NASEO National Association of State Energy Officials

NARUC National Association of Regulatory Utility Commissioners

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group: Scaling Demand Flexibility with Software

January 30, 2025, 3:00 pm ET

Welcome: ***Rodney Sobin*** *(NASEO) and* ***Jeff Loiter*** *(NARUC)*

Scaling Demand Flexibility with Software: Octopus Energy and Kraken Technologies

Rajiv Shah*, Head of North American Policy and Markets, Octopus Energy Group*

Q&A and discussion

Wrap-up

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NASEO-NARUC Grid-Interactive Efficient Buildings Working Group: Scaling Demand Flexibility with Software

January 30, 2025, 3:00 pm ET

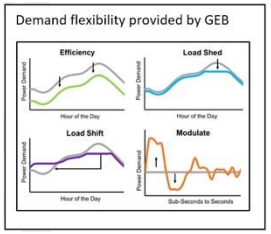
Logistics:

- Please mute when not speaking.
- Please use Q&A box or chat to offer questions.
- Slides and recording will be posted.

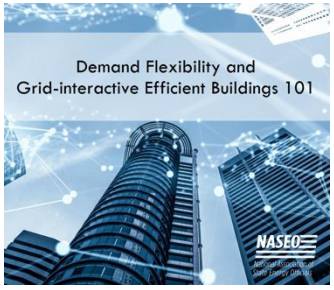
NASEO-NARUC Grid-Interactive Efficient Buildings (GEB) Working Group

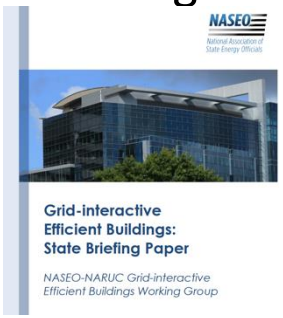
https://naseo.org/issues/buildings/naseo-naruc-geb-working-group

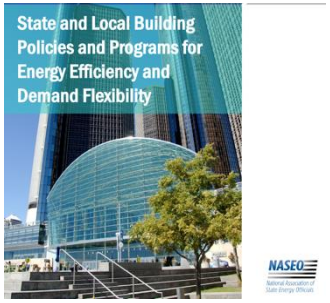
Inquiries: GEB@naseo.org

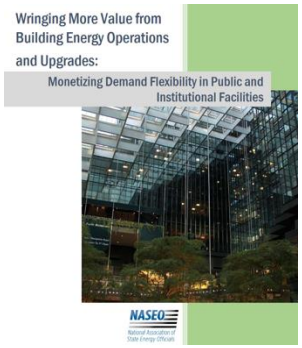


- GEB/demand flexibility/grid-edge management can:
  - Lower costs, enhance resilience, reduce emissions
  - Reduce peak loads, moderate ramp rates, provide grid services
  - Enhance energy efficiency, integrate distributed and renewable energy resources
- Questions:
  - How to optimize facility interactions with grid? How to coordinate DERs?
  - How can state policies, programs, regulations advance GEB/DF/DER benefits?
  - What are roles for states, facility owners and operators, utilities, tech and service providers, and others?
- Forums, state exchanges, national lab tech assistance, reports, resources…
- U.S. DOE, Building Technologies Office support









NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

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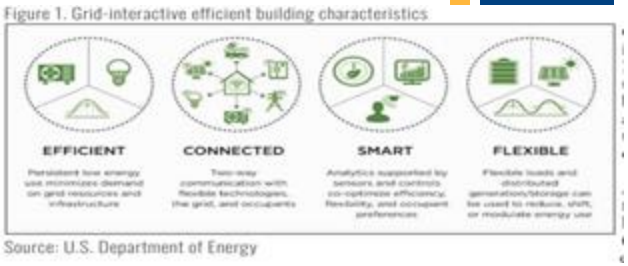
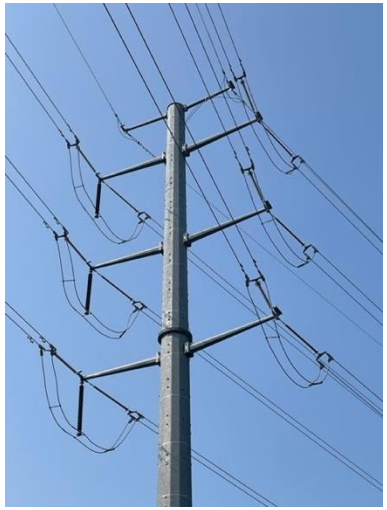


Figure 1. Grid-interactive efficient building characteristics
Source: U.S. Department of Energy

- Working Group co-chairs:
  - Liz Reichart, MA Dept. of Energy Resources
  - Ashley Norman, Hawaii PUC staff
- Working Group – 30 states and territories:

Arkansas	Maryland	Oregon
Arizona	Massachusetts	South Carolina
California	Michigan	Tennessee
Colorado	Minnesota	Utah
Connecticut	Mississippi	Vermont
Florida	Nebraska	Virginia
Georgia	New Jersey	Washington
Hawaii	New York	Wisconsin
Idaho	Pennsylvania	Wyoming
Illinois	District of Columbia	Virgin Islands



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NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://www.naseo.org/issues/buildings/naseo-geb-resources

New/recent items:

- DOE announced Connected Community 2.0 and Smart Charge Management Awards
- DOE, Pathways to Commercial Liftoff; Virtual Power Plants 2025 Update
- DOE, Sourcing Distributed Energy Resources for Distributed Grid Services
- LBNL VPP and Demand Flexibility Reports (December 2024 - January 2025)
  - DER Integration Framework: Regulatory Innovation for DER Compensation and Cost Allocation
  - Distributed Energy, Utility Scale: 30 Proven Strategies to Increase VPP Enrollment
  - Virtual Power Plants: Insights, Profiles and Inventory
  - Moving Beyond Direct Load Control: A Maturity Model for Realizing the Promise of Demand Flexibility
  - State regulator opportunities to advance distributed energy resources aggregations in wholesale markets.
- Colorado Microgrid Roadmap -- NASEO-NARUC State Microgrid WG webinar March 21, 1-2pm ET
- Maine Governor's Energy Office (GEO) Distribution System Operator (DSO) Feasibility Study
- Ann Arbor's Sustainable Energy Utility (SEU): opt-in, supplemental, community-owned energy utility that will 100% RE from local solar and battery storage systems installed at participating homes and businesses in the city.

Our previous Working Group Forum

- **NASEO-NARUC Grid-interactive Efficient Buildings (GEB) Working Groups Forum: RMI Virtual Power Plant (VPP) Flipbook - September 4, 2024**

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://www.naseo.org/issues/buildings/naseo-geb-resources

Upcoming:

- In-person training open to NASEO, NARUC, NASUCA members:
  - NASEO-NARUC Training for States on Integrated Distribution System Planning 2.0: Planning for Electrification and Distributed Energy Resources March 11-12, 2025 - Detroit, MI
  - NASEO-NARUC Training for States on Integrated Distribution System Planning 2.0: Planning for Electrification and Distributed Energy Resources April 30-May 1, 2025 - Denver, CO

Seek suggestions for future forums and webinars. Possibilities:

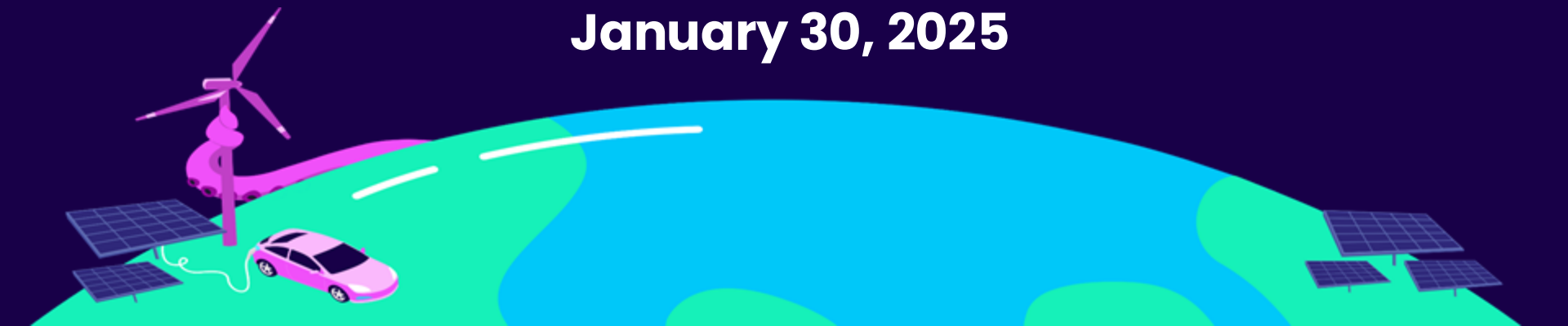
- Sourcing DERs for Distributed Grid Services
- Connected Communities Update
- Smart Charge Management
- Upcoming LBL reports on
  - Coordinated Controls – DERMS
  - Utility and Business Model Frameworks and Scaling

KRAKEN

PART OF THE octopus energy GROUP

Presentation to the NASEO-NARUC GEB Working Group

January 30, 2025



Agenda

- Intro to the Octopus Energy Group + Kraken (5 mins)
- Problem Statement and Challenges (10 mins)
- Scaling Demand Flex & VPP Solutions (15 mins)
  - Customer-centric approach
  - Interoperability
  - Promoting market-based solutions to valuing DERs
- Q&A/Discussion (30 mins)

KRAKEN

Introduction to the Octopus Energy Group and Kraken

OEG | Working across 4 key areas for the energy transition

Octopus Energy

Generation

- **$7bn** generation assets managed
- **14 countries**
- Fan Club community generation

Retail Energy

- **8m customers / 12m accounts**
- **8 countries**
- #1 for customer service
- World-leading consumer flex
- Europe's largest VPP (**170k+ devices**)

Services

- **EV leasing** & EV charger installation
- **Heat pump** tech & installations
- **Solar and meter** installations
- **Electroverse** EV charging network

Kraken

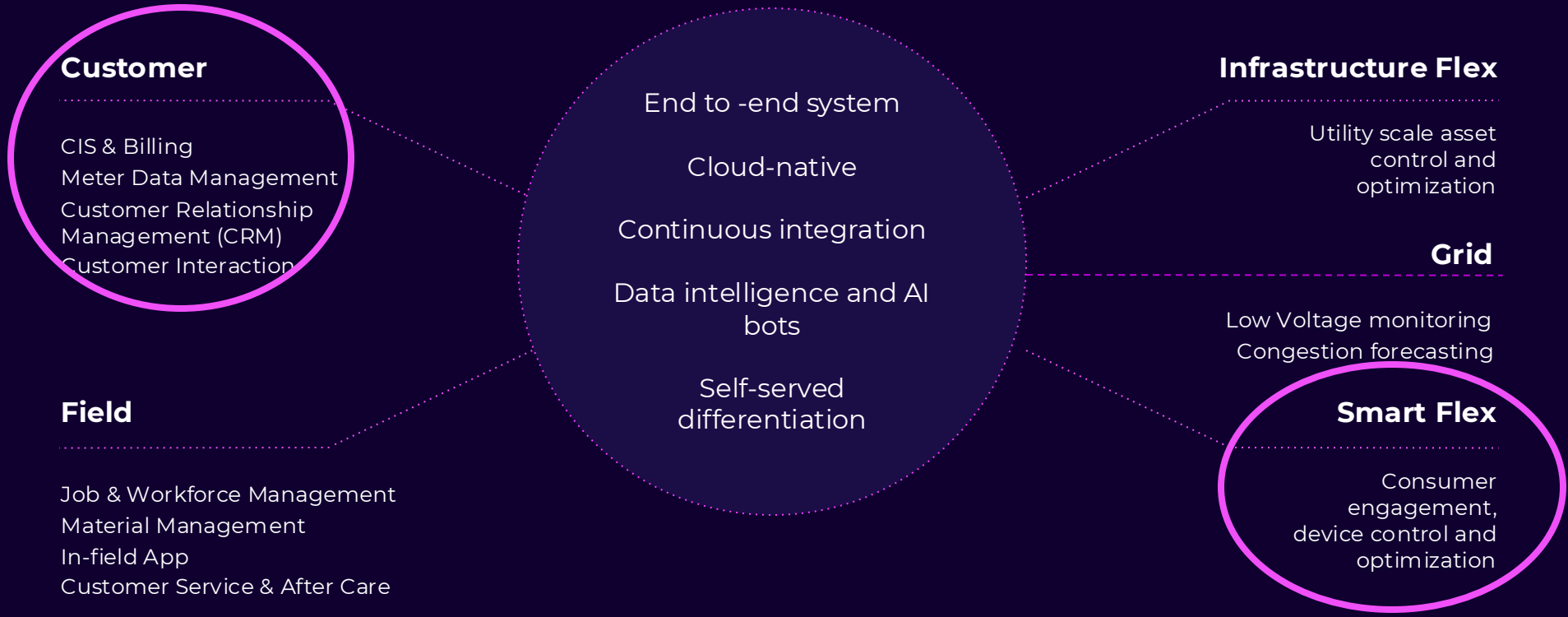
Tech

- Single platform to manage customers and assets
- **18 countries**
- **50m** contracted retail accounts
- **43GW** flexible assets contracted

>$9bn valuation, with financial backing from: Tokyo Gas · generation · CPP Investments · origin · octopus investments

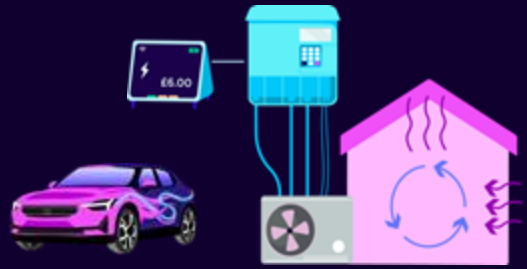
Quick Overview of the Kraken Platform

Kraken is the new end-to-end operating system for future-focused utilities



Flexibility Products

Residential



SmartFlex

- EV charging
- Heat pump optimization
- Solar PV control
- Home battery control
- Thermostat control

Commercial & Industrial / Front of meter

InfraFlex

- Large scale storage
- Utility scale solar PV
- On/offshore wind farms
- Demand side response

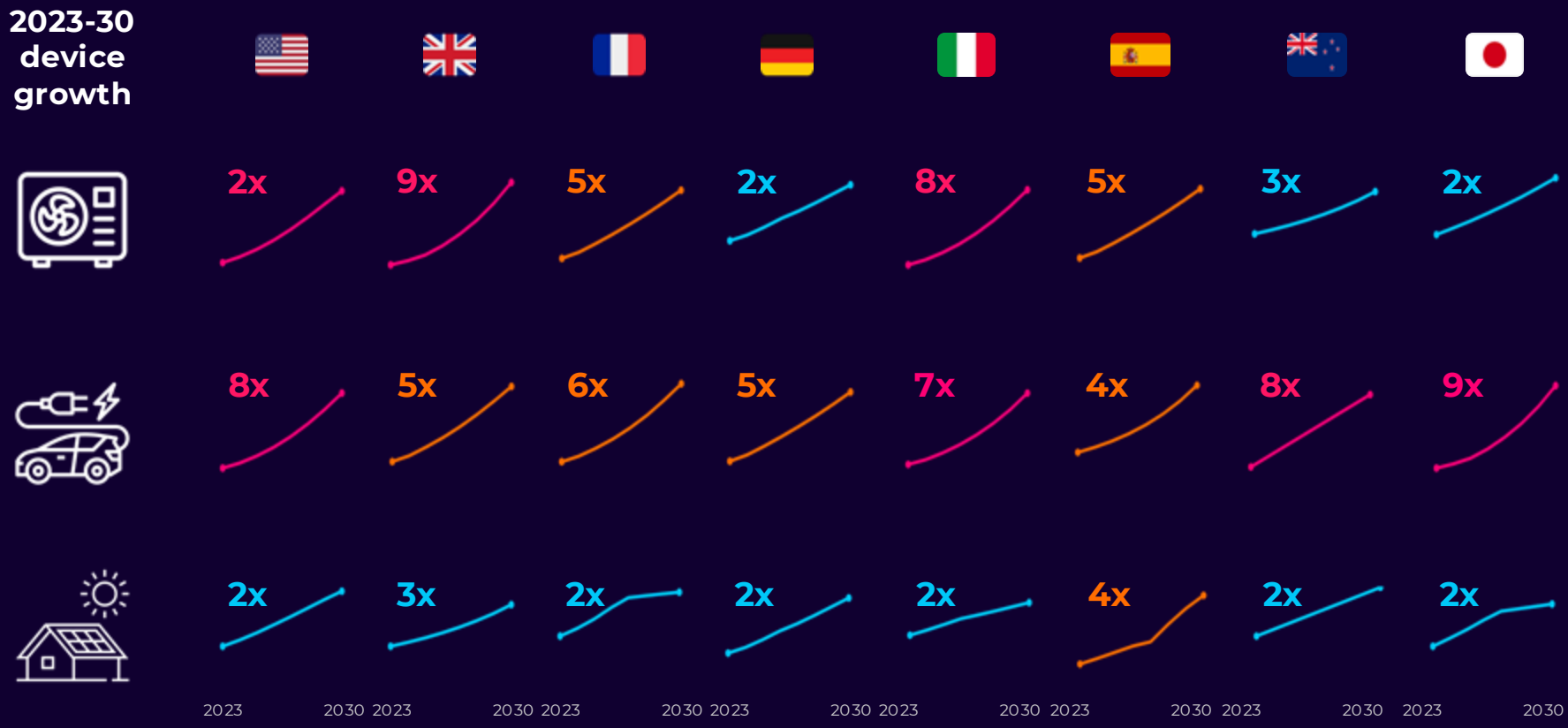
Most diverse portfolio of DERs and largest EV VPP

Background context:
Proliferation of DERs is changing power flows on the grid and increasing demand, shapes → leading to system balancing challenges & increasing costs

Problem statement:
To manage the challenges posed by DER proliferation, utilities are deploying various demand flexibility tools (e.g. DERMS, VPPs) → but results have largely been small and siloed

Challenge #1
Booming number and variety of energy assets

200 million new devices by 2030



Source: Kraken, Bloomberg New Energy Finance

200 million new devices by 2030

Devices

Countries

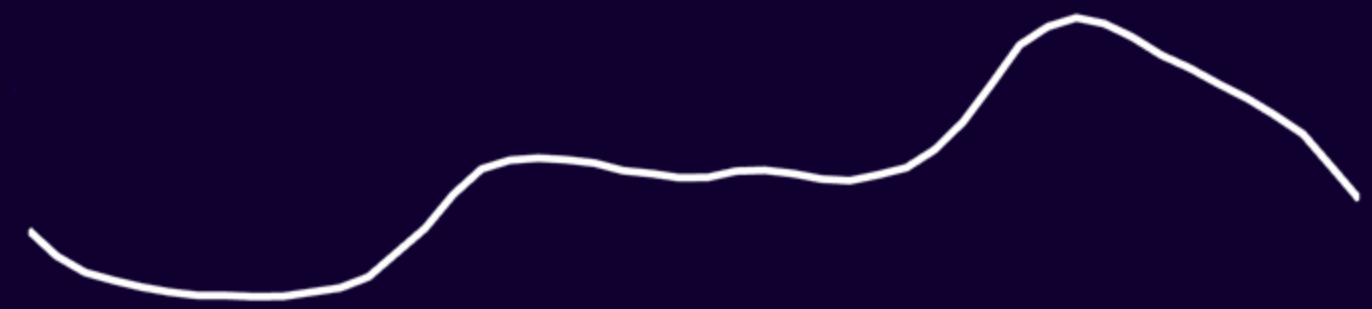
40 million today

2023-30 growth

Source: BNEF

Challenge #2
Changing consumer demand profile

Energy Use



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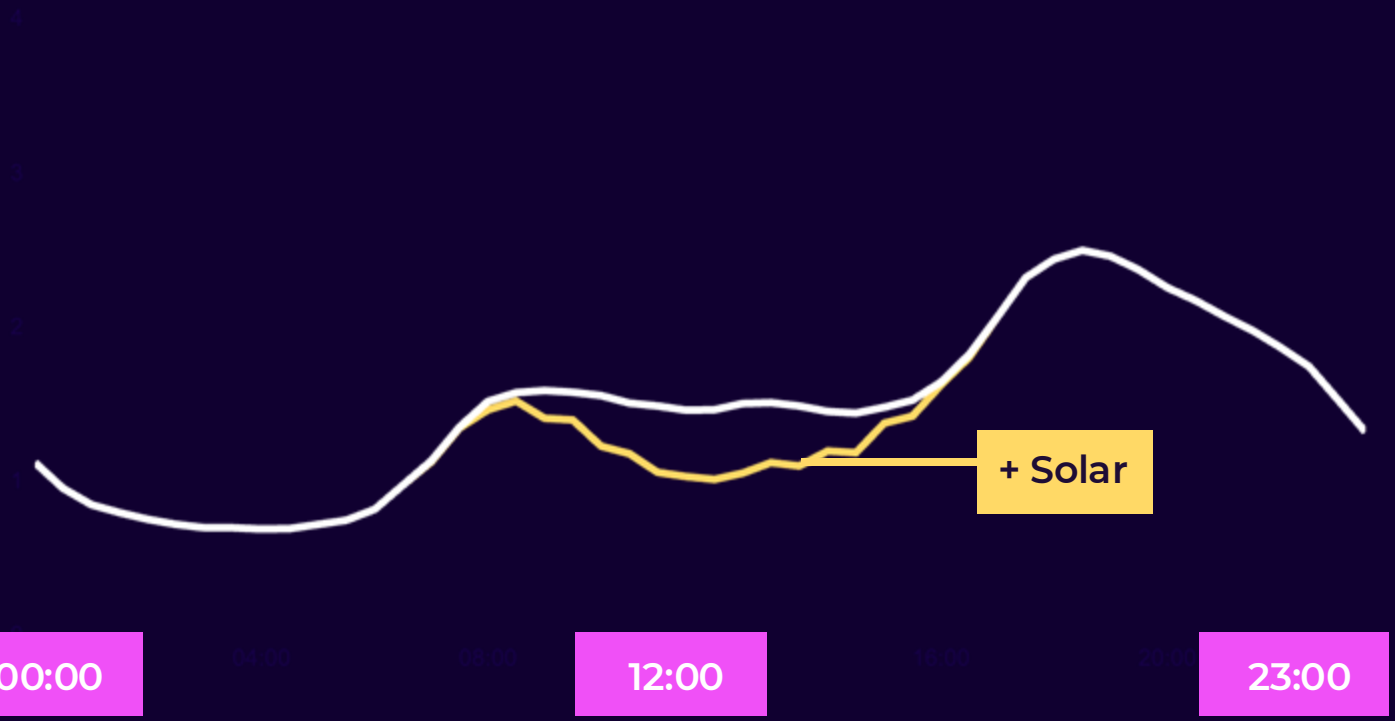
12:00

23:00

Energy Use



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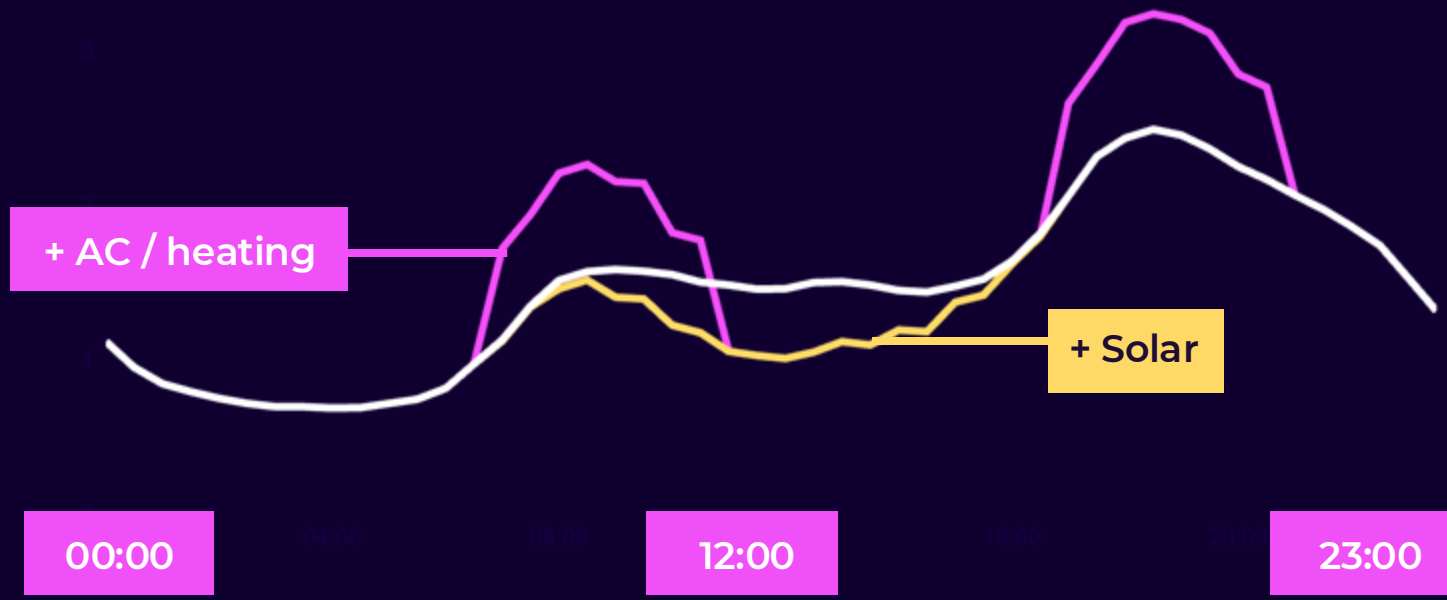

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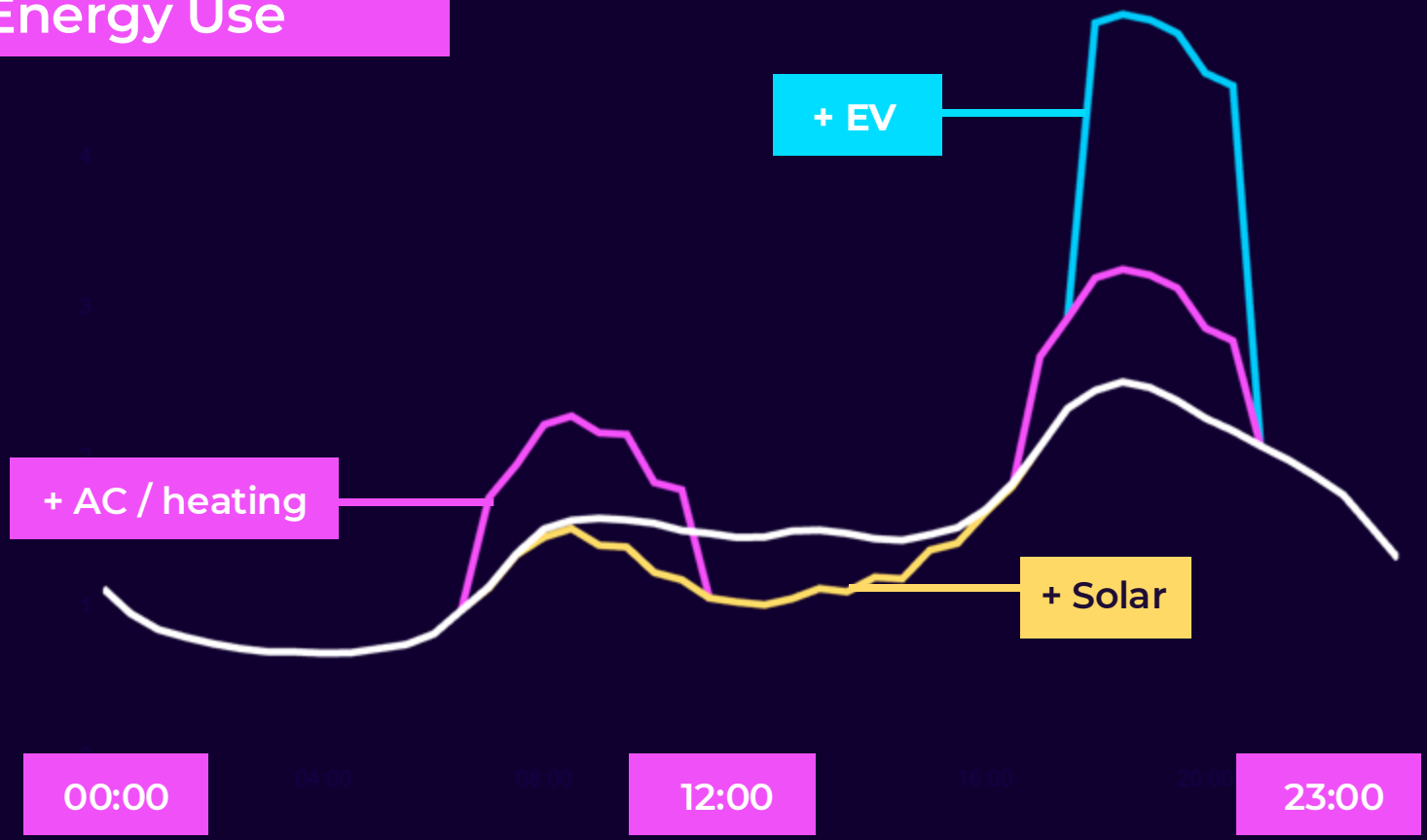

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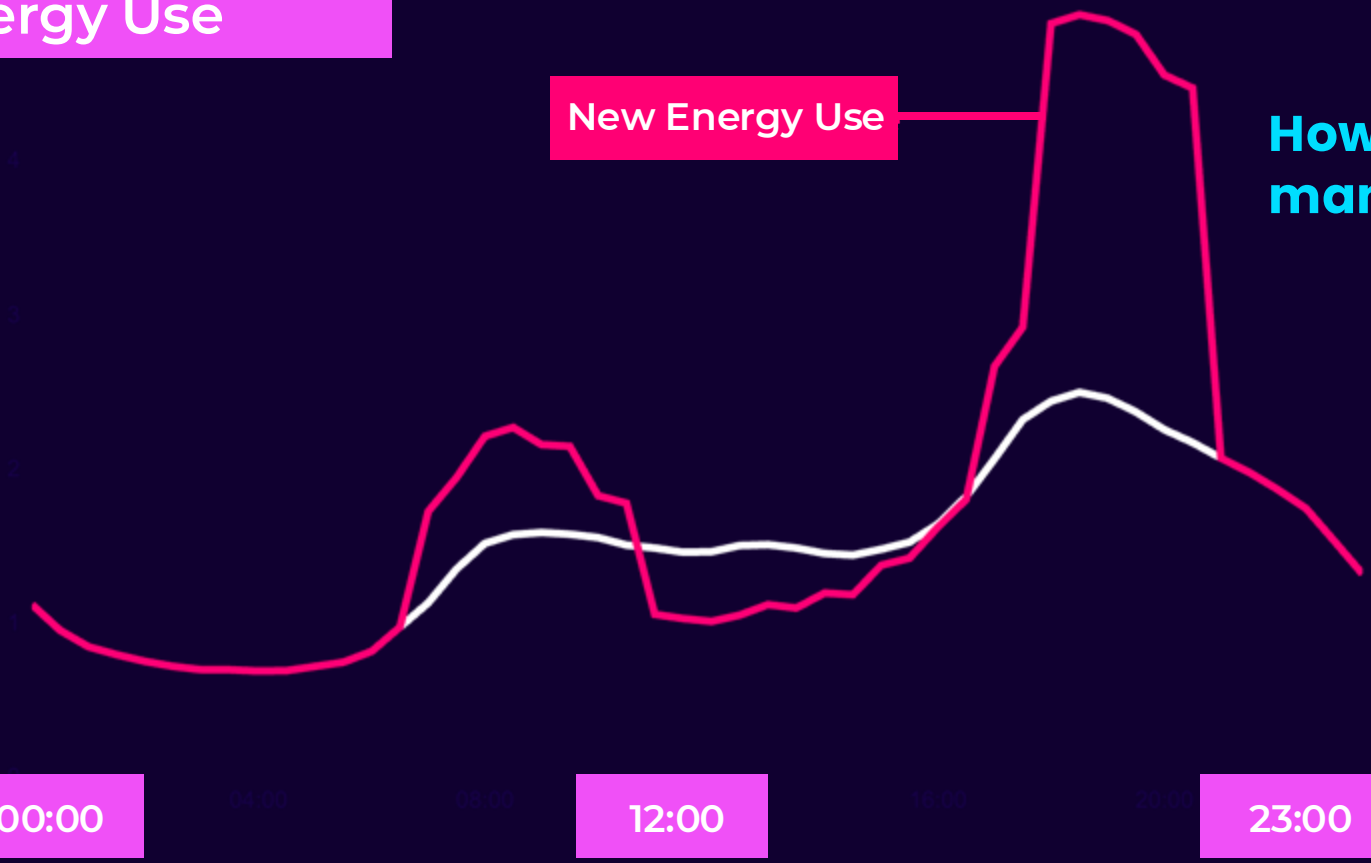

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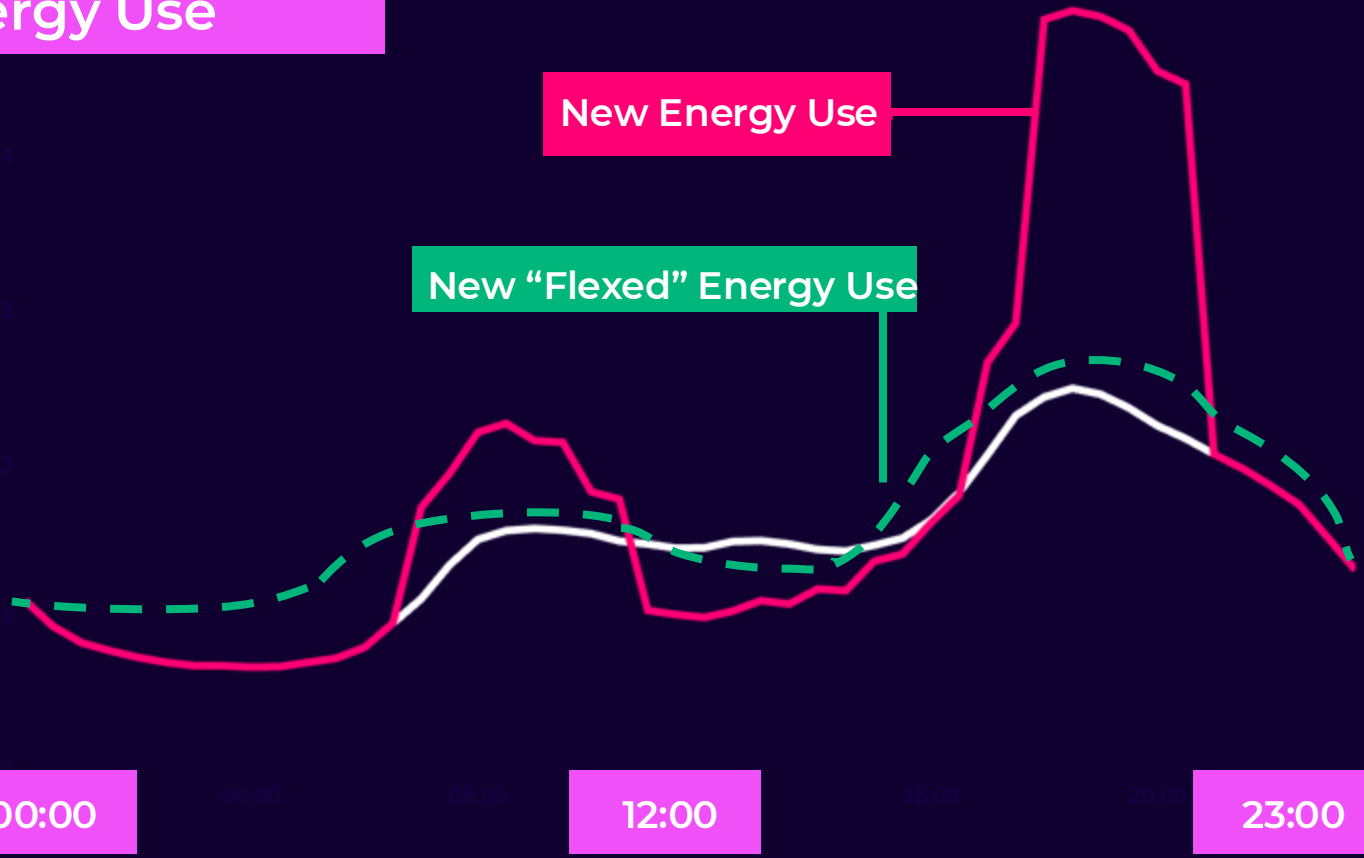
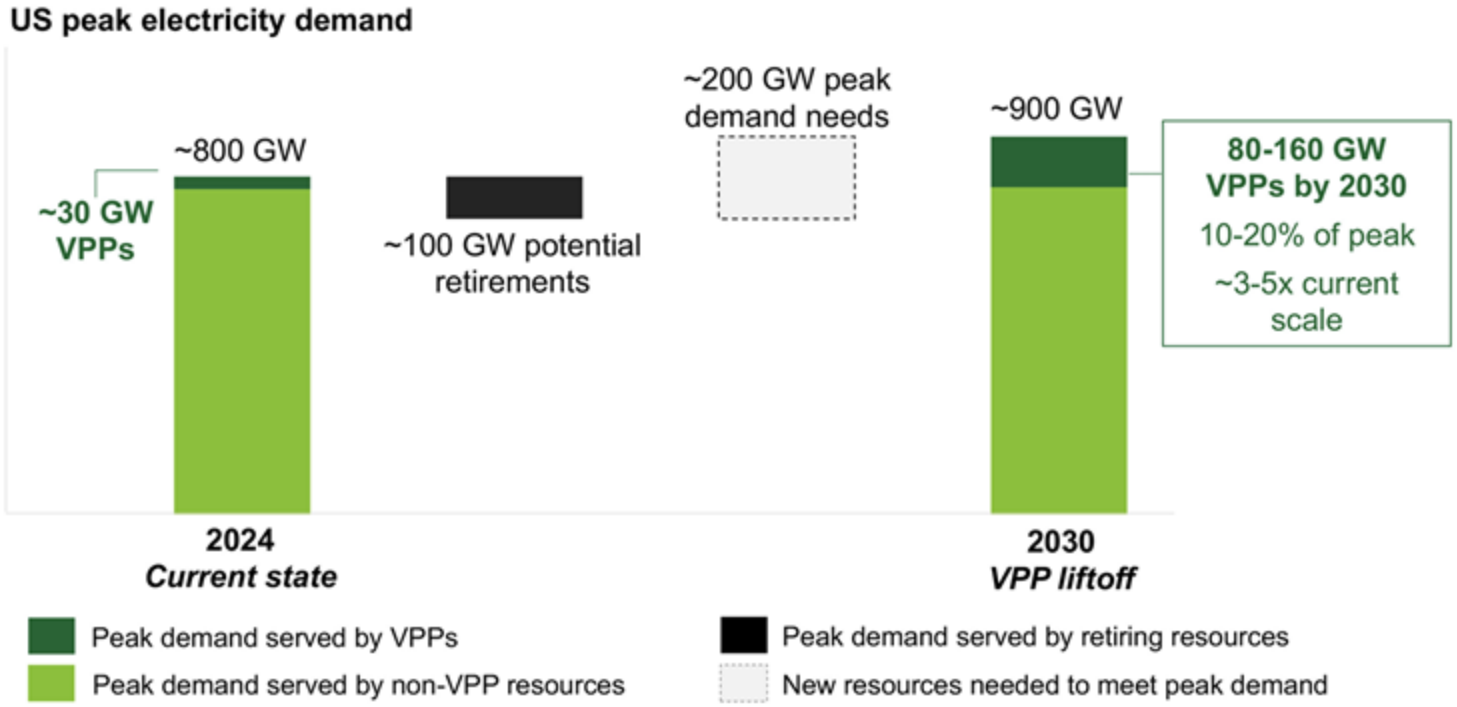


Challenge #3
Growth in demand and associated costs

Why are we here? We need 160 GW of flex



Source: 2025 DOE Virtual Power Plants 2025 Update

KRAKEN

Where we are coming from

Over **50%** of eligible EVs enrolled in Octopus Energy's VPP

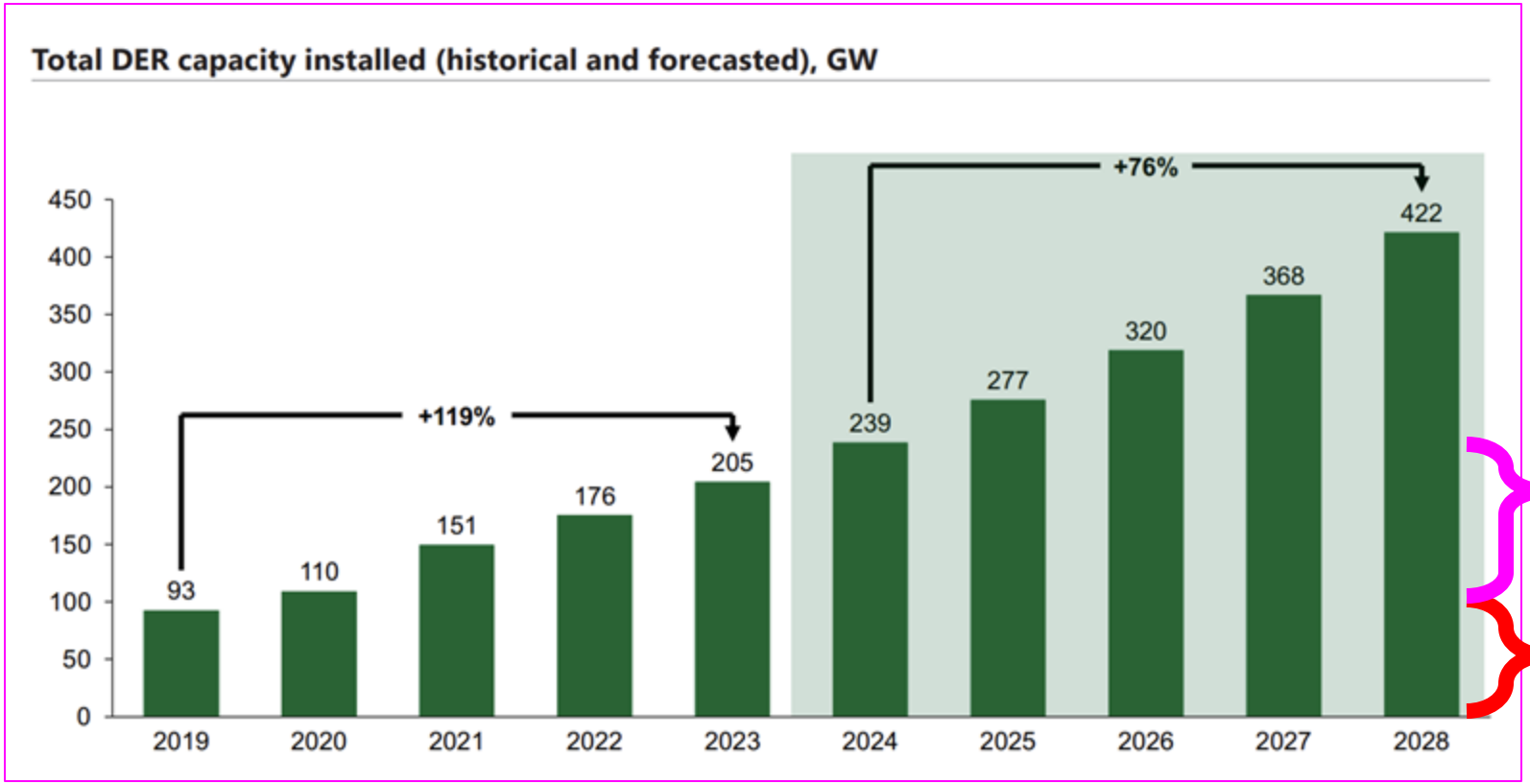
Where we find ourselves

"Less than **20%** of eligible DER enrolled in VPPs"

Wood Mackenzie

KRAKEN

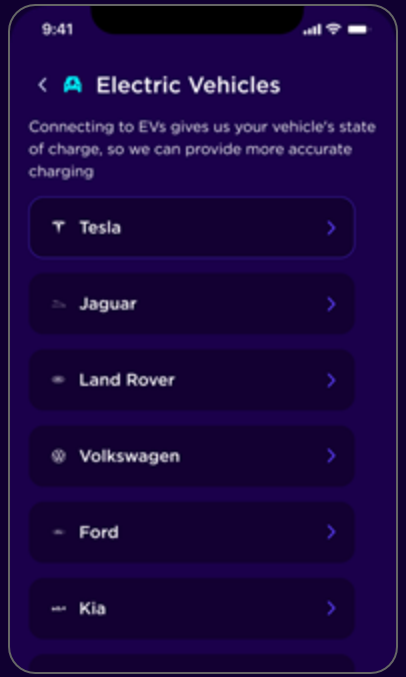
20% does not get us to 160 GW

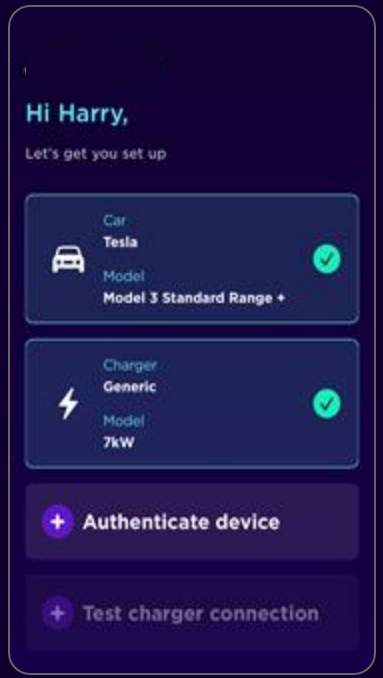


KRAKEN

SmartFlex in Action - Intelligent Octopus

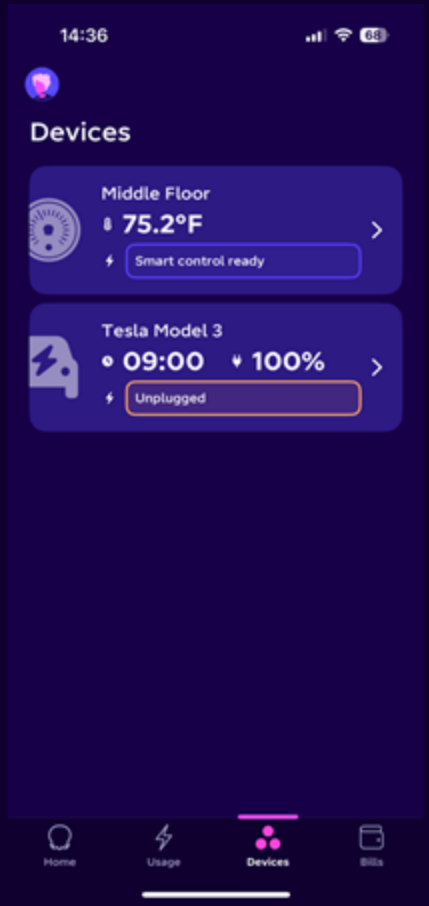

Select the device you would like to integrate with
If you have multiple devices, just pick one.
Intelligent Octopus may only be able to connect to certain models.
Electric Vehicles
Chargers
Heat pumps
Thermostats


9:41
Electric Vehicles
Connecting to EVs gives us your vehicle's state of charge, so we can provide more accurate charging
Tesla
Jaguar
Land Rover
Volkswagen
Ford
Kia

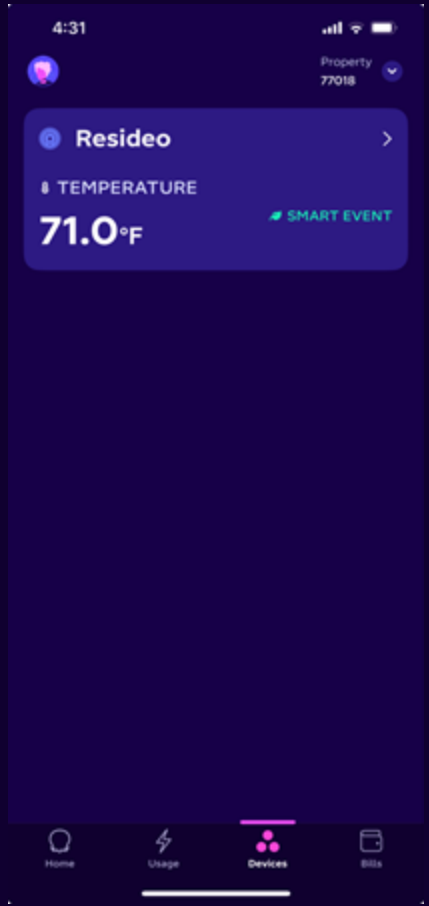

Hi Harry,
Let's get you set up
Car
Tesla
Model
Model 3 Standard Range +
Charger
Generic
Model
7kW
Authenticate device
Test charger connection


Plug in your car after 5pm to create your Smart Charge plan
Charging preferences
80%
07:30
Need to charge now?
Bump Charge
12 hour Charging History
153kWh

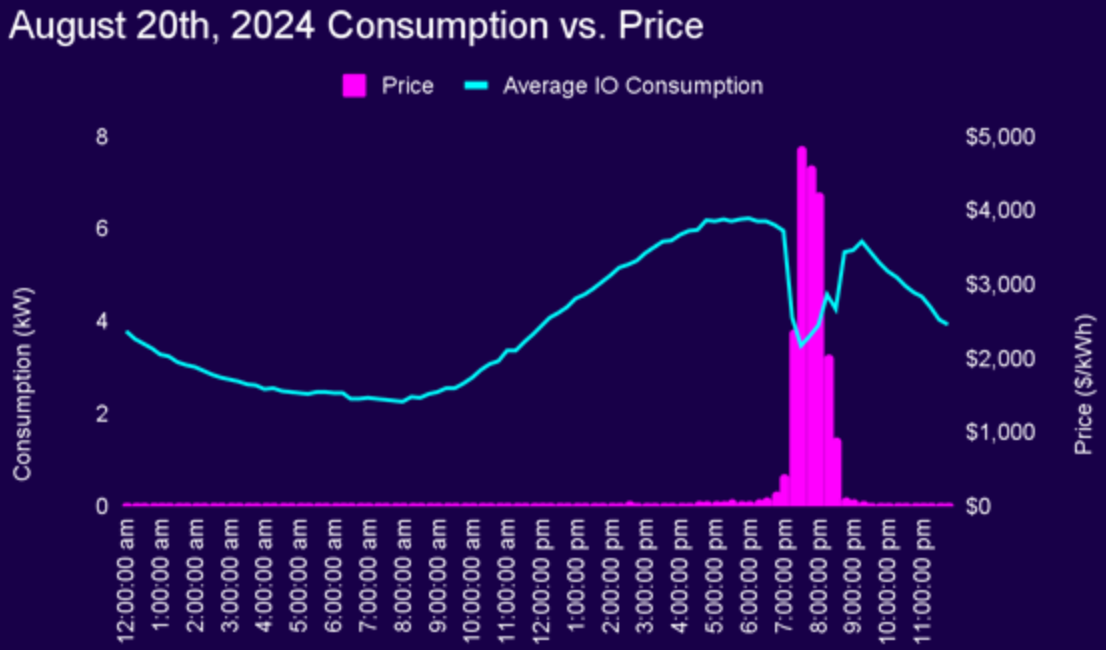

We've mapped tonight's Smart Charge!
Charging preferences
80%
07:30
Need to charge now?
Bump Charge
12 hour Charging History
153kWh


14:36
Devices
Middle Floor
75.2°F
Smart control ready
Tesla Model 3
09:00
100%
Unplugged
Home
Usage
Devices
Bills


14:36
Middle Floor
Device status
Smart control ready
75.2°F
TEMPERATURE
Home
Usage
Devices
Bills


4:31
Property
77018
Resideo
TEMPERATURE
71.0°F
SMART EVENT
Home
Usage
Devices
Bills

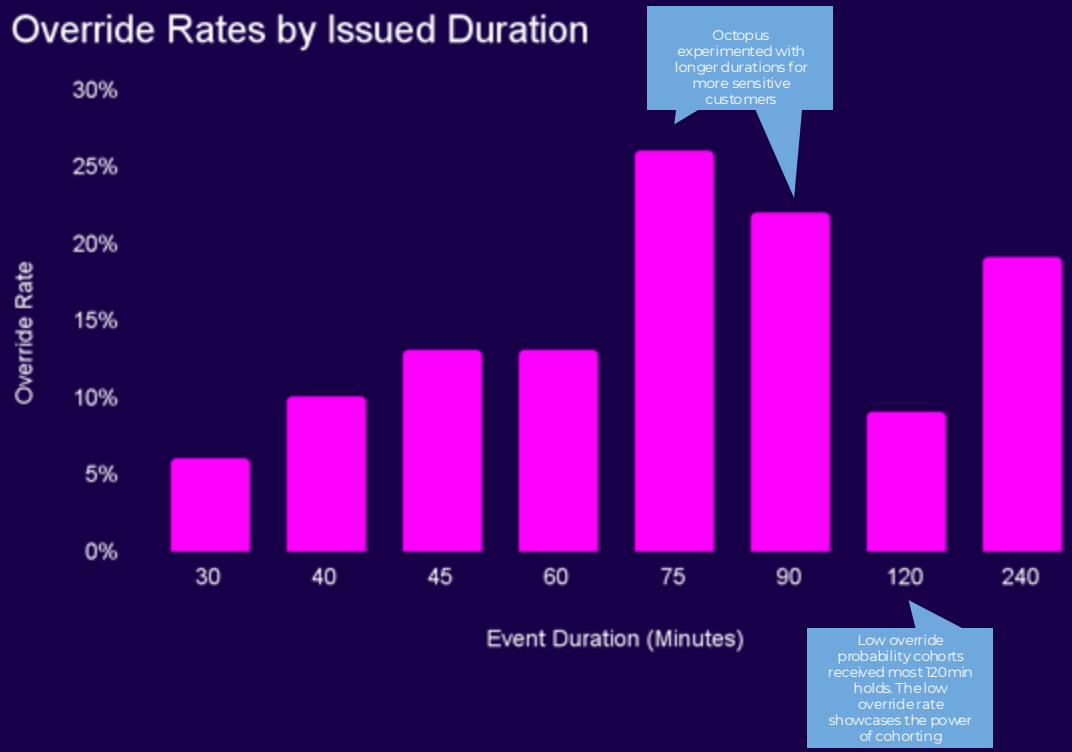
On the warmest Texas days, Octopus leverages Kraken to call thermostats to provide a 40% reduction in peak load when the grid is stressed



💡Potential load reduction increases as peak load increases with progressively higher temperatures.

💡On the hottest days, we have observed a **2.5kW peak load reduction per customer** on average for OEUS customers.

We can squeeze more demand flex value by utilizing customer data to experiment and innovate



🔑 Evidence suggests that most OEUS customers can tolerate up to 60 minutes without increasing override rates substantially.

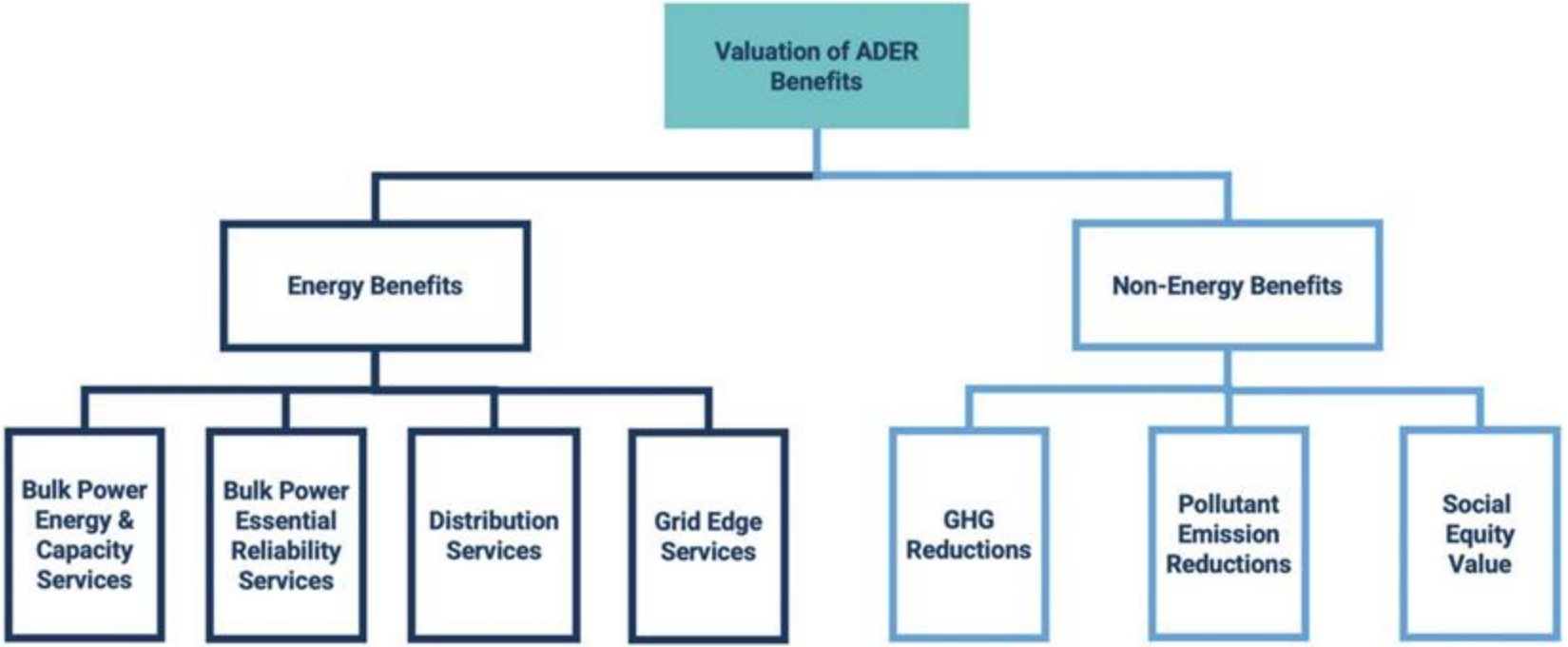
🔑 Cohorting customers enables us to maximize the duration and depth of events across the portfolio while maintaining ~10% override rate.

💡 With most price events lasting 45 - 60 minutes this year, we have confidence that we can clip consumption for most or all of our portfolio for the entire event duration.

Scaling Demand Flexibility and VPPs

#1. Promoting solutions for valuing DERs

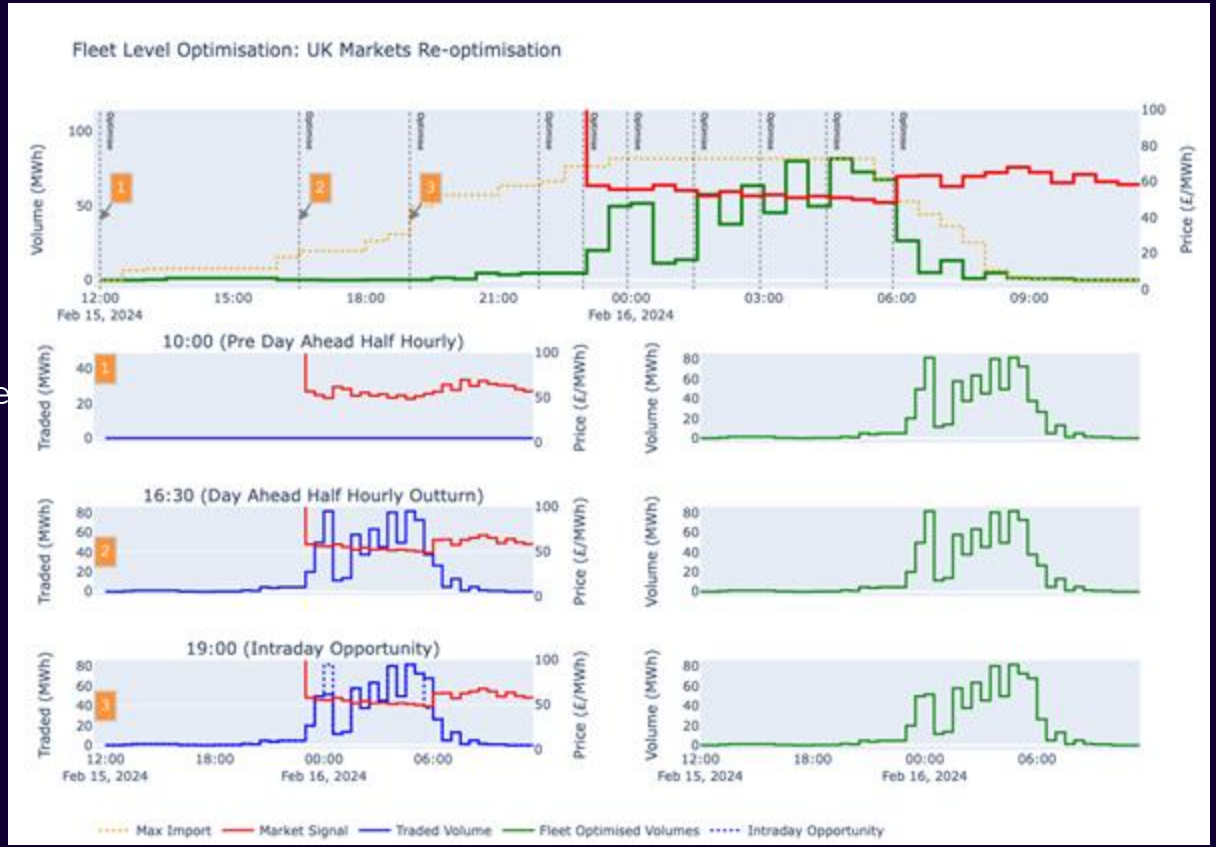
Overview of the value streams DERs can provide



Source: Aggregated Distributed Energy Resources in 2024: The Fundamentals - Prepared for NARUC by RMI

Kraken in the UK - optimizing across different markets

- ✅ Day ahead trading
- ✅ Real-time trading & Net Imbalance Volume (NIV) chasing
- ✅ Capacity market
- ✅ Balancing Mechanism
- ✅ DNO contracts



Approaches to benefits valuation by utility "cohort"

Value Category			Cohort		
			Outside organized markets; utilities own generation assets (Turquoise cohort)	Within organized markets; utilities do not own generation assets (Jade cohort)	Within organized markets; utilities own generation assets (Coral cohort)
Energy Benefits	Energy & Capacity Grid Services	Bulk Power	Based on avoided costs or least cost solution, including ADERs.	Based on market values.	
		Distribution	Based on avoided grid upgrade costs.		
		Grid Edge	Based on customer benefits from service, typically a reduction in bills.		
	Essential Reliability Services	Bulk Power	Based on avoided costs or least cost solution, including ADERs.	Based on market values where they exist. Otherwise based on avoided costs.	
		Distribution	Ancillary service and reliability values based on avoided grid upgrade costs. Resilience values based on value of lost load or reliability improvements.		
		Grid Edge	Based on customer benefits from service, typically through avoided outage costs for the customer.		
Non-Energy Benefits	Reduction in GHG Emissions and Pollutant Emissions, Social Equity		Modeled based on state-specific goals and societal impact assumptions or use values estimated by the EPA.		

Source: Aggregated Distributed Energy Resources in 2024: The Fundamentals - Prepared for NARUC by RMI

Sample data needed to properly value flexibility as a grid service

Grid + System

- real-time grid status;
- peak demand & load variability;
- forecasting models for demand, generation, and grid constraints

DERs

- capabilities, performance metrics, and cost structures
- **real-time telemetry monitoring**

Markets

- price signals (LMP, TOU rates time-of-use rates, and other market-based pricing signals);
- ancillary service requirements; participation models

Locational

- substation and feeder-level data, including line capacities and losses;
- congestion data; hosting capacity

Behavioral + Temporal

- historical DER utilization patterns; user behavior; temporal dynamics

Valuation Metrics

- avoided costs (e.g.T&D deferrals, avoided generation costs);
- environmental benefits (e.g. carbon reductions);
- resilience and reliability contributions

Role of SEOs and PUCs to promote valuation of DERs through fair compensation mechanisms

Advocate for Policies and Market Designs that Allow DERs to maximize their Value

- Develop fair compensation mechanisms (e.g., California's DSGS, New York's VDER, Powering Up Colorado*)
- Align DER valuation with state energy goals (resilience, equity, decarbonization, energy cost mitigation)

Share and Facilitate Learnings from other Markets

- Support development of hosting capacity maps, locational value assessments, and DER registries
- Convene stakeholders (utilities, third-party aggregators, and communities) to share best practices
- Highlight successful initiatives like:
  - Hawaiian Electric: DERs for peak shaving and demand response.
  - Green Mountain Power: Residential battery aggregation for grid services

Promote Solutions

- Encourage non-market solutions like microgrids and community solar for underserved areas

*Modernize Energy Distribution Systems

Scaling Demand Flexibility and VPPs

#2. Seamless Control, Maximum Impact: Why DERs should be interoperable and intro to Project Mercury

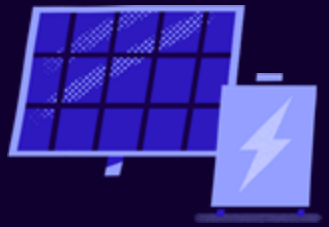
Growing variety of asset types, brands, models & technical capabilities...

CUPRA Audi SEAT SKODA

JAGUAR LAND ROVER Ford VW

BMW MINI PORSCHE RENAULT

TESLA Ohme wallbox



GivEnergy

Energizer

ENPHASE.

solaredge

HUAWEI

DAIKIN

NIBE

ecobee

sensi

amazon

How do we manage this complexity with scalable solutions...?

Managing the Proliferation of DERs: Interoperability is Critical

A surge in DER adoption is providing new grid resources at scale (from a variety of OEMs) with an opportunity to:

- Mitigate grid disruptions
- Tap into existing resources for market and grid operations
- Be proactive in incorporating DERs into Integrated Resource Planning

Seize the opportunity with integration

- To standardize signals/communications across all DERs for utilities, aggregators and ISOs/RTOs, require interoperability for DERs to receive SEO or ratepayer $$
- DERs are customer-owned resources– develop rules that allow the maximum flexibility to monetize their investments

Illustrative Scenario - customer w/multiple DERs from different OEMs

Consider a customer who owns the following devices from different OEMs:

EV

Battery

Smart Thermostat

Mercury is a collaborative, non-profit initiative, led by EPRI, bringing together manufacturers, utilities, regulators, associations, and tech providers

With a mission to develop and promote guidelines for consumer devices to integrate into energy systems to participate in demand-response programs and markets

Mercury will:

Develop a certification

Establish technical guidelines for functionality to support grid services

Foster collaboration

Promote consumer participation in demand flexibility

Mercury will not:

Founding Members

Utilities

Manufacturers

Tech Providers

Research Organizations

Scaling Demand Flexibility and VPPs

#3. Develop a customer-centric approach

Customer

Control Room

There are various well-documented lessons from VPP providers regarding customer engagement…

30 STRATEGIES OF LARGE VPP PROGRAMS

30 Strategies: Categories, relative feasibility, and impact

Marketing

1. Concisely message program benefits
2. Mention multiple motivators for participation
3. Deploy top-of-funnel marketing
4. Host in-person promotional events

Enrollment Process

5. Create a seamless enrollment process
6. Pre-enroll devices sold on utility marketplaces
7. Offer point-of-sale enrollment at retailers
8. Offer easy enrollment in multiple programs
9. Integrate value-add services into programs
10. Provide referral incentives

Ecosystem Partners

11. Harmonize messaging from utilities and OEMs
12. Engage customers through trusted entity
13. Partner with local installers
14. Exchange learnings with other utilities

Incentive Design

15. Maximize the financial incentive
16. Ensure customer pays a portion of device cost
17. Offer ongoing participation payments
18. Bundle device financing options with programs
19. Align price signals
20. Offer active and passive control models

Engagement and Retention

21. Improve program design over time
22. Regularly remind customers of their rewards
23. Compensate through channels customer will notice
24. Communicate societal impact of participation
25. Call regular testing events
26. Offer easy unenrollment
27. Offer flexibility to opt out of events
28. Limit event notifications in automated programs
29. Allow customers to set control range
30. Offer technology choice where available

30 Strategies: Impact and Ease of Implementation

Based on perspectives of VPP solutions providers

Note: The feasibility and impact scores for Strategy 18 reflect the views of the authors because it was not included in the survey.

Brattle

Spotlight on incentive design: things to consider

- Start simple, grow the customer base, and evolve the product over time
- At the outset, incentives might be different for different customer segments or assets
- Consider incentives for customers with and w/o smart meter
- Evolve from off-bill incentives/simple credits to dynamic retail pricing that is DER-agnostic
- There are always PROs and CONs…!

The offering should be:

1. Competitive
2. Attractive & Beneficial for the customer
3. Beneficial to the utility (eventually)
4. Incentivize the right customer behavior

Compensation models for load flexibility

Low complexity

Type	Example
device-specific enrollment-based off-bill payment	$20 gift card for enrolling your thermostat, mailed once per year
device-specific enrollment-based bill credit	$20 credit applied annually on Oct bill for customers with enrolled thermostats
device-specific performance-based bill credit	$10/kW-yr for thermostat-based load reduction, applied on Oct bill
device-specific retail rate with time-varying component	TOU rate for EVs
device-agnostic retail rate with time-varying component	whole-home TOU rate
device-agnostic retail rate with time- AND location -varying components	whole-home TOU rate with locational pricing overlay

High complexity

Incentivization | Examples & case studies

Client #1 *- credit $30/month for every 5 smart charges* 💰

Pros
Low effort
Great for Alpha/Beta testing

Cons
Less scalable
Less of a driver for behavioural change

Client #2 *- $30 discount applied via electricity statement each month (EV)* 💸

Pros
Low effort
Can be an add on
Easy to understand

Cons
Less of a driver for behavioural change

Client #3 *- credit $10 each month for being on the tariff* 💰

Pros
Low effort
Great for Alpha/Beta testing

Cons
Less scalable
Less of a driver for behavioural change

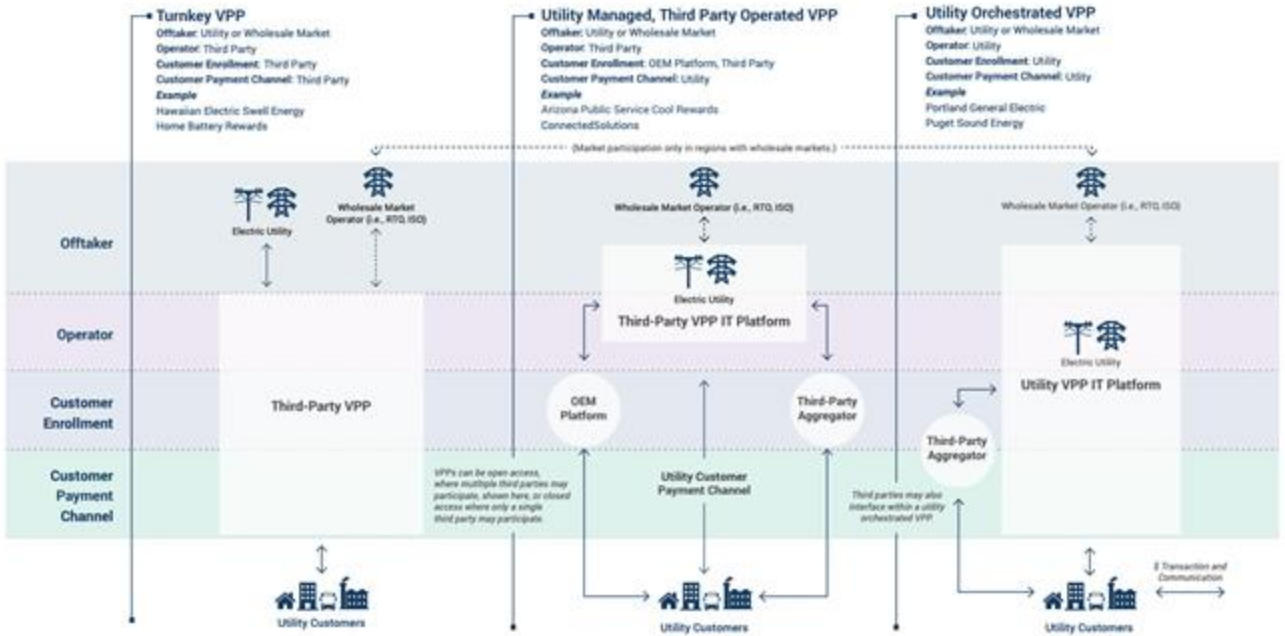
Client #4 *- dynamic time of use (7.5¢/kWh 12am - 5am, and all smart charging)* 🕛

Pros
Offers low rates
Drives changes to behaviour

Cons
Technically complex
Hard to explain to customers

Utility Participation Model – dictates who owns the customer relationship for flex services

Example VPP Utility Participation Models*



*The models and roles shown are representative and not exhaustive. Individual VPP features add more details to the structure and operations for each VPP. In addition to the models described above, some third parties have VPP programs that participate directly in wholesale markets. In this model, a utility may not hold any of the above roles, but may require visibility for management of distribution system impacts.
This framework has been adapted from the *DOE Pathways to VPP Commercial Liftoff Report*.

Thank you

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