Improving Customer Choice, Reducing Bills, and Shifting Loads with Time-Varying Rates

Josh Bode, Brian Kurtz, & Tim Larsen

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Time-varying rates on Long Island

KEY FACTS

- LIPA installed smart meters for over 1 million customers
- Residential Customers: 1,026,143
- Commercial Customers: 133,597
- 2023 Peak Demand ~5,000 MW
- 19,884 GWh of annual consumption
- ~5,500 MW of generating capacity

TIME VARYING RATE ROLL OUT

1. **Voluntary TOU rates** starting 2021
   - 4 different rates
   - Targeted “structural winners”, especially EV owners
   - Successful marketing – talk to Brian Kurtz
   - Focus on providing customer choice and analysis of AMI data to understand bill impacts
2. **Default TOD rates** starting 2024
   - *Time-of-day for approximately 800,000 sites*
   - Rolling out in waves
   - DSA/PSEG-LI Randomized Control Trial in 2024-2025
   - Only includes structural winners and sites that can lower bills if they take moderate actions

Did enrolling in TOU rates change behavior?

Marketing targeted customers with favorable load patterns

- Did TOU customers simply keep same patterns?
- Or did they change behavior once enrolled?

Other research questions

- Bill impacts
- Impacts for EV owners?
- Impacts for Balanced Billing customers? (50% on Long Island)
- Changing impacts over time?

Key Takeaways

1

HOURLY IMPACTS are clear, follow the expected pattern:

- Reduced demand during Peak hrs.
- Increased demand overnight

2

EVENING HOURS (8-10 P.M.): Large decreases between Peak and Super Off-Peak (lower cost to shift these loads)

3

CUSTOMER BILLS: Decreased because of price structure, but decreased further due to behavior changes

4

EV OWNERS: Decreased usage for all daytime hours and large increases overnight. About 50% of all daytime reductions from EV owners

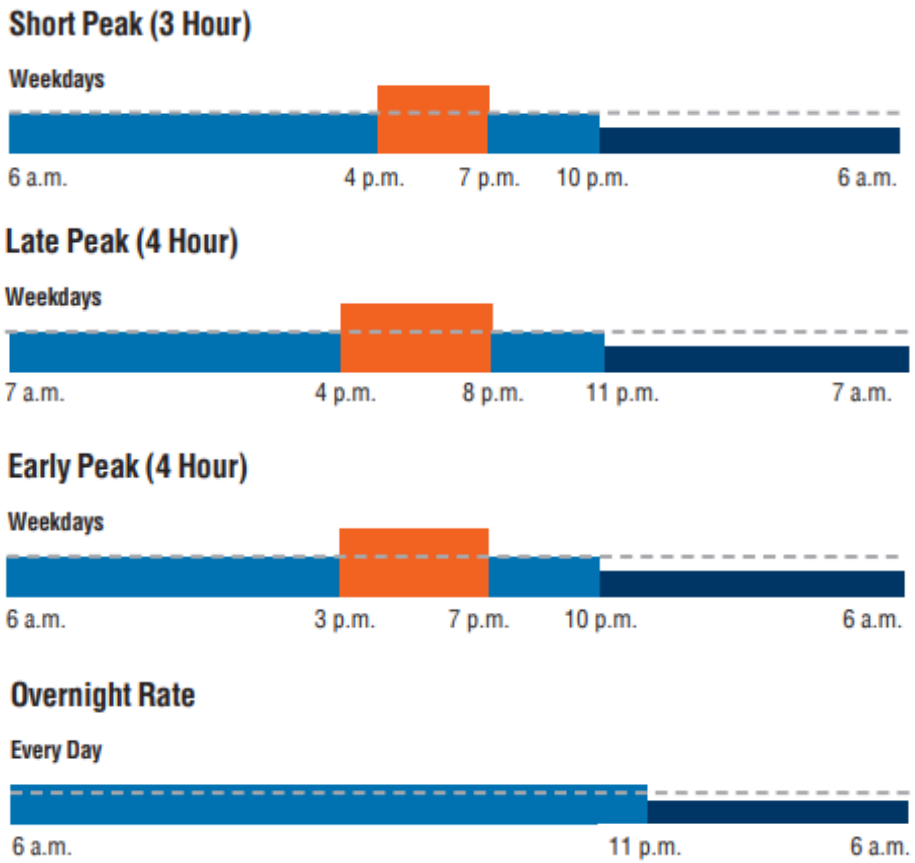
5

BALANCED BILLING: Customers still responded to price incentives. Made up almost half of TOU enrollees.

6

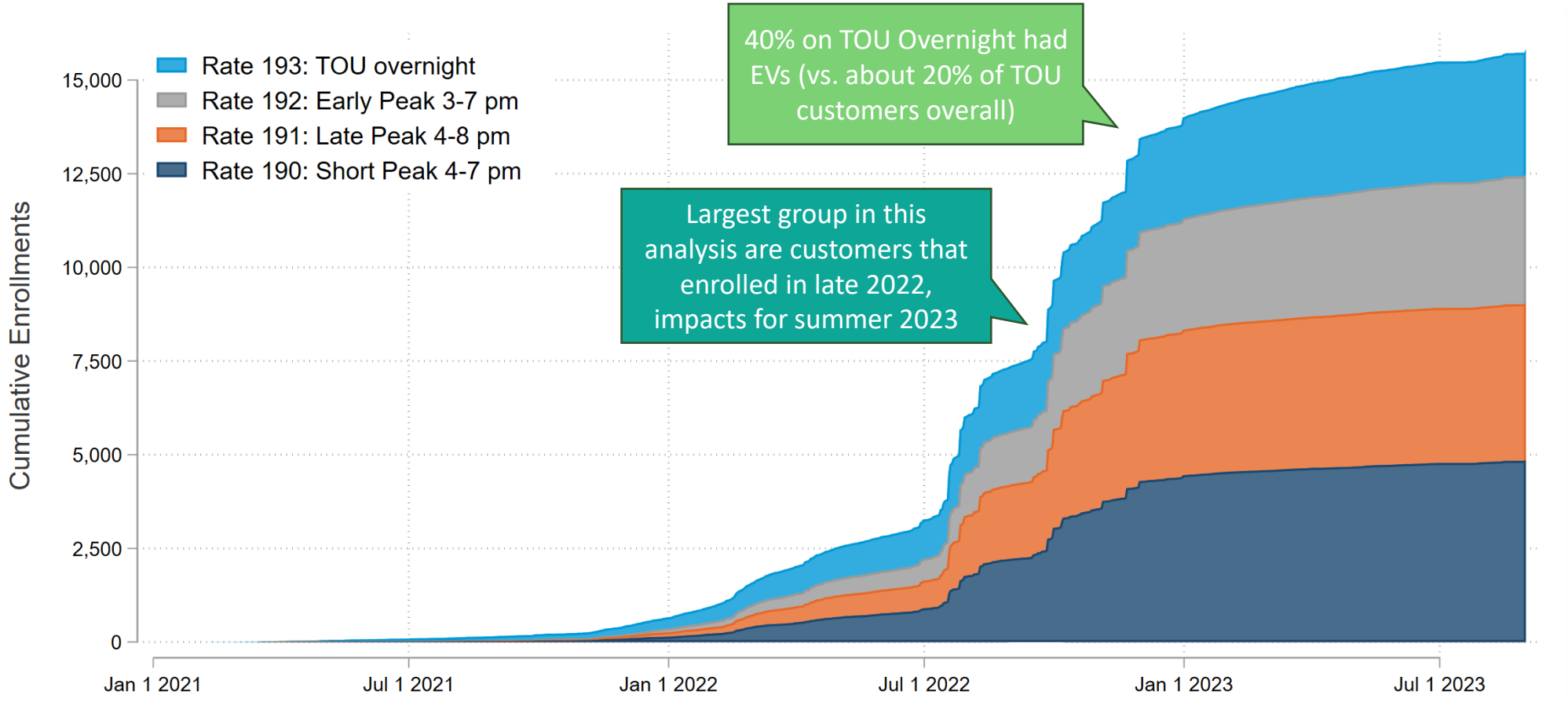
2nd SUMMER: Decreases in Peak usage, increases overnight usage persisted into second summer for customers enrolled by summer 2022

TOU rates by hour and price (Summer 2022)



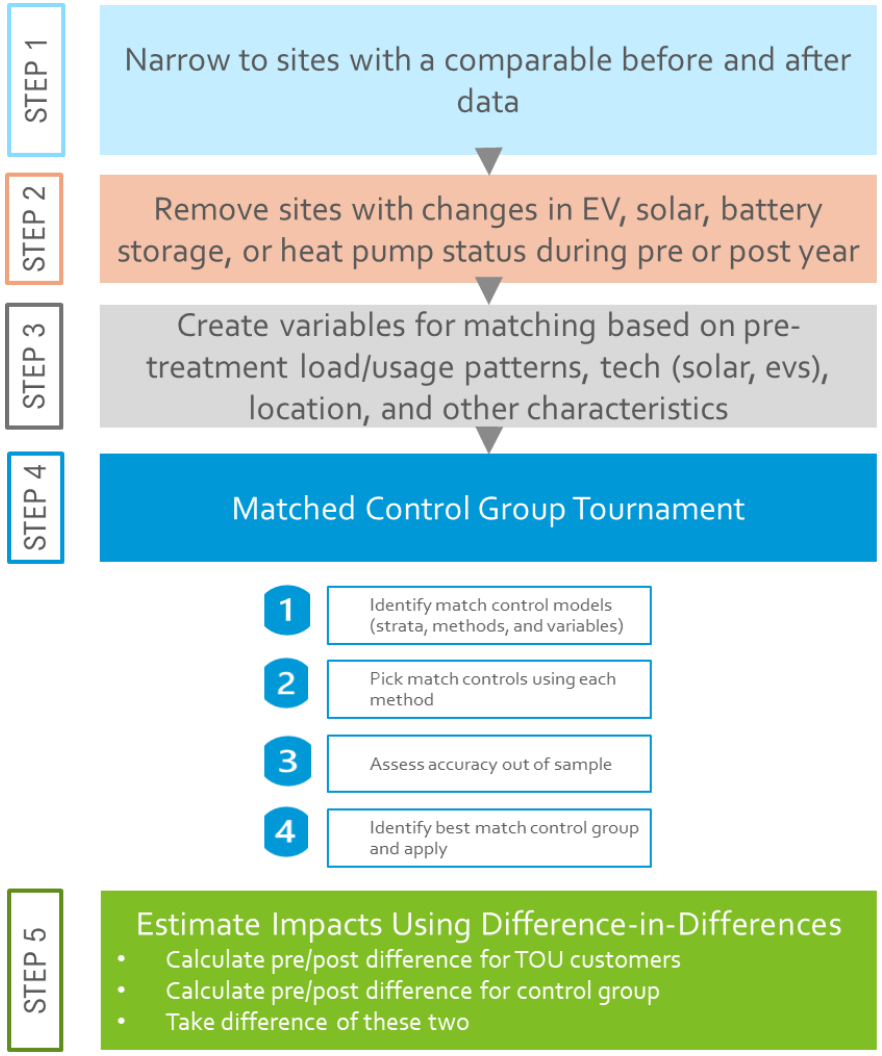
Rate (per kWh)	Super Off-peak	Off Peak	Peak
190: Short Peak (3-hour)	$0.12	$0.20	$0.43
191: Late Peak (4-hour)	$0.12	$0.20	$0.36
192: Early Peak (4-hour)	$0.12	$0.20	$0.38
193: Overnight Rate	$0.12	Daytime: $0.24	

Over 15,000 Residential Customers by Summer 2023



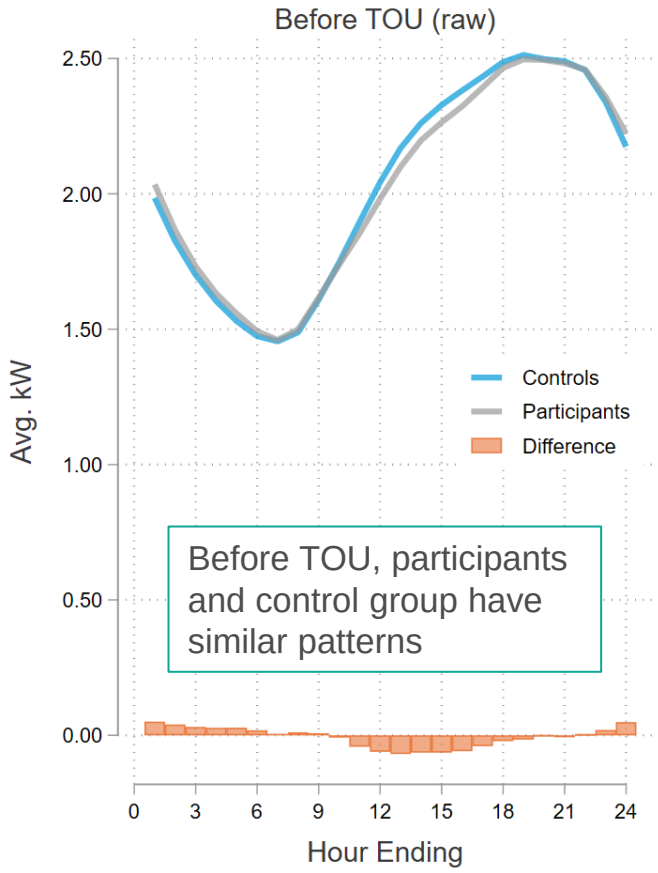
Analysis: Compare TOU enrollees to matched control group

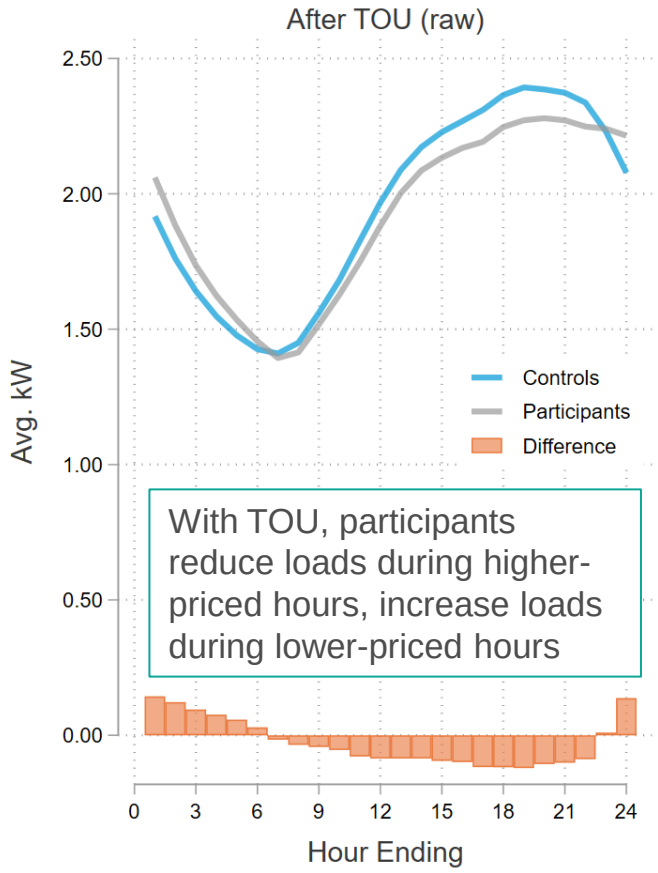
- TOU rates were voluntary ⇨ Need to construct a control group
  - Compare usage trends over time (*Differences-in-differences*)
- PSEG-LI targeted structural winners
  - TOU customers already had more overnight/less peak usage before enrolling
  - Very different from avg. customer
- Customer base was large enough for strong matches
  - Including for EV owners, Balanced Billing, etc.

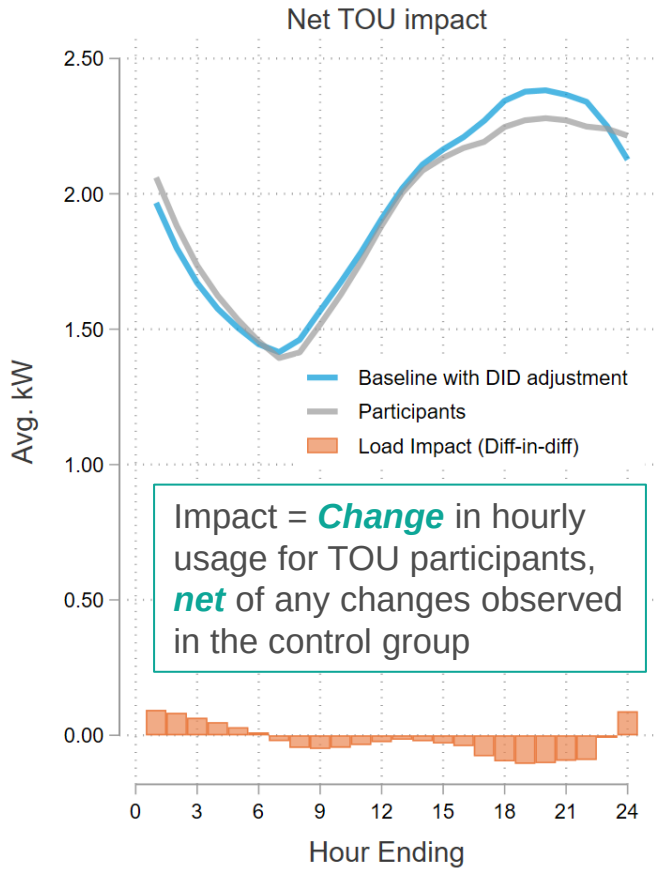


Raw data shows decrease during/after peak, increase overnight

- Hourly impacts, summer weekdays in 2022, 2023 combined (June – September)







Average Hourly Impacts – Summer Weekdays

Daytime

Hour	Impact (kW)	Impact (%)	t-stat
6 – 7 a.m.	-0.02	-2%	*-2.93*
7 – 8 a.m.	-0.05	-3%	*-5.97*
8 – 9 a.m.	-0.05	-3%	*-5.79*
9 – 10 a.m.	-0.04	-3%	*-4.97*
10 – 11 a.m.	-0.04	-2%	*-3.84*
11 – 12 p.m.	-0.03	-1%	*-2.76*
12 – 1 p.m.	-0.03	-1%	*-2.46*
1 – 2 p.m.	-0.03	-1%	*-2.78*

Afternoon & Evening

Hour	Impact (kW)	Impact (%)	t-stat
2 – 3 p.m.	-0.03	-2%	*-3.47*
3 – 4 p.m.	-0.04	-2%	*-4.34*
4 – 5 p.m.	-0.08	-3%	*-7.92*
5 – 6 p.m.	-0.10	-4%	*-10.09*
6 – 7 p.m.	-0.11	-5%	*-11.47*
7 – 8 p.m.	-0.12	-5%	*-11.73*
8 – 9 p.m.	-0.11	-4%	*-10.87*
9 – 10 p.m.	-0.12	-5%	*-11.37*

Night

Hour	Impact (kW)	Impact (%)	t-stat
10 – 11 p.m.	-0.03	-1%	*-3.02*
11 – 12 a.m.	0.08	3%	*5.99*
12 – 1 a.m.	0.10	5%	*8.03*
1 – 2 a.m.	0.09	5%	*8.08*
2 – 3 a.m.	0.07	4%	*6.51*
3 – 4 a.m.	0.05	3%	*4.86*
4 – 5 a.m.	0.02	2%	*2.57*
5 – 6 a.m.	0.00	0%	*0.33*

** Peak hours shown in blue, Super Off-Peak in green*

- ⇩ during Peak hours
  - .10 kW for 15,000 participants ⇨ ≈ 1.5 Mw aggregate impact
- ⇩ for ***most other daytime hours*** as well (especially 7 -10 a.m.)
- ⇧ in Super Off-Peak (overnight) usage
  - Especially in first few hours, likely scheduled EV charging
- ⇩ ***before*** Super Off-Peak (8 - 10 p.m.)
- No evidence of precooling, snapback

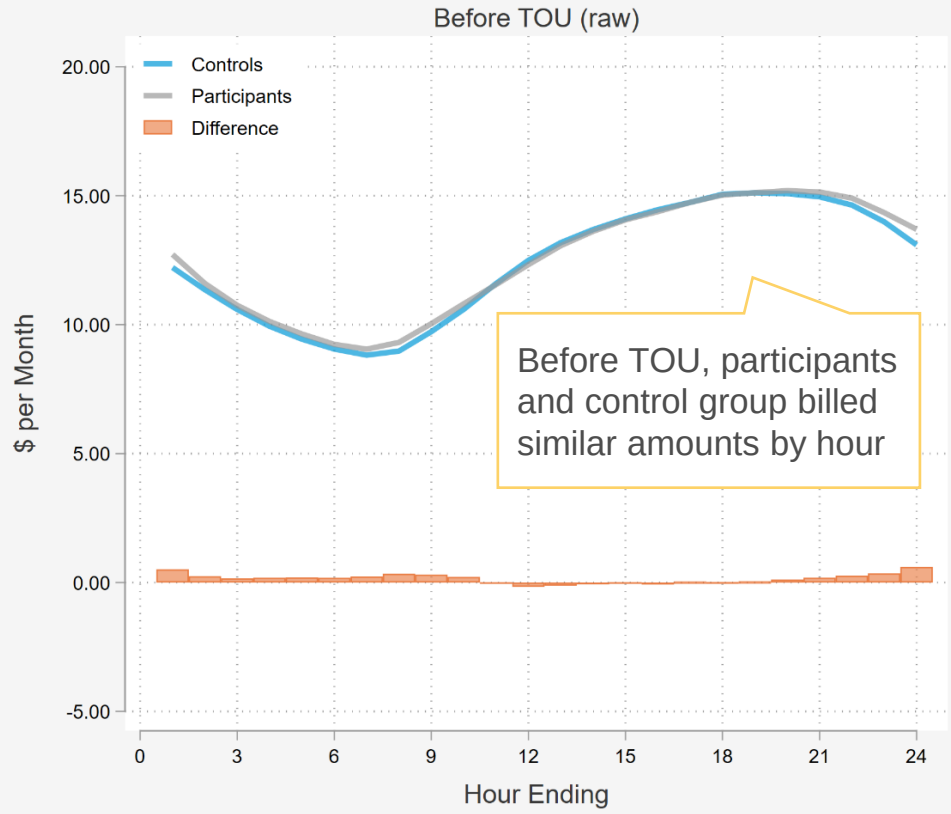
TOU customers saved on summer bills

- Targeted *structural winners* who were likely to save on TOU rates
  - Part of savings simply due to change in price structure
- Matched controls had similar usage patterns before TOU, so also structural winners
  - Diff.-in-diff. also includes bill impacts from ***change in usage pattern*** after enrolling in TOU rate

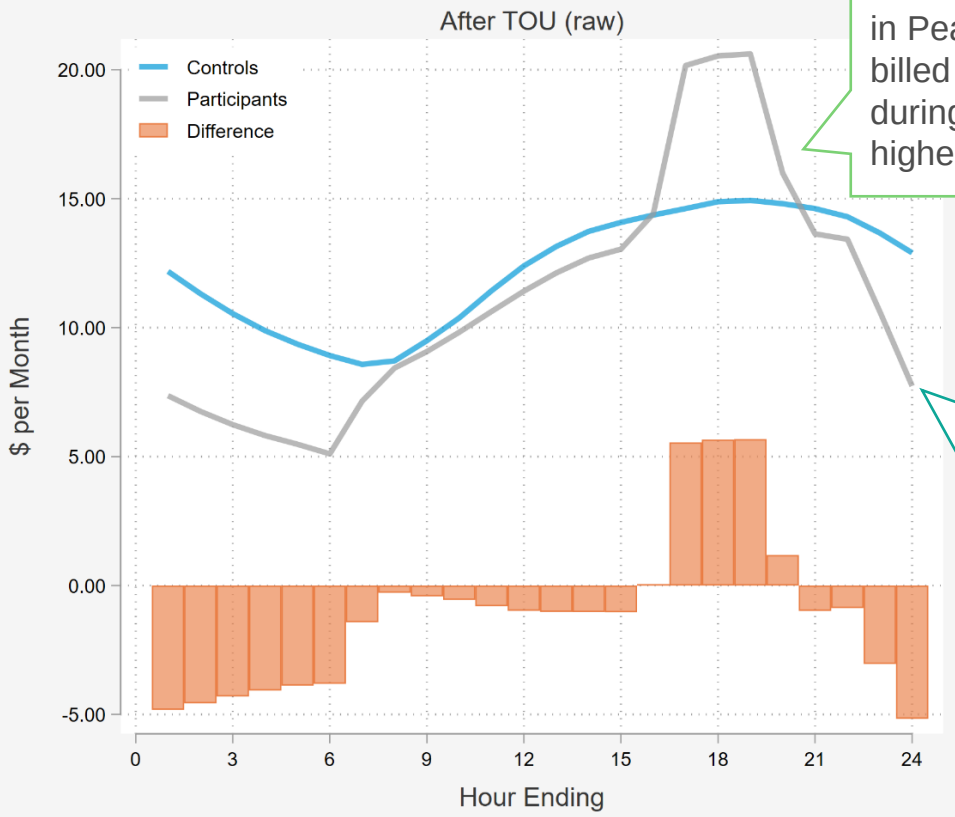
Month	TOU CUSTOMERS' BILLS			CONTROL GROUP BILLS			MONTHLY IMPACT	
	Before	After	Diff.	Before	After	Diff.	Bill Amt. ($)	Pct.
June	$324.88	$267.26	-$57.62	$318.26	$295.38	-$22.88	**-$34.73**	**-11.5%**
July	$358.05	$367.04	$8.99	$351.14	$404.74	$53.60	**-$44.60**	**-10.8%**
August	$377.16	$348.31	-$28.85	$371.60	$384.52	$12.92	**-$41.77**	**-10.7%**
September	$265.85	$222.12	-$43.73	$262.21	$242.19	-$20.02	**-$23.70**	**-9.6%**

TOU customers billed more during peak but less overall

- Monthly spending (30 days) by hour of day during summer months (hourly price x kWh usage)



Before TOU, participants and control group billed similar amounts by hour

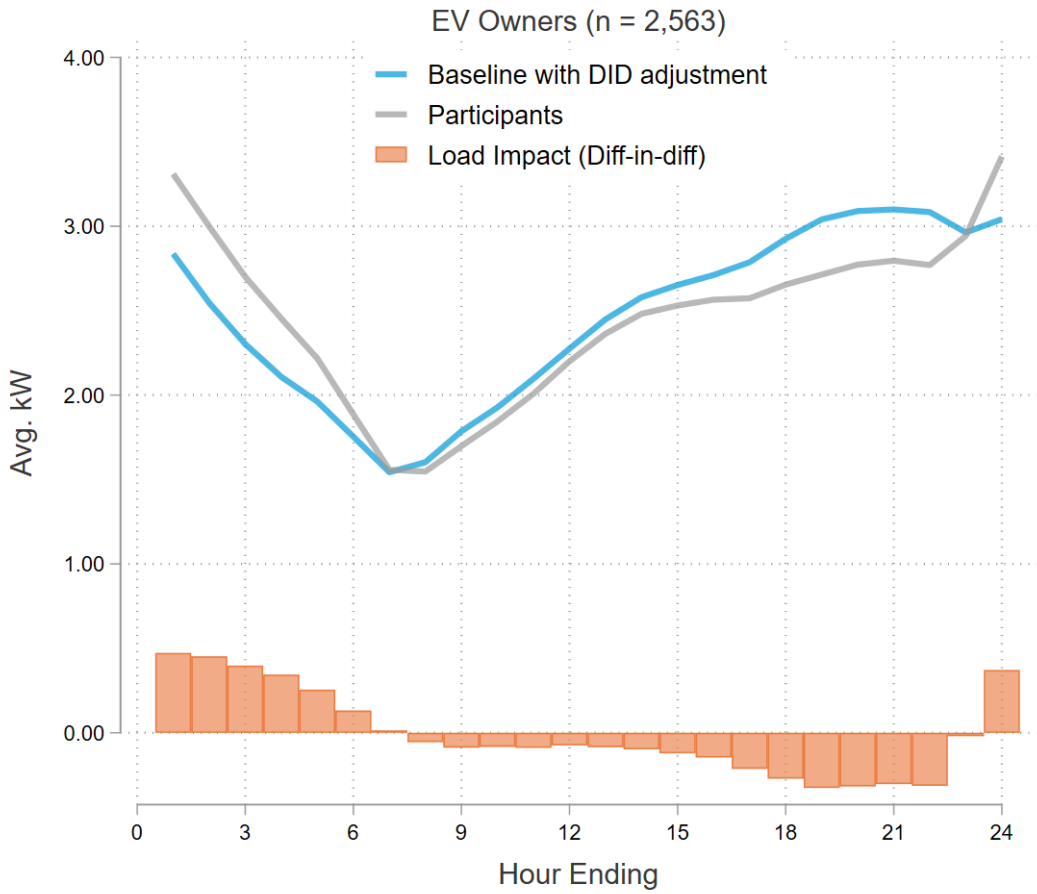


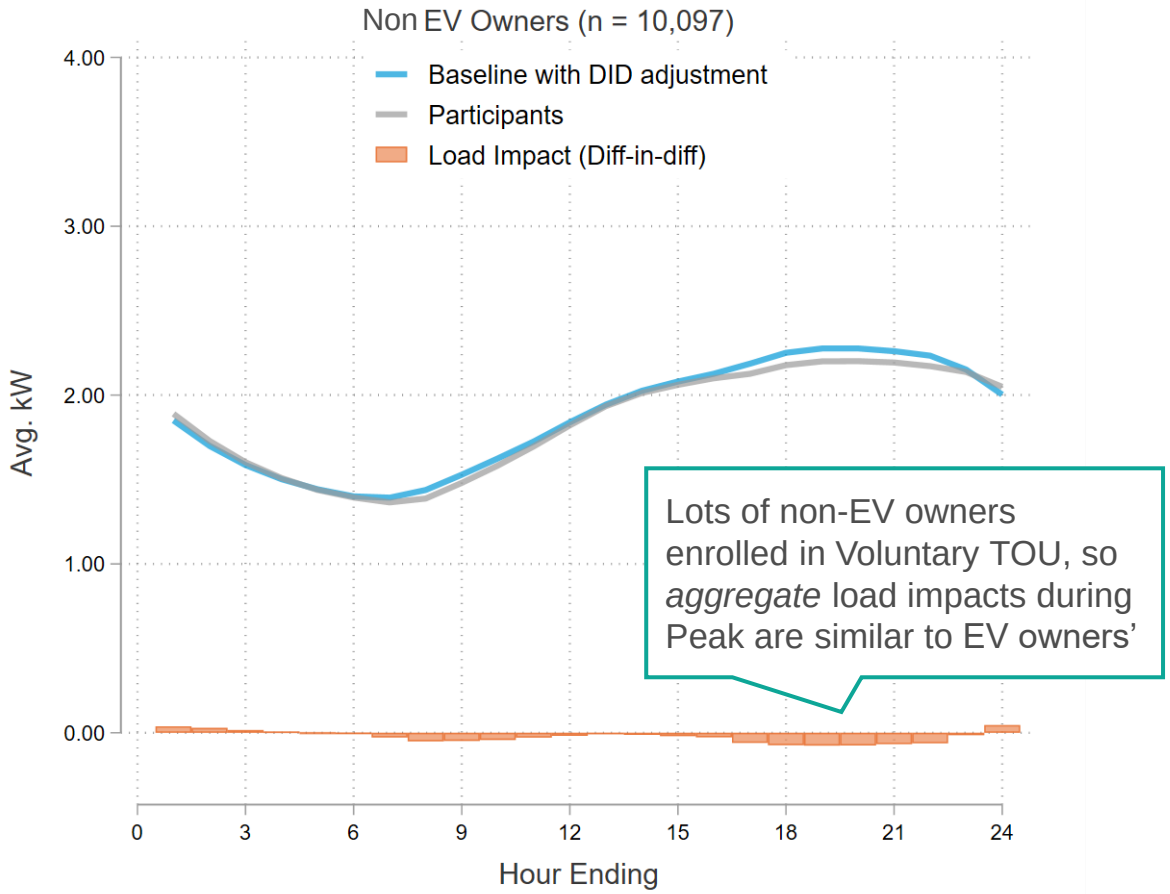
Even with decrease in Peak usage, billed more per hr. during Peak due to higher prices

Billed less per hr. for all Off-Peak, especially overnight

Much larger impacts for EV owners

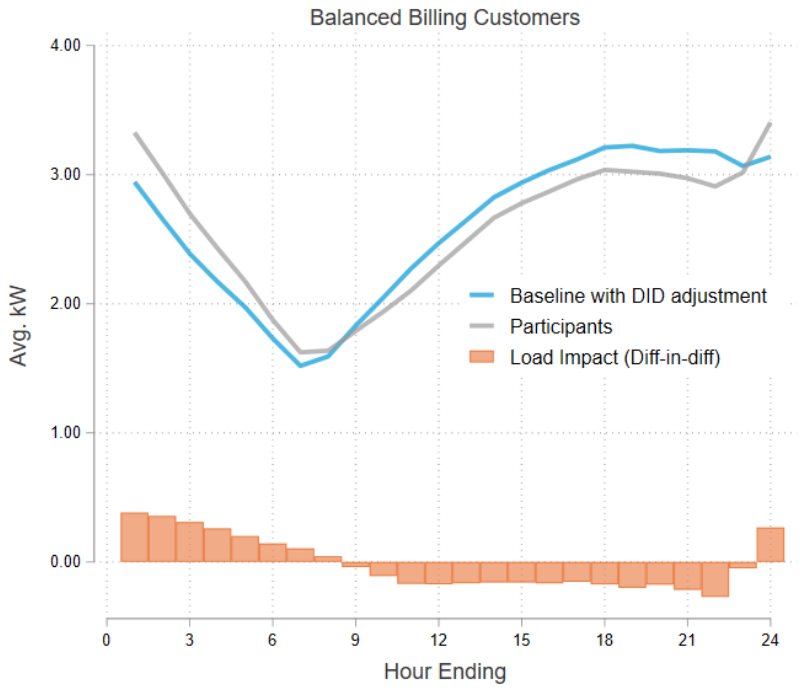
- Hourly impacts, summer weekdays in 2022, 2023 combined (June – September)



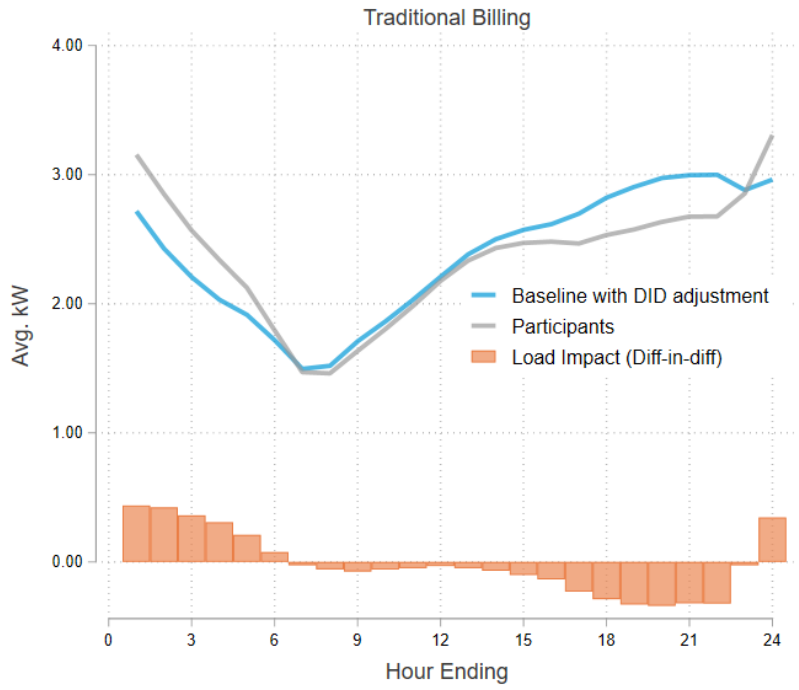


Balanced Billing customers responded to incentives, too

- **EV OWNERS:** Hourly impacts for, summer weekdays in 2022-2023



More tendency to save during all daytime hours for Balanced Billing



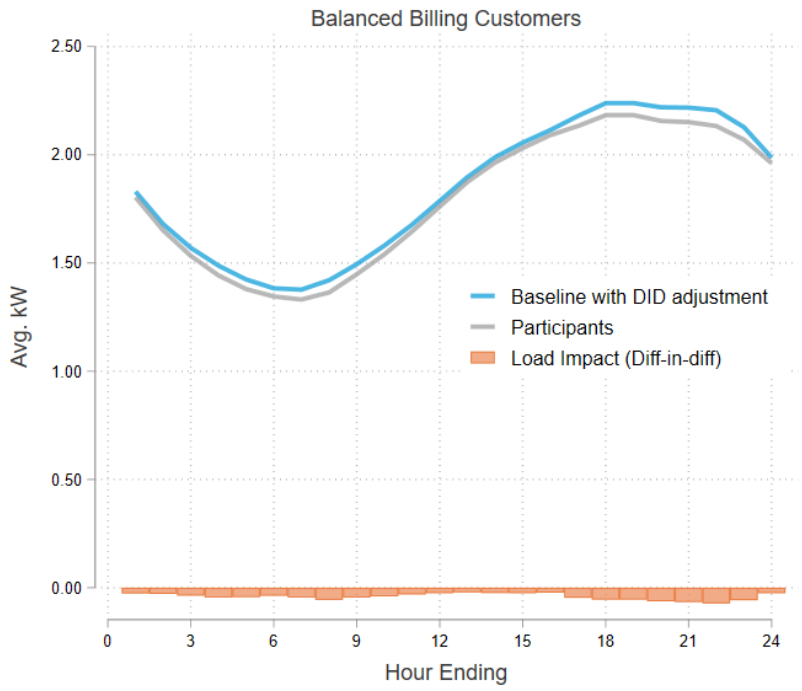
Overall, hourly results ***very similar regardless of bill timing***:

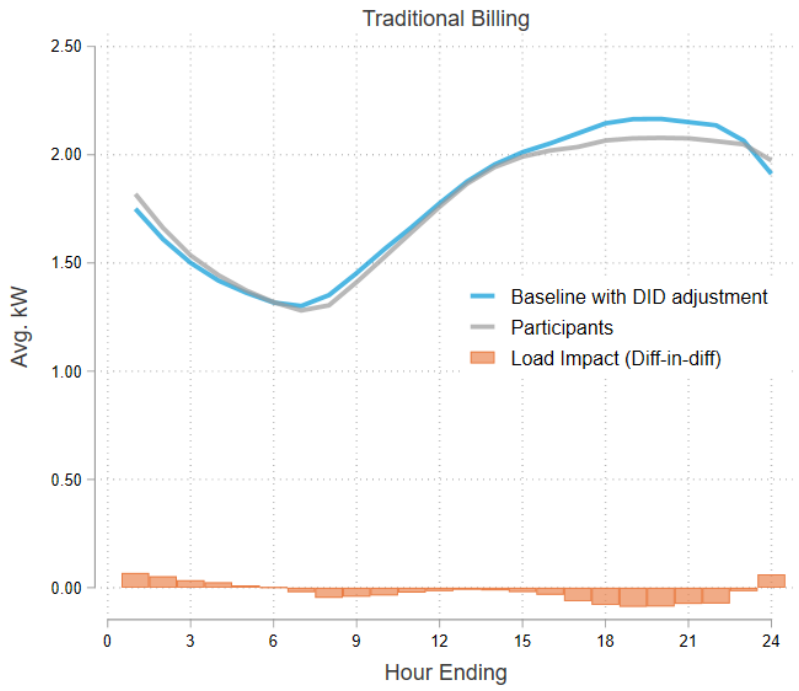
- Savings during Peak
- Increased overnight loads

- TOU rates impacted usage ***even when the price signal was significantly delayed***
- High rates of Balanced Billing for PSEG-LI (about 50%)
- Could pose challenge for default TOD rollout, but these customers responding to prices

Balanced Billing customers responded to incentives, too

- **NON-EV OWNERS:** Hourly impacts for, summer weekdays in 2022-2023





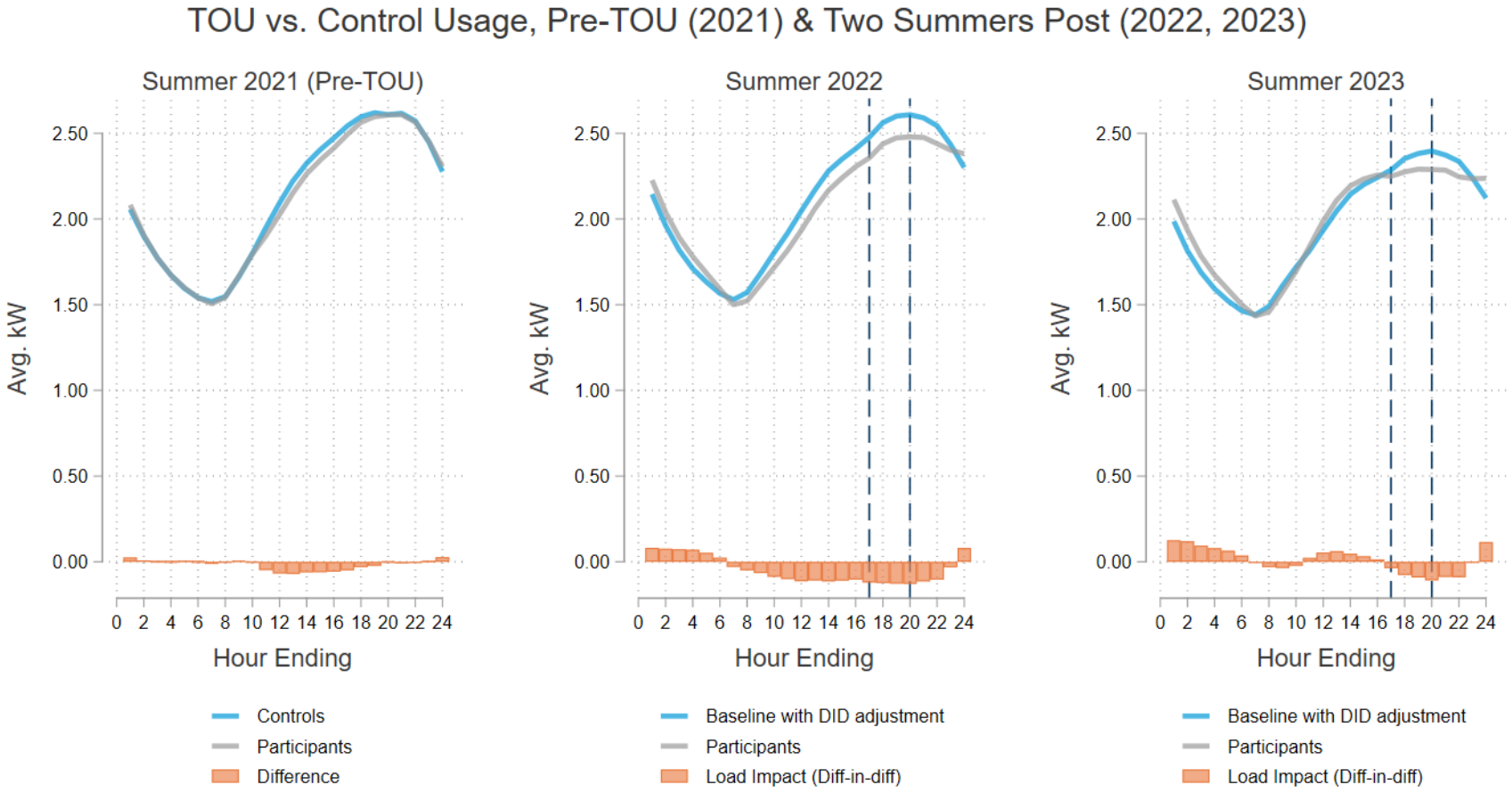
Balanced Billing customers tended to save during all hours

Overall, hourly results are very similar, especially Peak savings

- Some utilities worry about the tradeoff between bill smoothing and time-varying rates
- For these customers PSEG-LI was able to do ***both***

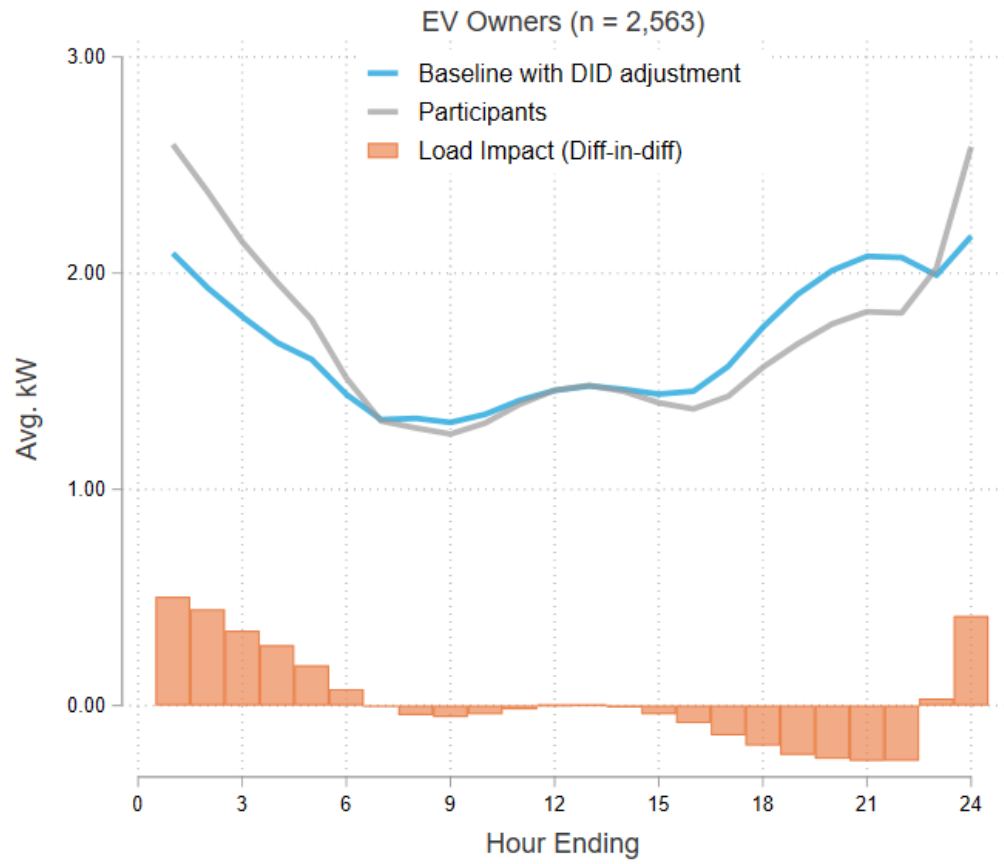
Impacts in 1st Summer vs. 2nd Summer

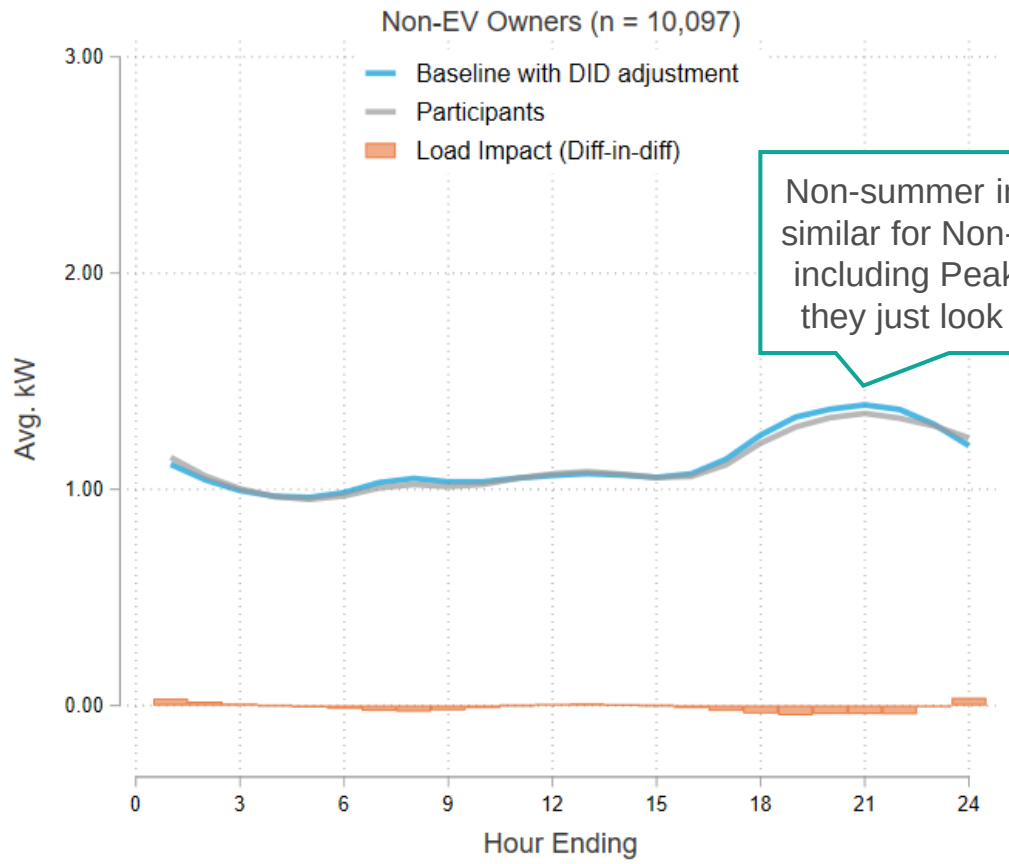
- Customers enrolled by summer 2022 only



- Only looking at customers w/ TOU in both 2022 & 2023 ⇨ comparing *exact same customers* on same day of year
- Still saw peak savings in 2023
- Overnight usage ⇧ further in 2023
- Daytime (non-peak) savings ⇩ in 2023
- Learning over time?

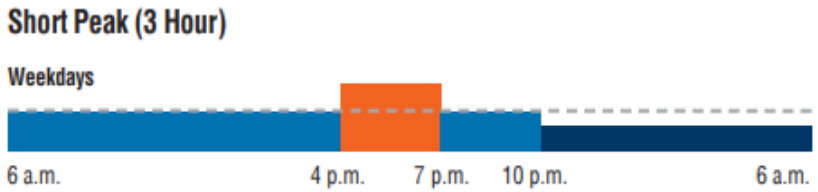
Non-Summer: EV owners had similar hourly savings

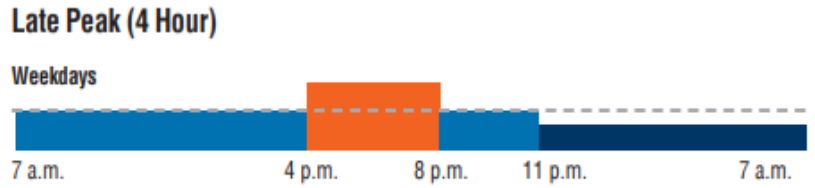


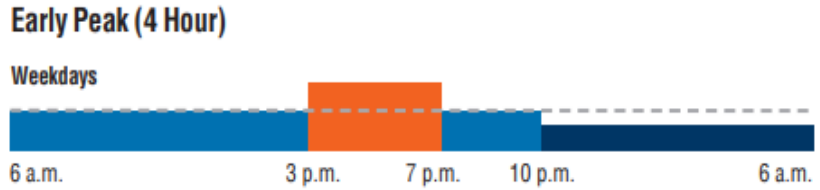


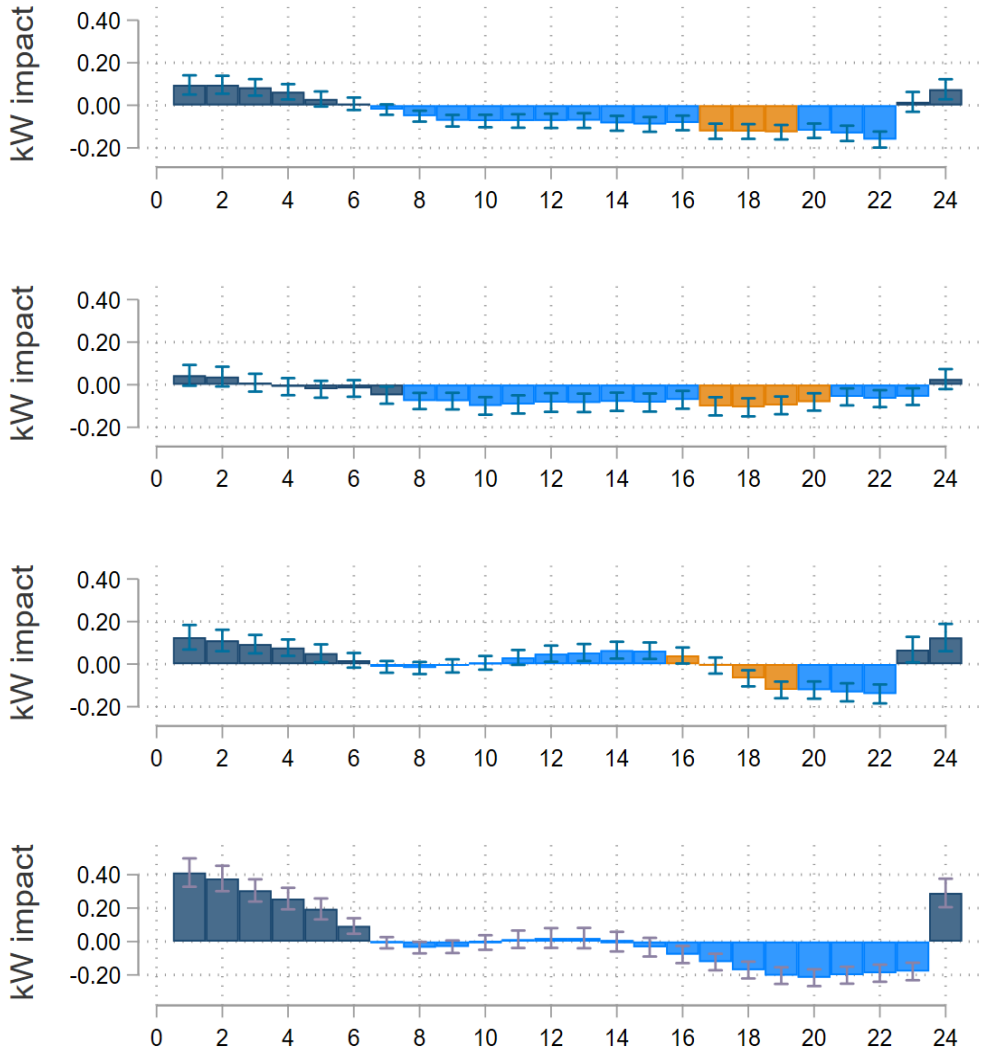
Non-summer impacts also similar for Non-EV owners, including Peak reduction, they just look small here

Impacts by Rate Code









- Largest hourly increase: 11 p.m. for overnight rate
- Increases at 10/11 p.m. on other rates, too
- ***Otherwise no sharp changes in usage***
- No evidence of pre-cooling or snapback (*could change in future*)
- Peak impacts not statistically different by rate code

Questions?

Josh Bode, MPP
Partner
Demand Side Analytics
jbode@demandsideanalytics.com

Brian Kurtz, MBA
Manager: Customer Satisfaction & Utility 2.0 PMO
PSEG-Long Island
brian.kurtz@pseg.com

Tim Larsen, PhD
Consultant
Demand Side Analytics
tlarsen@demandsideanalytics.com