups, the impacts for neither group were found to be statistically significant.

Evaluation Metric Scoring

Cost Recovery	**5**
How effectively have the price plans recovered [embedded commodity] costs?	
The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[43] After making the adjustments for the Ontario Fair Hydro Plan	

[43] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

(OFHP) Act, the average commodity price falls to $0.082/kWh.[44] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [45]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Enhanced TOU	$0.0817	$0.0820	-0.3%	0%
Control	N/A	$0.0840	N/A	2.4%

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour – is neither under- nor over-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

Although in net there is no over- or under-collection, this is due to off-setting factors in jurisdictional, behavioural, and rate-structural over- and under-collection.

- **Jurisdictional.** The bottom right cell of the table above indicates that the utilities that make up CustomerFirst over-collect (compared to the average supply cost) by about 2.4% for customers whose pre-pilot consumption patterns match those of the pilot participants. This may be due to the use of electric space and water-heating during status quo On-Peak periods. Fewer customers in the territories of the CustomerFirst utilities have access to a natural gas connection than the provincial average.
- **Behavioural.** The top row of the right-most column indicates the percentage under- or over-collection due to the combined effect of changes in behaviour and jurisdictional under-collection (described above). If participants had paid the status quo TOU price, but still changed their behaviour as they did in response to the pilot price plan, then on average the CustomerFirst LDCs would have collected exactly the RPA. After accounting for the jurisdictional over-collection of 2.4% (from the control group), this is a net behavioural under-collection of 2.4%.
  This suggests that, on average, participants' consumption either increased in lower-priced status quo TOU hours or decreased in higher-priced status quo TOU hours.
  The evaluation for this treatment group reports that although no impacts were statistically significant, winter On-Peak consumption fell by 3.6% and summer Off-Peak consumption increased by 3.12%. These are the largest impacts (in absolute value) estimated across all of the pilots that are statistically insignificant, due likely to a combination of the small number of enrolled participants (529) and the fact they were drawn from four different utilities (making the data "noisier" due to disparate consumption patterns). In this case the net behavioural under-collection result may be read as either evidence suggesting that the evaluation-estimated impacts are real (if highly uncertain) or as simply statistical noise.
- **Rate-Structural.** The total under-collection is only 0.3%. Subtracting the behavioural over-collection (0%), and the jurisdictional over-collection (-2.4%), this results in a net *rate-structural* over-collection of 2.1% (-0.3% - (0.0% - 2.4 %)). This rate-structural over-collection is likely a result of the higher incidence of electric space- and water-heating in the service territories of the CustomerFirst LDCs compared with the provincial average.

[44] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf
[45] This acronym does not quite match the underlying definition but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

Short-Term Cost Reflectiveness	3

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This rate treatment is the 4th most reflective *short-term cost-reflective* series out of 10 and has been given a score of 3.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-35%	-44%	-39%

The RMSE of this price series is 39% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	3

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the 4th most reflective *long-term cost-reflective* series out of 10 and has been given a score of 3.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
5%	-0.5%	2%

The RMSE of this price series is 2% smaller than that of the status quo price series, indicating that it is **more** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	1

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

None of the unit impacts reported from the CustomerFirst Enhanced TOU price treatment are statistically significant. Cost Minimizing is not calculated for price treatments without benefit streams.

Predictability	**4**

To what degree are prices predictable?

The CustomerFirst Enhanced TOU treatment involves modifications to existing prices but does not alter the period definitions. No CPP events or variable peak pricing are involved. Price periods and seasonal changes in the Enhanced TOU treatment are consistent with current consumer expectations.

Changing prices for existing TOU periods is equivalent to changing status quo prices, as they are on an annual basis. Prices are regularly scheduled, and that schedule is the same as that of the status quo TOU price periods. The Enhanced TOU treatment, similar to current pricing, features fewer price periods per day than other treatments being evaluated.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
4	2

Comprehensible	**4**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

CustomerFirst's survey revealed that 62% of participants plan to change their electricity consumption patterns as a result of their participation in the TOU pilot. The price treatment has three rate periods which were consistent and regular. As discussed under Customer Engagement, CustomerFirst had multiple customer support channels to help customers understand the rate but was limited to one personnel handling the call centre. CustomerFirst also used a status quo TOU clock as a visual depiction of the rate, which was found to be less comprehensible compared to a linear visual. The bill showed the usage by price period but could improve by providing a comparison of the cost or savings or showing a visual of consumption by period.

Based on the above factors, the Enhanced TOU treatment rated a score of **4**, indicating that the price structure was reasonably comprehensible.

Realized Opportunity for Bill Savings	**1**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%)	-0.4%	-1.6%
Bill Savings ($)	-$0.0	-$0.1

The CustomerFirst Enhanced treatment resulted in negative bill savings for both the summer and winter periods, or an increase in consumer's monthly bills.

The treatment delivered an average of -1.0% bill savings, resulting in a score of 1.

Potential Opportunity for Bill Savings	**2**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$0.6

The CustomerFirst Enhanced treatment delivers the 6th highest estimated bill savings opportunity through the pilot period (May 2018 to April 2019), of the 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill savings of $0.6, resulting in a score of 2, low to moderate bill savings.

Ease of Implementation	**3**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Enhanced TOU treatment involves the implementation of a price plan with price changes to existing TOU periods. As the definitions of the TOU periods does not change, the price changes for this treatment are equivalent to changing status quo pricing.

As this pricing structure involves only the changing of status quo pricing and does not alter period definitions or include other complexities (e.g., CPP events or variable peak pricing), this treatment would cause only slight disruptions to normal business operations, would require minimal consumer guidance.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. This treatment involved the installation of hardware, which was a substantial effort for pilot proponents, who spent resources on hardware selection and ensuring that devices were functioning correctly. Pilot proponents expressed that the deployment of hardware may be streamlined at scale - for example, including relying on existing programs for Smart Thermostats, or relying on self-installation of hardware.

CustomerFirst's customer engagement was primarily handled through a call centre established by CustomerFirst. Staffing and technology requirements were minimal for the call centre.

For the above reasons, the Enhanced TOU treatment receives a score of **3.**

CustomerFirst Seasonal TOU

Treatment Group Summary

Treatment Name	Seasonal TOU
LDC	CustomerFirst (Newmarket-Tay Power Distribution, Northern Ontario Wires)
Period of Analysis	2018-10-01 through 2019-08-31
Sample Size	~430
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments
Enabling Information
None provided.
Customer Engagement
• **Recruitment:** two-thirds of each utility's customer base were provided with brochures to encourage enrolment, offer of free smart thermostat (either at prior to start or following completion of pilot). No mass market engagement possible in order to enable the pilot's experimental design. • **Retention:** two participant online surveys, third-party (CustomerFirst) call centre support, e-mail
Price Treatments
• Flat price, 8.1 cents/kWh, applied at all times in shoulder months (March through May, September through November). • Mid-Peak eliminated, replaced by 12-hour On-Peak with modest price increase compared to status quo TOU (13.5 cents/kWh) – in place June through August, December through February. • Off-Peak discounted to 5.4 cents per kWh – in place June through August, December through February.
Technology Treatments
Thermostats. Half of participants that enrol are provided with a smart thermostat at the beginning of the pilot. The remaining half are provided with the smart thermostat at the end of the pilot. Allocation to both groups is randomly assigned.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	5	*No over- or under-collection. Under pilot prices the average revenue is equal to the RPA.*
Short-Term Cost Reflectiveness	5	*This rate treatment is the most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	1	*This rate treatment is the least reflective of long-term costs.*
Cost Minimizing	1	*No statistically significant impacts, benefits are non-existent*
Predictability	5	*Treatment involves the least number of price periods in a day, so customers experience fewer price changes over a season. Shoulder months involve a flat price.*
Comprehensible	4	*Fewer price period and consistent and regular in terms of timing. 61 % of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	2	*This treatment delivered low bill savings during the summer and slight increases during the winter.*
Estimated Bill Savings Opportunities	1	*This treatment is estimated to deliver increases to consumers bills; the largest of all treatments analysed.*
Ease of Implementation	3	*Treatment requires changes to both prices and period definitions. Opt-in treatment requires significant recruitment efforts. Installation/maintenance of enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

None provided.

Customer Engagement

- **Recruitment:**
  - Two-thirds of each utility's customer base provided with brochures to encourage enrolment, mailed separately from bills
  - Offer of free smart thermostat (either at prior to start or following completion of pilot).
  - The brochure had a website link and a phone number for customers to register for the pilot
  - No mass market engagement possible in order to enable the pilot's experimental design – pilot was designed as a random encouragement design (RED) and required that encouragement to enrol (i.e., advertising) be presented only to a randomly selected group of customers.
  - The process evaluation notes that LDC representatives believed that the recruitment timeframe was too short, especially when coupled with the limited marketing efforts. Due to lower than expected enrolment, a second round of recruitment was conducted to the same set of customers using the same brochure.
- **Retention:**
  - Two participant online surveys.
  - Utility websites provide no mention of the pilot (possible to ensure validity of experimental design.
  - CustomerFirst provided call-centre services to support this pilot (rather than support being provided directly by the utilities themselves). The process evaluation notes that customers were confused by being directed away from their utility's call centre to the dedicated CustomerFirst call centre.[46] Call centre staff was limited to one person handing the calls and addressing participants' issues.
  - Email was also available for participants to send in questions

[46] This echoes findings of the Alectra focus group analysis that found a third-party call centre increased customer frustration and confusion.

Price Treatments

Pricing Period	Commodity Rate (cents/kWh)	
	Standard RPP Consumers	Seasonal TOU Participants
Status Quo Off-Peak 7 pm to 7 am, on weekdays 24 hours on weekends and holidays.	6.5	6.0
Seasonal TOU Off-Peak Same as status quo Off-Peak, but only applies June through August and December through February.	N/A	5.4
Status Quo Mid-Peak 7am to 11am and 5pm to 7pm, summer weekdays 11am to 5pm, winter weekdays	9.4	N/A
Seasonal TOU Shoulder-Peak All days and all times, March through May, and September through November.	N/A	8.1
Status Quo On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 7pm, winter weekdays	13.2	N/A
Seasonal TOU On-Peak 7am to 7pm, weekdays, June through August and December through February	N/A	13.5

Technology Treatments

Thermostats. Half of participants that enrol were provided with a smart thermostat at the beginning of the pilot. The remaining half were provided with the smart thermostat at the end of the pilot. Allocation to both groups is randomly assigned.

Although the evaluation report does not identify it explicitly, it seems likely that a high proportion (relative to the provincial average) of CustomerFirst participants use electricity as their primary space-heating fuel. This assumption is driven by the utilities' location, and the frequency with which utility staff, in the process evaluation interviews, identify space-heating as a concern for the ability of participants to respond to prices.

Since homes that depend on electric baseboard heating typically require multiple thermostats (often one per room), it is possible that baseboard electric heating participants would derive less benefit from a smart thermostat than participants with centrally heated homes (potentially a reason for the lacklustre enrolment figures). This might also lead to some selection issues – for example the offer of a smart thermostat may have resulted in participants being disproportionately equipped with central heating systems compared to the average for the utility.

Participant Attrition

Of the 562 participants recruited to this group, 30, or approximately 5%, opted out of the pilot.

Pilot Report Findings

Price Treatment Key Findings

None of the estimated impacts were found to be statistically significant. The technical contractor concluded that participants had not, on average, made any real change in behaviour for three reasons:

- Limited discretionary consumption.
- The price plan was insufficiently different from the status quo (there was no novelty to adapt to).

The financial benefit of even very significant changes in behaviour are, under this price plan, trivially small.

The technical contractor estimated daily own-price elasticities of:

- -0.027 for price-only participants in the summer
- -0.102 for price-only participants in the winter – this estimate is statistically significant

- +0.053 for price and thermostat participants in the summer
- -0.004 for price and thermostat participants in the winter.

Only the estimate noted as such above is statistically significant.

The technical contractor estimated inter-period elasticities of substitution (between On-Peak and Off-Peak periods) of:

- -0.001 for price-only participants in the summer
- -0.024 for price-only participants in the winter
- -0.041 for price and thermostat participants in the summer
- -0.01 for price and thermostat participants in the winter.

None of these results is statistically significant.

Non-Price Treatment Key Findings

The technical contractor did not estimate the incremental impact of thermostat ownership on consumption. Though impacts were estimated separately for the "Rate-Only" and "Rate and Enabling Technology [thermostat]" groups, the impacts for neither group were found to be statistically significant.

Evaluation Metric Scoring

Cost Recovery	**5**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[47] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[48] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [49]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Seasonal TOU	$0.0820	$0.0824	0%	0.4%
Control	N/A	$0.0830	N/A	1.2%

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour – is neither under- nor over-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

Although in net there is no over- or under-collection, this is due to off-setting factors in jurisdictional, behavioural, and rate-structural over- and under-collection.

- **Jurisdictional.** The bottom right cell of the table above indicates that the utilities that make up CustomerFirst over-collect (compared to the average supply cost) by about 1.2% for customers whose pre-pilot consumption patterns match those of the pilot participants. This may be due to the use of electric space and water-heating during status quo On-Peak periods. Fewer customers in the territories of the CustomerFirst utilities have access to a natural gas connection than the provincial average.
- **Behavioural.** The top row of the right-most column indicates the percentage under- or over-collection due to the combined effect of changes in behaviour and jurisdictional under-

[47] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

[48] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf

[49] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…*"

collection (described above). If participants had paid the status quo TOU price, but still changed their behaviour as they did in response to the pilot price plan, then on average the CustomerFirst LDCs would have over-collected by 0.4%. After accounting for the jurisdictional over-collection of 1.2% (from the control group), this is a net behavioural under-collection of 0.8%.
This could indicate that on average participants have shifted their consumption to lower-priced status quo TOU periods or it could simply be statistical "noise". Given the findings of the evaluation report (i.e., no statistically significant impacts from the price plan) this net behavioural under-collection is just statistical noise.

- **Rate-Structural.** Overall, this price plan exhibits neither under- nor over-collection. Subtracting the behavioural over-collection (0.4%), and the jurisdictional over-collection (-1.2%), this results in a net *rate-structural* over-collection of 0.8% (0% - (0.4% - 1.2 %)). This rate-structural over-collection may be a result of the incidence of electric space- and water-heating in the CustomerFirst utilities' jurisdictions exceeding that of the provincial average, though the magnitude may simply indicate that this is statistical "noise".

Short-Term Cost Reflectiveness	**5**

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This rate treatment is the most reflective *short-term cost-reflective* series out of 10 and has been given a score of 5.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-9%	-4.6%	-5%

The RMSE of this price series is 39% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**1**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the least reflective long-term cost reflective series out of 10 and has been given a score of 1.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)

1%	-3%	-2%

The RMSE of this price series is 2% larger than that of the status quo price series, indicating that it is **less** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	**1**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

None of the unit impacts reported from the CustomerFirst Seasonal TOU price treatment are statistically significant. Cost Minimizing is not calculated for price treatments without benefit streams.

Predictability	**5**

To what degree are prices predictable?

The CustomerFirst Seasonal TOU treatment involves modifications to existing prices and period definitions but does not include CPP events or variable peak pricing. Treatments without CPP events or variable peak pricing have higher degrees of predictability.

The Seasonal TOU treatment has the fewest maximum number of price periods in a given day (e.g., off-peak and on-peak only). The pilot adds another season (shoulder), though the price structure in that season is very simple, with a flat price in all hours. Customers are required to be aware of four seasonal changes throughout the year; however, due to the simplicity of TOU periods in these seasons, this treatment receives a score of 5.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
2	4

Comprehensible	**4**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

CustomerFirst's survey revealed that 61% of participants claimed that they plan to change their electricity consumption patterns as a result of their participation in the TOU pilot. The price treatment has no more than two periods in each season, periods which were consistent and regular in terms of timing. As discussed under Customer Engagement, CustomerFirst had multiple customer support channels, to help customers understand the rate, but was limited to one individual handling the call

centre. CustomerFirst also used a status quo TOU clock as a visual depiction of the rate, which was found to be less comprehensible compared to a linear visual. The bill showed the usage by price period but could improve by providing a comparison of the cost or savings or showing a visual of consumption by period.

Based on the above factors, the Seasonal TOU treatment rated a score of **4**, indicating that the price structure was reasonably comprehensible.

Realized Opportunity for Bill Savings	**2**

How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?

	Summer 2018	**Winter 2018/2019**
Bill Savings (%)	1.2%	-0.6%
Bill Savings ($)	$0.1	-$0.0

The CustomerFirst Seasonal TOU treatment delivered the 4th highest summer monthly bill savings of the 10 treatments analysed but delivered negative bill savings in the winter period.

The treatment delivered an average of 0.3% bill savings, resulting in a score of 2, none or minimal savings compared to other treatments.

Bill savings during the summer offset the slight increase consumer's experienced on their winter bills. In both cases, the magnitude of absolute monthly bill savings was small.

Potential Opportunity for Bill Savings	**1**

Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?

	Pilot Period
Bill Savings ($)	-$4.3

The CustomerFirst Seasonal TOU treatment delivers negative estimated bill savings opportunities throughout the pilot period, resulting in increases to consumers bills. This treatment is estimated to deliver the largest increase to consumer bills of all treatments analyzed.

The treatment is estimated to deliver an average monthly bill increase of $4.3, resulting in a score of 1, negative savings.

Ease of Implementation	**3**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The CustomerFirst Seasonal TOU treatment involves the implementation of a price plan with pricing and period definition changes from the status quo TOU. Deviations from status quo pricing include a flat price applied at all times in shoulder months, the elimination of a Mid-peak period during the summer/winter months, and changes to the On-peak and Off-peak prices.

There was a wide range of perceived costs among LDCs for implementing price and/or TOU period definition changes. Many respondents did not believe this would pose significant time or cost challenges (<$100,000 and ~3-6 months), while others reported larger challenges (>$1,000,000 and > 6 months). The majority of respondents indicated additional required systems enhancements, i.e. the MDM/R and Operational Data Store including customer interaction channels, bill printing, how rate switching would be handled, and additional customer education and support.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. This treatment involved the installation of hardware, which was a substantial effort for pilot proponents, who spent resources on hardware selection and ensuring that devices were functioning correctly. Pilot proponents expressed that the deployment of hardware may be streamlined at scale - for example, including relying on existing programs for Smart Thermostats, or relying on self-installation of hardware.

CustomerFirst's customer engagement was primarily handled through a call centre established by CustomerFirst. Staffing and technology requirements were minimal for the call centre.

For the above reasons, the Seasonal TOU treatment receives a score of **3.**

London Hydro CPP and CPP/RT

Treatment Group Summary

Treatment Name	Fast-Ramp Critical Peak Pricing (CPP) with (and without) Real-Time Information (CPP and CPP/RT)
LDC	London Hydro
Period of Analysis	2018-05-01 through 2019-04-30
Sample Size	~600 (~300 RT-only, ~300 CPP/RT)
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

Provision of a mobile application ("Trickl") that tracks consumption in real-time (this functionality available to CPP/RT participants only), sends push notifications during critical peak events, and allows participants to monitor and turn off connected appliances remotely.

Customer Engagement

- **Recruitment:** bill inserts, radio, internet and public transit advertisements, website, social media, in-person activations, and offer of cash incentive and free technology to help reduce bills.
- **Retention:** Proactive engagement through regularly scheduled touchpoints or events to educate, motivate participation, and to identify and remedy technology issues; multiple support channels through the app, e-mail and call-centre; $75 end-of-pilot incentive

Price Treatments

- Discounted Off-Peak consumption (6 cents/kWh vs 6.5 cents/kWh).
- Subject to 18 critical peak events per season (36 total)
  - Events called to target system peak demand
  - 15-minute notice of events
  - Event price: 59.5 cents/kWh

Technology Treatments

- **Load Switch.** LDC contractor-installed load switch mounted at panel to curtail demand on participant-selected circuit during critical peak events.
- **Smart plug.** Receptacle plug that automatically curtails demand to connected devices during critical peak events.
- **Hub.** WiFi-enabled hub that receives controls signal from the LDC and transmits it to the switch and plugs

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	3	*Rates very slightly under-recover the RPA – less than 3% difference.*
Short-Term Cost Reflectiveness	4	*This rate treatment is the 3rd most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	2	*This rate treatment is the 7th most reflective of long-term costs.*
Cost Minimizing	5	*Highest per-participant benefits of all treatments evaluated. Majority of benefits are for avoided capacity due to CPP events, but has costly implementation*
Predictability	2	*Treatment involves CPP events, which are inherently dependent on system conditions and less predictable. Events do not occur every day during the season but may occur roughly monthly at least throughout the year.*
Comprehensible	3	*Price plan has three periods and CPP events introduced some element of inconsistency and irregularity in terms of timing.*
Opportunities for Bill Savings – Realized	3	*Larger bill savings in summer, modest bill savings available in winter*
Estimated Bill Savings Opportunities	3	*Moderate realized bill savings and potential bill savings.*
Ease of Implementation	2	*Treatment requires changes to prices and the implementation of CPP events. Opt-in treatment requires significant recruitment effort.*

Treatment Detailed Description

Informational Treatments

Enabling Information

Provision of a mobile application ("Trickl") that provides information and control to the participant. There are three groupings of mobile app functionality: those to which participants subject to the RT treatment have access (includes this treatment group), those to which participants subject to the CPP treatment have access (includes this treatment group), and those to which all participants in the pilot have access.

- **RT Treatment App Functionality. *(Applies only to CPP/RT and not CPP-only participants).***
  - *Real-Time Dashboard.* Real-time (sub-minute frequency) observation of whole home electricity demand and costs, to, e.g., allow users to immediately observe the effect of their behavioural response and, notionally, use this to optimize their price response.
- **CPP Treatment App Functionality.**
  - *Device Control and Monitoring*. Allows users to observe real-time power draw of circuits connected to panel-mounted control switch and pilot-provided smart plug[50]. This also allows users to remotely cut power to controlled devices (power is automatically cut to devices in response to CPP event signal from London Hydro).
  - *CPP Event Flow and Report.* Per preferences below, app may send push notifications 15 minutes prior to CPP event. Displays event countdown (until start of event, and then until end of event), and allows for user override of automatic curtailment of controlled devices.[51] During event, overlays alert banner and critical peak price on real-time dashboard. Provides a CPP event report showing savings achieved during each event. Estimated savings for CPP event report calculated as difference between event hour consumption and consumption in hour immediately prior to event.
- **All Treatments App Functionality.**
  - *Goal Reporting.* The app communicates to the user a daily personalized goal for energy savings derived from historical consumption patterns on similar weather conditions as that given day. Goals based on an assigned percentage reduction target applied to the average consumption levels observed in participant's historical data for similar temperature days. The app also tracks achievement, gamifying conservation attempts.

[50] The smart plug contains two receptacles, allowing two devices to be controlled from the plug.
[51] Device overrides appear to have been quite rare, with an average of less than four overrides per event observed during the period from May 1 through October 31, 2018. Note that this is the number of overrides of all participants subject to the CPP treatment, so includes the approximately 300 participants in this treatment group (CPP/RT) and the approximately 300 participants in the CPP-only treatment group.

Informational Treatments

- *Notification Preferences and Support*. Allows users to specify email(s) and phone number(s) for receiving notifications, and to specify how they receive pilot and outage notifications (email, app push notifications, SMS/text message). Provides support contact information and allows in-app requests for support (web-/app- form). In-app support is not isolated to app support but allows users to generate support tickets for all aspects of the pilot.
- *Daily Dashboard*. Provides daily TOU-period breakdown of consumption and costs. Provides graphic comparison of daily consumption and day-specific TOU period breakdowns.

Customer Engagement

The targeted participation was 600 participants for this set of treatments: 300 for the CPP and 300 CPP/RT treatment groups. Between July 2017 and May 2018, nearly 3,000 customers registered on the pilot website to participate in one of the three pilot groups (these two, as well as the RT group – see below). London Hydro deployed a multi-channel campaign and offered incentives for participant recruitment.

On-going touch points and events were held during the pilot to help ensure participants' understanding of the pilot, how their devices and Trickl worked, and to address issues participants were experiencing. Events were designed to create a sense of community and encourage participation in order to meet pilot objectives. In interviews conducted to support this meta-analysis, London Hydro noted that scaling of these events is unlikely to be cost-effective province-wide, but some elements of London Hydro's customer engagement strategy might be used to optimize customer comprehension and satisfaction of any scaled TOU treatments.

- **Recruitment.**
  - *Bill inserts.* The bill insert was the marketing channel most frequently cited in the pilot enrolment survey by participants as how they had heard of the pilot. The bill insert results emphasized the role customers can have in helping design the future of energy management, what financial and technology incentives they will receive for participating, and that there are limited number of participants who can join.
  - *Radio, internet and transit advertisements, website and social media.* Advertisements directed customers to a 1-800 support number and website for enrolment. Radio and internet advertisements were the next most effective after bill inserts.
  - *In-person activations.* In-person activations in retail stores (e.g. Home Depot, Lowes and malls) were less effective compared to other channels.
  - *Incentives.* Offered a $100 incentive ($25 at the beginning and $75 at the end of the pilot) and devices which they could keep and continue using after the pilot. Aeroplan Loyalty points were also offered for registration, but few customers were on Aeroplan.
- **Retention.**
  - *Breakfast events.* Two breakfasts attended by approximately 500 participants (across London Hydro's three treatments). Intended to provide an overview of the pilot, encourage participation and schedule home visits. Of the participants included in the evaluation analysis, 59 CPP-only (~15%) and 74 CPP/RT participants (~20%) attended the breakfast events.
  - *Ambassador focus groups.* Attended by approximately 60 participants, intended to share early pilot results, obtain participant feedback on Trickl features and pilot in general. Of the participants included in the evaluation analysis, 13 CPP-only and 12 CPP/RT participants also participated in the focus groups.
  - *Door to door campaign.* Approximately 125 appointments. Intended to troubleshoot connectivity issues and/or replace hardware at customer homes. Scheduling and having staff available for in-home visits will be a challenge for scaling.
  - *Family pizza picnic.* Attended by approximately 33 participants and their families. Intended to solicit pilot feedback through a survey. Of the participants included in the evaluation analysis, only 3 CPP/RT participants participated in the pizza picnic. No CPP-only participants participated in this event.
  - *3-month survey.* Initial pilot and Trickl app feedback.
  - *Open house events*. Attended by 20 CPP-only and 27 CPP/RT participants included in the analysis. Six weeks of open-houses were held, each running from 8am to 6pm. In effect these open houses acted as "office hours" allowing participants to access direct, in-person support with London Hydro personnel.
  - *Support channels.* Customer care and support channels through Trickl app, e-mails and call-centre.

Price Treatments

Pricing Period	Commodity Rate (cents/kWh)	
	Standard RPP Consumers	CPP and CPP/RT Participants
Off-Peak 7pm to 7am, on weekdays 24 hours on weekends and holidays.	6.5	6
Mid-Peak 7am to 11am and 5pm to 9pm, summer[52] weekdays 11am to 5pm, winter weekdays	9.4	9.4
On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 9pm, winter weekdays	13.2	13.2
Critical Peak 18 one-hour events in summer 18 one-hour events in winter Events occur only between 4pm and 8pm, prevailing time, on non-holiday weekdays	N/A	59.5

Critical peak events were selected by OEB staff and executed by LDC staff.

Technology Treatments

- **Load Switch.** LDC contractor installed load switch mounted at panel to curtail demand on participant-selected circuit during critical peak events.
- **Smart plug.** Receptacle plugs that automatically curtails demand to connected devices during critical peak events. These are installed by the participant.
- **Hub.** WiFi-enabled hub that receives controls signal from the LDC and transmits it to the switch and plugs. The evaluation report noted that on average for any given event approximately 80% of participants' hub was connected to WiFi and able to receive a curtailment signal. This means that approximately 20% of participants' response to any given CPP event was purely behavioural (no automatic curtailment). In summer months, disconnections appeared random – approximately 50% of all CPP participants (this treatment group and the other treatment group subject to the CPP treatment) were disconnected for at least one event. A small number of participants (4%) subject to the price treatment were disconnected for all summer events.

Participant Attrition

- **CPP-Only**
  - 5% of population exited the program in the summer period (the first six months)
  - An additional 1.5% of the population exited the program in the winter period
  - **Total annual attrition rate: 6.5%**
- **CPP/RT**
  - 6% of population exited the program in the summer period
  - An additional 3.5% of the population exited the program in the winter period
  - **Total annual attrition rate: 9.5%**

Note that the attrition numbers provided by London Hydro are inclusive of both opt-outs and move-outs.

[52] Throughout this document, unless explicitly stated otherwise, all references to "summer" and "winter" are intended to convey the RPP summer (May through October) and RPP winter (November through April) periods.

Pilot Report Findings

Energy Impacts Key Findings

- **The RT treatment has no incremental effect.** The impacts of CPP and CPP/RT treatment group participants were statistically significantly no different from one another, so CPP energy impacts are reported as identical for both treatment groups.
- **CPP/RT participants achieved statistically significant savings during summer On-Peak and Mid-Peak periods.** Despite receiving no incremental price signal (beyond status quo TOU prices) on non-event days, participants subject to CPP reduced their average On-Peak consumption by 0.049 kW (5%) and their average Mid-Peak consumption by 0.029 kW (3%) on non-CPP-event days.
- **Participants did not deliver any statistically significant energy savings in the winter months.** It is uncertain whether this is due to a lack of discretionary load to shift, or a disillusionment with the benefits of price-response (the winter period followed the summer period in the pilot).
- **Evidence suggests that a large portion of savings are driven by participant A/C response.** Summer CPP treatment energy impacts appear to be strongly correlated with temperature and were estimated with an intercept and slope (cooling degree hours) treatment effect. The intercept treatment parameter was not statistically significant, whereas the temperature interaction parameter was. The parameter estimates themselves suggest that more than half of estimated energy savings are driven by temperature-sensitive loads, although the highly uncertain intercept parameter could mean that this understates the A/C contribution to energy savings.
- The technical contractor estimated daily own-price elasticities of:
    - -3.97 in the summer
    - -1.83 in the winter

  The reason for these very high values has to do with the fact that despite a trivial increase in summer (decrease in winter) in the average daily cost (recall, that the only change in price for this group is critical peak events and a modest discount during the Off-Peak), is quite small relative to the change in consumption patterns (a decrease in summer, and increase in winter).
- The technical contractor estimated inter-period elasticities of substitution (between Mid-Peak and Off-Peak periods – in the summer, and On-Peak and Off-Peak periods in the winter):
    - -0.26 in the summer
    - -0.29 in the winter

CPP Event Demand Key Findings

- **The RT treatment has no incremental effect.** The impacts of CPP and CPP/RT treatment group participants were statistically significantly no different from one another, so CPP event demand impacts are reported as identical for both treatment groups.
- **Summer CPP event demand reductions were substantial.** Average summer event impact was a 0.67 kW (34%) reduction in demand, with the highest average event impact delivered was 1 kW (41%), estimated during the 31^{o} C event.
- **Winter CPP event demand reductions were modest, and slightly erratic.** On average participants delivered 0.13 kW (10%) of demand reductions per critical peak event, between impacts that are not statistically significant (two events, treated as zero impact) and 0.23 kW (17%), depending on the event. Winter CPP event impacts do not appear to be correlated with temperature
- **Summer CPP event impacts are behavioural as well as automated.** Participants whose automatic controls were disconnected delivered an average of 0.3 kW (15%) per event. Estimated model parameters suggest that the event-specific component of this impact is temperature-insensitive – participants, assuming their A/C was controlled by the enabling technology, looked for other end-uses to control.
- **Winter CPP events do not exhibit the same magnitude of estimated behavioural impacts as those in the summer.** Behavioural impacts are statistically significant for only two events in the winter. In addition, the observed distribution of device disconnections

differs considerably in the winter from the summer. Although overall fewer participants were affected by disconnections in the winter (37% subject to at least one disconnection) than in the summer (46% subject to at least one disconnection), many more participants were disconnected (more than 12%) for all events in the winter than in the summer (less than 4%). This suggests that disconnected participants may be a less suitable proxy for estimating behavioural impacts in the winter than in the summer.

Evaluation Metric Scoring

Cost Recovery	**3**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[53] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[54] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA.[55]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
CPP	$0.0802	$0.0810	-2.2%	-1.3%
CPP/RT	$0.0799	$0.0808	-2.6%	-1.5%
Control	N/A	$0.0816	N/A	-0.5%

Based on the evaluation report, it appears as though the price treatments – after accounting for any changes in behaviour – are very slightly under-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

The most important column in the table above is the one that is second from the right: "% Difference from RPA – Pilot Price Plan". This documents the percentage difference between the average revenue collected by the utility per kWh consumed by participant and the average provincial supply cost.

This indicates that, on average, these rates under-collected by 2.2% (CPP only) and 2.6% (CPP/RT).

This under-collection has three elements: jurisdictional, behavioural, and rate-structural.

- **Jurisdictional.** The bottom right cell of the table above indicates that on average London Hydro under-collects (compared to the average supply cost) for customers that would be inclined to opt in to the pilot by 0.5%.
- **Behavioural.** The top two rows of the right-most column indicate the percentage under-collection due to the combined effect of changes in behaviour and jurisdictional under-collection (described above). If participants had paid the status quo TOU rate, but still changed their behaviour as they did in response to the pilot price plan, then on average London Hydro would have under-collected by 1.3% (CPP only) or 1.5% (CPP/RT). After subtracting the jurisdictional under-collection of 0.5% (from the control group), this is a net behavioural under-collection of 0.8% (CPP-only) and 1% (CPP/RT). This is the outcome of the behavioural impact the pilot rate was designed to deliver.

[53] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf
[54] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf
[55] This acronym does not quite match the underlying definition but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…*"

Cost Recovery	3

How effectively have the price plans recovered [embedded commodity] costs?

- **Rate-Structural.** The total under-collection is 2.2% (CPP only) and 2.6% (CPP/RT). Subtracting the net behavioural under-collection (0.8% and 1%, respectively), and the jurisdictional under-collection (0.5%), this results in a *rate-structural* under-collection of 0.4% and 0.6%. This is the under-collection – relative to the RPA – that is purely the result of a windfall benefit from the new rate structure.
  Some amount of windfall or rate-structural under-collection must be expected from any opt-in rate: participants will, after all, only opt in to a rate that they believe will reduce their overall costs. That (likely intuitive) participant calculus will include an assessment of how much they could benefit by changing their behaviour, but also how much they will benefit without changing a thing.

Historically, the approach to setting prices in Ontario has followed the principle that changes in rate structure must be revenue neutral to the provincial average, *assuming no changes in behaviour*. The question of cost-recovery addressed above identifies to what degree this is a reasonable and sustainable approach to price-setting for a wider deployment of the piloted rate.

In this case, the magnitude of the difference is sufficiently small that – given the inherent uncertainty associated with applying this sample out to a wider roll-out of a provincial rate – no adjustment to the core price-setting assumption (revenue neutrality under the assumption of no behaviour change) would be required until such time as adoption of the rate became quite significant. As participation in such a rate approached 10% of the available population, price-setting should begin to address the question of rate-structural under-collection explicitly as part of the price-setting procedure. That is, as adoption grows, so too will the importance of minimizing the windfall benefit achieved by participants that opt into this rate.

Short-Term Cost Reflectiveness	4

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This rate treatment is the 3rd most reflective short-term cost-reflective series out of 10 and has been given a score of 4.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-46%	-33%	-38%

The RMSE of the London Hydro CPP/RT series is 38% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**2**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the 7th most reflective long-term cost-reflective series out of 10 and has been given a score of 2.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
1%	-2%	0%

The RMSE of the London Hydro CPP/RT series is nearly the same as that of the status quo price series, indicating that it is **about as** reflective of incurred supply cost as the status quo price series.

Cost Minimizing	**5**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$2	$237	$379	0.63

Cost Minimizing	5

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Over the deployment period, the NPV of system benefits for the London Hydro CPP and CPP/RT price plans, for a single participant enrolling at the start, is projected to be $1,145. For the same period, the unit costs are estimated to be $996, excluding fixed costs for the utility incurred for all participants.

Based on the assumptions below, the estimated benefit/cost ratio of this rate treatment, accounting for changes assumed to the treatment group design for full deployment makes it the most cost-effective treatment group out of the 10 considered.

The key driver of the assumed costs are the scaling factors applied to pilot costs. Scaling adjustments were applied to pilot costs to account for (1) costs that may be omitted at scale and (2) economies of scale. Scaling adjustments include:

Cost Category	Aggregate Scaling Factor	Description
Overhead	2%	• Guidehouse has assumed that EM&V costs are divided across all utilities provincially
Communication	75%	• Most costs are unaffected by provincial deployment; however, notably, no customer incentives would be required
Technology	38%	• Technology has already been tested, making selection of appropriate technology (either that deployed for the pilot, or another example) more efficient at scale, given the lessons learned. Self-installation may push the per participant hardware costs down 50%. • As the application has already been developed, Guidehouse anticipates that deployment costs will be reduced. Guidehouse estimated the cost for updating the app's interface based on available pilot cost data and LDC estimates; deployment costs were anticipated to be 4% of pilot costs

If pilot costs are taken as is, with no considerations for a province-wide rollout (i.e. costs are considered to be identical to pilot costs), the NPV of costs is estimated to be $2,380 million, lowering the benefit/cost ratio to 0.10 This reflects a high boundary cost estimate, as adjustments to program design or economics of scale would be expected to reduce costs.

Key Scaling Assumptions

Maximum Possible Market Share

Energy impact findings suggest that a large portion of energy savings are driven by participant A/C response. London Hydro's installation survey results revealed that a large majority of pilot participants were in single family homes and had central A/C. Based on the provincial population in single family homes with central A/C, the maximum potential market share of London Hydro's pilot treatments is 53%.

Achievable Market Share

Guidehouse's assumption is that 20% of the eligible customers would enrol in this program, reducing the market share to 11%. For opt-in price treatments, Guidehouse estimated annual enrolment using a standard S-shaped diffusion curve.

Predictability	**2**

To what degree are prices predictable?

The London Hydro CPP/RT treatment includes CPP events and changes of prices to existing TOU period definitions.

Although there is no change made to the TOU period definitions, participants in this treatment group were subject to CPP events. There were 36 CPP events, with participants receiving 15 minutes notice prior to an event. This quantity of events, combined with the short notice, greatly lowers the predictability of pricing for customers. CPP events are inherently dependent on system conditions and are therefore less predictable. Treatments involving CPP events had relatively high impacts on consumption patterns and revenue collection, relative to other treatments.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
4	2

Comprehensible	**3**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

81% of participants indicated that using less electricity during the day will save you more money than reducing the same amount of electricity during evening or overnight. The price treatment has three price periods but had CPP events, which has less consistent and regular timing. As discussed under Customer Engagement, London Hydro had multiple customer support channels to help customers understand the price. Customers could reference the Trickl app for the current electricity price and their bills clearly showed usage by price period.

Based on the above factors, the CPP/RT and CPP-only treatments rated a score of ***3***, indicating that the price structures were somewhat comprehensible.

Realized Opportunity for Bill Savings	3
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	Winter 2018/2019
Bill Savings (%)	2.1%	0.3%
Bill Savings ($)	$2.3	$0.3

The CPP/RT treatment had the 3rd highest summer monthly bill savings, and the 5th highest winter bill savings, of the 10 treatment groups. The treatment had an average bill savings of 1.2%, resulting in a score of 3, relatively low savings compared to other treatments.

Potential Opportunity for Bill Savings	3
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$2.4

The CPP/RT treatment delivers the 5th highest estimated bill savings opportunity through the pilot period (May 2018 to April 2019), of the 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill increase of $2.4, resulting in a score of 3, moderate bill savings.

Ease of Implementation	2

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The CPP/RT treatment involves the implementation of a price plan with price changes to existing TOU periods and the inclusion of CPP events. As the definitions of the TOU periods does not change, the price changes for this treatment are equivalent to changing status quo pricing.

The inclusion of CPP events increases the complexity of this price plan. LDC survey respondents reported substantially increased cost estimates for the price plans with CPP events relative to those without. While several still feel this is a <$100,000 endeavour, this cost is not consistent with our expectations of the level of complexity and required effort. Conversely, the two largest utilities, who utilize market leading CIS platforms (SAP and Oracle), indicated >$1,000,000 potential cost.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. This treatment involved the installation of hardware, which was a substantial effort for pilot proponents, who spent resources on hardware selection and ensuring that devices were functioning correctly. Pilot proponents expressed that the deployment of hardware may be streamlined at scale - for example, including relying on existing programs for Smart Thermostats, or relying on self-installation of hardware (e.g., a “bring your own thermostat”, or BYOT-style implementation).

Additionally, there were extensive customer engagement efforts for this treatment. In addition to call centres, many targeted events included focus groups, breakfast events, open houses and more were scheduled and hosted.

For the above reasons, the CPP/RT treatment receives a score of ***2.***

London Hydro RT-Only

Treatment Group Summary

Treatment Name	Real-Time (RT) Information
LDC	London Hydro
Period of Analysis	2018-05-01 through 2019-04-30
Sample Size	~1,100 RT-only
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments
Enabling Information
Provision of a mobile application ("Trickl") that tracks consumption in real-time (RT) and provides personalized savings goals.
Customer Engagement
• **Recruitment:** bill inserts, radio, internet and public transit advertisements, website, social media, in-person activations, offer of mobile application for tracking consumption and opportunity to reduce bills. • **Retention:** Proactive engagement through regularly scheduled touchpoints or events to educate, motivate participation, and to identify and remedy technology issues; multiple support channels through the app, e-mail and call-centre.
Price Treatments
None
Technology Treatments
None. No enabling technology provided.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	N/A	*Participants were subject to status quo TOU prices.*
Short-Term Cost Reflectiveness	N/A	*No price treatment*
Long-Term Cost Reflectiveness	N/A	*No price treatment*
Cost Minimizing	2	*Small benefit streams compared to large costs; benefit/cost ratio near zero*
Predictability	4	*Treatment involves price periods and seasonal changes consistent with current customer expectations.*
Comprehensible	5	*Three price periods and consistent and regular in terms of timing. 79% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	2	*No savings available; however, consumers bills are not anticipated to increase bill*
Estimated Bill Savings Opportunities	2	*No estimated bill savings opportunity.*
Ease of Implementation	4	*Requires no changes to existing systems, as there are no changes to price. Opt-in treatment requires significant recruitment effort; no enabling technology required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

Provision of a mobile application ("Trickl") that provides information to the participant. Mobile app functionality includes:

- *Real-Time Dashboard.* Real-time (sub-minute frequency) observation of whole home electricity demand and costs, to, e.g., allow users to immediately observe the effect of their behavioural response and, notionally, use this to optimize their price response.
- *Goal Reporting.* The app communicates to the user a daily personalized goal for energy savings derived from historical consumption patterns on similar weather conditions as that given day. Goals based on an assigned percentage reduction target applied to the average consumption levels observed in participant's historical data for similar temperature days. The app also tracks achievement, gamifying conservation attempts.
- *Notification Preferences and Support*. Allows users to specify email(s) and phone number(s) for receiving notifications, and to specify how they receive pilot and outage notifications (email, app push notifications, SMS/text message). Provides support contact information and allows in-app requests for support (web-/app- form).
- *Daily Dashboard*. Provides daily TOU-period breakdown of consumption and costs. Provides graphic comparison of daily consumption and day-specific TOU period breakdowns.

Customer Engagement

The targeted pilot participation for this treatment was 1,000 participants. Between July 2017 and May 2018, nearly 3,000 customers registered on the pilot website to participate in one of the three pilot groups (the real-time treatment group, as well as the CPP and CPP/RT groups – see above).

On-going touch points and events were held during the pilot to help ensure participants' understanding of the and the Trickl app. Events were designed to create a sense of community and encourage participation in order to meet pilot objectives. In interviews conducted to support this meta-analysis, London Hydro noted that scaling of these events is unlikely to be cost-effective province-wide, but some elements of London Hydro's customer engagement strategy might be used to optimize customer comprehension and satisfaction of any scaled TOU treatments.

- **Recruitment.**
  - *Bill inserts.* The bill insert was the marketing channel most frequently cited in the pilot enrolment survey by participants as how they had heard of the pilot. It emphasized the role customers can have in helping design the future of energy management, what financial and technology incentives they will receive for participating, and that there are limited number of participants who can join.
  - *Radio, internet and transit advertisements, website and social media.* Advertisements directed customers to a 1-800 support number and website for enrolment. Radio and internet advertisements were the next most effective after bill inserts.
  - *In-person activations.* In-person activations in retail stores (e.g. Home Depot, Lowes and malls) were less effective compared to other channels.
- **Retention.**
  - *Breakfast events.* Two breakfasts attended by approximately 500 participants (across London Hydro's three treatments). Intended to provide an overview of the pilot, encourage participation and schedule home visits. Of the participants included in the evaluation analysis, approximately 117 (about 10%) attended the breakfast events.
  - *Ambassador focus groups.* Attended by approximately 34 of the RT-only participants included in the analysis, intended to share early pilot results, obtain participant feedback on Trickl features and pilot in general.
  - *Family pizza picnic.* Attended by approximately 30 of the RT-only participants included in the evaluation.
  - *3-month survey.* Initial pilot and Trickl app feedback.
  - *Open house events*. Attended by 46 RT-only participants included in the analysis. Six weeks of open houses were held, each running from 8am to 6pm. In effect these open houses acted as "office hours" allowing participants to access direct, in-person support with London Hydro personnel.
  - *Support channels.* Customer care and support channels through Trickl app, e-mails and call-centre.

Price Treatments

None. Participants in the RT-only treatment group were subject to status quo TOU prices.

Technology Treatments
None. Participants in the RT-only treatment group were not provided with any enabling technology.

Participant Attrition
• No participants exited the program during the summer period. • 2.1% of participants exited the program during the winter period. Given that it seems highly unlikely that participants would contact London Hydro to opt out of a program with no financial downside, and that the attrition values provided by London Hydro include move-outs, it seems likely that the entirety of pilot attrition in this case is due to participant move-outs.

Pilot Report Findings

Non-Price Treatment Key Findings
• **RT-only participants deliver modest, and uncertain, energy impacts during the summer On-Peak period.** The evaluation estimated an average On-Peak energy reduction of 0.026 kW (2.36%) in the summer months. Although this value is not statistically significant at the 90% level, it was sufficiently close to statistical significance that the evaluator elected to present is as an achieved impact. • **RT-only participants do not appear to deliver any energy savings overall or in any periods other than the summer On-Peak period.** No other savings estimated for this treatment were statistically significant, in any other summer period, or in any period in the winter.

Evaluation Metric Scoring

Cost Recovery	**N/A**
How effectively have the price plans recovered [embedded commodity] costs?	

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[56] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[57] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [58]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
RT-Only	N/A	$0.0812	N/A	-0.9%
Control	N/A	$0.0816	N/A	-0.5%

Based on the evaluation report, it appears as though this treatment group (a non-price treatment) very slightly under-collects revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

This treatment group under-collected on average by 0.9%.

[56] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

[57] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf

[58] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…*"

This under-collection has two elements: jurisdictional, behavioural.

- **Jurisdictional.** The bottom right cell of the table above indicates that on average London Hydro under-collects (compared to the average supply cost) for customers that would be inclined to opt in to the pilot by 0.5%.
- **Behavioural.** The top row of the right-most column indicates the percentage under-collection due to the combined effect of changes in behaviour and jurisdictional under-collection (described above). After accounting for the jurisdictional under-collection of 0.5% (from the control group), this is a net behavioural under-collection of 0.4%. This is the outcome of the behavioural impact the pilot price was designed to deliver and is consistent with the (admittedly uncertain) estimated summer On-Peak impact of the program.

The under-collection is too small, and too uncertain, to affect considerations of any wider deployment of this treatment group.

Short-Term Cost Reflectiveness	**N/A**
Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?	
No price treatment is applied in this treatment group.	

Long-Term Cost Reflectiveness	**3**
Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?	
No price treatment is applied in this treatment group.	

Cost Minimizing			**2**
How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?			
Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$1	$0	$310	0.00

Over the deployment period, the NPV of system benefits for the London Hydro RT-Only price plan, for a single participant enrolling at the start, is projected to be $1. For the same period, the unit costs are estimated to be $354, excluding fixed costs for the utility incurred for all participants.

Based on the assumptions below, the estimated benefit/cost ratio of this rate treatment, accounting for changes assumed to the treatment group design for full deployment, makes it the 5th most cost-effective treatment group out of the 10 considered.

The key driver of the assumed costs are the scaling factors applied to pilot costs. Scaling adjustments were applied to pilot costs to account for (1) costs that may be omitted at scale and (2) economies of scale. Scaling adjustments include:

Cost Category	Aggregate Scaling Factor	Description
Overhead	2%	• Guidehouse has assumed that EM&V costs are divided across all utilities provincially
Communication	50%	• Most costs are unaffected by provincial deployment; however, notably, no customer incentives would be required
Technology	52%	• As the application has already been developed, Guidehouse anticipates that deployment costs will be reduced. Guidehouse estimated the cost for updating the app's interface based on available pilot cost data and LDC estimates; deployment costs were anticipated to be 4% of pilot costs

Key Scaling Assumptions

Maximum Possible Market Share

Based on the provincial population in single family homes with central A/C, the maximum potential market share of Oshawa's pilot treatment is 48%.

Achievable Market Share

Guidehouse's assumption is that 60% of the eligible customers would enrol in this program, reducing the market share to 29%. For opt-in price treatments, Guidehouse estimated annual enrolment using a standard S-shaped diffusion curve.

Predictability	**4**

To what degree are prices predictable?

The London Hydro RT-Only treatment does not feature any pricing changes, period definition changes, or CPP events. The RT-Only treatment is equivalent to the status quo and is equivalently predictable; period definitions and pricing are aligned with current customer expectations.

The RT-Only treatment maintains 2 seasons annually and has fewer price periods per day than other price treatments being evaluated, increasing the predictability of prices for consumers.

Number of Price Periods (per Day)	Number of Changes to Price Periods (e.g., Season Change)
4	2

Comprehensible	**5**
How well are the price structures understood by customers?	

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

79% of participants indicated that using less electricity during the day will save them more money than reducing the same amount of electricity during evening or night. The price treatment has three price periods which were consistent and regular. As discussed under Customer Engagement, London Hydro had multiple customer support channels to help customers understand the price. Customers could reference the Trickl app for the current electricity price and their bills clearly showed usage by price period.

Based on the above factors, the RT-only treatment rated a score of ***5***, indicating that the price structure was very comprehensible.

Realized Opportunity for Bill Savings		**2**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?		
Bill Savings (%)	0%	0%
Bill Savings ($)	N/A	N/A

The RT-Only treatment delivered no statistically significant impacts and therefore no bill savings, resulting in a score of 2, none or minimal savings compared to other treatments.

Potential Opportunity for Bill Savings	**2**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	
	Pilot Period
Bill Savings ($)	$0.0

The London Hydro RT-Only treatment is not estimated to deliver any bill savings opportunities through the pilot period (May 2018 to April 2019). This results in a score of 2; zero to minimal monthly bill savings.

Ease of Implementation	**4**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The RT-Only treatment does not require any changes in pricing or period definitions from status quo TOU.

As this pricing structure is not different than the status quo, this treatment would cause minimal disruption to normal business operations and would require minimal consumer guidance.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide. The installation/maintenance of enabling technology was not required for this treatment.

There were extensive customer engagement efforts for this treatment. In addition to call centres, many targeted events included focus groups, breakfast events, open houses and more were scheduled and hosted.

For the above reasons, the RT-Only treatment receives a score of **4.**

Oshawa Super-Peak

Treatment Group Summary

Treatment Name	Super-Peak Time-of-Use
LDC	Oshawa PUC
Period of Analysis	2018-05-01 through 2019-10-31
Sample Size	~1,270
Enrolment Type	Opt-Out

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

Provision of a mobile application ("Peak") and web portal that provides personalized messaging to participants based on their profile and past behaviour. App personalization is dynamic and iterative, based on current weather conditions, participant profiling inputs, and historical usage patterns. The app gamifies savings by providing peer- and historical self-comparison and suggests savings strategies and weather-specific savings tips.

Only 20% of participants in this treatment group downloaded the app and used it at least once; these participants are referred to as "digitally engaged" participants.

Customer Engagement

- **Recruitment:** participants were randomly selected by Oshawa PUC to match the distribution of key characteristics in the utility's customer population.
- **Retention:** participants were subject to communications across a wide array of channels, including weekly email summaries[59], follow-up SMS reminder messages, push notifications and in-app messaging providing. Bill inserts, direct mailers and on-bill messaging are also provided.

Price Treatments

- Super-Peak price of 25.2 cents/kWh applies 1pm to 7pm non-holiday weekdays, June through August.
- All other non-Off-Peak times are an On-Peak price of 9.5 cents
- Modest Off-Peak discount (6.3 cents/kWh vs. 6.5 cents/kWh)

Technology Treatments

No enabling technology was deployed to this participant treatment group.

[59] Note that 56% of participants did not have email addresses on file with Oshawa PUC and so did not receive these communications.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	3	*This rate over-collects by 3.1% due to the structure of the rate itself and the relatively modest behavioural response..*
Short-Term Cost Reflectiveness	2	*This price treatment is the 6th most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	4	*This price treatment is the 3rd most reflective of long-term costs.*
Cost Minimizing	3	*3rd largest per-participant benefits of all treatments considered. Majority of benefits are for avoided capacity. Major costs include app development.*
Predictability	3	*Treatment involves additional price periods in each day, which customers must be aware of. Due to the additional number of periods, Customers experience more frequent price changes.*
Comprehensible	5	*Three price periods and consistent and regular timing. 92% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	1	*Consumer bills increase during summer, winter evaluation not yet available*
Estimated Bill Savings Opportunities	4	*Estimated to deliver moderate savings to consumers' bills; 3rd highest of treatments analysed.*
Ease of Implementation	5	*Treatment requires changes to both prices and period definitions. Opt-out treatment simplifies level of effort required.*

Treatment Detailed Description

Informational Treatments

Enabling Information

The focus of this treatment group was the leveraging of participant price response through a mobile application ("Peak") and associated web portal.[60] A key feature of the software underlying both tools is its iterative nature. App messaging and notifications are customized based on observed historical patterns of use of that software, information input by users (prompted by the software)[61], and historical electricity consumption patterns.

The Peak app provides users with:

- *Benchmarking*. Comparison of current consumption against historical averages. Although not explicitly stated, the evaluation report suggests that temperature and humidity data may be incorporated to this analysis to ensure a weather-normal comparison.
- *Gamification*. Participants are grouped based on observed usage patterns and input information, and ranked based on their estimated energy and bill savings. Participants can see how they compare to others (via a leader board) and are provided with motivational messaging to improve their performance. Participants achieve "badges" for meeting certain milestones (Electric Star for participants in the top 10% of energy savers in their peer group, etc.)
- *Savings Strategies*. Energy savings tips, behavioural and longer-term (related to acquisition of more efficient equipment, including participating in additional CDM programs) are provided on a daily basis in the app home screen. The description of the app in the evaluation report suggests acceptance of strategies by users is tracked and used to inform future recommendations.
- *Ways to Save.* Push notifications with personalized recommendations for savings actions are dispatched to participants with demonstrated app engagement.
- *Weather-Based Tips.* Conservation tips customized to current temperatures and humidity.
- *Daily Energy Costs.* The billing amount for each day's electricity use.

The app and web portal capture data from page views/app interactions (marking a saving strategy/tip as read) to adjust timing for the dispatch of push notifications or in-app messaging to match observed historical app use habits.

[60] The web portal has identical functionality to the app except in that it cannot provide push notifications to participants.

[61] A selection of 116 possible questions were asked of each participant to develop their profile. The evaluation report provides examples including: "What temperature do you set your thermostat to in the summer?" and "Do you clean your outside A/C unit?".

For this treatment group only 20% of participants used the app. These are referred to in the evaluation report as "digitally engaged" participants.

Customer Engagement

- **Recruitment:** participants were randomly selected by Oshawa PUC for inclusion in this treatment group provided they met a set of key eligibility criteria (were not participating in any other pilots, had three or more years of electricity consumption history, and lived in a single-family dwelling). The sample frame was selected from mix of digital and traditional customers, accounting for age and location.[62]
  Once enrolled in the program, participants received a price change notification package informing them of the price change and providing additional details regarding the pilot.
- **Retention:** piloted customer engagement was focused primarily, but not exclusively, through digital channels. Participants were engaged through email, SMS text messages, the Peak app, the Peak web portal, bill inserts, direct mailers, and on-bill messaging.
  - *Peak app.* The functionality of this app is described above. Only 20% of participants in this treatment group downloaded the app and logged in at least once to view their consumption.
  - *Peak web portal.* Same functionality as app (but without push notifications), as described above. The evaluation report does not note how many participants used this tool.
  - *Emails.* Weekly emails circulated to participants at 7am each Tuesday morning. Emails include a summary of prior week consumption, conservation tips relevant to the current week and rank within their automatically generated peer group (gamification). Email addresses were not available to Oshawa PUC for approximately 56% of participants.
    The evaluation report indicates that across the pilot as a whole[63] these emails were opened approximately 50% of the time on average, with opening prices highest in July.[64] Beginning in October 2018 more delivered emails remained unopened than were opened, through the end of the pilot in April 2019. Open rates within a given week decline sharply with time: if the participant hasn't opened their email on Tuesday or Wednesday, they are unlikely to open it all.
  - *SMS.* Participants are provided an SMS reminder on Thursdays to open their weekly email summary. The evaluation report claims these reminders modestly increase the email open price in later days of the week.
  - *Targeted Communications Campaigns*. The evaluation report notes that Oshawa conducted several distinct communications campaigns over the course of the pilot. No details are provided in the evaluation report regarding the channels used for these campaigns.
    - "Nudge to Save More" Campaign. This began in July, with communications supporting this campaign provided approximately twice weekly.[65]
    - "App Download" Campaign. This began in June and continued throughout the pilot, with messaging provided weekly.
    - "Additional Family Member" Campaign. This took place in September. Two communications were issued as part of this campaign.
    - Additional campaign communications included communications regarding the Affordability Fund Trust, survey reminders, and communications in September to promote the Save on Energy Heating and Cooling program to high-usage customers living in single family homes built prior to 2000. The evaluation report notes that the pilot's "campaign engine" delivered "over 60 relevant campaigns to various participant groups via their preferred channels".
  - *Bill Inserts and Direct Mailers*. In addition to the digital communications channels noted above, traditional communications (bill inserts and direct mailers) were used. No indication is provided in the evaluation report regarding the frequency or content of these communications.

[62] Guidehouse has assumed that this description indicates that the sample distribution across these parameters is representative of the overall Oshawa PUC customer population, after accounting for the eligibility exclusions cited above.
[63] Email open rates specific to this treatment group are not included in the report.
[64] It does not appear as though weekly email summaries were circulated in May. June email receipt and opening statistics, and the campaign calendar, included in the evaluation report suggest that only a portion of participants received emails in that month. The evaluation reports that it was in July that the weekly recap report was introduced for all three treatments.
[65] Content related to this campaign is unclear. The "Nudge to Save More" nomenclature appears only in the evaluation report appendix providing the communications calendar.

Price Treatments

Pricing Period	Commodity Price (cents/kWh)	
	Standard RPP Consumers	Super-Peak Participants
Off-Peak 7pm to 7am, on weekdays 24 hours on weekends and holidays.	6.5	6.3
Mid-Peak 7am to 11am and 5pm to 9pm, summer weekdays 11am to 5pm, winter weekdays	9.4	N/A
Status Quo On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 9pm, winter weekdays	13.2	N/A
Super-Peak Price On-Peak 7am to 1pm, weekdays, June through August 7am to 7pm, weekdays, all other months	N/A	9.5
Super-Peak Price Super-Peak 1 pm to 7pm, weekdays, June through August	N/A	25.2

Technology Treatments

No enabling technology was deployed to this participant treatment group.

Participant Attrition

Of the 1,996 participants allocated to this group to this group, 258 opted out before pilot began (Table 78 of the evaluation report), and 387 dropped out (note this number includes participants that had to drop out because they were moving house) between the date at which the pilot started and the end of March, 2019.[66] This delivers an overall attrition rate of 24.4%

[66] See dropouts counted in Table 81. Note that it appears that the dropouts (and move-outs) in this table are incremental to the drop-outs in Table 78, and have been treated as such in the table above.

Pilot Report Findings

Price Treatment Key Findings

- **All demand reductions were delivered by the 20% of participants that were digitally engaged.** The subset of digitally engaged customers[67] delivered an average demand reduction in the summer (June through August) Super-Peak and On-Peak periods of 0.14 kW (9.5%) and 0.065 kW (5.9%), respectively. In contrast the average impacts of the non-digitally engaged participants in the same period were not statistically significantly different from zero.
- **Digitally engaged participants reduced demand during the pilot's summer On-Peak period, despite the average price of that period being lower than that of the same span of time under status quo prices.** All else equal, the average price in the On-Peak period has *fallen* compared to the status quo TOU – under pilot prices, the price in this period was 9.5 cents per kWh.
  Under status quo prices, the price in this period was some weighted average of 9.4 cents (the status quo Mid-Peak price) and 13.2 cents (the status quo On-Peak price). This would almost certainly be higher than the price which applies in the same time period under the pilot prices.
  This suggests either some potential misunderstanding of price levels amongst participants (which could reduce the persistence of impacts as participants observe lower-than hoped-for savings) or else that the change in price structure motivated, in the digitally engaged participants, general instinct for conservation. This effect is also evident in the decrease in summer (June through August) weekend demand (0.014 kW, or 2.2%) by digitally engaged participants.
- **Participants increased their demand by in nearly all winter and winter shoulder periods.** Given the seasonal differential in prices this is a not unexpected result. During winter months, digitally engaged participants did not increase their On-Peak demand (the estimated impact is not statistically significant), though they did increase their Off-Peak demand (0.048 kW, or 4.1%) by *more* than the non-digitally engaged participants (0.018 kW or 1.7%), suggesting that these participants enjoyed a more sophisticated understanding of the prices they faced.

Non-Price Treatment Key Findings

The evaluation report does not differentiate app usage statistics by treatment group, so all app usage statistics presented below apply across all treatment groups.

- **The seasonal asymmetry of the price reduced customer satisfaction.** Although the price is designed to be revenue neutral on an annual basis, it does, by design, result in a shifting of customer costs toward the summer period. The technical consultant notes that it was "*a challenge to articulate the price-neutral design... participant feedback reflected resentment about… the general price of electricity*"
- **App usage was dominated by users viewing their usage**. Users viewed their past energy usage approximately a third of the times they opened their app. This increases somewhat over time, from 29% in May, 2018 to 40% in April, 2019. This was by far the most frequently used aspect of app functionality.
- **App home page visits declined over the initial summer of participation.** In May, participants accessed the home page a third of the time. On average between September 2018 and April, 2019, the home page was accessed on only 20% of visits.
- **Use of the Message Centre was modest but grew substantially over time**. In May, users accessed the Message Centre only on 5% of visits. This grew over time peaking at 18.5% of visits in February and closing the evaluation period at 17.4%.
- **The app was most commonly used on Tuesdays, perhaps as a result of the dispatch of the weekly summary on that day.** Typically, approximately 20% of visits (the plurality) took place on Tuesdays. In August, in contrast to all other months, a plurality of visits took place on Thursday.
- **On average the app was consulted by only approximately 20% of users in any given month**.[68] App usage was highest for participants 25 – 34 years, where it grew from 30% of users consulting it per month (April, 2018) to a peak of 32% (October) before declining again to approximately 27% in March, 2019. App usage declined over the same period for participants 35 – 44 years old, from 27% in April to just 15% in March, 2019. Usage trends appear generally flat for other demographics.

[67] Participants that had downloaded the app and used it at least once or used the web portal.
[68] This observation is based on Figure 107 of the evaluation report. Guidehouse's understanding is that this shows the percent of users that used the app in each month of the summer period, by age group.

Evaluation Metric Scoring

Cost Recovery	**3**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[69] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[70] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [71]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Super-Peak	$0.0845	$0.0827	3.1%	0.9%
Control	N/A	$0.0820	N/A	0%

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour –over-collected revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

The most important column in the table above is the one that is second from the right: "% Difference from RPA – Pilot Price Plan". This documents the percentage difference between the average revenue collected by the utility per kWh consumed by participant and the average provincial supply cost.

This indicates that, on average, this price over-collected by 3.1%.

This over-collection has three elements: jurisdictional, behavioural, and rate-structural.

- **Jurisdictional.** The bottom right cell of the table above indicates that on average Oshawa PUC neither over- nor under-collects from its customers, with average revenue matching the RPA.
- **Behavioural.** The top row of the right-most column indicates the percentage over-collection due to t changes in behaviour. If participants had paid the status quo TOU price, but still changed their behaviour as they did in response to the pilot price plan, then on average Oshawa PUC would have over-collected by 0.9%.
  This suggests that, on average, participants' consumption increased in higher-priced *status quo TOU hours*.
  This result accords with the impact evaluation findings, that overall consumption increased in all four seasons (summer, summer shoulder, winter, and winter shoulder). In particular, increased consumption in the shoulder months – where the pilot price during the status quo On-Peak period was much lower than under the status quo price plan and thus encouraged increased consumption in a costlier time period – drove this effect. .
- **Rate-Structural.** The total over-collection is 3.1%. Subtracting the behavioural over-collection (0.9%) this results in a *rate-structural* over-collection of 2.2%. This is the over-collection – relative to the RPA – that is purely the result of the change in the price structure, specifically the sustained high price during the summer Super-Peak period (partially offset by the lower shoulder period price).

[69] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf
[70] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf
[71] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

This price is the second worst-performing from a cost recovery standpoint and is rated as such. As noted above, this is expected to change following the delivery of the winter season revenue adequacy data.

Short-Term Cost Reflectiveness	**2**

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

This price treatment is the 6th most reflective *short-term cost-reflective* series out of 10 and has been given a score of 2.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the RMSE of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)
-85%	-16%	-49%

The RMSE of this price series is 39% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**4**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the 3rd most reflective *long-term cost-reflective* series out of 10 and has been given a score of 4.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
13%	N/A	13%

The RMSE of this price series is 13% smaller than that of the status quo price series, indicating that it is **more** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	**3**
How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?	

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$1.2	$142.4	$657.8	0.22

Over the deployment period, the NPV of system benefits for the Oshawa Super-Peak price plan, for a single participant enrolling at the start, is projected to be $38.

For the same period, the unit costs are estimated to be $21, excluding fixed costs for the utility incurred for all participants. Fixed costs that cannot be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment.

The key driver of the assumed costs are the scaling factors applied to pilot costs. Scaling adjustments were applied to pilot costs to account for (1) costs that may be omitted at scale and (2) economies of scale. Scaling adjustments include:

Cost Category	**Aggregate Scaling Factor**	**Description**
Overhead	70%	• Guidehouse has assumed that EM&V costs are divided across all utilities provincially • Guidehouse has assumed that incentives are omitted from a provincial deployment
Communication	10%	• Guidehouse anticipates participant marketing and outreach costs will be reduced on a per-participant basis based on economies of scale
Technology	30%	• Guidehouse anticipates a reduction in costs for development of application, assuming the same or similar application is used in provincial deployment

If pilot costs are taken as is, with no considerations for a province-wide rollout (i.e. costs are considered to be identical to pilot costs), the NPV of costs is estimated to be $2,024 million.

Based on the assumptions below, the estimated benefit/cost ratio of this price treatment, accounting for changes assumed to the treatment group design for full deployment makes it the 3rd most cost-effective treatment group out of the 10 considered.

Key Scaling Assumptions

Maximum Possible Market Share

The Oshawa Super-Peak program's targeted characteristic is single-family households. Based on the proportion of the population residing in single-family households, the maximum possible market share for this price treatment is 75%.

Achievable Market Share

For opt-out price treatments, Guidehouse assumed that 100% of the maximum market share is eligible for enrolment in the program. To account for annual program attrition prices (22%), the achievable market share is reduced in year 0 to 58%. Each year, the incremental provincial population (from population growth) is enrolled in the program.

Predictability	**3**

To what degree are prices predictable?

The Oshawa Super-Peak treatment involves changes to existing pricing and period definitions from status quo. The treatment includes a super-peak price from 1 to 7pm. This additional price period requires customer to experience more frequent price changes, decreasing predictability.

The Super-Peak treatment requires changes to both prices and period definitions. The addition of the Super-Peak period and the conflation of the Mid-Peak and On-Peak periods in the non-summer makes prices less predictable. In addition, the opt-out nature of the pilot makes it less predictable than many other price plans, as involuntary participation will inevitably be less predictable than voluntary participation.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
4	2

Comprehensible	**5**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

Oshawa's survey revealed that 92% of participants have a good understanding of the difference between flat pricing and time-of-use pricing. The price treatment has three periods, which was consistent and regular in terms of timing. As discussed under Customer Engagement, Oshawa had multiple customer support channels, to help customers understand the price plans. Oshawa also used a status quo TOU clock as a visual depiction of the price, which was found to be less comprehensible compared to a linear visual. The bill showed the usage by price period but could improve by providing a comparison of the cost or savings or showing a visual of consumption by period.

Based on the above factors, the Super Peak treatment rated a score of **5**, indicating that the price structure was very comprehensible.

Realized Opportunity for Bill Savings	**1**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%) - Average	-19.1%	4.4%
Bill Savings (%) – Digitally Engaged Participants	-14.1%	3.9%
Bill Savings (%) – Non-Digitally Engaged Participants	-20.4%	4.5%
Bill Savings ($) – Average	-$22.6	$5.09
Bill Savings ($) – Digitally Engaged Participants	-$17.1	$4.51
Bill Savings ($) – Non-Digitally Engaged Participants	-$23.92	$5.23

The Oshawa Super-Peak treatment had the lowest summer bill savings – monthly participant bills on average increased more than under in any other treatment group. Although consumers experience bill savings in the winter, the large increase in summer results in an average savings of -7.4%.This results in a score of 1, negative savings. This treatment was ineffective at delivering bill savings.

Potential Opportunity for Bill Savings	**4**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$3.3

The Oshawa Super-Peak treatment delivers the 3rd highest estimated monthly bill savings opportunity through the pilot period (May 2018 to April 2019), of the 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill savings of $3.3, resulting in a score of 4, savings between $3 and $5.

Ease of Implementation	**5**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Oshawa Super-Peak treatment involves the implementation of a price plan with pricing and period definition changes from the status quo TOU. Deviations from status quo pricing include the addition of a super-peak period from 1pm to 7pm during weekdays in July/August.

There was a wide range of perceived costs among LDCs for implementing price and/or TOU period definition changes. Many respondents did not believe this would pose significant time or cost challenges (<$100,000 and ~3-6 months), while others reported larger challenges (>$1,000,000 and > 6 months). The majority of respondents indicated additional required systems enhancements, i.e. the MDM/R and Operational Data Store including customer interaction channels, bill printing, how price switching would be handled, and additional customer education and support.

The Super-Peak treatment is an opt-out treatment – opt-out treatments do not present the same recruitment challenges as opt-in treatments. Further, the treatment did not require any enabling technology installation.

Customer engagement efforts were less intensive for this treatment than others; engagement efforts included email blasts, bill inserts, and the generation of targeted campaigns.

For the above reasons, the Super-Peak treatment receives a score of **5.**

Oshawa Seasonal TOU with CPP

Treatment Group Summary

Treatment Name	Seasonal Time-of-Use with Critical Peak Pricing
LDC	Oshawa PUC
Period of Analysis	2018-05-01 through 2018-10-31
Sample Size	~430
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments

Enabling Information

Provision of a mobile application ("Peak") and web portal that provides personalized messaging to participants based on their profile and past behaviour. App personalization is dynamic and iterative, based on current weather conditions, participant profiling inputs, and historical usage patterns. The app gamifies savings by providing peer- and historical self-comparison, and suggests savings strategies and weather-specific savings tips.

Critical peak event notification was provided multiple times in the 24 hours leading up to the critical peak event, across multiple channels.

Seventy-nine percent of participants in this treatment group downloaded the app and used it at least once, these participants are referred to as "digitally engaged" participants.

Customer Engagement

- **Recruitment:** enrolment was solicited through a number of channels both physical (bill inserts, a direct mailer) and virtual (emails, social media advertisements). An overwhelming majority (92%) of participants that enrolled did so on the basis of the email engagement.
- **Retention:** participants were subject to communications across a wide array of channels, including weekly email summaries[72], follow-up SMS reminder messages, push notifications and in-app messaging providing. Bill inserts, direct mailers and on-bill messaging are also provided.

Price Treatments

- Flat price, 7.9 cents/kWh, applied at all times in shoulder months (March through May, September through November).
- Mid-Peak eliminated, replaced by 12-hour On-Peak with modest price increase compared to status quo TOU (13.2 cents/kWh) – in place June through August, December through February.
- Off-Peak discounted to 5.4 cents per kWh – in place June through August, December through February.
- Subject to 10 critical peak events per season (20 total)
  - Events called to target system peak demand
  - Events last four hours, between 4 and 8pm
  - Notification is provided 26 hours ahead of event.
- Event price: 59.5 cents/kWh

Technology Treatments

No enabling technology was deployed to this participant treatment group.

[72] Note that 56% of participants did not have email addresses on file with Oshawa PUC and so did not receive these communications.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	5	*Virtually no under- or over-collection relative to the RPA. Deviation in revenue collection is likely statistical noise..*
Short-Term Cost Reflectiveness	4	*This price treatment is the 2nd most reflective short-term cost-reflective series.*
Long-Term Cost Reflectiveness	4	*This price treatment is the 2nd most reflective of long-term costs.*
Cost Minimizing	3	*4th largest per-participant benefits of all treatments considered, but higher costs per participant than other treatments due to smaller enrolment.*
Predictability	2	*Treatment involves CPP events, which are inherently dependent on system conditions and less predictable. Events do not occur every day during the season but may occur roughly monthly at least throughout the year.*
Comprehensible	3	*CPP events introduced some element of inconsistency and irregularity in terms of timing. 88% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	2	*Slight bill savings available during the summer, winter evaluation not yet available. Opt-in treatment requires significant recruitment efforts.*
Estimated Bill Savings Opportunities	4	*Estimated to deliver moderate savings to consumer's bills; 4th highest of treatments analysed.*
Ease of Implementation	2	*Treatment requires changes to prices, changes to period definitions, and the implementation of CPP events. Opt-in treatment requires significant recruitment efforts.*

Treatment Detailed Description

Informational Treatments

Enabling Information

The focus of this treatment group was the leveraging of participant price response through a mobile application ("Peak") and associated web portal.[73] A key feature of the software underlying both tools is its iterative nature. App messaging and notifications are customized based on observed historical patterns of use of that software, information input by users (prompted by the software)[74], and historical electricity consumption patterns.

Critical peak event notification is provided across all channels (app push notification, email, SMS text message). Notification is provided 26 hours in advance (2pm the day prior), nine hours in advance (7am the day of), and thirty minutes in advance (push notification and SMS only). Participants were informed of the end of each event by a push notification at 8pm of the event day.

The Peak app provides users with:

- Event Notification:
- *Benchmarking*. Comparison of current consumption against historical averages. Although not explicitly stated, the evaluation report suggests that temperature and humidity data may be incorporated to this analysis to ensure a weather-normal comparison.
- *Gamification*. Participants are grouped based on observed usage patterns and input information and ranked based on their estimated energy and bill savings. Participants can see how they compare to others (via a leader board) and are provided with motivational messaging to improve their performance. Participants achieve "badges" for meeting certain milestones (Electric Star for participants in the top 10% of energy savers in their peer group, etc.)
- *Savings Strategies*. Energy savings tips, behavioural and longer-term (related to acquisition of more efficient equipment, including participating in additional CDM programs) are provided on a daily basis in the app home screen. The description of the app in the evaluation report suggests acceptance of strategies by users is tracked and used to inform future recommendations.

[73] The web portal has identical functionality to the app except in that it cannot provide push notifications to participants.

[74] A selection of 116 possible questions were asked of each participant to develop their profile. The evaluation report provides examples including: "What temperature do you set your thermostat to in the summer?" and "Do you clean your outside A/C unit?".

- *Ways to Save.* Push notifications with personalized recommendations for savings actions are dispatched to participants with demonstrated app engagement.
- *Weather-Based Tips.* Conservation tips customized to current temperatures and humidity.
- *Daily Energy Costs.* The billing amount for each day's electricity use.

The app and web portal capture data from page views/app interactions (marking a saving strategy/tip as read) to adjust timing for the dispatch of push notifications or in-app messaging to match observed historical app use habits.

For this treatment group 79% of participants downloaded the app and used it at least once. These are referred to in the evaluation report as "digitally engaged" participants.

Customer Engagement

- **Recruitment:** participants were recruited through five channels. These are listed immediately below along with the proportion of enrolments delivered by each.
  - *Initial email:* 24% of enrolments.
  - *Reminder email(s):* 68% of enrolments
  - *Bill insert:* 4% of enrolments
  - *Facebook/Twitter:* 2% of enrolments
  - *Direct mail:* 2% of enrolments
- **Retention:** piloted customer engagement was focused primarily, but not exclusively, through digital channels. Participants were engaged through email, SMS text messages, the Peak app, the Peak web portal, bill inserts, direct mailers, and on-bill messaging.
  - *Peak app.* The functionality of this app is described above. Seventy-nine percent of participants in this treatment group downloaded the app and logged in at least once to view their consumption.
  - *Peak web portal.* Same functionality as app (but without push notifications), as described above. The evaluation report does not note how many participants used this tool.
  - *Emails.* Weekly emails circulated to participants at 7am each Tuesday morning. Emails include a summary of prior week consumption, conservation tips relevant to the current week and rank within their automatically generated peer group (gamification).
    The evaluation report indicates that across the pilot as a whole[75] these emails were opened approximately 50% of the time on average, with opening prices highest in July.[76] Beginning in October 2018 more delivered emails remained unopened than were opened, through the end of the pilot in April 2019. Open rates within a given week decline sharply with time: if the participant hasn't opened their email on Tuesday or Wednesday, they are unlikely to open it at all.
  - *SMS.* Participants are provided an SMS reminder on Thursdays to open their weekly email summary. The evaluation report claims these reminders modestly increase the email open price in later days of the week.
  - *Targeted Communications Campaigns*. The evaluation report notes that Oshawa conducted several distinct communications campaigns over the course of the pilot. No details are provided in the evaluation report regarding the channels used for these campaigns.
    - "Nudge to Save More" Campaign. This began in July, with communications supporting this campaign provided approximately twice weekly.[77]
    - "App Download" Campaign. This began in June and continued throughout the pilot, with messaging provided weekly.
    - "Additional Family Member" Campaign. This took place in September. Two communications were issued as part of this campaign.
    - Additional campaign communications included communications regarding the Affordability Fund Trust, survey reminders, and communications in September to promote the Save on Energy Heating and Cooling program to high-usage customers living in single family homes built prior to 2000. The evaluation report notes that the pilot's "campaign engine" delivered "over 60 relevant campaigns to various participant groups via their preferred channels".
  - *Bill Inserts and Direct Mailers*. In addition to the digital communications channels noted above, traditional communications (bill inserts and direct mailers) were used. No indication

[75] Email open rates specific to this treatment group are not included in the evaluation report.
[76] It does not appear as though weekly email summaries were circulated in May. June email receipt and opening statistics, and the campaign calendar, included in the evaluation report suggest that only a portion of participants received emails in that month. The evaluation reports that it was in July that the weekly recap report was introduced for all three treatments.
[77] Content related to this campaign is unclear. The "Nudge to Save More" nomenclature appears only in the evaluation report appendix providing the communications calendar.

is provided in the evaluation report regarding the frequency or content of these communications.

Price Treatments

Pricing Period	Commodity Price (cents/kWh)	
	Standard RPP Consumers	Seasonal with CPP Participants
Off-Peak 7pm to 7am, on weekdays 24 hours on weekends and holidays.	6.5	5.3
Status Quo Mid-Peak 7am to 11am and 5pm to 9pm, summer weekdays 11am to 5pm, winter weekdays	9.4	N/A
Seasonal TOU with CPP Shoulder Peak 24 hours, every day, March through May and September through November	N/A	7.9
Status Quo On-Peak 11am to 5pm, summer weekdays 7am to 11am and 5pm to 9pm, winter weekdays	13.2	N/A
Seasonal TOU with CPP On-Peak 7am to 7pm, weekdays, June through August and December through February	N/A	13.2
Seasonal TOU with CPP Critical Peak 10 four-hour events in summer 10 four-hour events in winter Events occur between 4pm and 8pm, prevailing time, only on non-holiday weekdays.	N/A	26.3

Technology Treatments

No enabling technology was deployed to this participant treatment group.

Participant Attrition

Of the 562 participants that enrolled in this group, 77, or approximately 5% opted out by the end of March 2019.

Pilot Report Findings

Price Treatment Key Findings

- **As with the Super-Peak treatment group, reductions in regularly scheduled price period (i.e., excluding CPP events) demand were driven entirely by the digitally engaged participants.** All impacts cited below are statistically significant unless otherwise noted.
  - *Summer (June through August)*
    - Digitally engaged participants reduced their average daily consumption during the On-Peak and weekend Off-Peak periods by 0.98 kWh (6.5%) and 0.78 kWh (2.4%) respectively.
    - Digitally engaged participants reduced monthly consumption by 27.2 kWh (2.9%).
    - Non-digitally engaged participants *increased* average daily consumption during the On-Peak and Weekend Off-Peak periods by 0.72 kWh (5%) and 1.55 kWh (5.1%), respectively.
    - Non-digitally engaged participants *increased* monthly consumption by 32.7 kWh (3.7%).
  - *Winter (December through February)*
    - Digitally engaged participants reduced their average daily consumption during the On-Peak, weekday Off-Peak, and weekend Off-Peak periods by 0.27 kWh (1.9%), 0.23 kWh (1.6%), and 0.98 kWh (3 %) respectively.
    - Digitally engaged participants reduced monthly consumption by 18.5 kWh (2.1%)
    - Non-digitally engaged participants *increased* their average daily consumption during the On-Peak period by 0.43 kWh (2.8%)
    - Non-digitally engaged participants *increased* monthly consumption by 10.6 kWh (1.1%).
  - *Summer Shoulder (May, September, October)*
    - Digitally engaged participants reduced monthly consumption by 14.2 kWh (2%).
    - Non-digitally engaged participants *increased* monthly consumption by 38 kWh (5.5%).
  - *Winter Shoulder (November, March, April)*
    - Non-digitally engaged participants *increased* monthly consumption by 24 kWh (3%).
- **Digitally engaged participants contributed substantially more demand response during summer critical peak events, but – counterintuitively – non-digitally engaged participants contributed more demand response in the winter months.**
  - *Summer*
    - Digitally engaged participants reduced critical peak period consumption by an average of 0.93 kWh (0.23 kW, or 12.8%).
    - Non-digitally engaged participants reduced critical peak period consumption by an average of 0.2 kWh (0.05 kW, or 2.6%).
  - *Winter*
    - Digitally engaged participants reduced critical peak period consumption by an average of 0.26 kWh (0.065 kW, or 4.2%).
    - Non-digitally engaged participants reduced critical peak period consumption by an average of 0.35 kWh (0.09 kW, or 5%).
- **Participants found consecutive summer events challenging.** System demand is highly correlated with temperature, and temperature is highly serially correlated – the hottest days tend to come as part of a wave, not as individual events. These led to two sets of two consecutive CPP events. The evaluation report notes that heat waves (and consecutive CPP events) resulted in an increase in call volume. In both of these instances of consecutive event days, impacts were lower on the second day than the first, although it is unclear if this was due to participant fatigue, lower outdoor temperatures, or noise in the data (these differences may not be statistically significant).

Non-Price Treatment Key Findings

The evaluation report does not differentiate app usage statistics by treatment group, so all app usage statistics presented below apply across all treatment groups.

- **App usage was dominated by users viewing their usage**. Users viewed their past energy usage approximately a third of the times they opened their app. This increases somewhat over time, from 29% in May, 2018 to 40% in April, 2019. This was by far the most frequently used aspect of app functionality.
- **App home page visits declined over the initial summer of participation.** In May, participants accessed the home page a third of the time. On average between September 2018 and April, 2019, the home page was accessed on only 20% of visits.
- **Use of the Message Centre was modest but grew substantially over time**. In May, users accessed the Message Centre only on 5% of visits. This grew over time peaking at 18.5% of visits in February and closing the evaluation period at 17.4%.

- **The app was most commonly used on Tuesdays, perhaps as a result of the dispatch of the weekly summary on that day.** Typically, approximately 20% of visits (the plurality) took place on Tuesdays. In August, in contrast to all other months, a plurality of visits took place on Thursday.
- **On average the app was consulted by only approximately 20% of users in any given month**.[78] App usage was highest for participants 25 – 34 years, where it grew from 30% of users consulting it per month (April, 2018) to a peak of 32% (October) before declining again to approximately 27% in March, 2019. App usage declined over the same period for participants 35 – 44 years old, from 27% in April to just 15% in March, 2019. Usage trends appear generally flat for other demographics.

Evaluation Metric Scoring

Cost Recovery	**5**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[79] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[80] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [81]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Seasonal TOU with CPP	$0.0821	$0.0823	0.2%	0.4%
Control	N/A	$0.0818	N/A	-0.2%

Based on the evaluation report, it appears as though the price treatment – after accounting for any changes in behaviour – is very slightly over-collecting revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

The most important column in the table above is the one that is second from the right: "% Difference from RPA – Pilot Price Plan". This documents the percentage difference between the average revenue collected by the utility per kWh consumed by participant and the average provincial supply cost.

This indicates that, on average, this price over-collected by 0.2%.

This over-collection has three elements: jurisdictional, behavioural, and rate-structural.

- **Jurisdictional.** The bottom right cell of the table above indicates that Oshawa PUC very slightly under-collects (compared to the average supply cost) by about 0.2% for customers whose pre-pilot consumption patterns match those of the pilot participants. This difference is sufficiently small that it may likely be regarded as statistical "noise".
- **Behavioural.** The top row of the right-most column indicates the percentage over-collection due to the combined effect of changes in behaviour and jurisdictional under-collection (described above). If participants had paid the status quo TOU price, but still changed their behaviour as they did in response to the pilot price plan, then on average Oshawa PUC

[78] This observation is based on Figure 107 of the evaluation report. Guidehouse's understanding is that this shows the percent of users that used the app in each month of the summer period, by age group.
[79] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf
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https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf
[81] This acronym does not quite match the underlying definition but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…"*

would have over-collected by 0.4%. After accounting for the jurisdictional under-collection of 0.2% (from the control group), this is a net behavioural over-collection of 0.6%.
This suggests that, on average, participants' consumption increased in higher-priced *status quo TOU hours*.
This result is not incompatible with the pilot evaluation's finding of statistically significant reductions in demand in the price-specific summer On-Peak periods (7am to 7pm, non-holiday weekdays in June through August and December through February).
In the summer months, between 7am and 7pm the commodity price is set at 13.2 cents per kWh. For six hours of this period, there is no change from the status quo price (status quo On-Peak is the same price). However, in the remaining six status quo Mid-Peak hours, the price has increased by 40%. The expected response would be a shift of consumption from the status quo Mid-Peak to the status quo On-Peak period, changing behaviour in such a manner as would result in over-collection if status quo TOU prices were in effect.
Furthermore, and perhaps more significantly, in the shoulder season, the price in all hours of the day is 7.9 cents per kWh, a 16% discount in the status quo Mid-Peak period, and a 40% discount in the status quo On-Peak period. This set of incentives encourages the shifting of consumption away from the lower-priced status quo TOU period (e.g., Mid-Peak) to the higher-priced – but now heavily discounted – status quo On-Peak period.

- **Rate-Structural.** The total over-collection is only 0.2%. Subtracting the behavioural over-collection (0.4%), and the jurisdictional under-collection (-0.2%), this results in a net *rate-structural* under-collection of -0.4% (0.2% - 0.4% - (- 0.2 %)). This is the under-collection – relative to the RPA – remaining after accounting for behaviour changes that is purely the result of the change in the price structure. The magnitude of this under collection is sufficiently small that it can likely be ascribed to statistical "noise" and not an inherent issue with the price plan structure itself.

Historically, the approach to setting prices in Ontario has followed the principle that changes in price structure must be revenue neutral to the provincial average, *assuming no changes in behaviour*. The question of cost-recovery addressed above identifies to what degree this is a reasonable and sustainable approach to price-setting for a wider deployment of the piloted price.

In this case, the magnitude of the difference is sufficiently small that – given the inherent uncertainty associated with applying this sample out to a wider roll-out of a provincial price – no adjustment to the core price-setting assumption (revenue neutrality under the assumption of no behaviour change) would be required until such time as adoption of the price became quite significant. As participation in such a price approached 15% to 20% of the available population, price-setting should begin to address the question of behavioural adjustments made by participants faced with these prices in setting future iterations of that price plan.

Short-Term Cost Reflectiveness	**4**
Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?	

This price treatment is the 2nd most reflective *short-term cost-reflective* series out of 10 and has been given a score of 4.

Short-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to the contemporaneous hourly series of system supply costs developed by Guidehouse. The comparison metric is the percentage difference between the root mean squared error (RMSE) of the treatment price series and the RMSE of the status quo TOU price series. A negative percentage value indicates that the given price treatment is less reflective of the charged system cost than the status quo TOU. A positive value indicates that is more reflective of charged system cost than the status quo TOU.

Summer 2018	Winter 2018/2019	Total (Pilot Period)

-33%	-21%	-25%

The RMSE of this price series is 25% larger than that of the status quo price series, indicating that it is **less** reflective of charged supply cost than the status quo price series.

Long-Term Cost Reflectiveness	**5**

Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?

This rate treatment is the most reflective *long-term cost-reflective* series out of 10 and has been given a score of 5.

Long-term cost reflectiveness is evaluated by comparing the price series to which participants were exposed during the pilot period to demand-shaped cost series provided by OEB staff. The comparison metric is the same as for the short-term cost reflectiveness and interpreted the same way: a positive number indicates the price series is more cost reflective than the status quo TOU price series, a negative number indicates that it is less so than the status quo TOU price series

Summer 2018	Winter 2018/2019	Total (Pilot Period)
4.2%	2.5%	3.6%

The RMSE of this price series is 3.6% smaller than that of the status quo price series, indicating that it is **more** reflective of incurred supply cost than the status quo price series.

Cost Minimizing	**3**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
$1.0	$114.4	$589.8	0.20

Over the deployment period, the NPV of system benefits for the Oshawa Super-Peak price plan, for a participant enrolling at the start, is projected to be $294.

For the same period, the unit costs are estimated to be $21, excluding fixed costs for the utility incurred for all participants. Fixed costs that cannot be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment.

The key driver of the assumed costs are the scaling factors applied to pilot costs. Scaling adjustments were applied to pilot costs to account for (1) costs that may be omitted at scale and (2) economies of scale. Scaling adjustments include:

Cost Category	**Aggregate Scaling Factor**	**Description**
Overhead	70%	• Guidehouse has assumed that EM&V costs are divided across all utilities provincially • Guidehouse has assumed that incentives are omitted from a provincial deployment
Communication	10%	• Guidehouse anticipates participant marketing and outreach costs will be reduced on a per-participant basis based on economies of scale
Technology	30%	• Guidehouse anticipates a reduction in costs for development of application, assuming the same or similar application is used in provincial deployment

If pilot costs are taken as is, with no considerations for a province-wide rollout (i.e. costs are considered to be identical to pilot costs), the NPV of costs is estimated to be $1,344 million.

Based on the assumptions below, the estimated benefit/cost ratio of this price treatment, accounting for changes assumed to the treatment group design for full deployment makes it the 4th-most cost-effective treatment group out of the 10 considered.

Key Scaling Assumptions

Maximum Possible Market Share

Guidehouse estimated the maximum possible market share for the Oshawa Seasonal TOU treatment based on the market share of the London Hydro CPP treatment. The two treatments are similar; however, the Oshawa treatment provides a longer warning period and a lower critical peak price. As such, Guidehouse estimates that the market share is larger. The market share is assumed to be 20%.

Achievable Market Share

For opt-in price treatments, Guidehouse estimated annual enrolment using a standard S-shaped diffusion curve.

Predictability	**2**

To what degree are prices predictable?

The Oshawa Seasonal TOU with CPP treatment features changes to existing period definitions and pricing and includes CPP events.

The Seasonal TOU treatment has the fewest maximum number of price periods in a given day (e.g., off-peak and on-peak only). The pilot adds another season (shoulder), though the price structure in that season is very simple, with a flat price in all hours. Customers are required to be aware of four seasonal changes throughout the year; however, the TOU periods in these seasons are simple.

This treatment involves CPP events, which are inherently dependent on system conditions and less predictable. Treatments involving CPP events had relatively high impacts on consumption patterns, relative to other treatments. This treatment included 20 CPP events per season. Customers were given 26 hours' notice prior to CPP events. Although customers benefit from simplified TOU periods, the unpredictability of CPP events, which occur roughly monthly, results in the treatment being provided a score of 2.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
2	4

Comprehensible	**3**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

Oshawa's survey revealed that 88% of participants claim to have a good understanding of the difference between flat pricing and time-of-use pricing. The price treatment has three periods with CPP, and thus is irregular and inconsistent in terms of timing. As discussed under Customer Engagement, Oshawa had multiple customer support channels, to help customers understand the price plans. Oshawa also used a status quo TOU clock as a visual depiction of the price, which was found to be less comprehensible compared to a linear visual. The bill showed the usage by price period but could improve by providing a comparison of the cost or savings or showing a visual of consumption by period.

Based on the above factors, the Seasonal treatment rated a score of **3**, indicating that the price structure was somewhat comprehensible.

Realized Opportunity for Bill Savings	**2**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%) – Average	0.2%	0.14%
Bill Savings (%) – Digitally Engaged Participants	1.71%	0.93%
Bill Savings (%) – Non-Digitally Engaged Participants	-5.57%	-2.6%
Bill Savings ($) – Average	$0.23	$0.16
Bill Savings ($) – Digitally Engaged Participants	$2.07	$1.10
Bill Savings ($) – Non-Digitally Engaged Participants	-$6.43	-$3.23

The Oshawa Seasonal TOU with CPP treatment had the 4th highest summer monthly bill savings and 8th highest winter bill savings of the 10 treatment groups, resulting in a score of 2, none or minimal savings relative to other treatments.

Estimated Opportunity for Bill Savings	**4**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$3.2

The Oshawa Seasonal TOU with CPP treatment delivers the 4th highest estimated monthly bill savings opportunity through the pilot period (May 2018 to April 2019), of the 10 treatment groups analysed.

The treatment is estimated to deliver an average monthly bill savings of $3.2, resulting in a score of 4, savings between $3 and $5.

Ease of Implementation	**2**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Seasonal TOU with CPP treatment involves the implementation of a price plan with pricing and period definition changes from the status quo TOU, and the inclusion of CPP events. Deviations from status quo pricing include a flat price during the shoulder months, the elimination of the mid-peak period during summer/winter months, and changes to the on- and off-peak pricing.

There was a wide range of perceived costs among LDCs for implementing price and/or TOU period definition changes. Many respondents did not believe this would pose significant time or cost challenges (<$100,000 and ~3-6 months), while others reported larger challenges (>$1,000,000 and > 6 months). The majority of respondents indicated additional required systems enhancements, i.e. the MDM/R and Operational Data Store including customer interaction channels, bill printing, how price switching would be handled, and additional customer education and support.

The inclusion of CPP events further increases the complexity of this price plan. LDC survey respondents reported substantially increased cost estimates for the price plans with CPP events relative to those without. While several still feel this is a <$100,000 endeavour, this cost is not consistent with our expectations of the level of complexity and required effort. Conversely, the two largest utilities, who utilize market leading CIS platforms (SAP and Oracle), indicated >$1,000,000 potential cost.

Customer engagement efforts were less intensive for this treatment than others; engagement efforts included email blasts, bill inserts, and the generation of targeted campaigns.

Although the installation of enabling technology was required for this treatment, implementation is complicated through opt-in recruitment. Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide.

For the above reasons, the Seasonal TOU with CPP treatment receives a score of **2.**

Oshawa Information Only

Treatment Group Summary

Treatment Name	Information Only
LDC	Oshawa PUC
Period of Analysis	2018-05-01 through 2018-10-31
Sample Size	~470
Enrolment Type	Opt-In

Summary Description of Treatments Applied

Informational Treatments
Enabling Information
Provision of a mobile application ("Peak") and web portal that provides personalized messaging to participants based on their profile and past behaviour. App personalization is dynamic and iterative, based on current weather conditions, participant profiling inputs, and historical usage patterns. The app gamifies savings by providing peer- and historical self-comparison and suggests savings strategies and weather-specific savings tips. Eighty-five percent of participants in this treatment group downloaded the app and used it at least once; these participants are referred to as "digitally engaged" participants.
Customer Engagement
• **Recruitment:** enrolment was solicited through a number of channels both physical (bill inserts, a direct mailer) and virtual (emails, social media advertisements). An overwhelming majority (94%) of participants that enrolled did so on the basis of the email engagement. • **Retention:** participants were subject to communications across a wide array of channels, including weekly email summaries[82], follow-up SMS reminder messages, push notifications and in-app messaging providing. Bill inserts, direct mailers and on-bill messaging are also provided.
Price Treatments
None
Technology Treatments
None. No enabling technology provided.

[82] Note that 56% of participants did not have email addresses on file with Oshawa PUC and so did not receive these communications.

Evaluation Metric Scoring Summary

Metric	Score	Summary Rationale for Score
Cost Recovery	N/A	*Participants were subject to status quo TOU prices.*
Short-Term Cost Reflectiveness	N/A	*No price treatment*
Long-Term Cost Reflectiveness	N/A	*No price treatment*
Cost Minimizing	1	*Negative system benefits due to increased consumption and no avoided capacity benefit.*
Predictability	4	*Treatment involves price periods and seasonal changes consistent with current customer expectations.*
Comprehensible	5	*Three price periods and consistent and regular timing. 86% of participants self-reported comprehension.*
Opportunities for Bill Savings – Realized	1	*Consumer bills increase slightly during summer; winter evaluation not yet available*
Estimated Bill Savings Opportunities	2	*No estimated bill savings opportunity.*
Ease of Implementation	4	*Requires no changes to existing systems, as there are no changes to price. Opt-in treatment requires significant recruitment efforts.*

Treatment Detailed Description

Informational Treatments

Enabling Information

The focus of this treatment group was the leveraging of participant price response through a mobile application ("Peak") and associated web portal.[83] A key feature of the software underlying both tools is its iterative nature. App messaging and notifications are customized based on observed historical patterns of use of that software, information input by users (prompted by the software)[84], and historical electricity consumption patterns.

The Peak app provides users with:

- *Benchmarking*. Comparison of current consumption against historical averages. Although not explicitly stated, the evaluation report suggests that temperature and humidity data may be incorporated to this analysis to ensure a weather-normal comparison.
- *Gamification*. Participants are grouped based on observed usage patterns and input information and ranked based on their estimated energy and bill savings. Participants can see how they compare to others (via a leader board) and are provided with motivational messaging to improve their performance. Participants achieve "badges" for meeting certain milestones (Electric Star for participants in the top 10% of energy savers in their peer group, etc.)
- *Savings Strategies*. Energy savings tips, behavioural and longer-term (related to acquisition of more efficient equipment, including participating in additional CDM programs) are provided on a daily basis in the app home screen. The description of the app in the evaluation report suggests acceptance of strategies by users is tracked and used to inform future recommendations.
- *Ways to Save.* Push notifications with personalized recommendations for savings actions are dispatched to participants with demonstrated app engagement.
- *Weather-Based Tips.* Conservation tips customized to current temperatures and humidity.
- *Daily Energy Costs.* The billing amount for each day's electricity use.

The app and web portal capture data from page views/app interactions (marking a saving strategy/tip as read) to adjust timing for the dispatch of push notifications or in-app messaging to match observed historical app use habits.

For this treatment group 85% of participants downloaded the app and used it at least once. These are referred to in the evaluation report as "digitally engaged" participants.

Customer Engagement

- **Recruitment:** participants were recruited through five channels. These are listed immediately below along with the proportion of enrolments delivered by each.
  - *Initial email:* 46% of enrolments.
  - *Reminder email(s):* 49% of enrolments
  - *Bill insert:* 4% of enrolments
  - *Facebook/Twitter:* 2% of enrolments
- **Retention:** piloted customer engagement was focused primarily, but not exclusively, through digital channels. Participants were engaged through email, SMS text messages, the Peak app, the Peak web portal, bill inserts, direct mailers, and on-bill messaging.
  - *Peak app.* The functionality of this app is described above. Eighty-five percent of participants in this treatment group downloaded the app and logged in at least once to view their consumption.
  - *Peak web portal.* Same functionality as app (but without push notifications), as described above. The evaluation report does not note how many participants used this tool.
  - *Emails.* Weekly emails circulated to participants at 7am each Tuesday morning. Emails include a summary of prior week consumption, conservation tips relevant to the current week and rank within their automatically generated peer group (gamification).

[83] The web portal has identical functionality to the app except in that it cannot provide push notifications to participants.

[84] In the first six months of the pilot, a selection of 116 possible questions were asked of each participant to develop their profile. The evaluation report provides examples including: "What temperature do you set your thermostat to in the summer?" and "Do you clean your outside A/C unit?".

- The evaluation report indicates that across the pilot as a whole[85] these emails were opened approximately 50% of the time on average, with opening prices highest in July.[86] Beginning in October 2018 more delivered emails remained unopened than were opened, through the end of the pilot in April 2019. Open rates within a given week decline sharply with time: if the participant hasn't opened their email on Tuesday or Wednesday, they are unlikely to open it at all.*SMS.* Participants are provided an SMS reminder on Thursdays to open their weekly email summary. The evaluation report claims these reminders modestly increase the email open rate in later days of the week.
- *Targeted Communications Campaigns*. The evaluation report notes that Oshawa conducted several distinct communications campaigns over the course of the pilot. No details are provided in the evaluation report regarding the channels used for these campaigns.
  - "Nudge to Save More" Campaign. This began in July, with communications supporting this campaign provided approximately twice weekly.[87]
  - "App Download" Campaign. This began in June and continued throughout the pilot, with messaging provided weekly.
  - "Additional Family Member" Campaign. This took place in September. Two communications were issued as part of this campaign.
  - Additional campaign communications included communications regarding the Affordability Fund Trust, survey reminders, and communications in September to promote the Save on Energy Heating and Cooling program to high-usage customers living in single family homes built prior to 2000. The evaluation report notes that the pilot's "campaign engine" delivered "over 60 relevant campaigns to various participant groups via their preferred channels".
- *Bill Inserts and Direct Mailers*. In addition to the digital communications channels noted above, traditional communications (bill inserts and direct mailers) were used. No indication is provided in the evaluation report regarding the frequency or content of these communications.

Price Treatments

None

Technology Treatments

No enabling technology was deployed to this participant treatment group.

Participant Attrition

Of the 512 participants that enrolled in this group, 38, or approximately 7% opted out by by the end of March 2019.

[85] Email open rates specific to this treatment group are not included in the evaluation report.
[86] It does not appear as though weekly email summaries were circulated in May. June email receipt and opening statistics, and the campaign calendar, included in the evaluation report suggest that only a portion of participants received emails in that month. The evaluation reports that it was in July that the weekly recap report was introduced for all three treatments.
[87] Content related to this campaign is unclear. The "Nudge to Save More" nomenclature appears only in the evaluation report appendix providing the communications calendar.

Pilot Report Findings

Non-Price Treatment Key Findings

The evaluation report does not differentiate app usage statistics by treatment group, so all app usage statistics presented below apply across all treatment groups.

- **Participant consumption increased as a result of the pilot treatment.** Participant average monthly consumption increased by a statistically significant 31.7 kWh (3.9%).
- **In contrast to the Super-Peak and Seasonal TOU with CPP price plans, digitally engaged participants of the Information Only treatment group increased their consumption *more* than non-digitally engaged participants.** Digitally engaged participants delivered statistically significant increases in *all* periods except summer (June through August) On-Peak and Mid-Peak. Non-digitally engaged participants' impacts in the summer (June through August) were, in contrast, not statistically significant. Overall, digitally engaged participants increased their average monthly consumption by a statistically significant 33.1 kWh (4%), while non-digitally engaged participants increased their average monthly consumption only by 25.8 kWh (3.1%).
- **App home page visits declined over the initial summer of participation.** In May, participants accessed the home page a third of the time. On average between September 2018 and April, 2019, the home page was accessed on only 20% of visits.
- **Use of the Message Centre was modest but grew substantially over time**. In May, users accessed the Message Centre only on 5% of visits. This grew over time peaking at 18.5% of visits in February and closing the evaluation period at 17.4%.
- **The app was most commonly used on Tuesdays, perhaps as a result of the dispatch of the weekly summary on that day.** Typically, approximately 20% of visits (the plurality) took place on Tuesdays. In August, in contrast to all other months, a plurality of visits took place on Thursday.
- **On average the app was consulted by only approximately 20% of users in any given month**.[88] App usage was highest for participants 25 – 34 years, where it grew from 30% of users consulting it per month (April, 2018) to a peak of 32% (October) before declining again to approximately 27% in March, 2019. App usage declined over the same period for participants 35 – 44 years old, from 27% in April to just 15% in March, 2019. Usage trends appear generally flat for other demographics.

[88] This observation is based on Figure 107 of the evaluation report. Guidehouse's understanding is that this shows the percent of users that used the app in each month of the summer period, by age group.

Evaluation Metric Scoring

Cost Recovery	**N/A**

How effectively have the price plans recovered [embedded commodity] costs?

The total average Ontario RPP supply cost forecast for the pilot period (May 1, 2018, through April 30, 2019) was $0.12637/kWh.[89] After making the adjustments for the Ontario Fair Hydro Plan (OFHP) Act, the average commodity price falls to $0.082/kWh.[90] This is referred to as the average supply cost (reflecting the OFHP adjustment) for RPP customers, or the RPA. [91]

Annual Revenue Adequacy

Customer Group	Average Revenue per kWh		% Difference from RPA	
	Pilot Price Plan	Status Quo TOU	Pilot Price Plan	Status Quo TOU
Information Only	N/A	$0.0817	N/A	-0.4%
Control	N/A	$0.0820	N/A	0 %

Based on the evaluation report, it appears as though this treatment group (a non-price treatment) very slightly under-collects revenues relative to the provincial average RPP supply cost as forecast for price-setting purposes and adjusted to reflect the OFHP.

This treatment group under-collected on average by 0.4%.

This over-collection has two elements: jurisdictional and behavioural.

- **Jurisdictional.** The bottom right cell of the table above indicates that on average Oshawa PUC neither over- nor under-collects from its customers, with average revenue matching the RPA.
- **Behavioural.** The top row of the right-most column indicates the percentage under-collection due to the effect of changes in behaviour

The under-collection is too small, and too uncertain, to affect considerations of any wider deployment of this treatment group. Recall that this treatment group increased consumption in 14 of the 16 different TOU/season periods to which it was exposed, delivering non-significant impacts only during the summer (June, July, and August) On-Peak and Mid-Peak periods. The reason why an under-collection occurs for this group despite nearly universal increases in consumption (which increase *total* revenue) is due to the fact that consumption increased in the lower-priced periods (e.g., summer weekday Off-Peak, +6.85%, weekend Off-Peak, +4.4%) by considerably more than in the higher-priced periods (non-significant impacts during summer On-Peak and Mid-Peak).

Short-Term Cost Reflectiveness	**N/A**

Does the price provide a reasonable reflection of the short-term [embedded] value of power at different times?

No price treatment is applied in this treatment group.

[89] Table 3 of:
Ontario Energy Board, Supply Cost Report (Formerly the Regulated Price Plan Report): May 1, 2018 to April 30, 2019, April 2018.
https://www.oeb.ca/sites/default/files/RPP-Supply-Cost-Report-20180501-20190430-correction.pdf

[90] Table 1 of:
Ontario Energy Board, Regulated Price Plan Prices and the Global Adjustment Modifier for the Period May 1, 2018 to April 30, 2019, April 2018
https://www.oeb.ca/sites/default/files/RPP-GA-Modifier-Report-20180419.pdf

[91] This acronym does not quite match the underlying definition, but is the accepted RPP nomenclature. From the document cited immediately above: "*the average supply cost for RPP consumers (RPA)…*"

Long-Term Cost Reflectiveness	**N/A**
Does the price provide a reasonable reflection of the long-term [embedded] value of power at different times?	
No price treatment is applied in this treatment group.	

Cost Minimizing	**1**

How cost-effective is the given treatment group relative to all the others, assuming full deployment between 2022 and 2035 (14 years)?

Net Present Value (NPV) of Avoided Cost ($M 2018)	***NPV of Avoided Cost Capacity Benefits ($M 2018)***	***NPV of Costs ($M 2018)***	***Benefit/Cost Ratio***
-$13.8	$0.0	$594.4	0.00

Over the deployment period, the NPV of system benefits for the Oshawa Information-Only treatment, for a participant enrolling at the start, is projected to be -$56. There are no significant coincident peak impacts to provide avoided capacity benefits, and a negative benefit for avoided energy due to increased consumption.

For the same period, the unit costs are estimated to be $214, excluding fixed costs for the utility incurred for all participants. Fixed costs that cannot be separated from other treatments deployed simultaneously may inflate the unit cost – Guidehouse assumes that each treatment would be deployed independently of any other treatment.

The key driver of the assumed costs are the scaling factors applied to pilot costs. Scaling adjustments were applied to pilot costs to account for (1) costs that may be omitted at scale and (2) economies of scale. Scaling adjustments include:

Cost Category	**Aggregate Scaling Factor**	**Description**
Overhead	70%	• Guidehouse has assumed that EM&V costs are divided across all utilities provincially • Guidehouse has assumed that incentives are omitted from a provincial deployment
Communication	10%	• Guidehouse anticipates participant marketing and outreach costs will be reduced on a per-participant basis based on economies of scale
Technology	30%	• Guidehouse anticipates a reduction in costs for development of application, assuming the same or similar application is used in provincial deployment

If pilot costs are taken as is, with no considerations for a province-wide rollout (i.e. costs are considered to be identical to pilot costs), the NPV of costs is estimated to be $1,390 million.

The lack of benefits for this treatment makes it the least cost-effective treatment group out of the 10 considered. Regardless of scaling factors applied, it is not possible for this treatment to achieve cost-effective results, as the benefits are not positive.

Key Scaling Assumptions

Maximum Possible Market Share

Based on the provincial population in single family homes with central A/C, the maximum potential market share of Oshawa's pilot treatment is 48%.

Achievable Market Share

Guidehouse's assumption is that 60% of the eligible customers would enrol in this program, reducing the market share to 29%. For opt-in price treatments, Guidehouse estimated annual enrolment using a standard S-shaped diffusion curve.

Predictability	**4**

To what degree are prices predictable?

The Oshawa Information-Only treatment does not feature any pricing changes, period definition changes, or CPP events. The Information-Only treatment is equivalent to the status quo and is equivalently predictable; period definitions and pricing are aligned with current customer expectations.

The Information-Only treatment maintains 2 seasons annually and has fewer price periods per day than other price treatments being evaluated, increasing the predictability of prices for consumers.

Number of Price Periods (per Day)	**Number of Changes to Price Periods** (e.g., Season Change)
4	2

Comprehensible	**5**

How well are the price structures understood by customers?

Guidehouse scored the comprehensibility of all treatments based on the number of price periods, consistent and regular timing of price periods, and self-reported comprehension. These factors indicate not only the theoretical comprehensibility of the price plans based on their design, but also the participants' claimed comprehension. Outside of the quantitative scoring framework, Guidehouse qualitatively reviewed pilot design and implementation elements that would facilitate participants' ease of comprehending the pricing plan and what actions they could take to save under the new plan.

Oshawa's survey revealed that 86% of participants have a good understanding of the difference between flat pricing and time-of-use pricing. The price treatment is identical to status quo TOU price. As discussed under Customer Engagement, Oshawa had multiple customer support channels, to help customers understand the price plans. Oshawa also used a status quo TOU clock as a visual depiction of the price, which was found to be less comprehensible compared to a linear visual. The bill showed the usage by price period but could improve by providing a comparison of the cost or savings or showing a visual of consumption by period.

Based on the above factors, the Information treatment rated a score of **5**, indicating that the price structure was very comprehensible.

Realized Opportunity for Bill Savings	**1**
How effective are the price plans at delivering consumer bill savings, based on the evaluation reports completed?	

	Summer 2018	**Winter 2018/2019**
Bill Savings (%) - Average	-2.46%	-2.85%
Bill Savings (%) – Digitally Engaged Participants	-3.15%	-2.26%
Bill Savings (%) – Non-Digitally Engaged Participants	0.27%	-5.33%
Bill Savings ($) – Average	-$3.15	-$3.2
Bill Savings ($) – Digitally Engaged Participants	-$4.01	-$2.58
Bill Savings ($) – Non-Digitally Engaged Participants	$0.35	-$5.94

The Oshawa Information-Only treatment delivered increases to consumers' bills in both the summer and winter periods. The treatment resulted in the 2nd highest increases to consumer bills in the summer, and larger increase in consumer bills in the winter of all treatments analysed, resulting in a score of 1, negative savings. This treatment was ineffective at delivering bill savings.

Potential Opportunity for Bill Savings	**2**
Given estimated consumer response, how effective are the price plans at delivering consumer bill savings, based on the own-price elasticity?	

	Pilot Period
Bill Savings ($)	$0.0

The Oshawa Information Only treatment is not estimated to deliver any bill savings opportunities through the pilot period (May 2018 to April 2019). This results in a score of 2; zero to minimal bill savings.

Ease of Implementation	**4**

Are the price plans sufficiently durable and flexible to support updating and modification over time, as system conditions and other factors change? Are the pricing plans or non-price tools more suitable for opt-in or opt-out recruitment?

The Information-Only treatment does not require any changes in pricing or period definitions from status quo TOU.

As this pricing structure is not different than the status quo, this treatment would cause minimal disruption to normal business operations and would require consumer guidance.

Opt-in recruitment proved to be a challenge for many pilot proponents, where many reported difficulty reaching the planned sample of participants for their pilots. As a result, recruitment for this pilot may prove to be a substantial challenge for deployment province-wide.

Customer engagement efforts were less intensive for this treatment than others; engagement efforts included email blasts, bill inserts, and the generation of targeted campaigns.

For the above reasons, the Information-Only treatment receives a score of **4.**