# Vehicle-to-Grid Compensation Mechanisms for Customers

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PREPARED FOR

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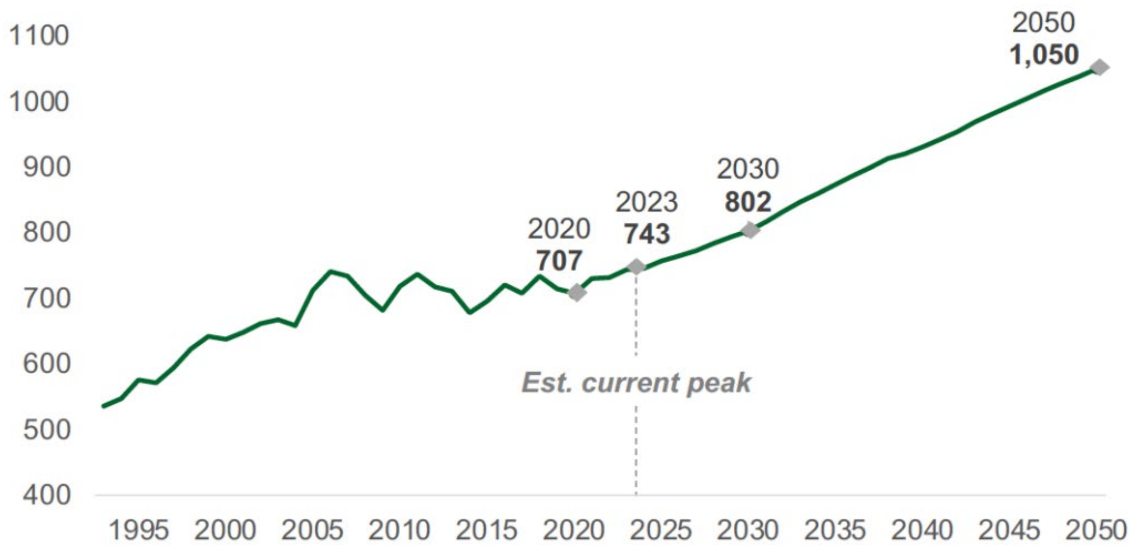
# Electric vehicles as grid assets – why now?

## Today's electric system is facing unprecedented changes:

- Rapid load growth fueled by data centers and electrification – much of which is uncertain
- Distribution system strain driven by geographically concentrated electrification
- Rising cost of capacity resources due to tariffs, global supply chain constraints, and unanticipated demand
- High electric rates (especially in California!)
- Long development lead times plagued by interconnection queue backlogs
- Increased reliance on carbon-free resources, driven by costs and clean energy policies
- Organic growth in consumer adoption of EVs

### U.S. System Peak Demand (GW) 1995 – 2050E

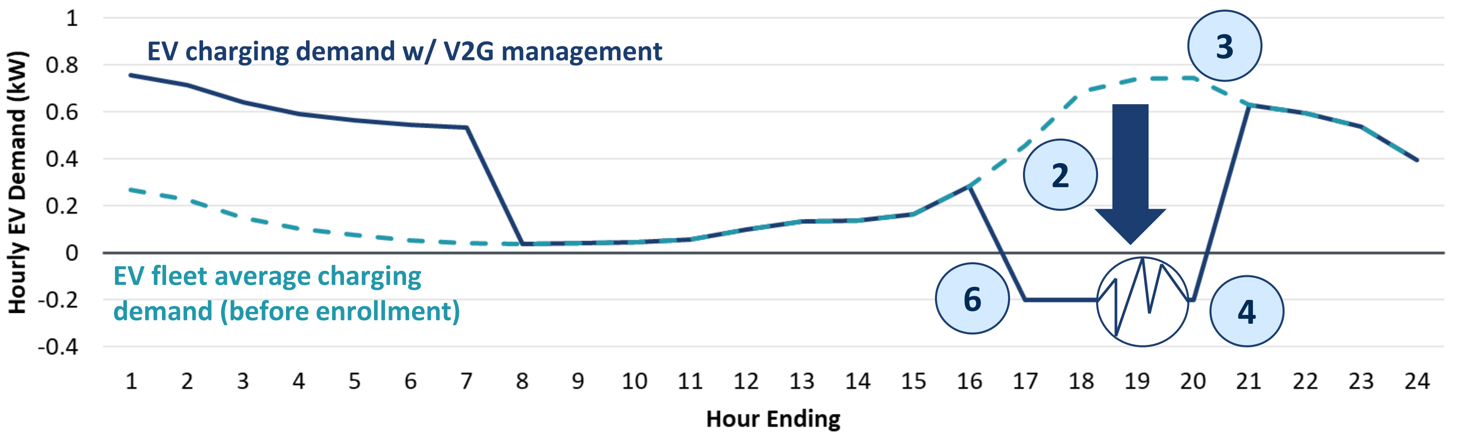



*Note: National coincident peak demand is based on sum of peaks across FERC regions. Source: [DOE VPP Liftoff Report (2023)]. Historical energy demand sourced from AEO. Coincident peak demand (point-in-time peak, not total energy consumption) estimated by The Brattle Group (2023) based on forecasted total energy consumption sourced from OP-NEMS mid-case scenario. This mid-case scenario includes increasing consumption from industrial electrification and electrification of HVAC; however, the EVs contribute the most demand to coincident peak according to estimated hourly consumption patterns that will vary by region.*

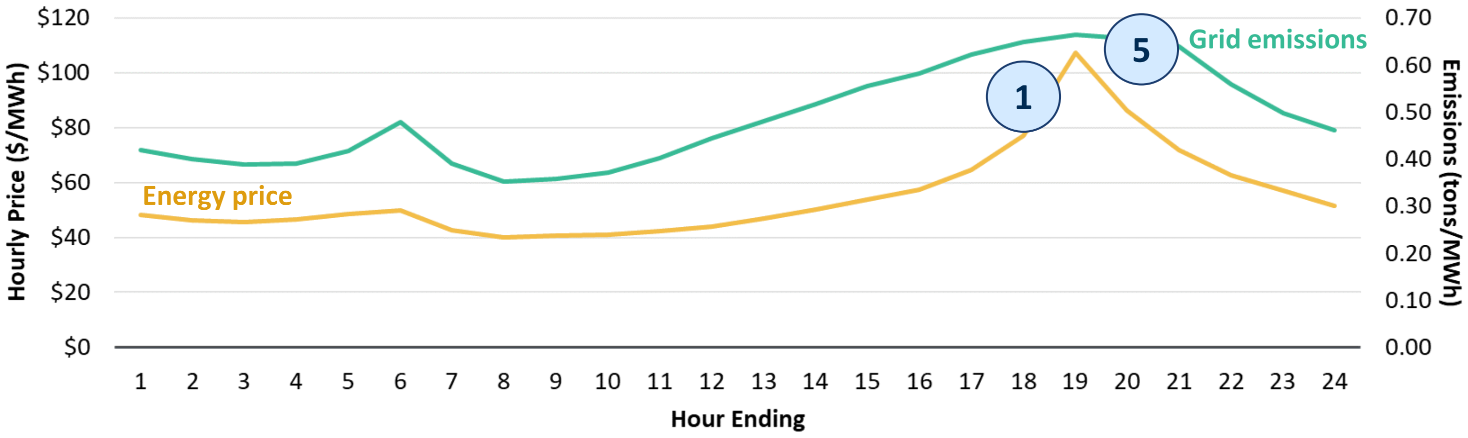
# EV batteries can provide valuable grid services to meet today's challenges

1. **Reduce hourly system operational cost**
2. **Provide peaking capacity and resource adequacy value**
3. **Avoid transmission and distribution system investments with geo-targeted evening-spike reduction**

## Vehicle-to-Grid Daily Demand (before and after V2G event)




## Daily Grid Conditions on Event Day




4. **Provide grid regulation and frequency services (with adequate telemetry)**
5. **Lower emissions and displace fossil intensive peaker generation**
6. **Customer resilience during power outages (vehicle-to home)** *non-grid service*

*Note there are many barriers to unlocking this value today, many of which are discussed in Brattle's recent report, "New York's Grid Flexibility Potential". EV charging profile sourced from NREL EVI-Pro Lite for Fresno California for a weekday fleet average profile. Energy prices and hourly emissions are 2023 historical from NP15 zone retrieved from, California's Avoided Cost Calculator shown for an average July day.*

# For EV owners, is it all about the money?

## Compensation structures need to effectively incentivize drivers to transform their vehicles into grid assets.

| | Compensation Principles | Successful Practices in Various Flexibility Offerings |
|---|---|---|
| **Certain** | Compensation **certainty** for customers, aggregators, and DER market participants attracts enrollment and supports third-party business cases | BGE/Weavegrid's smart charging program offers an upfront and ongoing incentive that attracts and retains customer involvement |
| **Simple** | Enrollment **simplicity** increases likelihood of customer participation, since most drivers care more about owning a functioning vehicle than a grid asset | APS's cooling VPP program allows for auto enrollment upon smart thermostat purchase through their marketplace, eliminating paperwork and customer attention after point of sale |
| **Transparent** | Compensation **transparency** while retaining flexibility increases customer willingness for management | SMUD's EV managed charging pilot has a clear incentive structure and allows customers to update charging schedules based on driving needs |
| **Cost reflective** | **Cost reflectivity** to ensure resources are not overcompensated for grid benefits | New York's Value of Distributed Energy Resources (VDER) value stack attributes locational system relief value (LSRV) only to assets located in high-value areas |
| **Scalable** | Successful compensation structures will be **scalable** once more EVs are deployed and enrolled in a service area | As program enrollment grows, programs like PG&E's FlexConnect Pilot gives operators and planners flexibility to adjust based on grid needs |

# Kate Peters

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Kate Peters focuses on strategic planning and regulatory issues related to an increasingly decarbonized electric power system. She has supported utilities, renewable developers, research organizations, and technology companies in matters related to resource planning, capacity expansion modeling, electrification grid-impact studies, and the emerging role of virtual power plants (VPPs) in decarbonized markets.

Ms. Peters has contributed to high-profile studies assessing the economic viability of distributed energy resources, modeling the grid impacts of electrification, and evaluating the role of demand flexibility in mitigating peak load growth. Her recent consulting experience includes estimating the cost-effective potential for grid flexibility in New York, assessing the market opportunity for VPP deployment in California, and modeling electrification scenarios to inform climate policy decisions in Maryland. She additionally has expertise in capacity expansion modeling, using Brattle's in-house model (gridSIM) to lead utility integrated resource planning studies and economic analyses of generation resources.

Ms. Peters holds a B.A. in Environmental Economics with a minor in Mathematics from Middlebury College.

# Further Reading: Recent Brattle Studies on EV Grid Flexibility


Hledik, Ryan, Akhilesh Ramakrishnan, Serena Patel, and Andy Satchwell, "Distributed Energy, Utility Scale: 30 Proven Strategies to Increase VPP Enrollment," prepared for U.S. DOE, December 2024.

Hledik, Ryan, and Kate Peters, "Real Reliability: The Value of Virtual Power," prepared for Google, May 2023.

Hledik, Ryan, Kate Peters, and Sophie Edelman, "California's Virtual Power Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability," prepared for GridLab, April 2024.

Hledik, Ryan, Akhilesh Ramakrishnan, Kate Peters, Ryan Nelson, Xander Bartone, "Xcel Energy Colorado Demand Response Study: Opportunities in 2030," prepared for Xcel Energy, June 2022.

Hledik, Ryan, Akhilesh Ramakrishnan, Kate Peters, Sophie Edelman, Alison Savage Brooks, "New York's Grid Flexibility Potential," prepared for NYSERDA and NY Dept. of Public Service, January 2025.

Hledik, Ryan, Ahmad Faruqui, and Tony Lee, "The National Potential for Load Flexibility," Brattle report, June 2019.

Langevin, Jared, Aven Satre-Meloy, Andrew Satchwell, Ryan Hledik, Julia Olszewski, Kate Peters, and Handi Chandra Putra, "The Role of Buildings in U.S. Energy System Decarbonization by Mid-Century," October 2022.

Sergici, Sanem, Akhilesh Ramakrishnan, Kate Peters, Ryan Hledik, Michael Hagerty, Ethan Snyder, Julia Olszewski, and Hazel Ethier, "An Assessment of Electrification Impacts on the Maryland Electric Grid," Brattle report for the Maryland Public Service Commission, December 2023.

US Department of Energy, "A National Roadmap for Grid-Interactive Efficient Buildings," prepared by Berkeley Lab, The Brattle Group, Energy Solutions, and Wedgemere Group, May 2021.