Time Varying Rates Pilot

Stakeholder Collaborative No. 3

PUGET SOUND ENERGY

September 23, 2021

Welcome, Introduction & Ground Rules

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Speakers: Dr. Ahmad Faruqui, The Brattle Group
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Ground Rules

- Meeting is being recorded; please mute yourself
- Come with a clean slate and open mind
- Be respectful of diverse view points
- Listen actively to others and ask questions – no question is too elementary
- Do not interrupt other participants
- Manage your input – no long speeches please
- Leave the meeting with a clear sense of next steps

PSE PUGET SOUND ENERGY

Agenda

- Introduction
- Safety Moment
- Review of Proposed Rate Designs
- Pilot Design Approach
- EM&V Plan
- Recap and Next Steps

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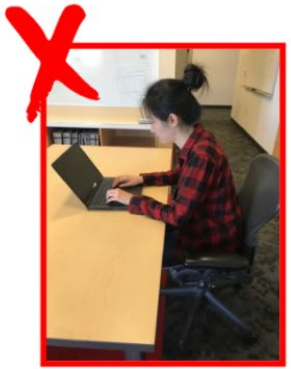
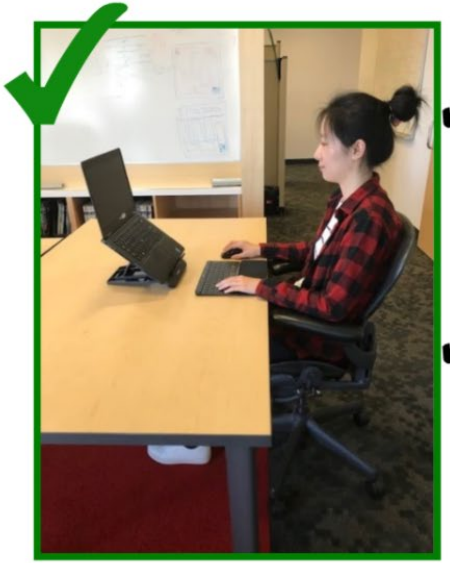
Safety Moment

Be mindful while working directly on laptops. There is evidence to show that prolonged exposure to working directly on laptops can lead to musculoskeletal issues in the neck, shoulders, wrists, and/or hands. Some studies suggest that 'no' amount of direct laptop use is safe.





✔ Use an external monitor, laptop riser or books for improved neck positioning while viewing screen

✔ Use external keyboard and mouse

PUGET SOUND ENERGY

Pilot Design and EM&V Approach for PSE's TVR Pilot

PRESENTED BY

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PRESENTED TO

Third Collaborative
Puget Sound Energy

SEPTEMBER 23, 2021

Brattle

Objectives of Today's Meeting

- Review the rate design elements that the PSE and Brattle teams have developed to date after taking feedback and input from stakeholders from previous meetings into consideration
- Discuss the pilot design approach, sample size determination, and the Evaluation, Measurement, and Verification (EM&V) approach

Agenda

1- Review of Proposed Rate Designs and Bill Distribution Analysis

2- Pilot Design Approach

3- Sample Size Determination

4- Evaluation, Measurement, and Verification (EM&V) Plan

5- Next Steps

1- Rate Design Review and Bill Distribution Analysis

Proposed TVR Pilot Rate Treatments

- Based on input from stakeholders from the previous Collaboratives and internal deliberations, PSE is proposing to test **six different treatments** during its TVR pilot

Rate	Non-Low-Income Residential	Low Income Residential	All Residential	Small Business
TOU	√	√	N/A	N/A
TOU+PTR	√	√	N/A	√
Three-period TOU (EV)	N/A	N/A	√	N/A

- PSE is testing these rates on an **opt-in basis**, which is consistent with its plans for a full scale deployment in the future
- Bill discounts for low income customers are under development in a separate collaborative

Residential and Small C&I Rate Design

- We followed a data-driven approach to determine the pricing seasons and peak windows for the TVR pilot, using data from:
  1. PSE hourly gross system load
  2. Net system load data (equals load minus non-dispatchable generation)
  3. Mid-Columbia (Mid-C) wholesale prices

- Key results
  - Winter season definition is the same as the current definition in PSE's rates
  - Peak periods: HE 18-20 year-round; and HE 8-10 for Winter (shorter periods are more appealing to customers)

Season	Peak Period	Off-peak Period
Winter (October- March)	HE 8-10 and HE 18-20 on weekdays	All other hours, weekends and holidays
Non-Winter (April – September)	HE 18-20 on weekdays	All other hours, weekends and holidays

Proposed Rate Designs

All rates have strong price signals

- 5:1 P/OP ratio for the residential TOU rate
- Roughly 2:1 P/OP ratio for the TOU, and 8.5:1 ratio for the PTR component of the TOU+PTR rate for both residential and small C&I customers
- 7.5:1 peak to super-off peak ratio for the Three Period TOU rate targeting EV customers

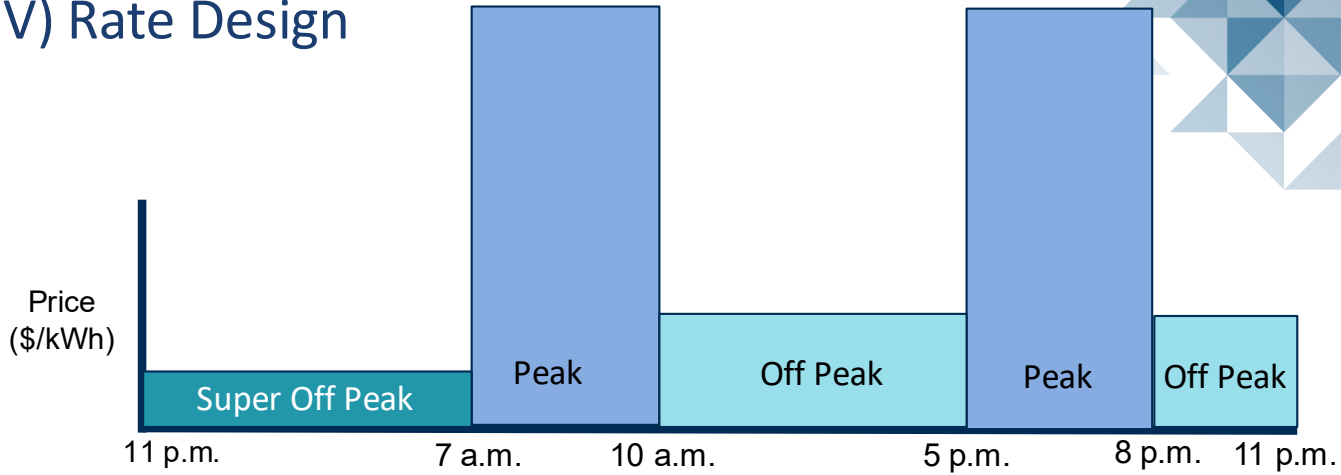
		Current Residential Rate	Residential TOU	Residential TOU+PTR	Res. Three-Period TOU	Small C&I TOU + PTR
Customer Charge	$/mo	$7.49	$7.49	$7.49	$7.49	$10.39
Current Rate						
<=600 kWh	$/kWh	0.09				
>600 kWh	$/kWh	0.11				
TOU Charges						
Winter						
On-Peak	$/kWh		$0.31	$0.18	$0.30	$0.18
Off-Peak	$/kWh		$0.06	$0.08	$0.08	$0.07
Super Off-Peak	$/kWh		-	-	$0.04	-
Non-Winter						
On-Peak	$/kWh		$0.17	$0.17	$0.14	$0.17
Off-Peak	$/kWh		$0.06	$0.08	$0.06	$0.07
Super Off-Peak	$/kWh		-	-	$0.04	-
Full Year						
Peak Time Rebate	$/kWh		-	$0.48	-	$0.48
On-Peak : Off-Peak Ratios						
Winter			5.2 : 1	2.3 : 1	7.5 : 1.9 : 1	2.4 : 1
Non-Winter			2.8 : 1	2.2 : 1	3.6 : 1.5 : 1	2.3 : 1
PTR:Off-Peak (Winter)			-	8.4 : 1	-	8.9 : 1

Note: The proposed rates may change slightly once updated for the latest COS study and allocations in PSE's GRC filing

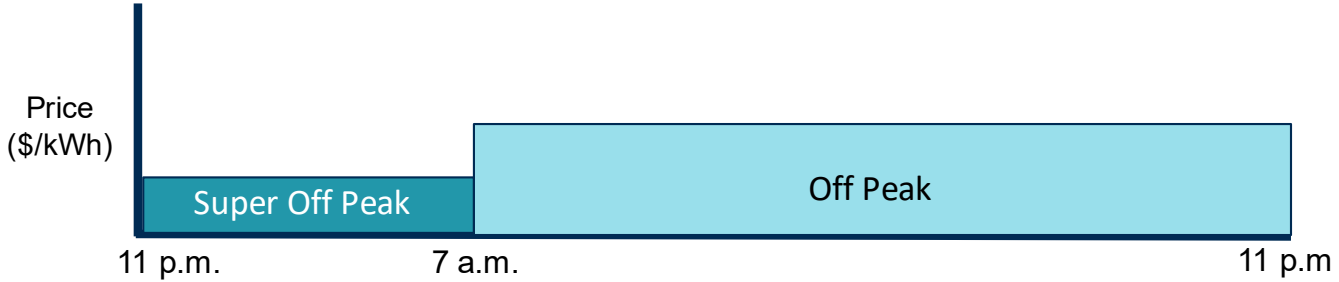
Three-Period TOU (EV) Rate Design

We designed the year-round peak and off peak hours using the following conventions:

- Strong price signals during the peak periods
- Patterns mirror patterns of average weekday Mid-C prices
- Super off-peak occurs during night-time hours
- Shorter morning and evening peak windows are the same as TOU peak to make it more appealing to customers
- Weekends involve only Super Off-peak and Off-peak windows



Three-Period TOU Schedule (Weekdays)



Three-Period TOU Schedule (Weekends)

Note: There are 1,512 Peak hours (17%); 4,328 Off Peak hours (49%); and 2,920 Super Off Peak hours (33%) in a year

Bill Distribution Analysis

- Bill distribution analysis helps answer the question: Do time varying rates lead to lower bills?

- When transitioning from the existing inclining block rate to TOU rates, the customer's bill change typically depends on the rate difference, the customer's load shape, and their response
  - Under a revenue neutral rate, there is no bill change for the class-average customer
  - Customers who currently consume proportionately less electricity during off-peak hours will experience bill savings under the new TOU rates (even if they don't change their load profile). On the other hand, customers who consume use proportionately more electricity during peak hours will experience an bill increase
  - Most customers can lower their bills by shifting electricity usage away from peak periods

Bill Distribution Analysis Approach

- Collect 2019 hourly usage data from customers (randomly sampled from AMI data)

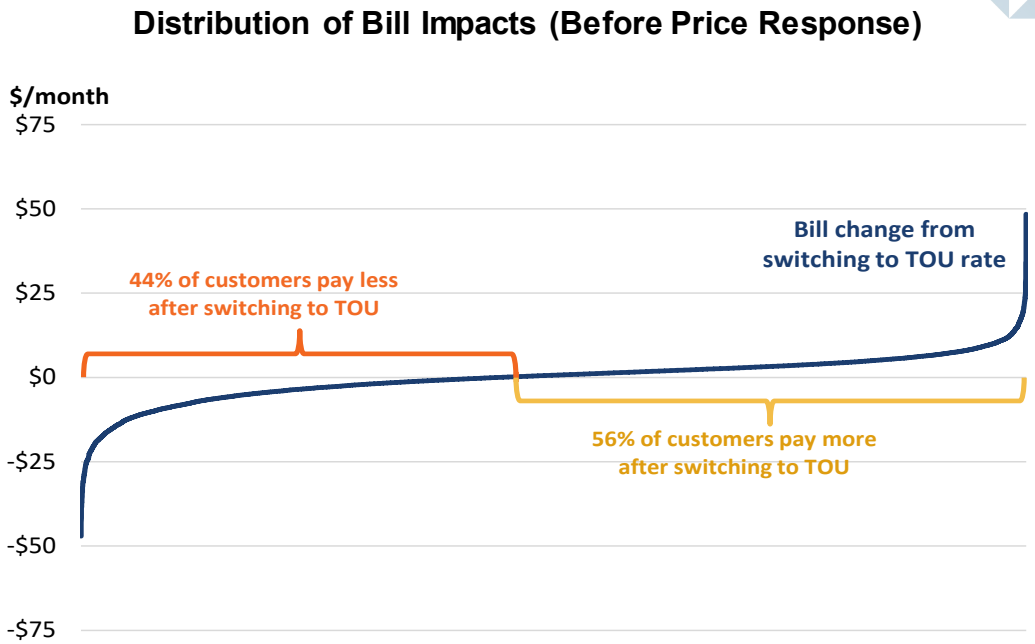
- Using customer usage data, calculate and compare the monthly bills for each customer under:
  - The current inclining block rates
  - The proposed TVR *before* price response
  - The proposed TVR *after* price response

- Each customer's bill impact is computed as:

  Total annual bill under the new TVR rates *minus* total annual bill under the current rates

Residential TOU Results: Before Price Response

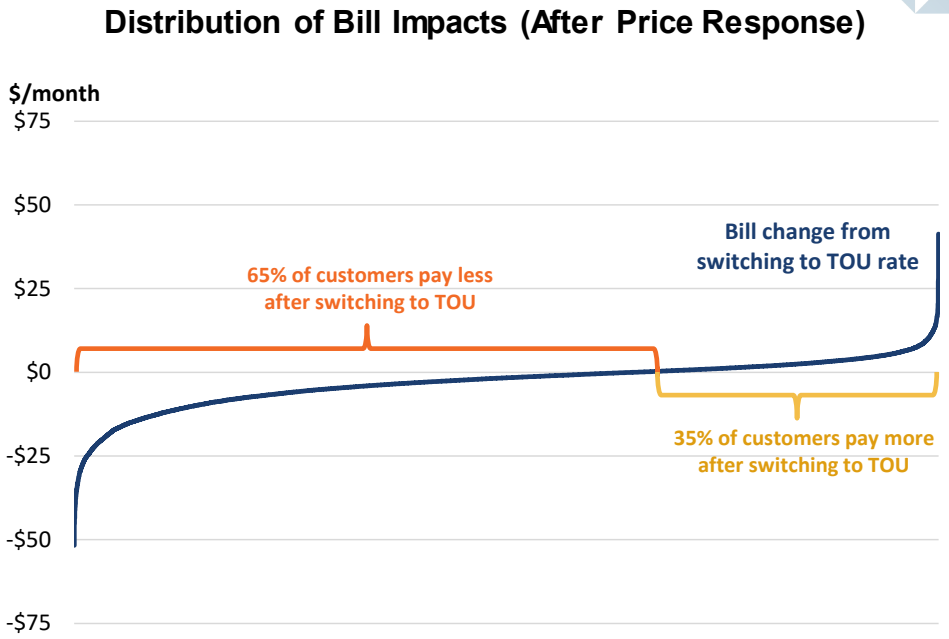
- We estimated the bill impacts for about 18k residential customers
- If no action is taken, 44% of the customers will pay less after switching to TOU rates and 56% will pay more
  - Among those who experience a bill decrease, the median customer will save $4 per month
  - Among those who experience bill increases, the median customer will experience a bill increase of $3 per month
  - Monthly bills for 92% of customers will change within +/- $10 per month
- For the sample as a whole, the average monthly bill change is about $0 per customer per month



Residential TOU Results: After Price Response

- We also calculated the monthly bills for each customer under the new TVR rates (after price response) and compared against current bills
  - Lower off-peak rates would encourage customers to increase off-peak usage, and higher peak rates would encourage them to decrease usage
  - Peak impacts are estimated using Brattle's Arcturus database (10.9% for winter; 6.8% for non-winter)
  - We assume no energy conservation effects

- After price response, 65% of customers experience lower bills vs. 35% experiencing bill increases
  - Among those who experience lower bills, the median customer will save $5 per month
  - Among those who experience higher bills, the median customer will pay $3 more per month
  - For the sample as a whole, the average monthly bill is about $3 lower per customer per month



2-Pilot Design Approach

Requirements for Designing a Scientifically Valid Pilot

- Clearly articulate pilot objectives
- Ensure **internal validity**, meaning a cause and effect relationship can be established between the treatment being tested (the TOU rate) in the pilot and the outcome of interest (change in peak usage)

  → requires a robust control group and pre-treatment data
- Ensure **external validity**, meaning that the results from the pilot program can be extrapolated to the population of interest

  → requires pilot recruitment to mimic potential wide scale deployment; can be ensured by selecting appropriate pilot design approach
- Determine sampling frame/eligible population for the pilot
- Undertake "**statistical power calculations**" to determine minimum size requirement for treatment and control groups to detect statistically significant impacts
- Incorporate attrition assumptions in the final sample sizes

Scientifically Valid Pilot Design Approaches (and control group strategy)

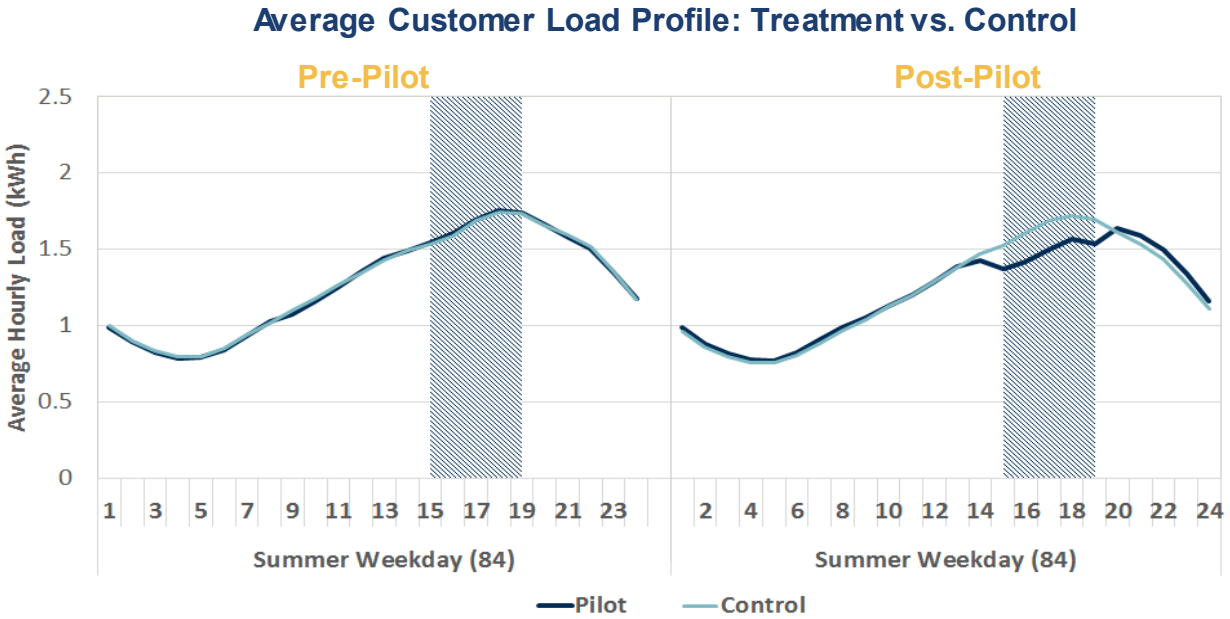
There are three widely accepted pilot design approaches:

Possible Pilot Design Approaches	Description and Pros/Cons
Randomized Controlled Trial ("RCT")	Involves a random assignment of the recruited customers into the treatment and control groups. While this is the most rigorous approach from a measurement perspective, it is rarely used by electric utilities due to a potentially adverse impact on customer satisfaction (as it would involve either "recruit-and-deny" or "recruit-and-delay" approaches for some portion of the recruited customers).
Randomized Encouragement Design ("RED")	Allows the researcher to construct a valid control group, maintaining the benefits of an RCT design by not negatively affecting the customer experience. However, it requires much larger sample sizes, relative to the RCT approach, in order to be able to detect a statistically significant impact. Large sample sizes increase pilot implementation costs.
Random Sampling with Matched Control Group	Involves recruiting treated customers from a randomly selected sample, and using regression analysis to identify and match customers from the rest of the population that are most similar to the treatment customers. This matched control group approach strikes a good balance between achieving statistically valid results and requiring a manageable level of pilot participants.

Source: Sergici *et al., "Evaluation, Measurement and Verification Plan for the PC44 TOU Pilots," prepared for Maryland PC44 Rate Design Work Group, June 2018*

A statistically valid pilot design yields comparable treatment and control groups

This is an essential requirement in order to be able to attribute the difference between the two groups to the treatment impact



Note: The shaded regions indicate peak hours. Control group was constructed using a matching analysis

Recommended Design Approach for PSE's TVR Pilot

As required by the external validity principle, the recruitment of the treatment group should mimic the full-scale deployment of the TVRs

At this time, it seems that PSE's TVR broader deployment will be on an **opt-in** basis

Given this context, we considered three robust pilot design methods before proposing the pilot design approach for PSE:

- randomized controlled trial
- randomized encouragement design
- random sampling with matched controlled group

Assessing the pros and cons of each approach as well as the practical and budget implications of customer recruitment, we propose that the pilot is deployed using **"random sampling with matched controlled group"**

We discuss the implications of this approach for treatment group recruitment and control group selection in the next few slides

Treatment Group Recruitment Approach

Treatment group customers will be recruited from a randomly selected group of eligible customers (the rest of the eligible customers will be set aside for the control group design)

The random sample of eligible customers will be drawn from several recruitment waves, and customers in each wave will be sent recruitment materials and asked to participate in the pilot

- If a customer shows interest, they will be recruited for the pilot and asked to fill-in a pre-launch survey that confirms their eligibility and collects some socio-demographic data
- If a customer declines participation, they will be flagged as "declined to participate"
- The recruitment team will stay with the wave-based deployment until the recruitment targets/enrollment caps are reached
- Prior experience suggests that no more than 5% of customers who are contacted will join the pilot

The rest of the eligible customers will be used for designing the matched control group (discussed in the next slide)

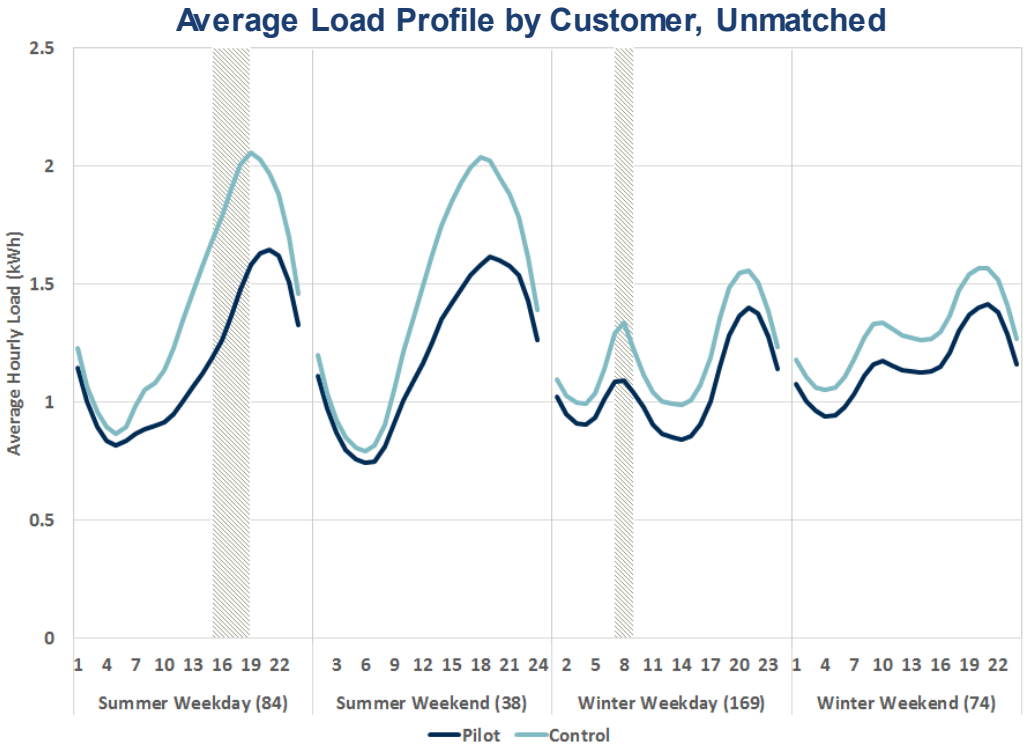
Control Group Design Approach

The control group will be chosen from the set-aside group of customers who were never approached for the pilot using the "propensity score matching" approach

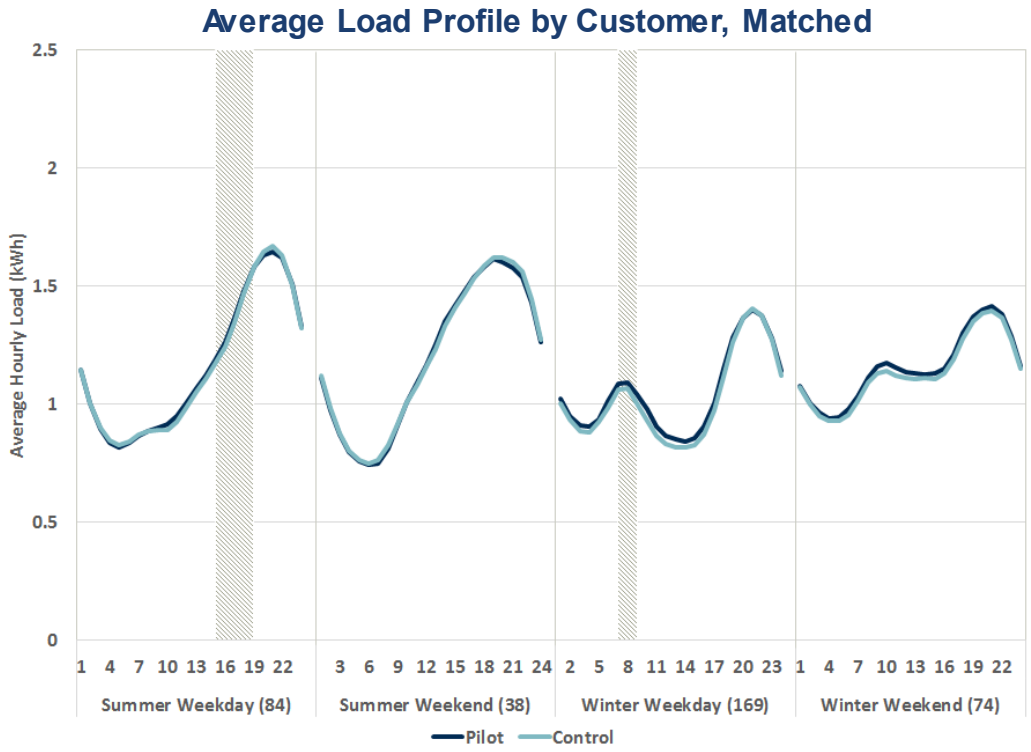
Propensity score matching is a widely-used statistical matching method in economics and other social sciences

- Uses statistical analysis to identify the variables that are most closely correlated with enrollment in the pilot
  - For example: individual customer peak demand, monthly usage, ratio of peak to off-peak usage; observable household-level data such as dwelling type, square footage, or socio-economic data; and geographic information, including zip code
- Using the results of that analysis, "predicts" the propensity score or probability of participation for both enrollees and control group
  - This propensity score can be thought of as the probability of a customer to opt-in to the pilot based on their observable characteristics, had they been approached to.
- For each participating customer, the unapproached customer whose propensity score is most similar to the treatment customer is placed in the control group

Treatment vs. Control groups (Before Matching)



Treatment vs. Control groups (After Matching)



Pilot Design Approaches Used in Other Pilots

Early pilots relied on random sampling with voluntary participation + randomly selected control groups

- California Statewide Pricing Pilot, 2003; Baltimore Gas and Electric Smart Energy Pricing Pilot, 2007)

Some of the more recent pilots used RCT and RED

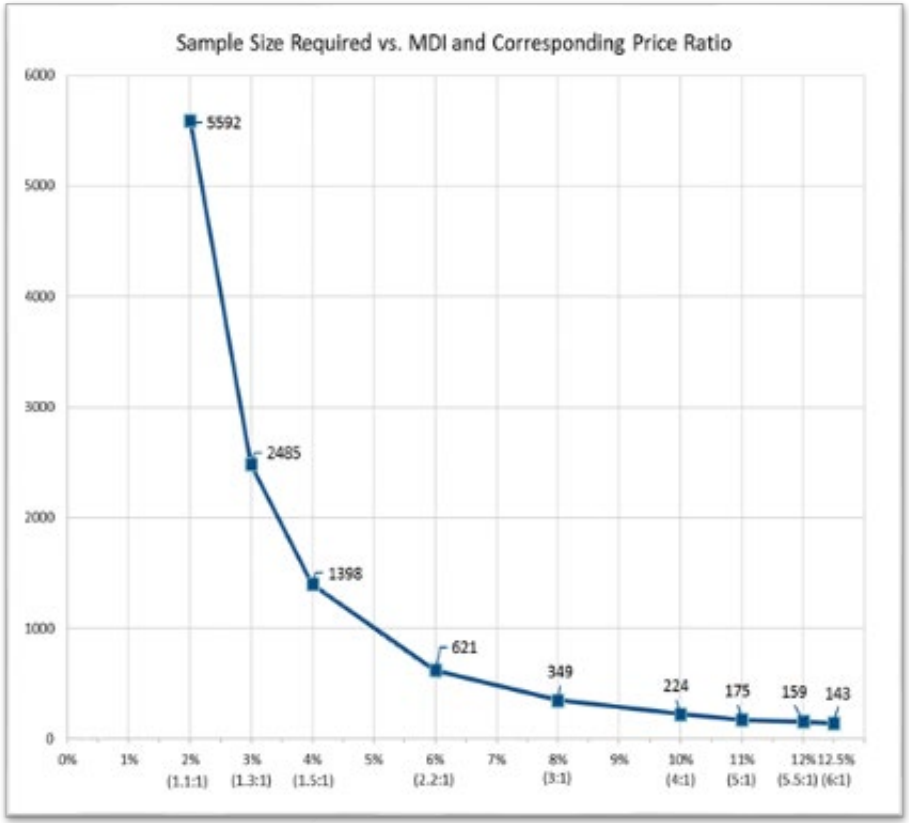
- SMUD SmartPricing Pilot, 2014; Ontario RPP Pilots, 2018

However, practical considerations (i.e., denying participation to the recruited customers in the RCT or large sample size requirements of RED) were not surmountable for other recent pilots. These pilots opted to use random sampling with matched control group

- PC44 TOU Pilot in Maryland, 2019; PowerPath DC Pepco Residential TOU Pilot, 2020; Alectra Advantage Power Pricing Pilot, 2017; Evergy Missouri 2021.

3-Sample Size Determination

Statistical power calculations are necessary to determine the sample size



Statistical power calculations are undertaken to ensure sample size is large enough to detect statistically significant impacts

- As the minimum detectable impact (MDI) increases (i.e. due to higher peak to offpeak ratio), sample size requirement decreases
- As the statistical power and statistical significance requirements increase, the sample size increases
- As the resolution of the analysis increases (i.e. hourly vs. monthly), sample size requirement decreases

SAMPLE SIZE

Inputs to the Statistical Power Calculations

We undertook statistical power calculations and calculated minimum sample size requirements to be able to estimate the impacts at acceptable statistical significance levels

- For our calculations, we targeted a minimum 80% statistical power, 5% statistical significance
- We calculated the sample sizes which will be large enough to detect the "minimum detectable impacts"

Rate	Season	Ratio *(P:OP)*	Estimated Peak Demand Reduction	50% Derate for Winter Peaking System
Residential TOU	Winter	5.2:1	10.9%	5.5%
	Non-winter	2.8:1	6.8%	3.4%
Residential TOU+PTR	Winter	2.3:1	5.5%	2.8%
	Non-Winter	2.2:1	5.2%	2.6%
	Event day	8.4:1	11.0%	5.5%
Residential Three-Period TOU (EV)	Winter	7.5:1	12.6%	N/A
	Non-winter	3.6:1	11.9%	N/A
Small C&I TOU+PTR	Winter	2.4:1	5.8%	2.9%
	Non-Winter	2.3:1	5.5%	2.8%
	Event day	8.9:1	11.3%	5.7%

Treatment Group Sample Sizes using Arcturus Impacts (Low Case)

We calculated required sample sizes to be able to detect the customer price response given the statistical precision criteria. Next, we boosted the sample sizes by 20% to account for potential attrition over the two years of the pilot

		Based on Statistical Power Calculations		Assuming 20% Attrition		Required Sample Size
	Rate	Winter	Non-Winter	Winter	Non-Winter	
Residential	TOU	113	353	136	424	500
	TOU+PTR (TOU Part)	445	604	534	725	750
	TOU+PTR (PTR Part)	111	135	134	162	
	Three-Period TOU	85	115	102	138	250
Small C&I	TOU+PTR (TOU Part)	942	1,451	1,130	1,741	1,800
	TOU+PTR (PTR Part)	248	344	298	412	

Treatment Group Sample Sizes using *Derated* Arcturus Impacts (High Case)

We repeated the same calculations using **50% derated impacts** to be conservative in the sample size determination and not to undershoot the required sample

		Based on Statistical Power Calculations		Assuming 20% Attrition		Required Sample Size
	Rate	**Winter**	**Non-Winter**	**Winter**	**Non-Winter**	
Residential	TOU	453	1,414	544	1,696	1,700
	TOU+PTR (TOU Part)	1,780	2,417	2,137	2,901	3,000
	TOU+PTR (PTR Part)	445	540	534	648	
	Three-Period TOU	339	462	407	554	600
Small C&I	TOU+PTR (TOU Part)	3,767	5,803	4,520	6,964	7,000
	TOU+PTR (PTR Part)	992	1,375	1,191	1,650	

Recommended Treatment and Control Sample Sizes

Given the potential range of the sample size requirements (based on the likely load response by customers), we propose sample sizes that are in between the low and high cases

	Rate	Low Case	High Case	Recommended Treatment Sample Size Target	Recommended Control Sample Size Target
Residential	TOU	500	1,700	1,000	1,000
	TOU+PTR	750	3,000	1,500	1,500
	Three-Period TOU	250	600	500	500
Low Income	TOU	500	1,700	1,000	1,000
	TOU+PTR	750	3,000	1,500	1,500
Small C&I	TOU+PTR	1,800	7,000	2,000	2,000
	TOTAL			**7,500**	**7,500**

Note: The final sample size may be larger than the target sample size if many customers are interested in participating in the study

Recruiting Treatment Customers

Practices followed in the recruitment process play a key role in maintaining the validity of the pilot design and offer important insights for broader deployments

- Follow best practices in developing customer education and outreach materials (including samples of effective vs. ineffective marketing materials)
- Consider different recruitment strategies through different channels based on the type of treatment offered and recruitment for special interest groups
- Identify approaches to minimize marketing costs while maximizing the number of recruited customers;
- Develop strategies to improve retention rates
- Be aware of correct and incorrect ways to introduce incentives to the recruitment process
- Incorporate new information that becomes available during the recruitment process to improve the success of recruitment
- Provide robust training to the marketing team to ensure that they don't inadvertently compromise the random nature of the sample
- Design pre- and post-treatment customer experience surveys aligned with pilot objectives

Common Mistakes during Recruitment

- Recruitment team deviating from the pilot design plan to meet the sample size targets
- Nonexistent or infrequent communication between the recruitment and design teams that might introduce inefficiencies in overall pilot management
  - Loss of marketing cost savings
  - Loss of valuable course correction opportunities
- Misuse of incentive payments
- Recruitment starting around the holiday times
- Recruitment process that necessitates too many touch points with the customers before sign up
- Not capturing useful customer interactions/communications that might inform future program deployment strategies

4-Evaluation, Measurement & Verification Method

PSE's EM&V Approach

Evaluation, measurement and verification efforts allow utilities maximize the learnings from pilot programs

PSE is planning to undertake various EM&V activities throughout and at the conclusion of the two year TVR pilot

- Load impact evaluation after the 1st year of the pilot
- Load impact evaluation after the 2nd year of the pilot
- Process evaluation after the 2nd year of the pilot
- Customer surveys before, during and at the conclusion of the pilot

Load Impact Evaluation Best Practices

The experimental design of each pilot dictates the optimal evaluation method: difference -in-differences (ANOVA or ANCOVA); panel regressions (fixed-effects or random-effects); individual customer regressions

- Decide on the evaluation approach based on the experimental design
- Identify load impact metrics to be quantified (i.e. peak, mid-peak, off-peak impacts, average daily conservation impact, etc.)
- Estimate alternative models and select the one that leads to most accurate predictions
- Quantify customers' overall price responsiveness in the form of price elasticities which would allow predicting impacts for prices other than those tested in the pilot. These typically consist of two price elasticities:
  - Own/daily price elasticity (captures the change in the level of overall consumption due to the changes in the average daily price
  - Substitution price elasticity (captures customer's ability to substitute inexpensive off-peak consumption for more expensive peak consumption)

Proposed Load Impact Evaluation Approach

We propose a two -prong approach to load impact evaluation of PSE's TVR pilot:

1. **Ex-post load impact analysis**
   - Involves estimation of the load impacts resulting from the implementation through regression analysis
   - Estimates X% reduction in peak demand and Y% reduction in overall usage
   - Central piece of a load-impact evaluation effort
   - Generally straightforward to estimate with good modeling/econometric skills

2. **Price elasticity estimation**
   - Involves estimating customer demand models to estimate own and substitution price elasticities representing customers' sensitivity to prices
     - **Own/daily price elasticity** (captures the change in the level of overall consumption due to the changes in the average daily price
     - **Substitution price elasticity** (captures customer's ability to substitute inexpensive off-peak consumption for more expensive peak consumption)
   - These price elasticities can be used to "simulate" the impact of other rate levels that were not tested in the soft launch
   - Good to have especially if future rates are likely to be different from the rates tested in the pilot
   - More complex to estimate demand systems and requires a thorough understanding of demand models

Proposed Load Impact Evaluation Approach II

TOU Ex -post Load Impact Analysis

- We propose to undertake a panel data estimation with control group and pre-treatment data
- More specifically, a **fixed effects regression**, which accounts for the impact of unobservable time-invariant variables and prevent them from biasing the estimates (such as individual customer lifestyles or housing types)
- This analysis will determine the peak demand reductions and overall conservation impact demonstrated by the treatment customers

PTR Ex-post Load Impact Analysis

- We propose to undertake a "**within-subject**" panel data estimation using only the treatment period data
- Fixed effects regression between event days and non-event days for the treatment customers
- Another variation is to only use "comparable" non-event days for control purposes
- Comparable non-event days can be determined by choosing the days with most similar weather conditions to the event-days
- Model specifications are flexible in that it is possible to estimate separate impacts for individual peak hours by event day, or average peak impacts on average event day

Process Evaluation Requirements

A process evaluation consists of an assessment of the implementation of the program, with the goal of producing better and more cost-effective programs in the future

- Typically conducted by surveying or soliciting feedback from the various groups involved in the pilot program, including both participants, implementers and administrators of the program

Data collection efforts include but are not limited to:

- Customer recruitment and outreach (pre-treatment survey)
- Customer acceptance and interest in treatment (post-treatment survey)
- Understanding the reasons for non-participation and attrition
- Quality control practices
- Time, schedule and budget management
- Lessons learned
- Project resource constraints and staff training
- In-field and back-office challenges with implementation

5-Recap & Next Steps

TVR Pilot Design Survey Follow-Up

Question	Recommendation	Rationale
Will EV-Only rates be offered?	3-Tier TOU rates w/ super off-peak will be offered for EV customers on a whole-house basis.	• Technological feasibility for billing grade charging consumption data from smart chargers, vehicle telematics, or load disaggregation software is rapidly evolving. • At this time, PSE proposes to conduct feasibility demonstrations in parallel to explore various technologies to assess for billing grade data availability.
Will the rates be paired with enabling technologies?	Pilot should focus on responsiveness to pricing without imposing enabling tech.	• Enabling technology cannot be imposed as part of a full-scale offering. • It is also widely established that enabling tech boosts customer responsiveness; the use of such tools will be encouraged and customers referred to existing PSE programs that can provide subsidized devices. • PSE recommends identifying customers utilizing enabling tech and analyze them as a subgroup to directionally measure marginal impacts.
How will the rates be deployed?	Opt-in will be the default for all treatment groups.	• PSE would pursue same strategy that would be used for a full-scale offering of TVR rates.
Will "shadow bills" be offered in the pilot?	Bill impact simulations would be shared with customers.	• Static "shadow bill" would only provide a bill impact assessment based on no behavioral change. This would preempt any opportunity to present customers with opportunities to save and conserve. • PSE proposes to offer bill impact simulation so customers can make informed decisions with regard to their usage. At this time, PSE is investigating options to provide bill impact simulation.
Will the treatment customers be offered bill protection?	Bill protection should not be offered to non-low income customers. Low income customers to participate in bill discount program.	• Bill protection would dilute customer response to price signals. • These rates are opt-in, customers can exit the pilot at any time. • Low income customers will be protected through PSE's assistance programs. • PSE would pursue same strategy that would be used for a full-scale offering of TVR rates.

Next Steps

- The Brattle Group will prepare report detailing pilot design and EM&V plan.
- Post Collaborative No. 3 Stakeholder Survey for feedback on design and process.
- PSE and The Brattle Group will prepare testimony and filing package for GRC.

Appendix

How big of a sample size is needed?

In order to determine the pilot's impact in a statistically significant fashion, the sample size has to be of a certain size. There are several parameters that affect the sample size.

Parameter	Description of parameter
Group means	Average amount of electricity consumed by each group
Standard deviations	Amount that electricity consumption varies across households within each group
Number of repeat observations	Number of observations per household
Correlation coefficients	Degree to which electricity consumption is similar over time for a given household in the treatment and/or control group(s)
Statistical significance	Degree of certainty that the program reduces usage [one-sided test]
Statistical power	Degree of certainty that the statistical test gives the correct answer

Residential Class TOU

TOU Sample Size

	Winter	Non-Winter
Mean	1.52	1.17
Pre St. Dev	1.12	0.95
Post St. Dev	1.12	0.95
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.91	0.89
r1	0.91	0.89
r01	0.81	0.79
Detectable Impact	5.5%	3.4%
Sample Size (Change)	**453**	**1,414**
Sample Size (Change), Grossed 20%	**544**	**1,696**

Residential Class TOU + PTR (TOU Section)

TOU+PTR (TOU Part) Sample Size

	Winter	Non-Winter
Mean	1.52	1.17
Pre St. Dev	1.12	0.95
Post St. Dev	1.12	0.95
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.91	0.89
r1	0.91	0.89
r01	0.81	0.79
Detectable Impact	2.8%	2.6%
Sample Size (Change)	**1,780**	**2,417**
Sample Size (Change), Grossed 20%	**2,137**	**2,901**

Residential Class TOU + PTR (PTR Section)

TOU+PTR (PTR Part) Sample Size

	Winter	Non-Winter
Mean	1.52	1.17
Pre St. Dev	1.12	0.95
Post St. Dev	1.12	0.95
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.91	0.89
r1	0.91	0.89
r01	0.81	0.79
Detectable Impact	5.5%	5.5%
Sample Size (Change)	**445**	**540**
Sample Size (Change), Grossed 20%	**534**	**648**

Residential Class Three-Period TOU (EV)

Three-Period TOU Sample Size

	Winter	Non-Winter
Mean	1.52	1.17
Pre St. Dev	1.12	0.95
Post St. Dev	1.12	0.95
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.91	0.89
r1	0.91	0.89
r01	0.81	0.79
Detectable Impact	6.3%	6.0%
Sample Size (Change)	**339**	**462**
Sample Size (Change), Grossed 20%	**407**	**554**

Small Commercial TOU + PTR (TOU Section)

TOU+PTR (TOU Part) Sample Size

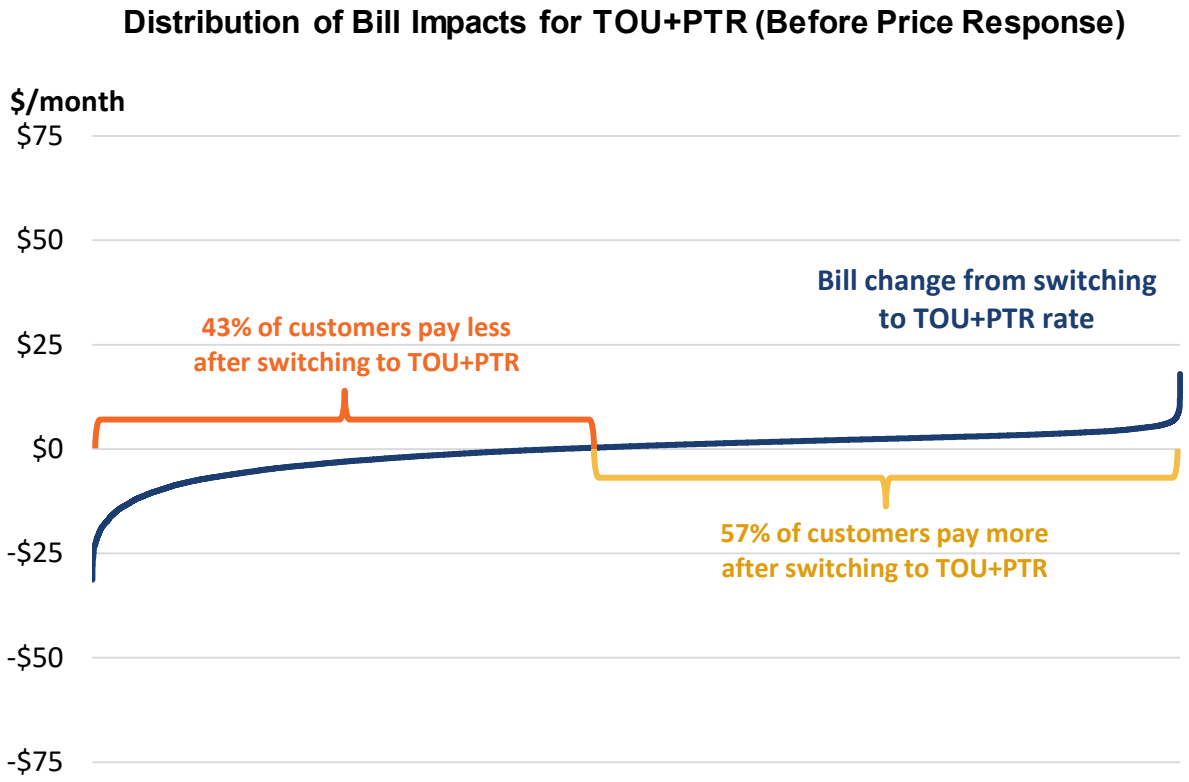
	Winter	Non-Winter
Mean	1.64	1.17
Pre St. Dev	1.85	1.55
Post St. Dev	1.85	1.55
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.94	0.96
r1	0.94	0.96
r01	0.84	0.86
Detectable Impact	2.9%	2.8%
Sample Size (Change)	**3,767**	**5,803**
Sample Size (Change), Grossed 20%	**4,520**	**6,964**

Small Commercial TOU + PTR (PTR Section)

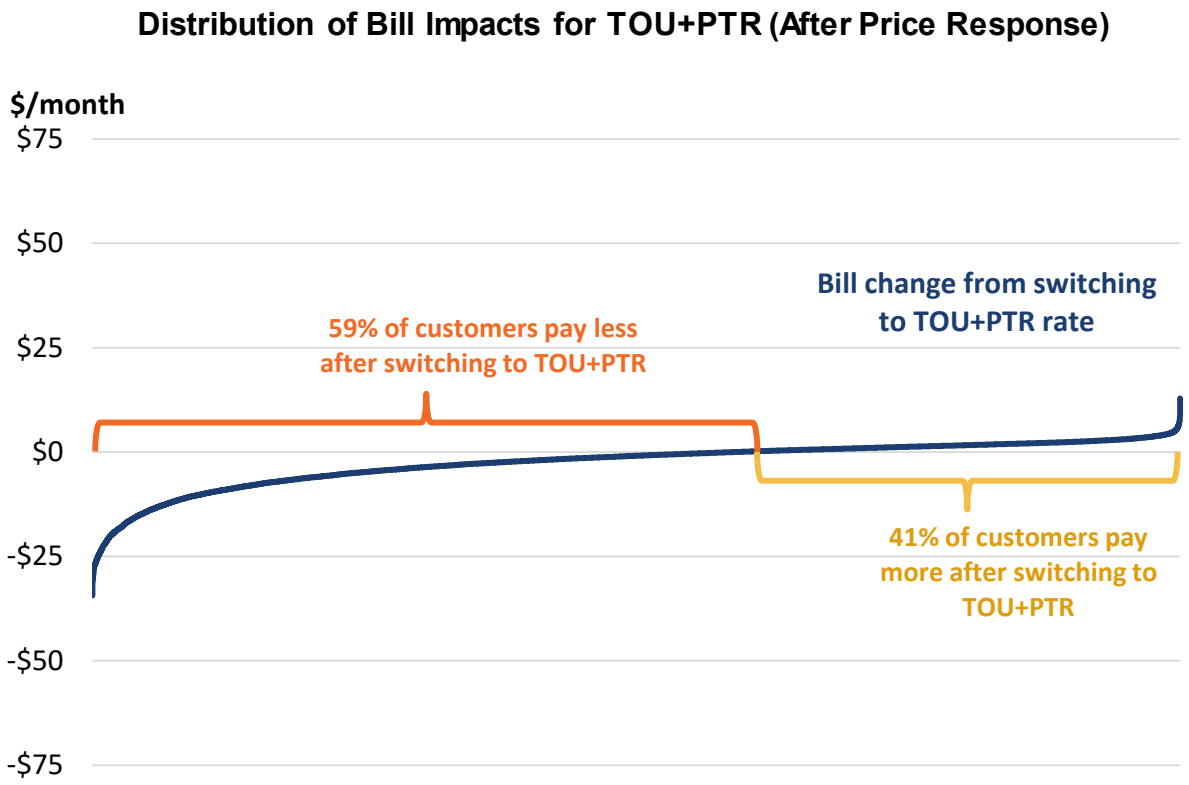
TOU+PTR (PTR Part) Sample Size

	Winter	Non-Winter
Mean	1.64	1.17
Pre St. Dev	1.85	1.55
Post St. Dev	1.85	1.55
Statistical significance	5%	5%
Power	80%	80%
Number of pre observations	180	180
Number of post observations	180	180
r0	0.94	0.96
r1	0.94	0.96
r01	0.84	0.86
Detectable Impact	5.7%	5.7%
Sample Size (Change)	**992**	**1,375**
Sample Size (Change), Grossed 20%	**1,191**	**1,650**

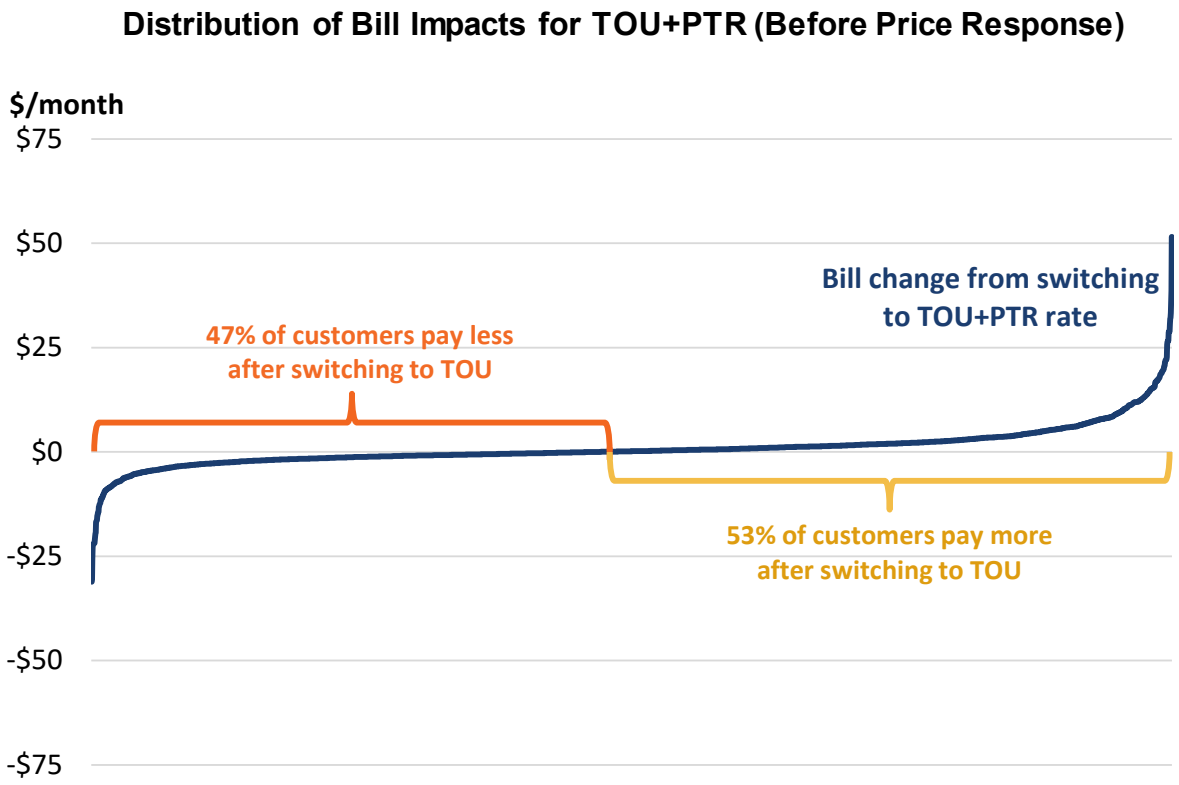
Residential TOU+PTR Bill Impacts



Residential TOU+PTR Bill Impacts



Small Commercial TOU+PTR Bill Impacts



Small Commercial TOU+PTR Bill Impacts