NARUC Electric Vehicles State Working Group

MAY MEETING – **EV RATE IMPACTS**

MAY 30, 2023, 3:00- 4:30PM

Welcome

EV SWG Chair

Commissioner Katherine Peretick, Michigan Public Service Commission

EV SWG Vice-Chair

Chair Jason Stanek, Maryland Public Service Commission

NARUC Staff

- Danielle Sass Byrnett, Robert Bennett

Feel free to enter questions into chat at any time

Agenda

3:00 PM	**Welcome and Announcements – Commissioner Katherine Peretick (5 minutes)** • Agenda review • Announcements
3:05 PM	**Presentation: Andy Satchwell, Lawrence Berkeley National Lab (15 minutes)** • Overview of findings from recent economic analysis about the financial impacts of EVs on ratepayers
3:20 PM	**Scott Drake, East Kentucky Power (15 minutes)**
3:35 PM	**Stephanie Leach, Baltimore Gas and Electric (BG&E) (15 minutes)**
3:50 PM	**Q and A and Working Group Peer Sharing and Discussion (40 minutes**
4:30 PM	**Adjourn**

Event Announcements

- **June 15th, Webinar on Transportation Electrification: State Energy Office, PUC, State DOT Collaboration** from 4:00 to 5:00pm ET. NARUC, NASEO, and AASHTO will host a webinar on statewide collaboration on transportation electrification for PUCs, state DOTs, and other agencies. Register in advance, here.
- **July 13-14, 2023, National NEVI Conference,** hosted by NASEO and AASHTO in Arlington, VA. The conference will equip states with the tools they need to build out a national EV charging network that is convenient, reliable, affordable, accessible, and equitable. The meeting will convene officials from state and federal agencies, as well as representatives from utilities and private-sector partners to:

  More information including registration information can be found here: https://www.naseo.org/event?EventID=8413.

  NARUC can provide limited travel support and stipends for Commissioners and their staff.
- **July 16–19, 2023, The NARUC Summer Policy Summit** is coming up in Austin, Texas. It will feature at least four sessions on EVs:

  Registration is now open and is discounted through May 31.

Welcome

Moderator: **Commissioner Katherine Peretick, Michigan Public Service Commission**

Guest Speakers

- **Andy Satchwell, Lawrence Berkeley National Lab**
- **Scott Drake, East Kentucky Power**
- **Stephanie Leach, Baltimore Gas and Electric (BG&E)**

Quantifying the Financial Impacts of Electric Vehicles on Utility Ratepayers and Shareholders

Andrew Satchwell, Juan Pablo Carvallo, Peter Cappers,
James Milford, and Hadi Eshraghi

May 30, 2023 – NARUC EV State Working Group

This work was funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy Strategic Analysis Team under Contract No. DE-AC02-05CH11231.

Report and supplemental information available at: **https://emp.lbl.gov/publications/quantifying-financial-impacts**

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Lumina Decision Systems

Policy and regulatory context – why does this matter?

Ratepayer Impacts

Including customer EV adoption and balance among customers with and without EVs

Including how utility collects revenues and provides value to investors, as well as scope of utility roles and responsibilities

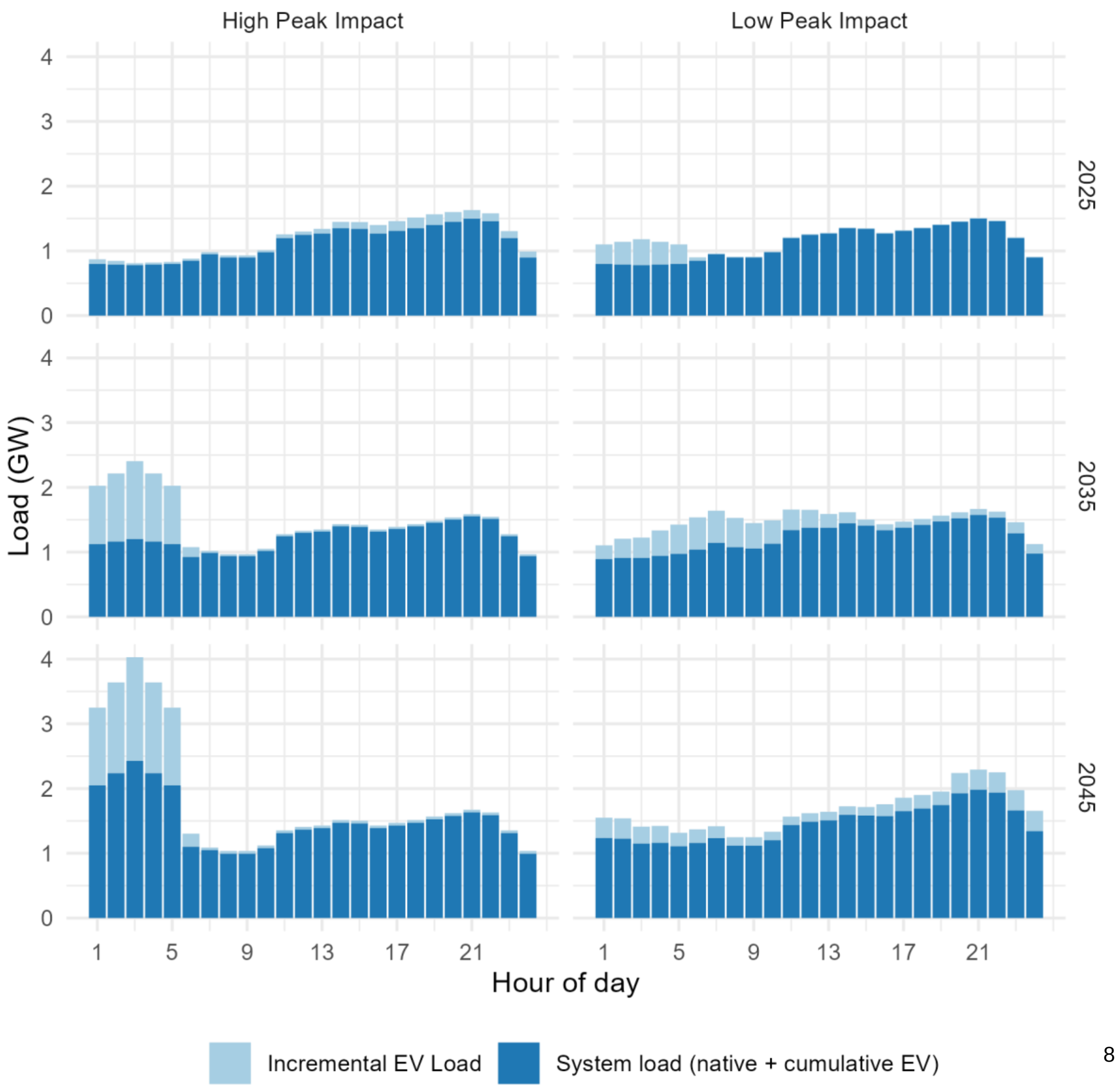
Utility Shareholder Impacts

Bookend charging strategies used in this study are characterized by system peak impacts

We use a performance-based definition related to system peak impacts.

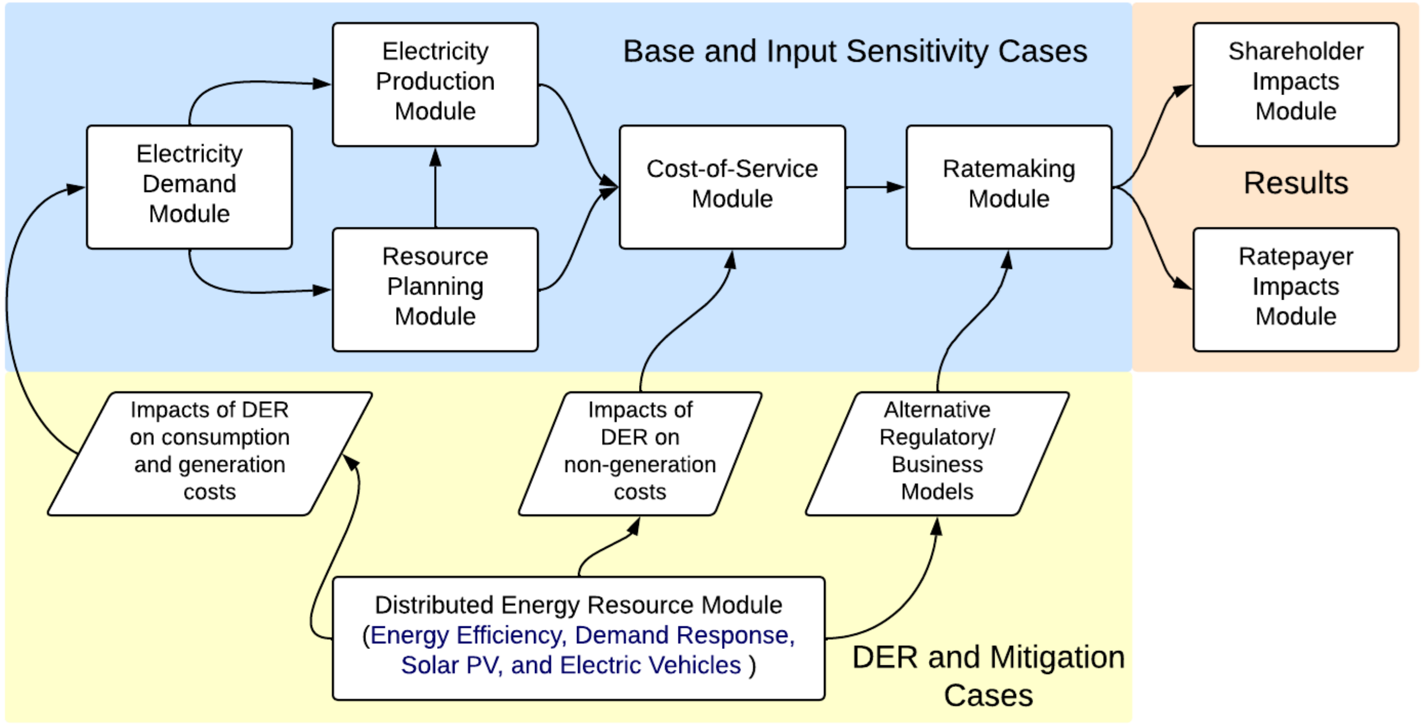
- **Low Peak Impact** is the charging strategy that <u>minimizes</u> EV impacts on peak demand.
- **High Peak Impact** is the charging strategy that <u>maximizes</u> EV impacts on peak demand.

The charging strategies adapt over time to achieve the performance objective.



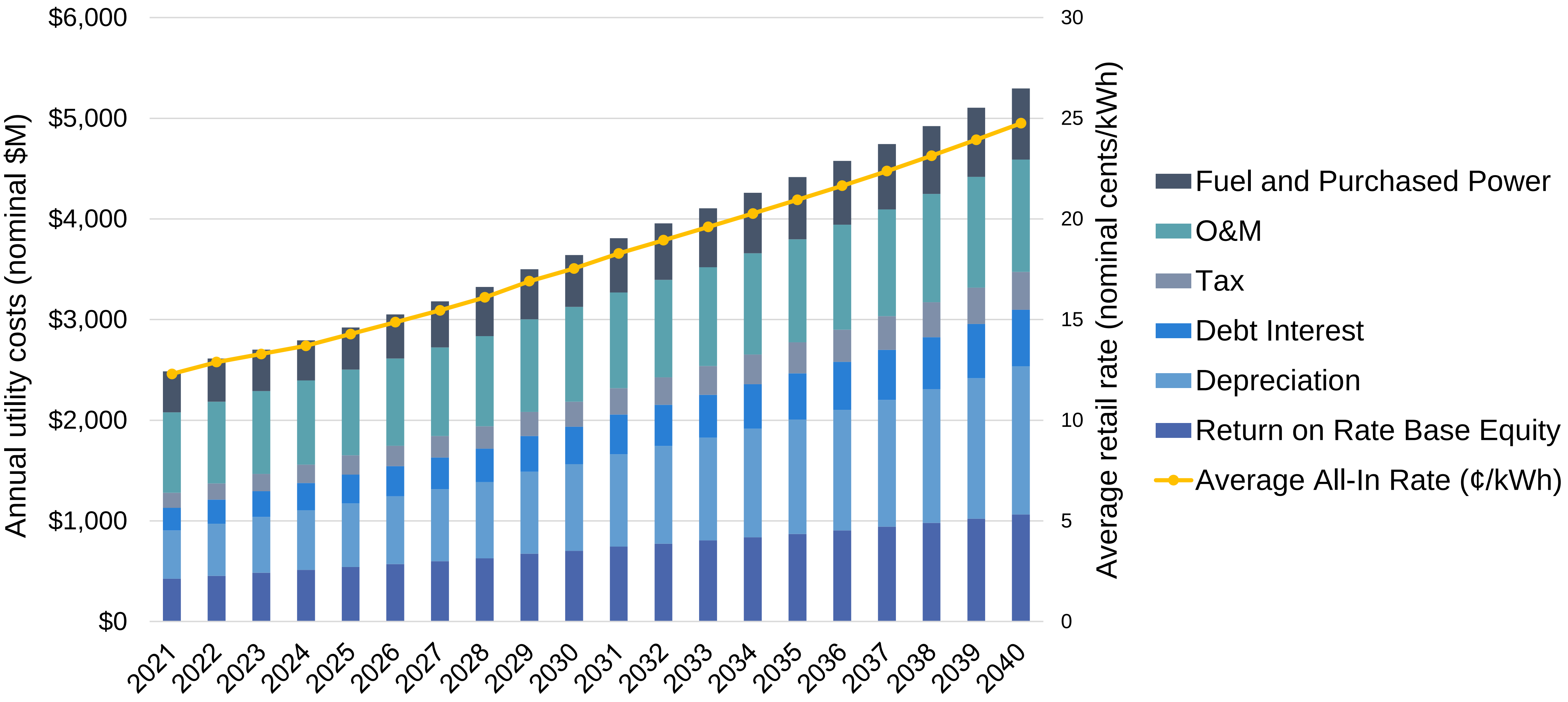
Berkeley Lab's FINDER model

- The FINDER model is a pro-forma financial model of changes in utility costs and revenues with the addition of DERs.
- Model outputs include shareholder metrics (achieved return-on-equity (ROE) and earnings) and ratepayer metrics (average retail rates and bills).
- The FINDER model has been developed over more than 14 years and used to support foundational research and state technical assistance in seven states and two regions.

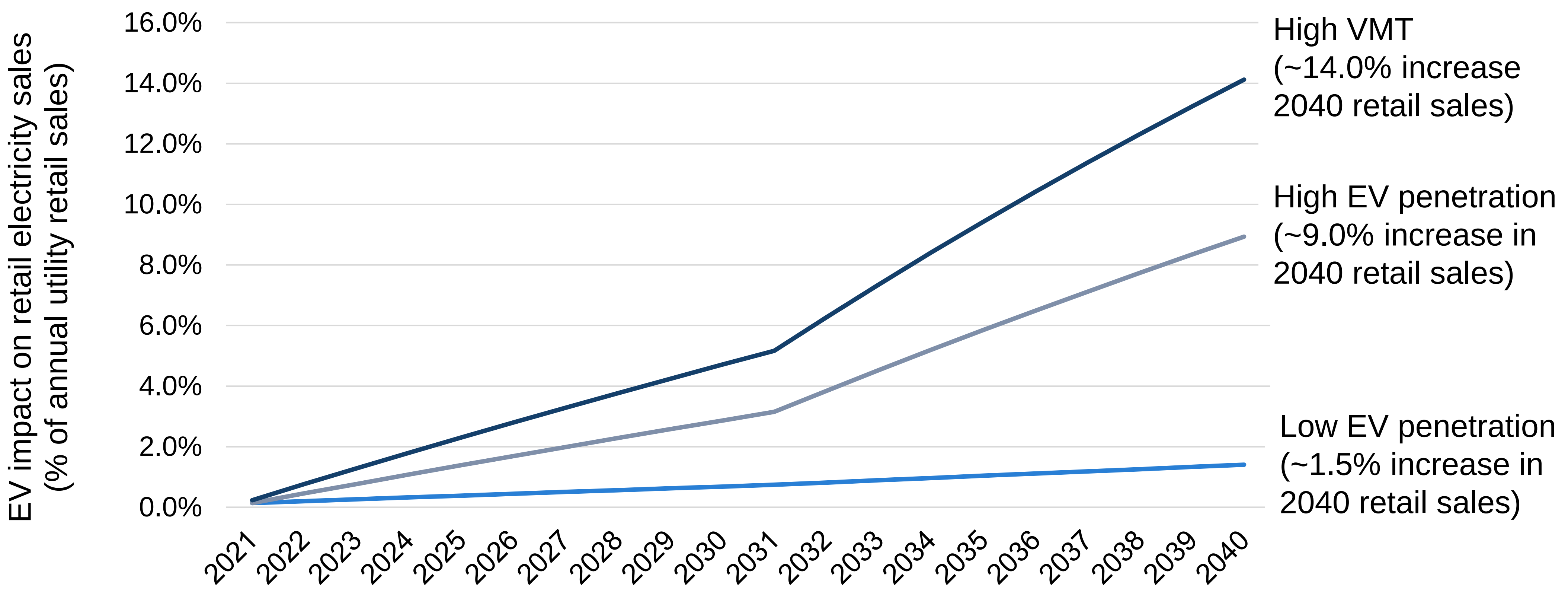


For more information on the FINDER model and related publications, see: https://emp.lbl.gov/projects/finder-model

Summer-peaking, vertically integrated utility characterization

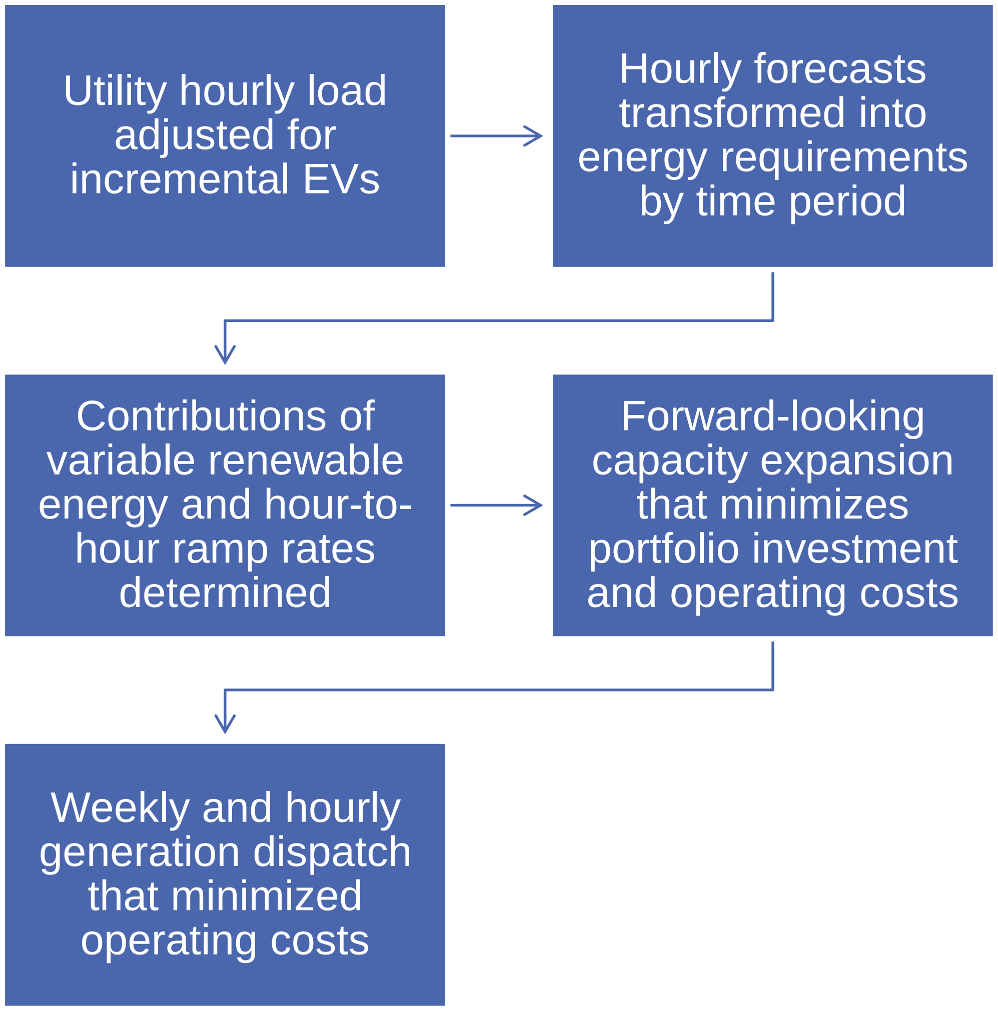


How do we represent EV impacts on utility sales?



How do we characterize EV impacts on utility generation and supply costs?

Generation capital, operations and maintenance (O&M), and FPP costs are modeled *endogenously* in FINDER using a built-in capacity expansion and dispatch logic.



How do we characterize EV impacts on utility distribution and program costs?

Distribution CapEx Costs

Expert-elicited probability of feeder upgrades and costs driven by EV impacts on coincident peak and non-coincident peak

EV Charging Infrastructure Costs

Regulatory filing data to inform ratepayer-funded EVSE and control costs, as well as caps on program size

EV Program Costs

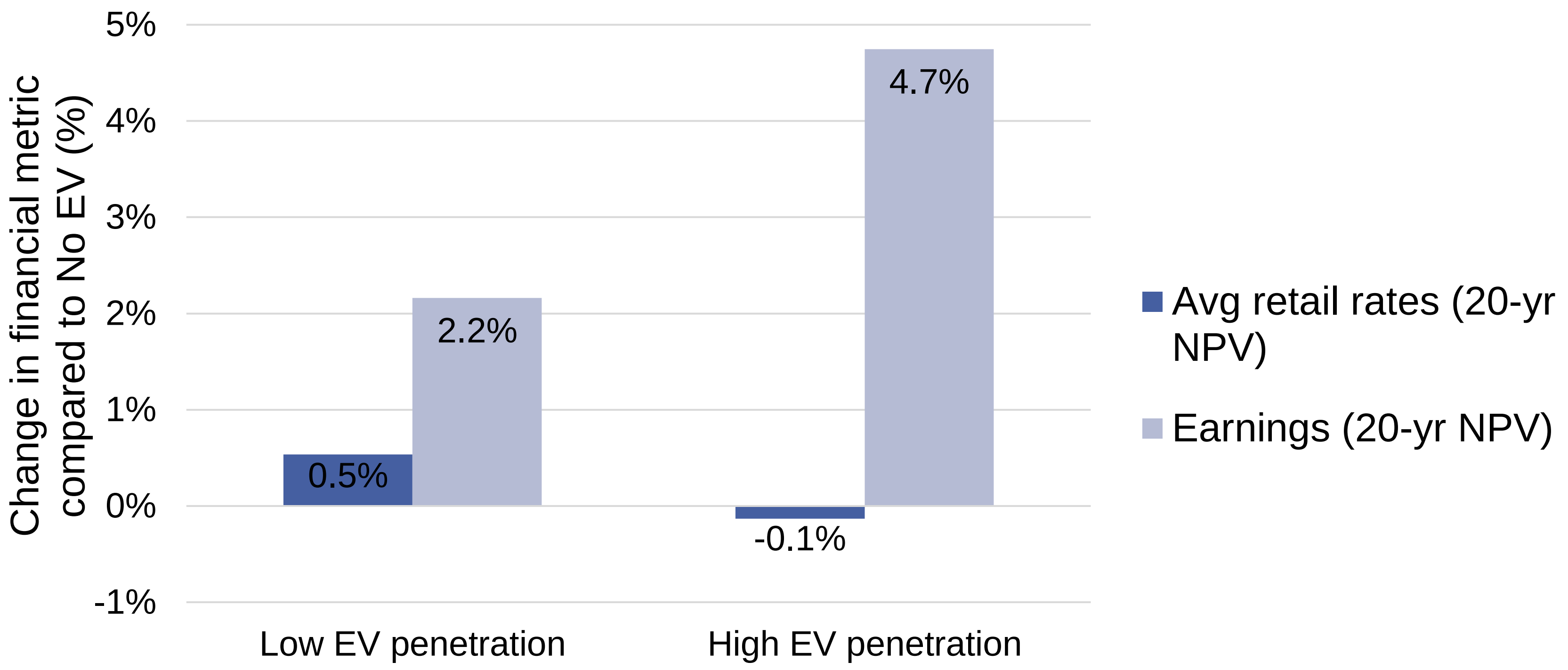
Regulatory filing data to inform ratepayer-funded EV program implementation and administrative costs, as well as caps on program size

Exogenous characterization

What are the financial impacts of EVs under High Peak Impact charging?

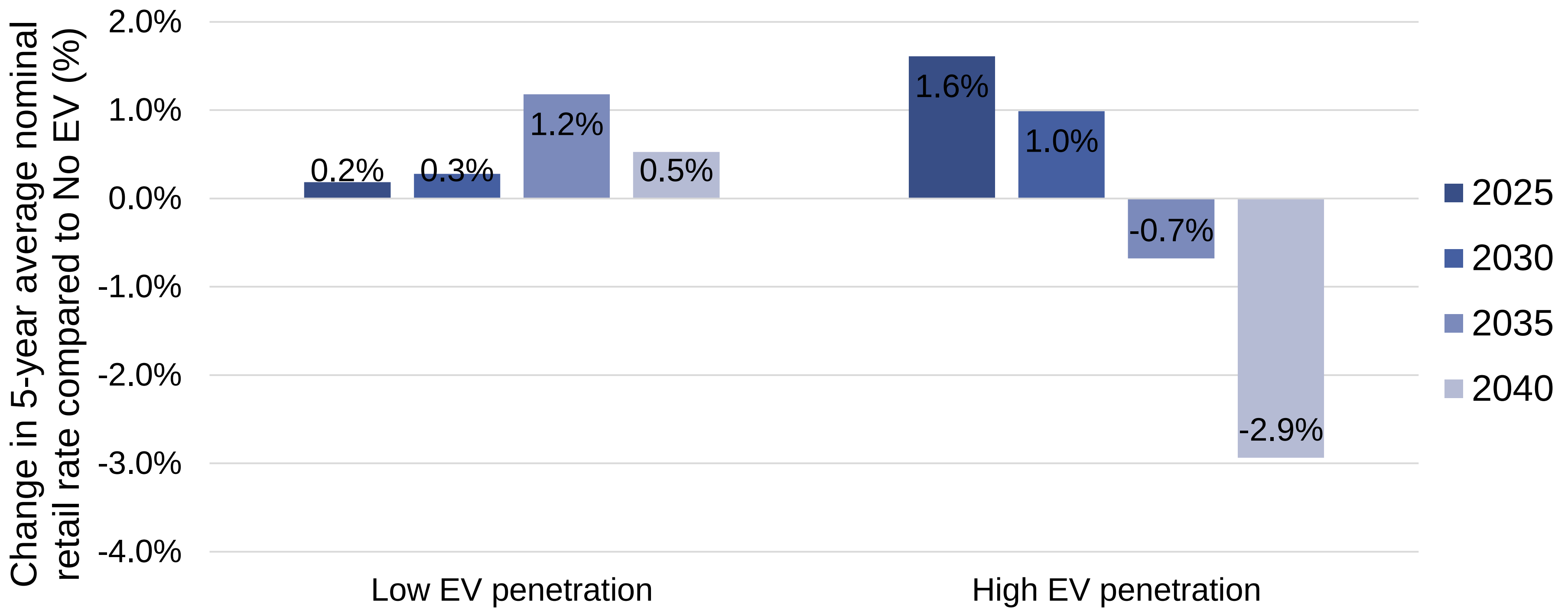
Comparison point: Utility without any incremental EV deployment

EVs generally increase shareholder earnings and retail rates remain roughly unchanged



High Peak Impact charging

Rate impacts are driven by timing of infrastructure investments and increase in sales



High Peak Impact charging

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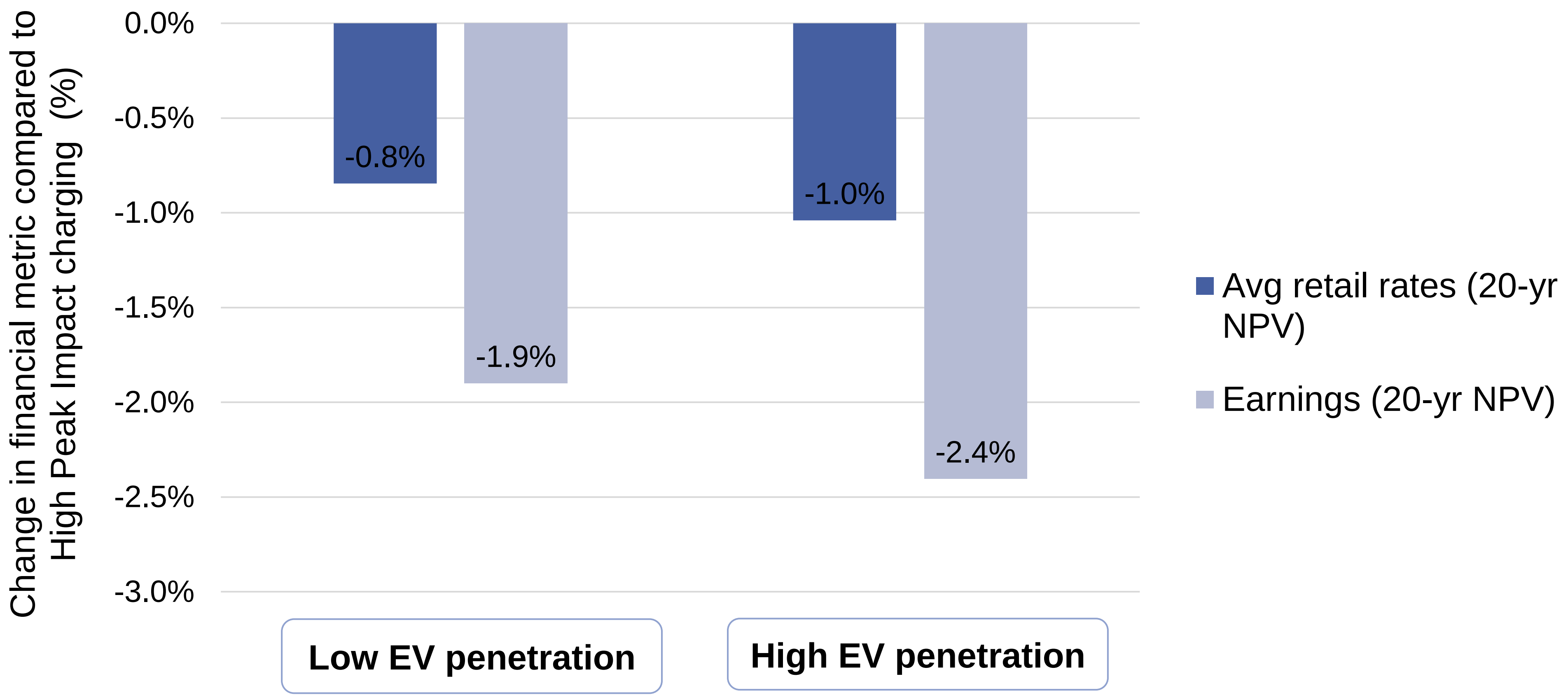
How does a Low Peak Impact charging strategy affect financial impacts, and how robust are results to different deployment assumptions?

Comparison point**:** ***Utility with incremental EVs deployed with High Peak Impact charging***

Low Peak Impact charging reduces rates and earnings



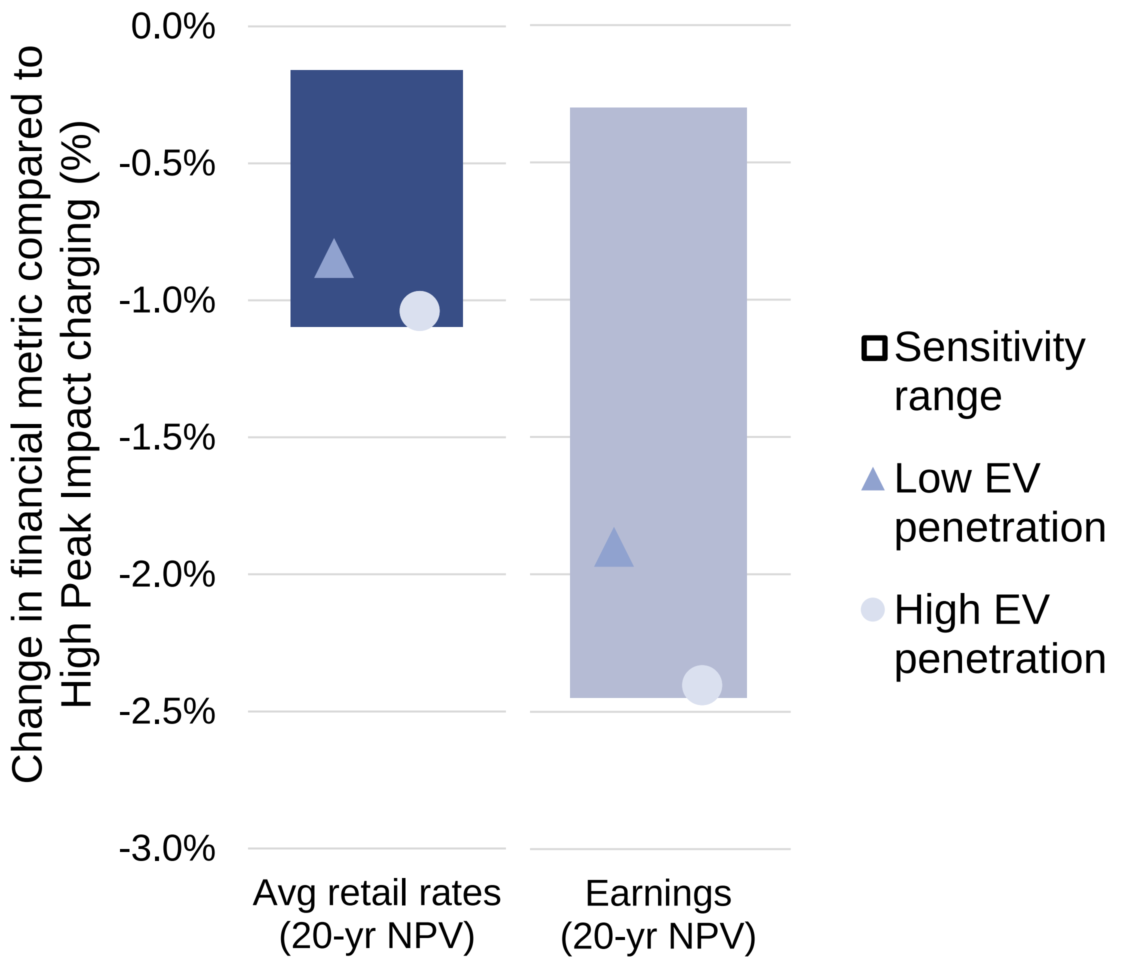
Shareholder earnings impacts are primarily driven by incremental investment costs that are typically much higher in High Peak Impact EV charging deployment scenarios

	Incremental Generation Costs ($M; 20-yr NPV)	Incremental Distribution Costs ($M; 20-yr NPV)	Incremental Capitalized EV Program Costs ($M; 20-yr NPV)	
Low EV High Peak Impact	$362	$175	$53	$589
Low EV Low Peak Impact	$12	$11	$62	$85
High EV High Peak Impact	$602	$357	$283	$1,242
High EV Low Peak Impact	$342	$213	$331	$886

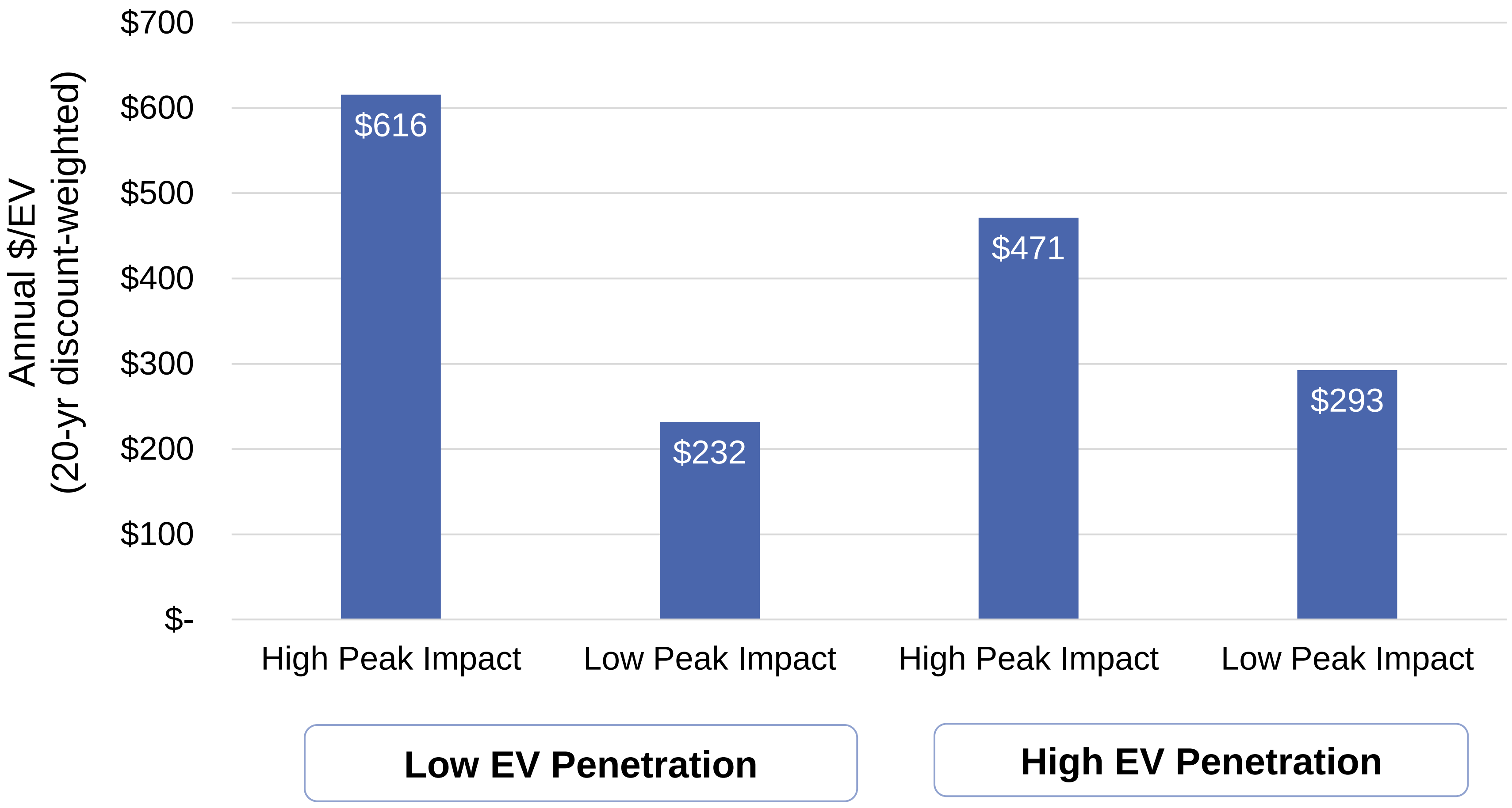
-86%

-29%

Financial impacts of Low Peak Impact charging are directionally consistent across sensitivities



Managed charging strategies reduce the incremental annual cost of integrating EVs by ~38-62%



Key findings and discussion

- **Ratepayers are almost always better off** and more so if EVs are deployed with managed charging strategies.
- Compared to a future without EVs, **shareholder are also better off**, but managed charging erodes some of the incremental earnings.
- **A forward-looking and long-term perspective is necessary** to make large initial utility infrastructure investments that enable greater EV deployment and result in later rate decreases.
- **Impacts are overall quite small on a total utility basis**; but, they could be more significant for particular customer classes depending on cost allocation and cost recovery, which were not explored in the study.
- To trigger managed behavior we model **requires dynamic infrastructure planning process and/or flexible managed charging strategy** to reflect how the utility load shape evolves inclusive EV load (e.g., EV TOU periods will change from overnight to middle-of-day as coincident peak EV load impacts build).

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For more information

Download publications from the Electricity Markets & Policy: https://emp.lbl.gov/publications

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Acknowledgements

This work was funded by the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Strategic Analysis Team (SA) under Contract No. DE-AC02-05CH11231. We would like to especially thank Ookie Ma and Kara Podkaminer (DOE) for their support of this work. For reviewing the study and providing valuable feedback, we thank Michelle Levinson (World Resources Institute), Galen Barbose (Berkeley Lab), and Kara Podkaminer, Noel Crisostomo, and Paul Spitsen (DOE).

Appended Slides for More Detail

What are the financial impacts of electric vehicles (EVs) on utilities and ratepayers and how do deployment strategies affect them?

Objectives

- Estimate **utility earnings and customer rate impacts** of EVs under **bookend charging strategies**.
- **Bound the likely and reasonable range** financial impacts across different EV characteristics and deployment assumptions and assess the sensitivity of results to different assumptions.

Methods

- Quantify financial impacts using **Berkeley Lab's FINDER model**.
- Assume utility characteristics for a **summer peaking, investor owned and vertically-integrated utility**.
- Characterize **EV impacts on key utility financial drivers** (i.e., retail sales, peak demand, and costs) across a range of analytical scenarios using bounded but reasonable values.
- **Leverage EVI Pro Lite** and other publicly available sources to inform modeling assumptions.

Study boundaries

This analysis does…	***This analysis does NOT…***
Compare outcomes between bookend charging strategies, across different EV deployment characteristics, and different EV adoption levels.	Model the “optimal” EV adoption or deployment characteristics that minimizes customer costs or to achieve other objectives.
Consider an illustrative utility and generalized light-duty EV charging strategies with a range of reasonable EV deployment characteristics.	Evaluate a broad range of utility physical and financial characteristics, highly specific EV charging strategies and deployments, or medium- and heavy-duty EVs.
Quantify impacts on utility shareholder earnings and customer average rates.	Quantify rate impacts by customer class or participant vs. non-participant customer bills.

Analysis structure

Research question	What are the financial impacts of EVs under High Peak Impact charging?	
EV charging strategy	High Peak Impact charging	
Comparison point	No incremental EVs	
Sensitivity cases	None	

Analysis structure

Research question	What are the financial impacts of EVs under High Peak Impact charging?	How does a Low Peak Impact charging strategy affect financial impacts, and how robust are results to different deployment assumptions?
EV charging strategy	High Peak Impact charging	Low Peak Impact charging
Comparison point	No incremental EVs	High Peak Impact charging
Sensitivity cases	None	Charging location, average VMT, utility EV enablement costs, and EV-driven distribution CapEx costs

Financial metrics

Metric	Calculation	Representation
Earnings	Revenues - Costs	Quantifies future utility earnings opportunities
All-in Average Retail Rate	Revenues / Sales	Quantifies total rate impacts across all utility ratepayers
Annual Cost per EV	Costs / EVs	Quantifies average incremental annual utility cost impact of integrating EVs (inclusive of utility generation, distribution, EV program, and charging control costs)

All financial metrics are discounted over 20 years assuming a 7% nominal rate for utility earnings (representing average utility weighted average cost of capital) and a 5% nominal rate for average all-in retail rates and costs per EV.

LBNL FINDER Model:
Generator Capacity Expansion & Dispatch Module

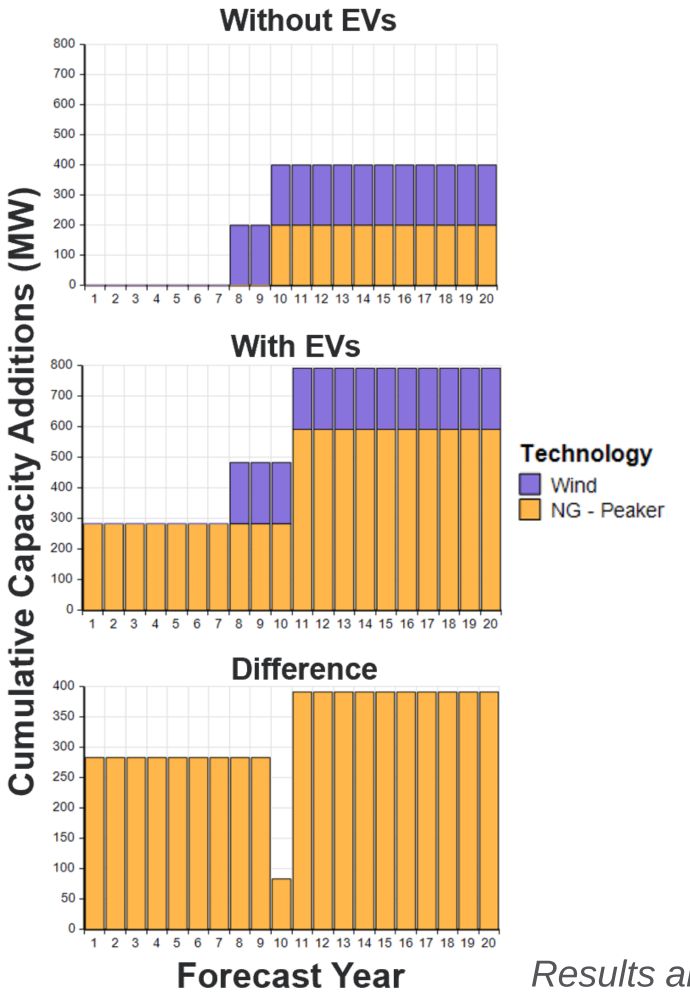
Hadi Eshraghi, PhD – Senior Consultant
James Milford – Director of Consulting

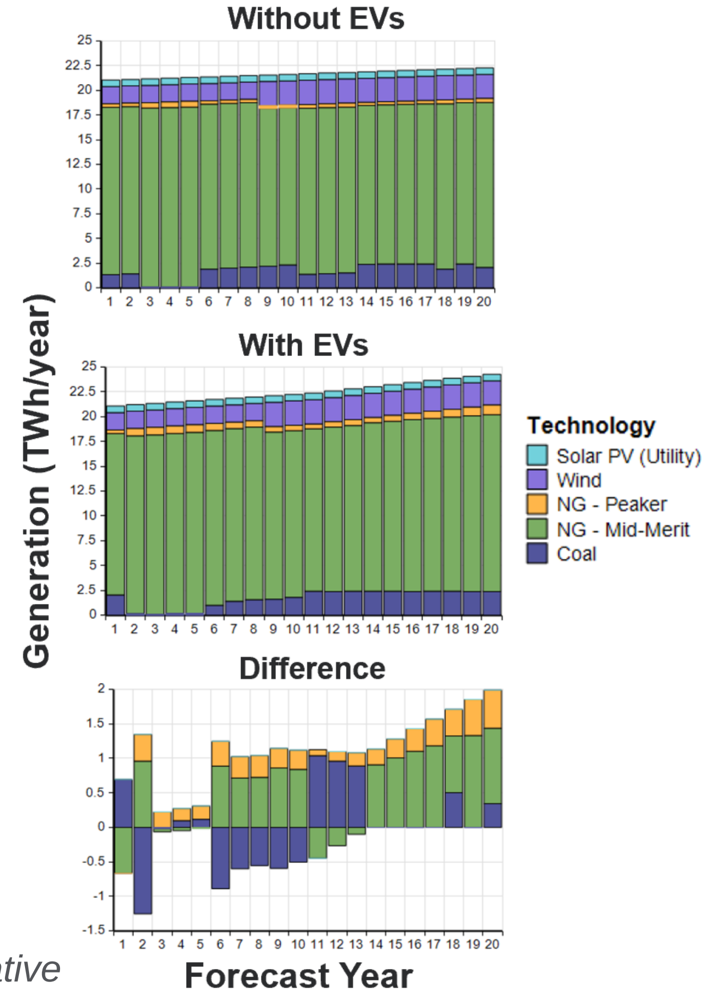
Relation of generator capacity and dispatch to retail rates and shareholder earnings

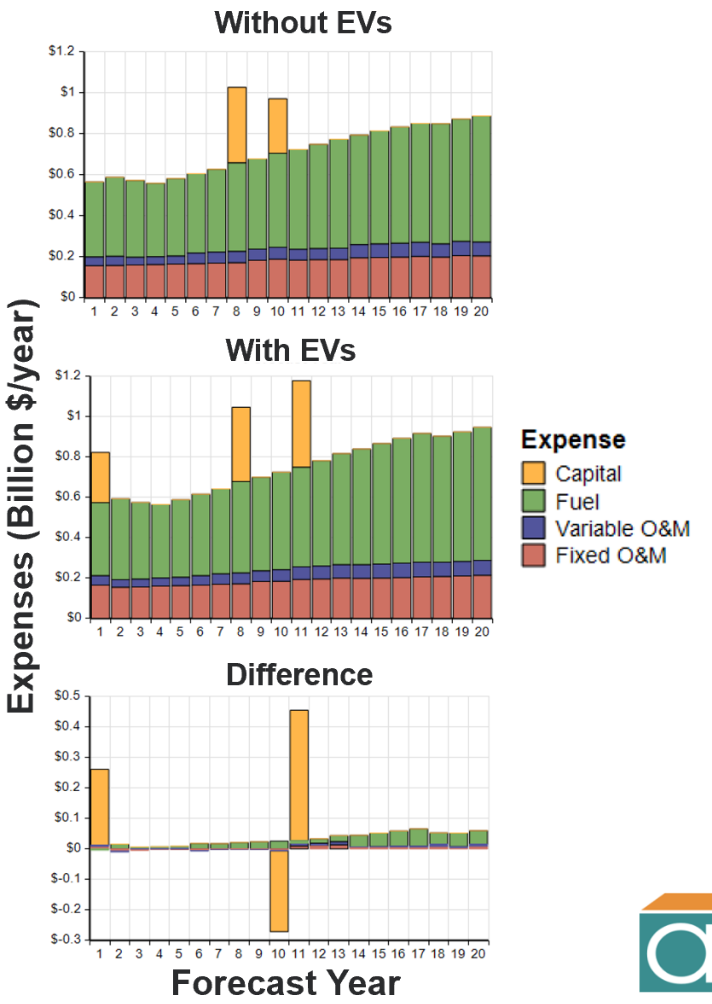
Incremental EV load may change capital investments in generating capacity

EV loads lead to more electricity generation, which may come from a different mix of generator types

EV loads impact capital and operating expenses, which influence retail rates and shareholder earnings



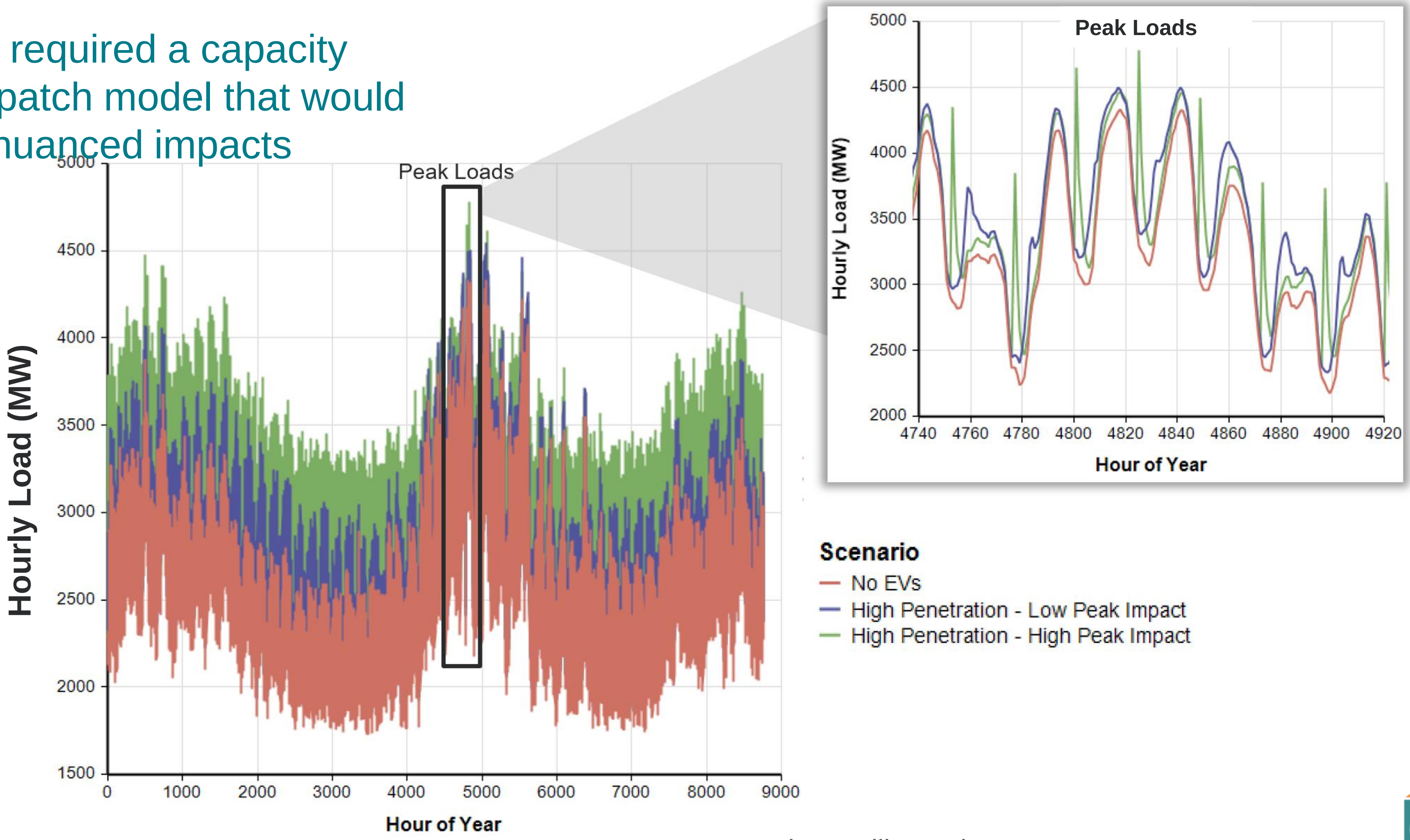




Results are illustrative

EV loads and charging strategies change the timing and magnitude of when generating capacity is needed

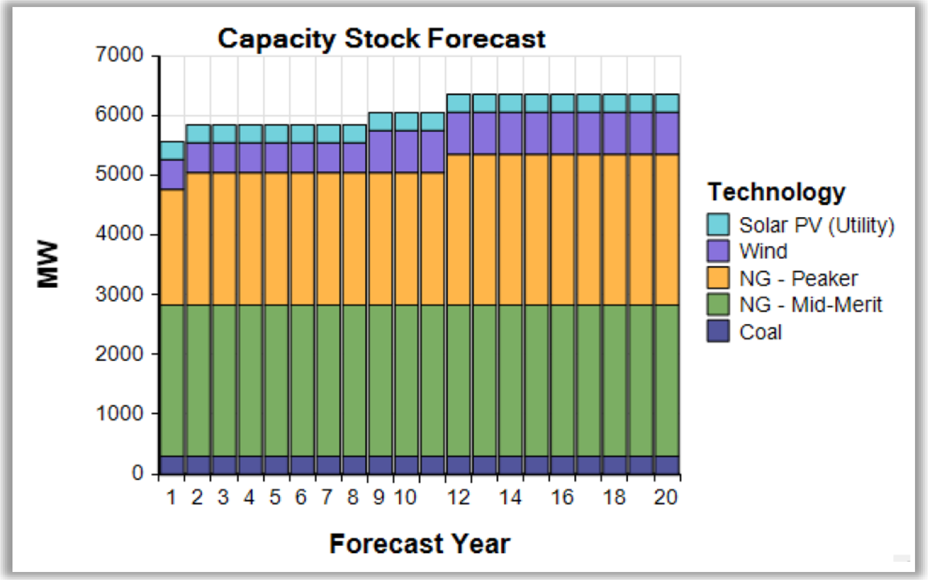
As such, the study required a capacity expansion and dispatch model that would account for these nuanced impacts



Results are illustrative

The capacity expansion optimization considers the following:

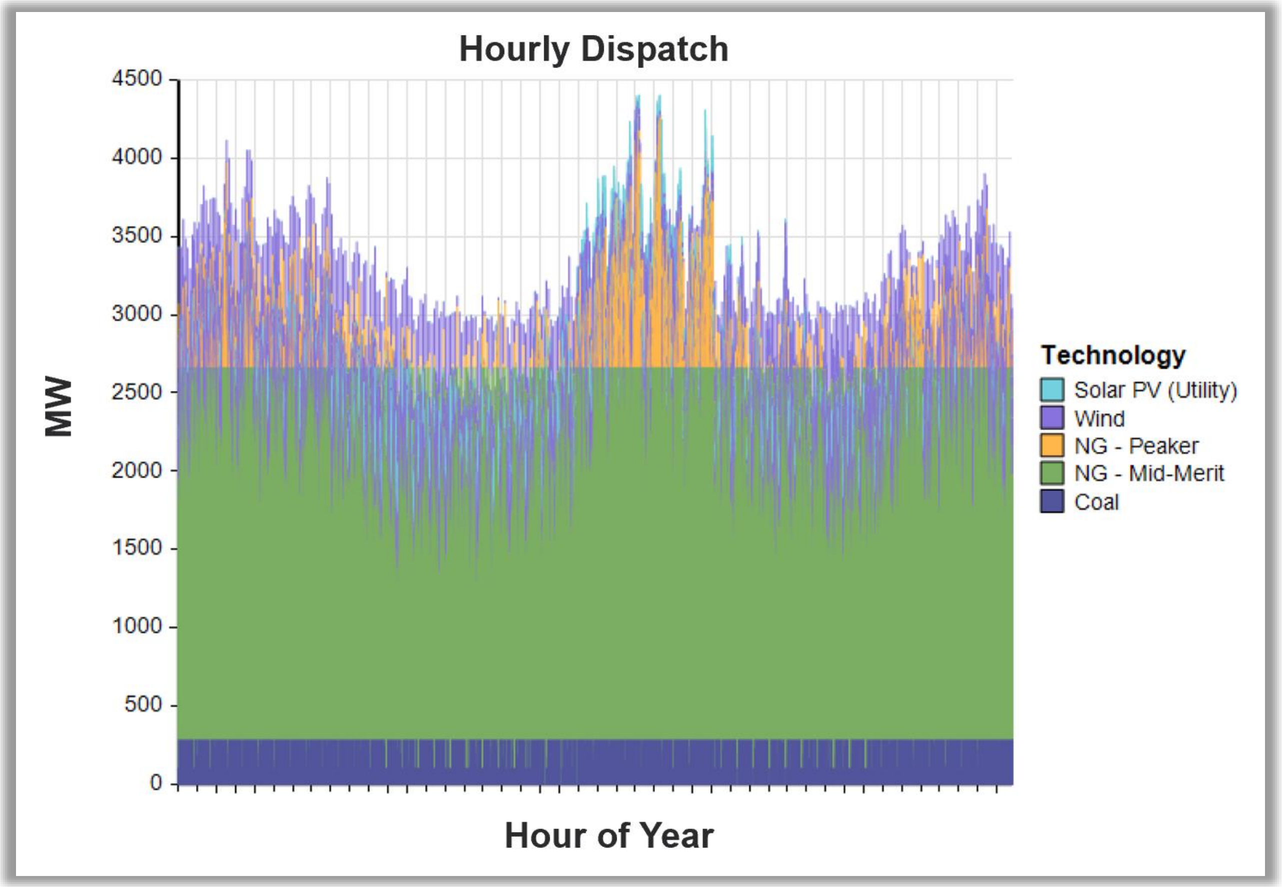
- What's the optimal technology-specific capacity additions and retirements that **minimize capital and operating expenses** over the long-term?
- Is it more economical to **retire capacity or simply mothball** it until a future need arises?
- Is it more economical to **add small plants** to meet incremental load, or is it better to **add large plants** with future growth in mind?
- Will the fleet of generators be able to **ramp up or down** to meet the variability in load?
- Is there enough **reserve capacity** throughout the year to handle unexpected events?
- How much **firm capacity** can variable renewable technologies provide?
- Has compliance with **renewable portfolio standards** been met?
- When will **minimum loading levels** require that generators shutdown?



Results are illustrative

Considerations addressed in the dispatch optimization

- What's the optimal dispatch of generators to **minimize operating costs**?
- Have the following generator **operating constraints** been respected:
  - Maximum ramp up and down rates
  - Minimum loading levels
  - Minimum up and down times
- What amount of energy can economically be **purchased from markets**
- Is there compliance with **renewable portfolio standards?**



Results are illustrative

Final thoughts on capacity expansion and dispatch

	Desired Modeling Outcome
☑	Responds to changes in load magnitude *and* timing
☑	Finds a least-cost capacity resource plan
☑	Recognizes tradeoffs in near-term capital and long-run operating costs
☑	Ensures resource adequacy
☑	Respects key generator operating constraints

This approach is equally applicable to other electric distributed energy resources!

- Solar PV
- Battery energy storage
- Electrification
- Energy efficiency
- Demand response

Future research opportunities

Assume different EV penetration levels and adoption rates.

Model medium-duty and heavy-duty EVs (MDVs and HDVs).

Incorporate a more detailed distribution cost model.

Explore additional charging strategies and profiles, utility characterizations, and customer-class impacts.

Model EV-specific rate designs and quantify cost shifts between EV owners and non-EV owners.

East Kentucky Power Cooperative (EKPC)

EV Home Charging Program
Cost-effective Managed Charge – Pilot

Scott Drake, PE

Director, Business & Technical Services

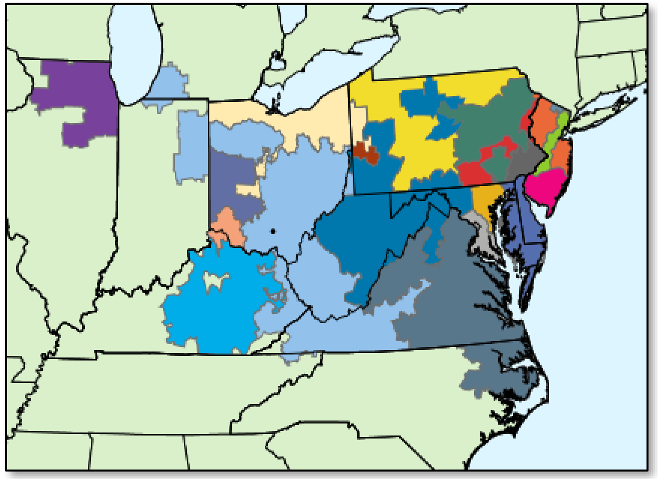
EAST KENTUCKY POWER COOPERATIVE

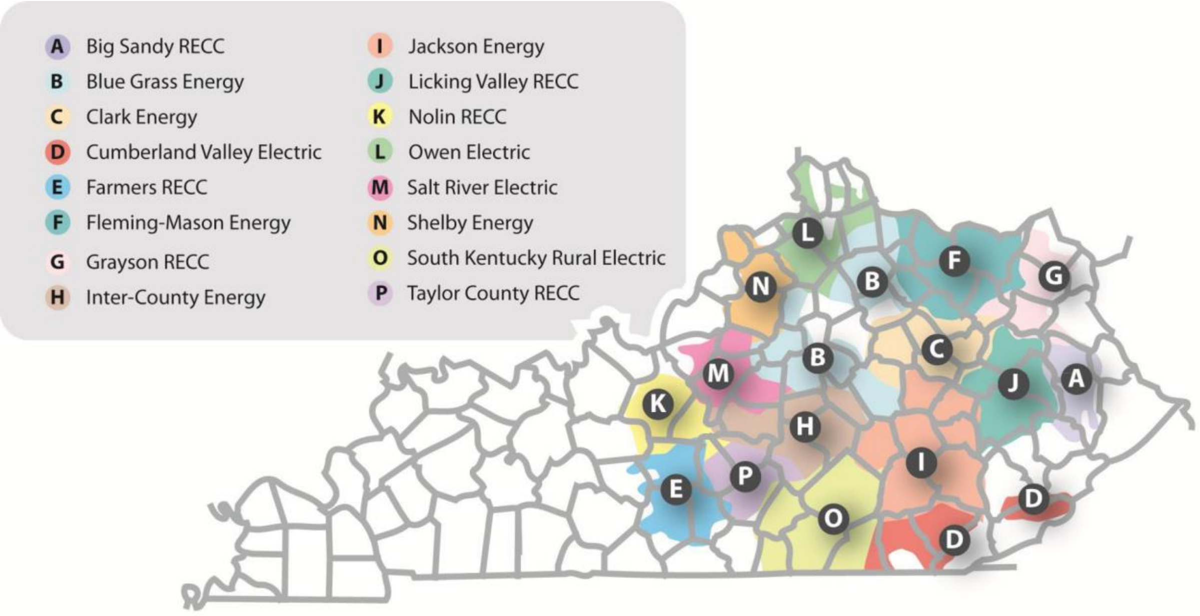
A Touchstone Energy Cooperative

EKPC

Kentucky's Touchstone Energy Cooperatives®

- Traditional Generation & Transmission (G&T) Cooperative
  - 3,700MW peak load, 3,500MW generation, Transmission owner
- Wholesale energy provider to 16 owner-member cooperatives
  - 550,000 meters
- Integrated into the PJM market in 2013
- Regulated by Kentucky PSC



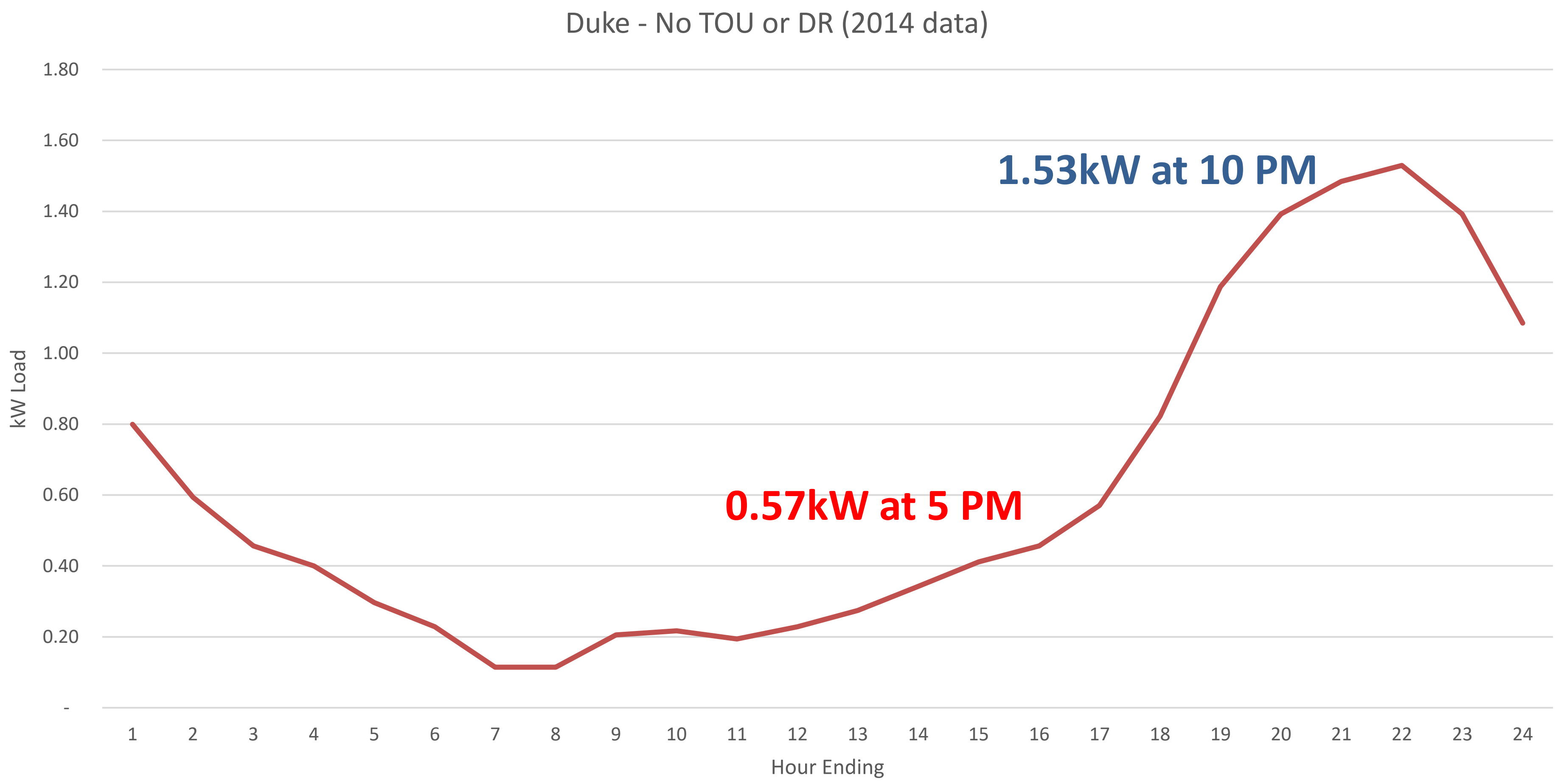


EAST KENTUCKY POWER COOPERATIVE
A Touchstone Energy Cooperative

What "we think" we know about EV home charging

- Energy sales are pretty good – new load!
- Diversified demand not too bad **yet**
  - Less than 1kW at 5PM - but growing
  - Peak EV demand around 10PM
  - Chargers getting larger – more kW demand in the future
- Demand cost erodes the benefit of more energy sales
- Without an EV program with high participation levels, we know nothing!

Demand per EV - Diversified



Note: Data from urban and suburban EV homes – not rural Kentucky

EAST KENTUCKY POWER COOPERATIVE
A Touchstone Energy Cooperative

Strategy for a Successful EV Home Managed Charging Program

- Effectively shift demand to off-peak energy consumption hours
- Low cost for co-ops (utilities) to implement
- High EV program participation rate – what's "high"?
  - Low cost for EV owner to participate in the program
  - Easy for the EV owner to participate
  - Saves $$$ monthly for the EV owners
  - Minimize life-style change for participants
  - Can we get 80% participation?
- Are we designing EV home managed charging programs that achieve these goals? Not in co-op land

Utility-Managed EV Charging at Home

- Requires a utility compatible level 2 charger
  - – Utility chargers aren’t OEM chargers
    - Try talking Tesla owners out of their Tesla level 2 charger
  - – EV owner may have already invested in a charger
- Expect push back from EV owners
  - – Many EV owners are not interested in utility controlling when they charge their $50k or higher investment
    - They want control
  - – Expect low program participation rate after early adopters

TOU Rates – EV Only or Whole-home

- Whole-home TOU rates are not popular in general – changes life-style too much
- TOU rate specific for an EV program
  - Penalty for charging during on-peak hours
  - Where does the data come from to create a revenue neutral TOU?
  - How much $$$ must the EV owner save each month to offset the risk of penalty during peak hours?
- Requiring a second meter?
  - EV owner required to install a second meter base? Cost too much
  - Monthly fee for a second meter? Cost too much

DR “Like” Program that Achieve the Goals

- Pay a DR incentive – flat per month or per off-peak kWh
- Use telematics to measure the kwh per hour each day
  - No utility installations at the home to minimize utility cost
- Have no cost to EV owner to participate in the program – no installations, no monthly fees
- Don’t change EV owner’s home electric rate – no life-style changes
- Give EV owner total control of participating in events or not without penalty
- Easy sign-up process – Telematics facilitates online sign-ups

Kentucky's Touchstone Energy Cooperatives DR EV Home Charging Pilot – Pending Approval

- For all EKPC owner-member cooperatives
- $0.02/kwh incentive for kwh charging the EV during off-peak hours
- 3 year pilot: Cost-effective DR program – TRC 2.47
- All "carrot" program – expecting high participation rates
- Easy for the owner-member cooperatives
  - EKPC handles online sign-ups skinned to owner-member
  - EKPC obtains telematics and pays incentive to retail bill
  - No cost of services studies, TOU rate justifications, installations, or data entry
- Obtain statistically significant energy and demand data and EV locations
- Evaluate the $0.02/kwh incentive (20% discount)

EAST KENTUCKY POWER COOPERATIVE
A Touchstone Energy Cooperative

Discussion

EAST KENTUCKY POWER COOPERATIVE

A Touchstone Energy Cooperative

Electric Vehicle (EV) Programs

Maryland's Focus on Climate Change

Ambitious goals to reach net-zero emissions

- 300,000 ZEVS on the road by 2025
- Climate Solutions Now Act of 2022
  - Reduce greenhouse gas by 60% (compared to 2006 baseline) by 2031
  - Reach net-zero emissions by 2045
  - Electric School Bus Act
- Infrastructure Investment and Jobs Act

EVsmart® Program

Program launched in 2019 as a result of Maryland's new sustainability goals

- **Residential Charger Rebate (closed)**: 1,000 rebates at $300 on eligible L2 home chargers
- **Home Charging Incentive**: Annual $50 incentive for charging during off-peak hours
- **Vehicle Charging Time-of-Use Rate:** Residential electric rate for EV drivers
- **Multifamily/Workplace/Fleet Rebate**: Rebates on the purchase and installation of L2 chargers and DCFC (up to $30,000) per commercial property site
- **Multifamily Program**: installation of 100 BGE-owned chargers at MUD properties, including LMI
- **Public Charging Network**: 500 BGE-owned chargers being installed throughout central Maryland at government owned sites
- **NEW! Department of Energy-funded programs**
  - **Smart Charge Management Program**
  - **Lyft Rideshare Program**

Vehicle Charging Time-of-Use Rate

Launched May 1, 2020. First of its kind in the industry.

Customers save approx. $120 annually charging off-peak.

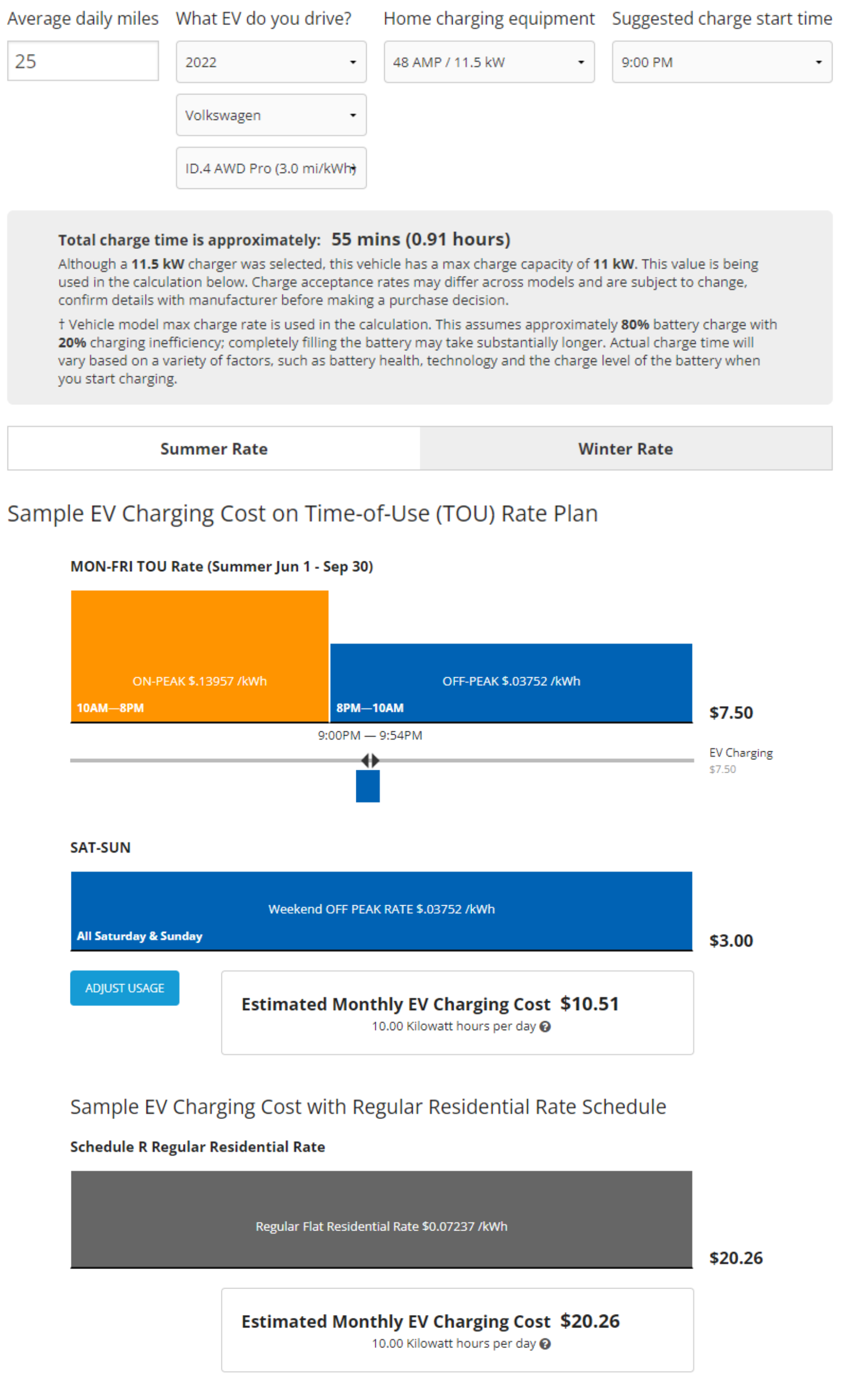
Nearly 2,000 customers on Vehicle Charging TOU rate

EVSE compatible (through EnergyHub)

- ChargePoint
- JuiceBox

Vehicle telematics compatible (through WeaveGrid)

- Tesla
- Hyundai/Kia
- Toyota
- Lexus
- more to come!



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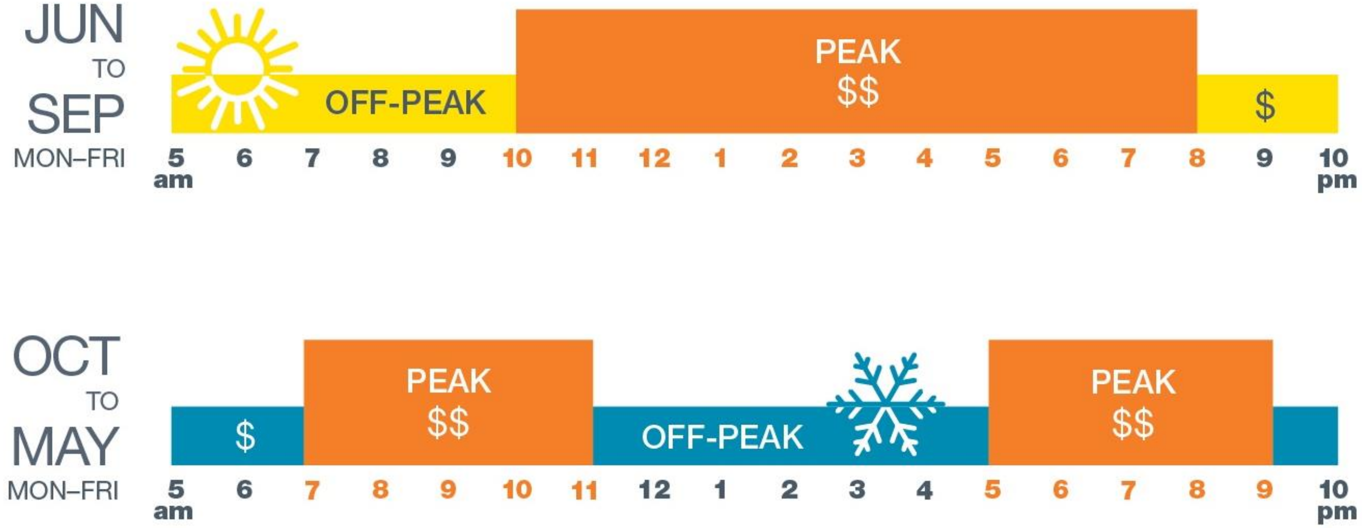
TOU rate comparison

Vehicle Charging TOU rate

- Customer must be on standard R rate
- TOU is Rate Rider and only applies to EV
- Credit appears on bill

EV Whole House TOU rate

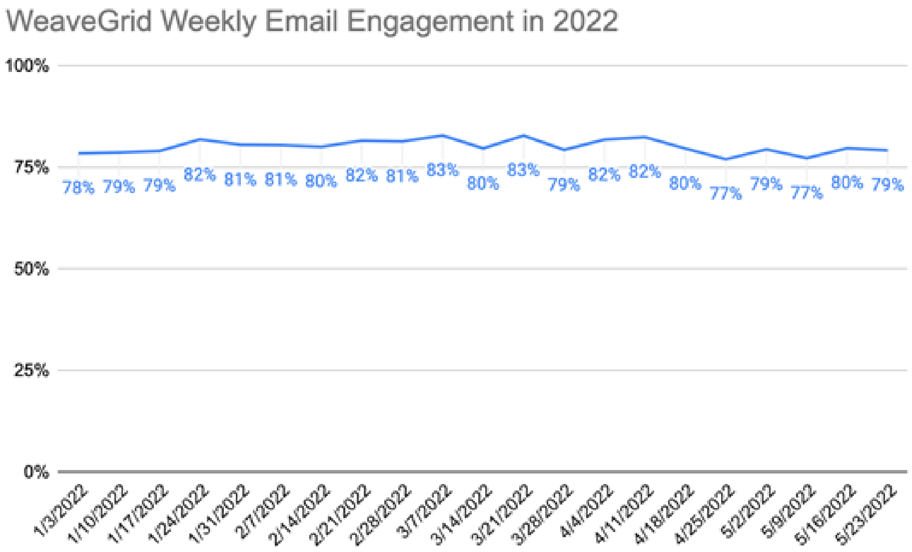
- TOU for the whole home
- Same rate and hours as VC TOU rate

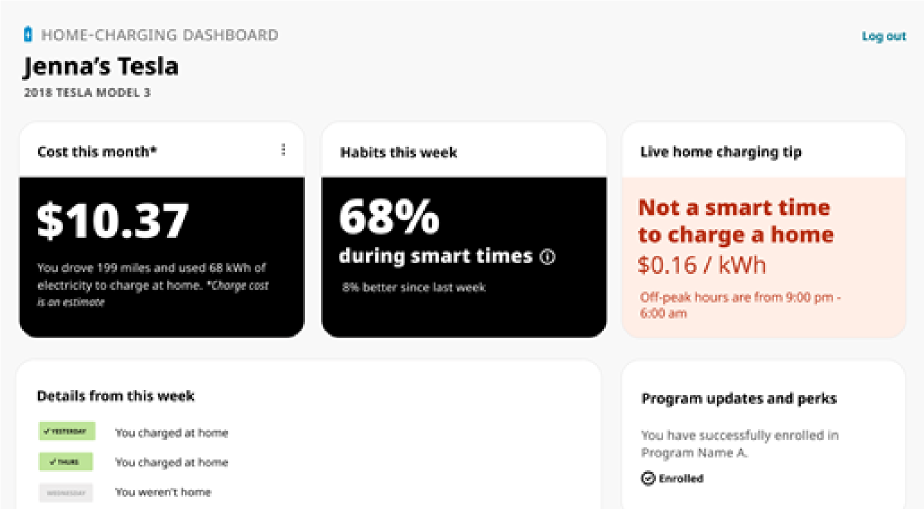


Customer Tools & Engagement

WeaveGrid Customer Insights

Weekly customer summary - High customer engagement





Electric Vehicle Managed Charging

What is Managed Charging?
Allows a utility or third-party to remotely control electric vehicle (EV) charging by increasing, decreasing, or curtailing charging to better correspond to electric grid needs, much like a demand response program.

Why is it important?
With estimates of more than 20 million EVs expected on the road in the U.S. by 2030, EVs will represent the most significant new electric load since the rise of air conditioning in the 1950s.* Being able to effectively manage the peaks this additional usage will bring is vitally important to maintain a reliable, stable electric grid.

*Source: SEPA, A Comprehensive Guide to Electric Vehicle Managed Charging, May 2019

Smart Charge Management Program
Who are we targeting?

Residential customers with electric vehicles

- Enrollment
  - >2,100 Tesla drivers enrolled since Nov. 2022
    - goal: enroll 5,000 by June 2024
- No limitations to enrollment (i.e., electric choice, net metering, budget billing customers all eligible)

Commercial customers with electric vehicles

- Enroll customers in 2023-2024
- Exelon to provide 200 level 2 chargers (split between BGE/PHI)
- Each utility to enroll 10-20 customers (up to 10 chargers per customer)

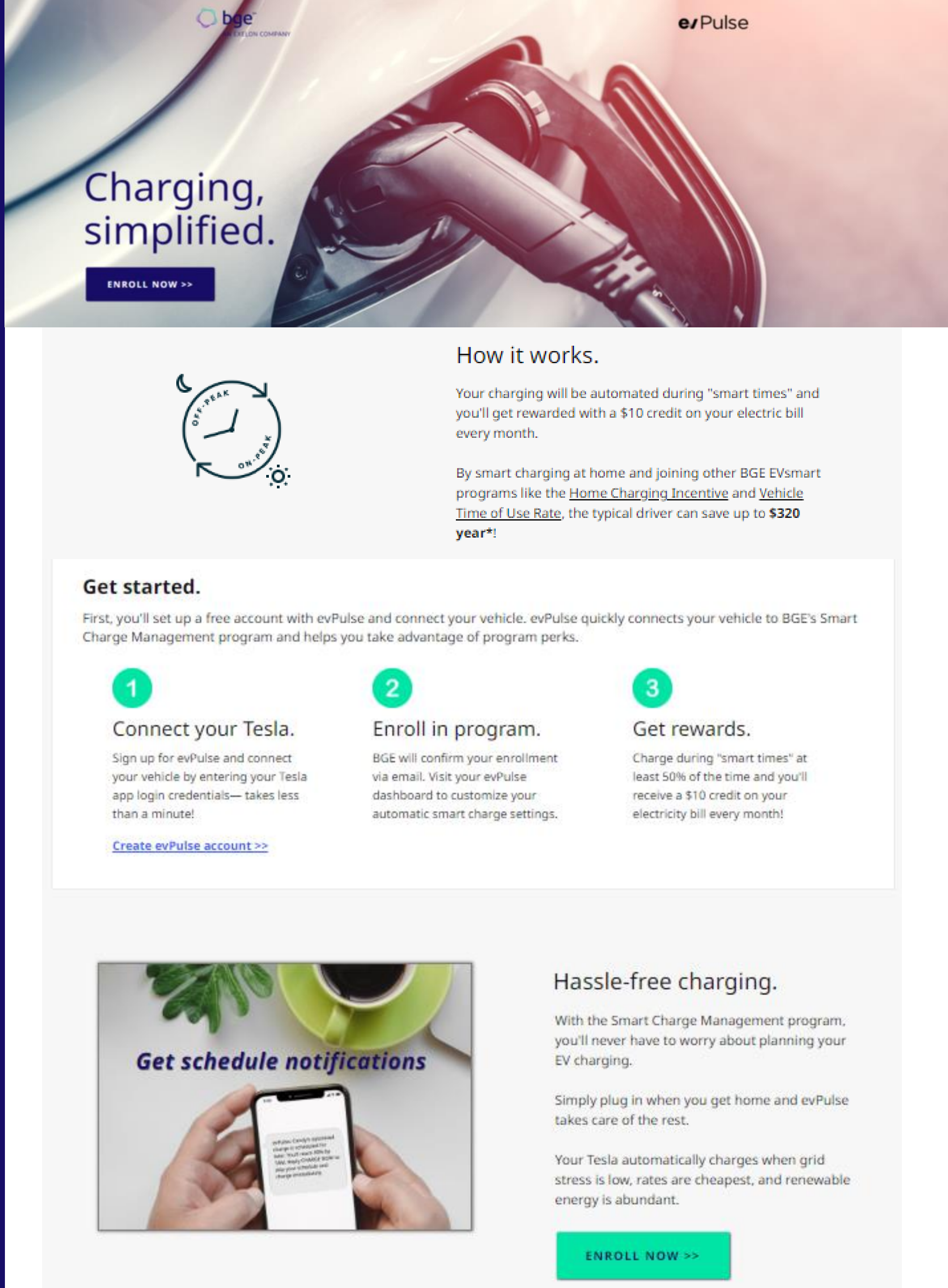
Smart Charge Management Residential Program

How it Works

Continuous Optimization:

- Utility/WeaveGrid throttles customers' charging through **vehicle telematics** to reduce peak demand, encourage charging during off-peak hours and improve reliability at individual feeder level
- Drivers set home charging schedule and vehicle is ready when they need to leave
- Charging optimization is seamless and unnoticeable to customer but offers opportunity to measure grid impact
- Limit of 4 opt-outs per month

Enroll at join.bge.ev-pulse.com



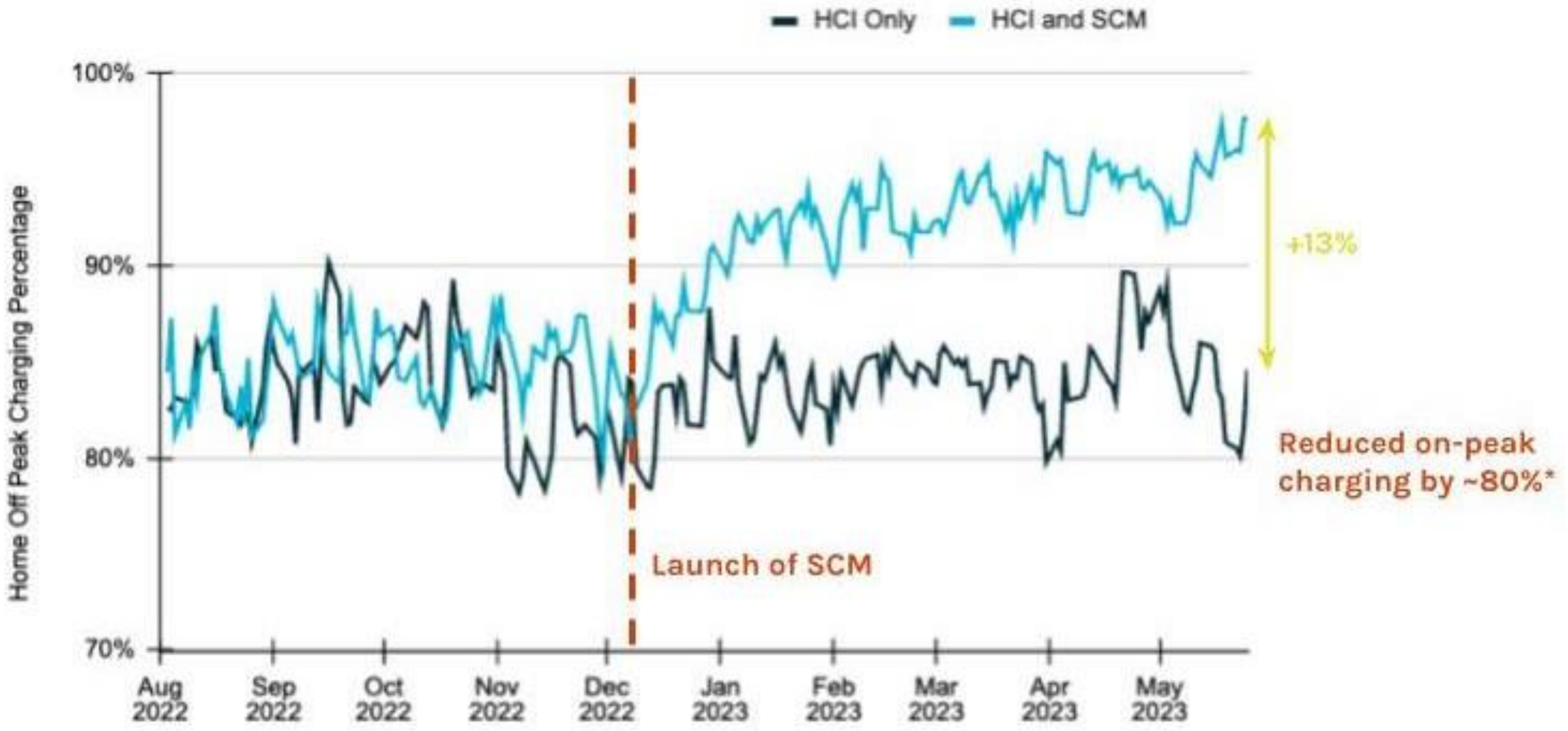
Smart Charge Management Residential Program

Credits & Penalties

- $10 monthly credit in exchange for participation (Equates to 10% of average customer bill. Incentive is comparable to other utility managed charging programs across the country)
- Opt-outs:
  - If customer charges >50% outside scheduled charging window during a particular day, this is an opt-out
  - 5+ opt-outs in one month, customer loses credit.
    - Warning email sent after 3rd opt-out

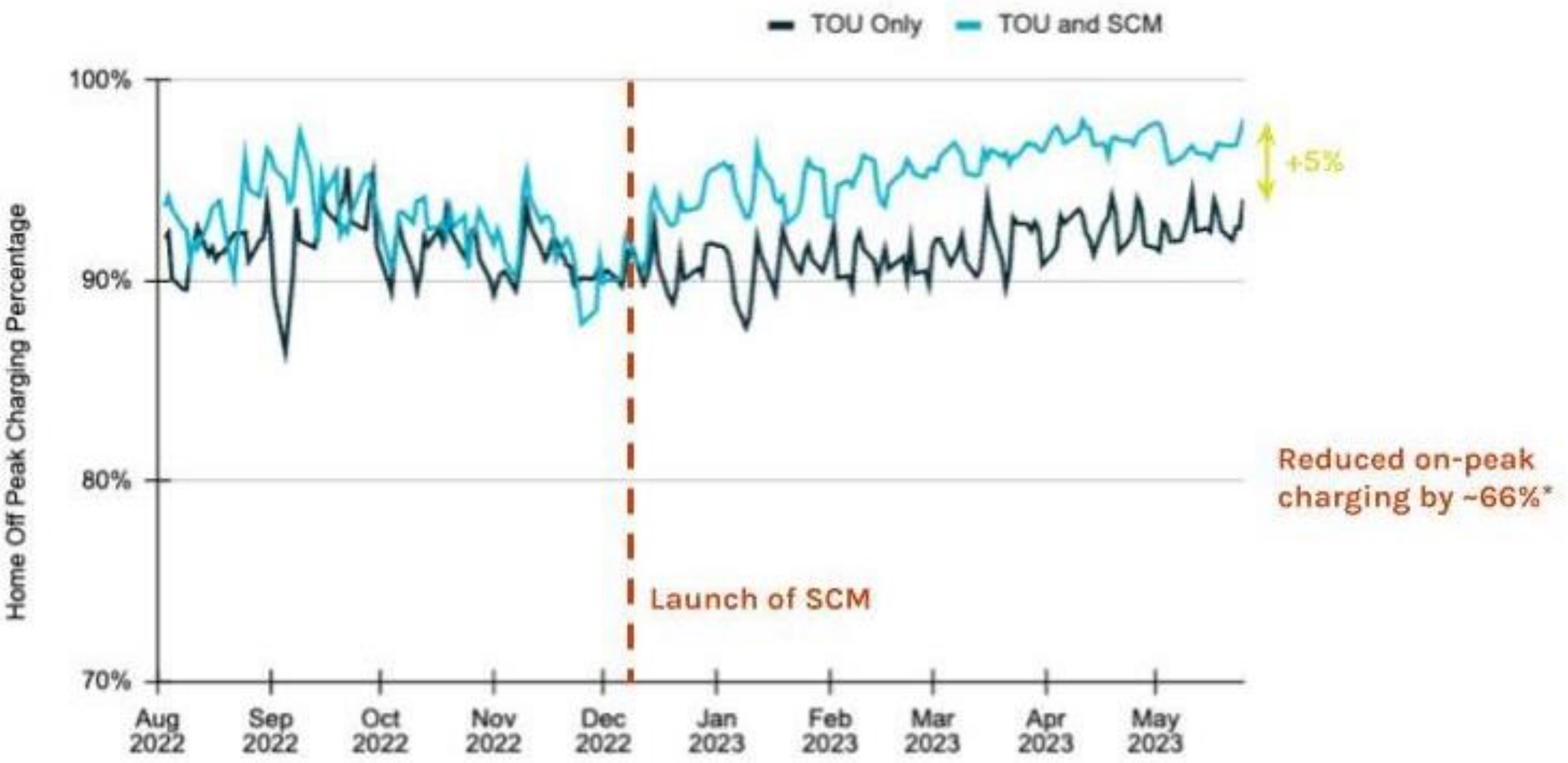
Smart Charge Management Residential Program

3,179 residential applications for HCI

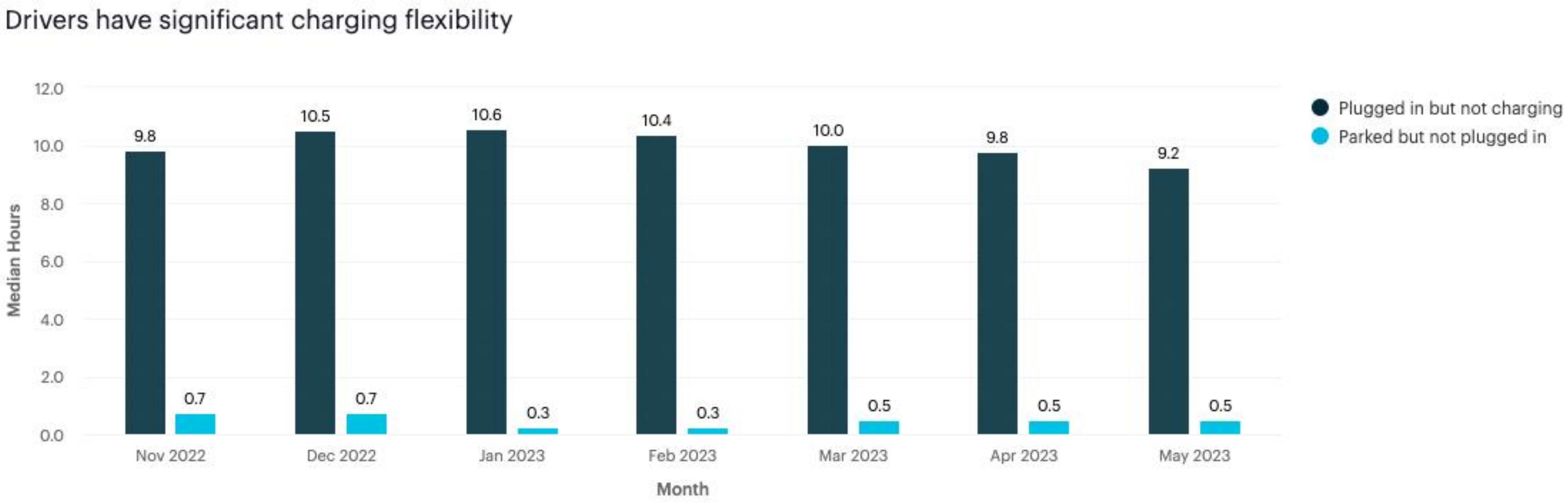


Smart Charge Management Residential Program

1,869 residential customers on TOU rate



Smart Charge Management Residential Program



Thank you

Stephanie Leach
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(stephanie.leach@bge.com)

Next EV SWG meeting: Tues, June 27th, 3:00 – 4:30pm

WWW.NARUC.ORG/CPI-1/ENERGY-INFRASTRUCTURE-MODERNIZATION/ELECTRIC-VEHICLES/

Appendix: Resources for Reference

- **DOE's EV Grid Assist webinar series** (June – November) recordings are posted at: www.energy.gov/eere/evgrid-assist-accelerating-transition
- **Presentations and recordings of past EVSWG events** are available on the NARUC website: www.naruc.org/cpi-1/energy-infrastructure-modernization/electric-vehicles/
- EVSWG Listserv: NARUC-EVSWG@lists.naruc.org
- ICYMI – **4 NARUC EV publications** released late 2022:
  - **Models for Incorporating Equity in Transportation Electrification**
  - **Electric Vehicle Interoperability: Considerations for Public Utility Regulators**
  - **Considering Interoperability for Electric Vehicle Charging: A Commission Case Study**
  - **Transportation Electrification: State Level Roles and Collaboration among Public Utility Commissions, State Energy Offices, and Departments of Transportation**