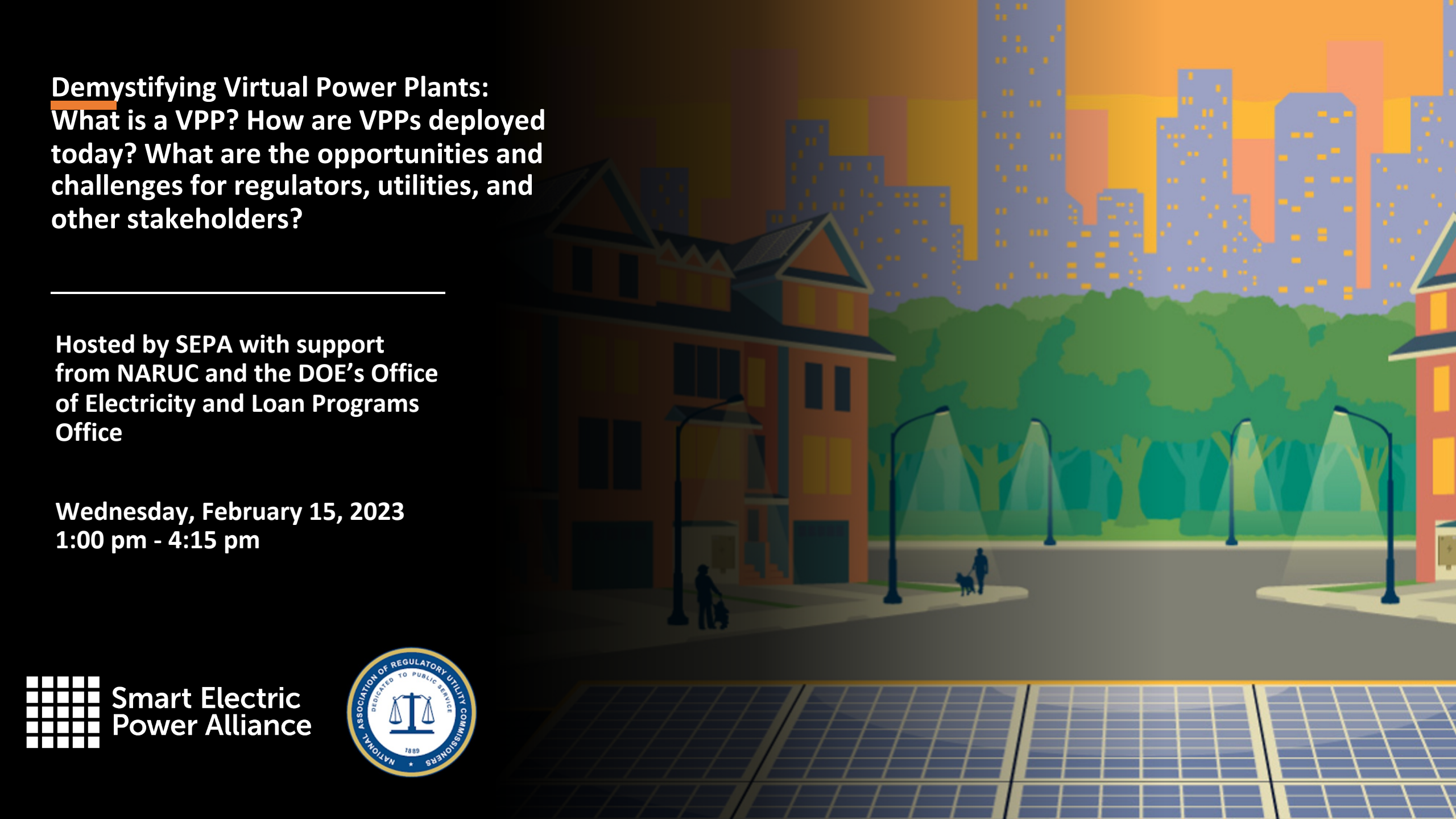
Demystifying Virtual Power Plants: What is a VPP? How are VPPs deployed today? What are the opportunities and challenges for regulators, utilities, and other stakeholders?

Hosted by SEPA with support from NARUC and the DOE's Office of Electricity and Loan Programs Office

Wednesday, February 15, 2023
1:00 pm - 4:15 pm



Smart Electric Power Alliance

Grid-interactive Efficient Buildings: Reinforcing the Grid with DERs

1:20 – 2:00 pm

Moderator:
David Nemtzow, Senior Advisor, Loan Programs Office, US DOE

Featuring:
Lea Márquez Peterson, Commissioner, Arizona Corporation Commission

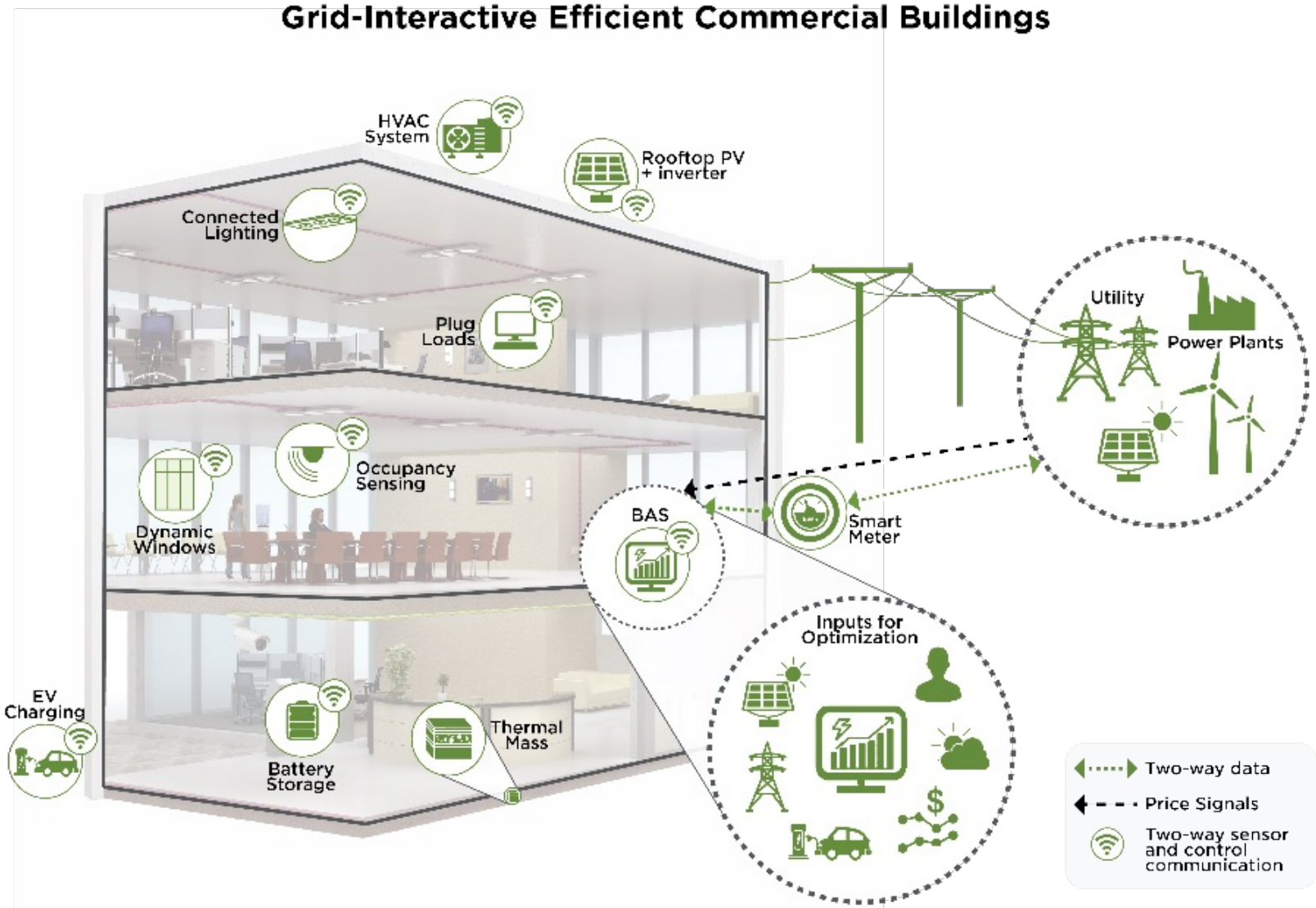
Lon Huber, SVP of Pricing & Customer Solutions, Duke Energy

Tilak Subrahmanian, VP, Distributed Energy Resources, Eversource

Chris Rauscher, Senior Director, Grid Services Policy, Sunrun

Smart Electric Power Alliance

Grid-Interactive Efficient Bldgs. (GEBs)…Resid. too

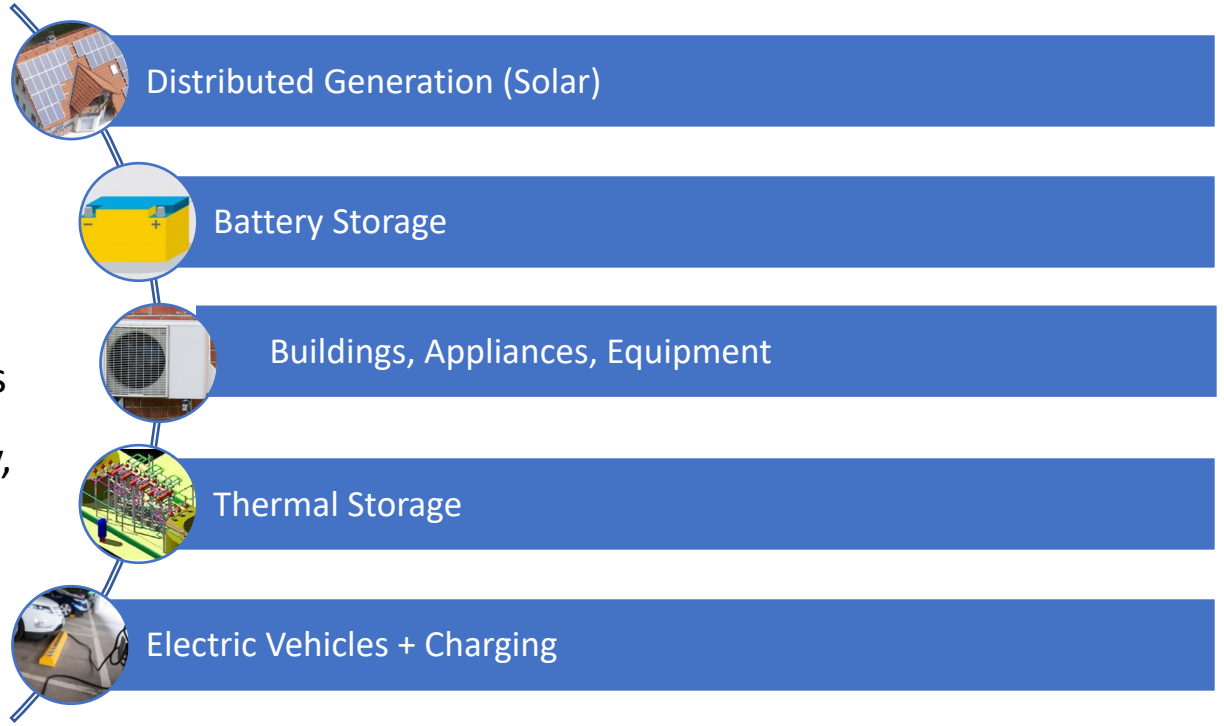


Groups of GEBs provide added value

Virtual Power Plants

VPPs are connected aggregations of DERs – PV, batteries, responsive loads, EV charging, controls & more – remotely and automatically controlled to deliver affordable power, reliability, decarbonization and clean grid services.

- ✓ Aggregations of DERs that are controllable
- ✓ Non-co-located assets scaled into a holistic demand-side and/or supply-side resource
- ✓ May entitle the VPP participants to compensation for grid services
- ✓ VPPs serve essential customer functions, create demand flexibility, fortify grid reliability & resilience
- ✓ VPPs support CO_2 reduction, energy equity, and energy bill reduction for households, small businesses, and other end users
- ✓ *VPPs are utility-scale and utility-grade*

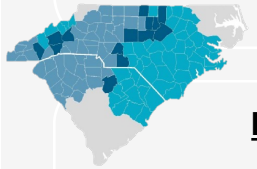


➢ *Don't sweat definitions, LPO/DOE is happy to talk about lots of technologies, structures, approaches*

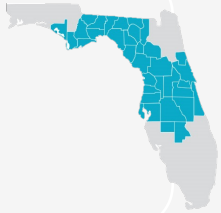
Traditional Demand Response Programs

EnergyWise Home

Duke Energy Progress (NC & SC)
Smart Thermostat
AC Control Device
Heat Strip Control Device
Water Heater Control Device
Smart Thermostat + Water Heater Bundle



Duke Energy Florida
Heating
Cooling
Water Heater
Pool Pump

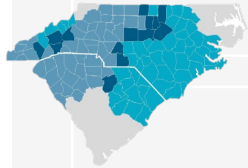


3,146 MW Summer Capacity

2,277 MW Winter Capacity

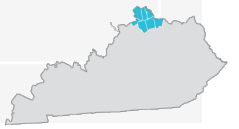
Power Manager

Duke Energy Carolinas (NC & SC)
Smart Thermostat
AC Control Device
Heat Strip Control Device



Duke Energy Indiana
Smart Thermostat
AC Control Device

Duke Energy Kentucky
AC Control Device



Both EnergyWise Home and Power Manager pay customers to reduce usage via specific devices when demand response events are called

Demand Response Evolution

1970s — Load control begins for emergency use only

2000s — Load control for economic purposes begins, starts with AC control devices

Early 2010s — Smart thermostats are added for summer reduction

Late 2010s — Smart thermostats are expanded to include winter reduction

2020s — Electric heat strip control device option added for winter peaks

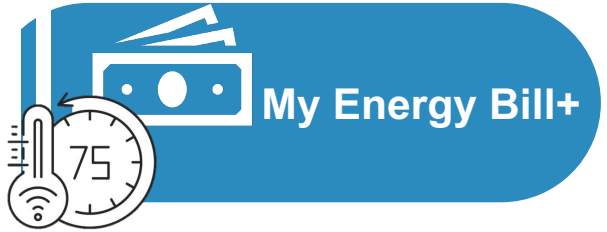
SERVICE TERRITORIES
Duke Energy Carolinas | Duke Energy Progress | Overlapping Service Territory

Next Generation Demand Response

Current Proposals

- Align net metering tariffs to embedded cost of service* through advanced time varying rates
- Filed bundled EE incentives to fairly allocate marginal system benefits + utility-controlled demand response programs
- Requires solar customers to enroll in the winter BYOT program

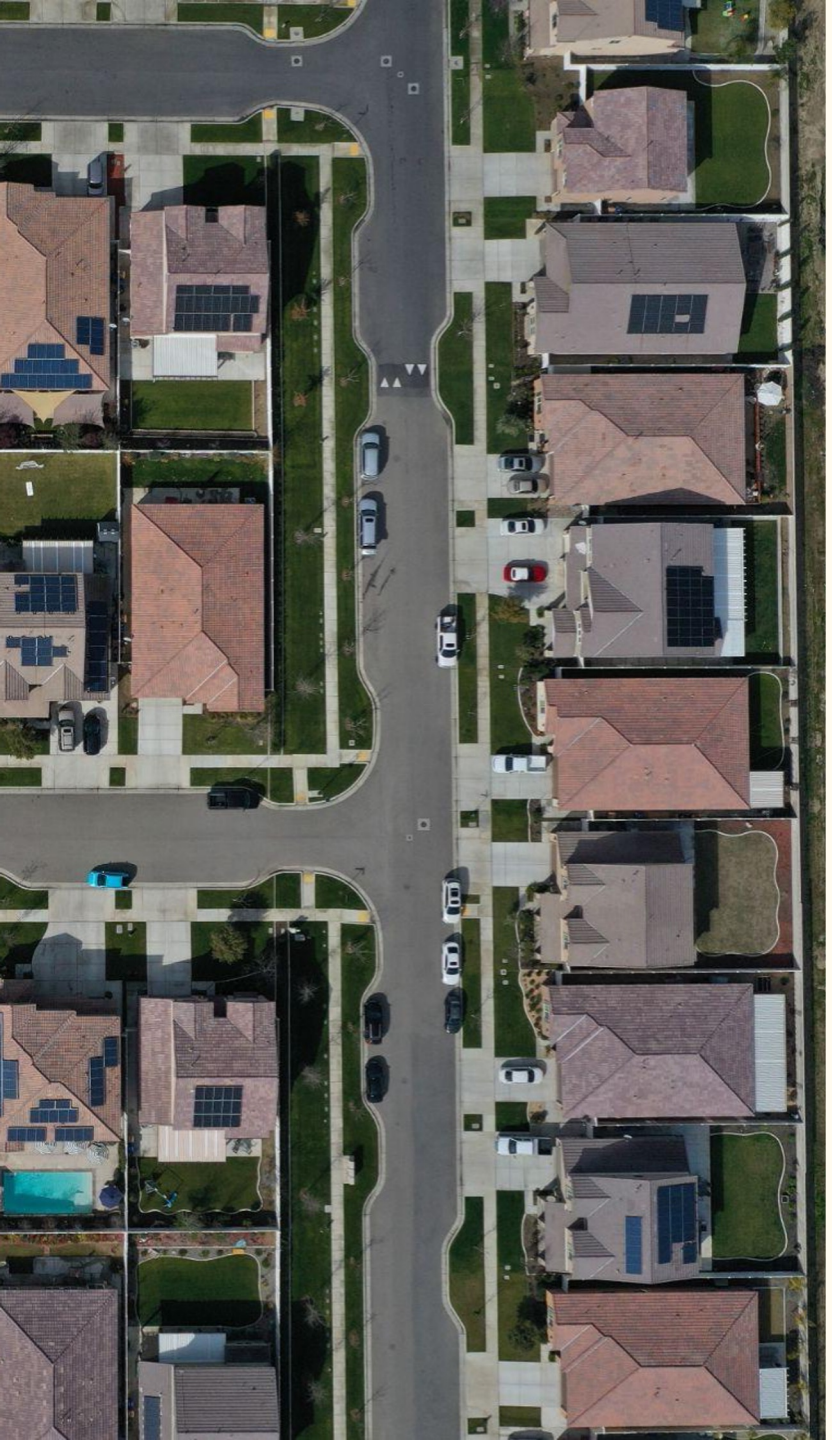
- Partnered with Ford to pilot the use of F150 Lightning^ batteries to support the grid
- Call up to 24 events per year, lasting no more than four hours
- Participating customers compensated approximately via a reduced lease payment



- A subscription-based program that provides bill certainty in exchange for utility control of a smart thermostat during periods of peak demand
- The option to purchase Renewable Energy Certificates as an easy way to participate in clean energy generation
- Income qualified customers will be offered a free to heavily discounted smart thermostat to expand accessibility to participate in such programs

*Updated NEM tariffs have been approved in South Carolina
^Additional Ford models and vehicles made by other OEMs may be included during the pilot

DUKE ENERGY®



The Power of Virtual Power Plants

Sunrun is a leader in Virtual Power Plant solutions

- Sunrun actively participates in more than a dozen VPPs
- VPPs in 10% of Sunrun markets; expect 50% in coming years
- Wholesale participation, state-level programs and contracts with utilities
- Recently approval of Puerto Rico's first Virtual Power Plant, serving the entire island grid

New England

First Residential VPP Successfully Bid Into Wholesale Market + BYOD

California

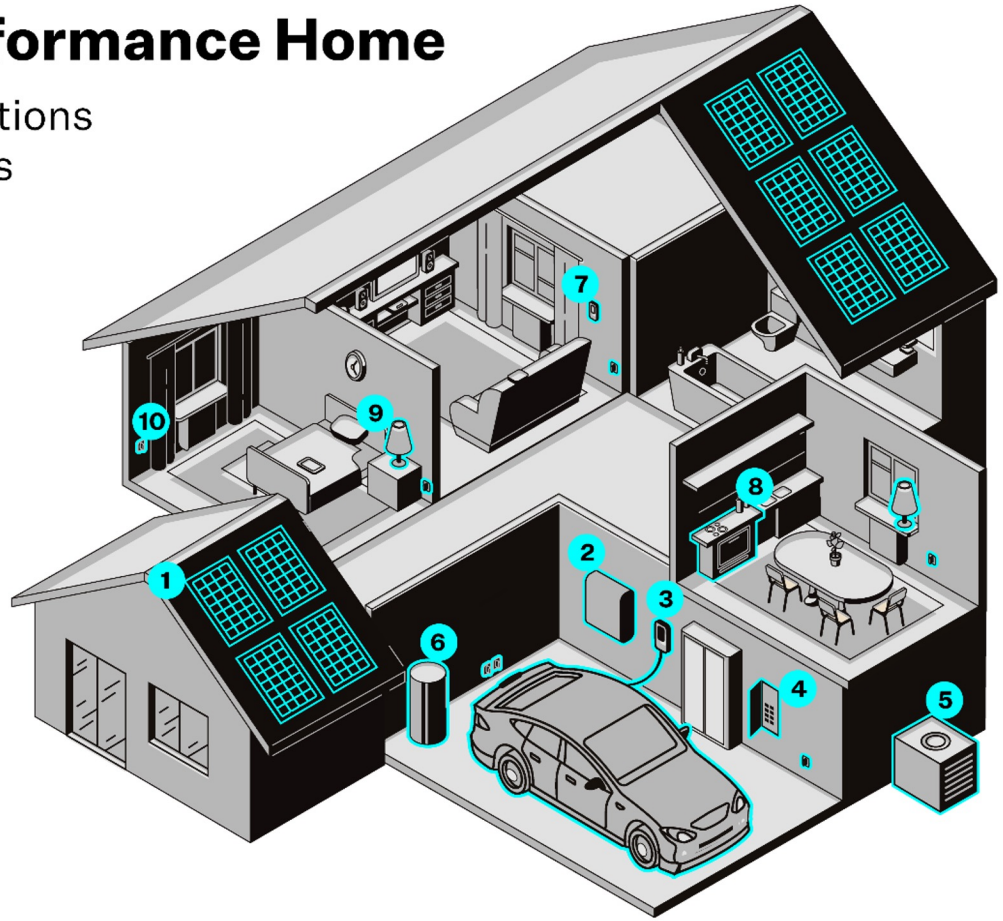
Enabling Participation In Utility Demand Response & CAISO Emergency Load Response Program

Puerto Rico

Customer-Driven Solution: 7000 Homes in First Large-Scale Residential VPP On The Island

Sunrun's High Performance Home

enabling electrification solutions
that address customer goals



1. Solar Panels
2. Batteries
3. EV charger
4. Smart circuits
5. Heat pump heating & cooling
6. Heat pump water heater
7. Smart thermostat
8. Induction cooktop
9. Smart bulbs
10. Smart plugs

sunrun

We Enable No-Compromise, High Performance Homes For Our Customers
(*that happen to be solar powered & all-electric*)

Millions of Mini Power Plants: What Vehicle-to-Grid Technology Means for Reliability, Resilience, and Affordability on the Grid

2:00 – 2:45 pm

Moderator:
Ann McCabe, Commissioner, Illinois Commerce Commission

Featuring:
Lydia Krefta, Director, Clean Energy Transportation, PG&E

Apoorv Bhargava, CEO & Cofounder, WeaveGrid

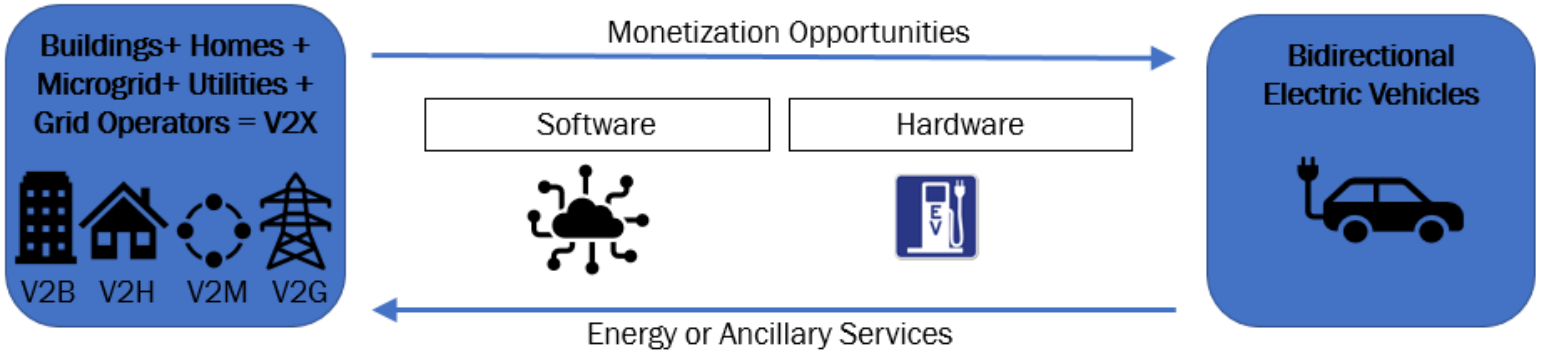
Dana Guernsey, Co-Founder and Chief Product Officer, Voltus, Inc.

Rima Kasia Oueid, Senior Commercialization Executive, Office of Technology Transitions, U.S. Department of Energy

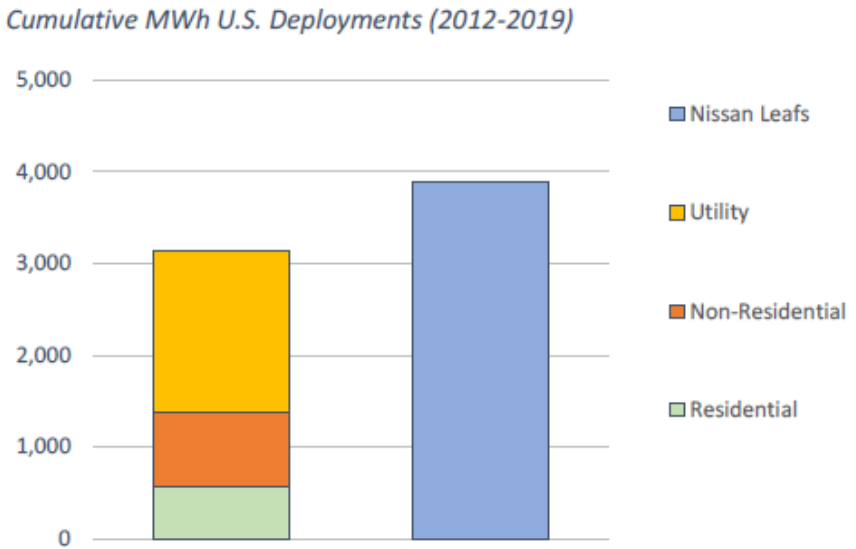
Smart Electric Power Alliance

Bidirectional Electric Vehicles = V2B+V2H+V2M+V2G = V2X

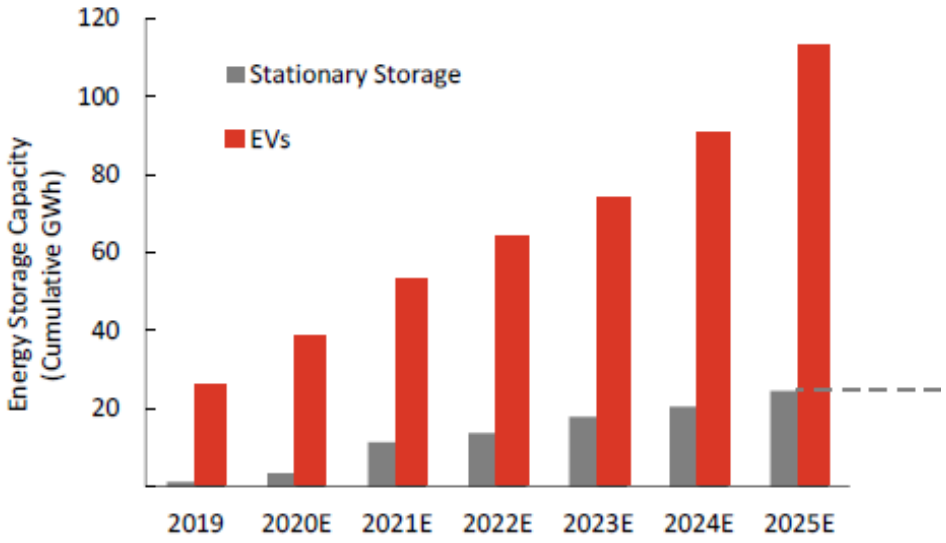
Electric Vehicles can be both a mobility asset and an energy asset



- International Energy Agency estimates 130 million electric vehicles globally by 2030
- These EVs could contain 10 times the amount of energy storage needed by the grid



Source: Wood Mackenzie Energy Transitions Practice, Inside EVs

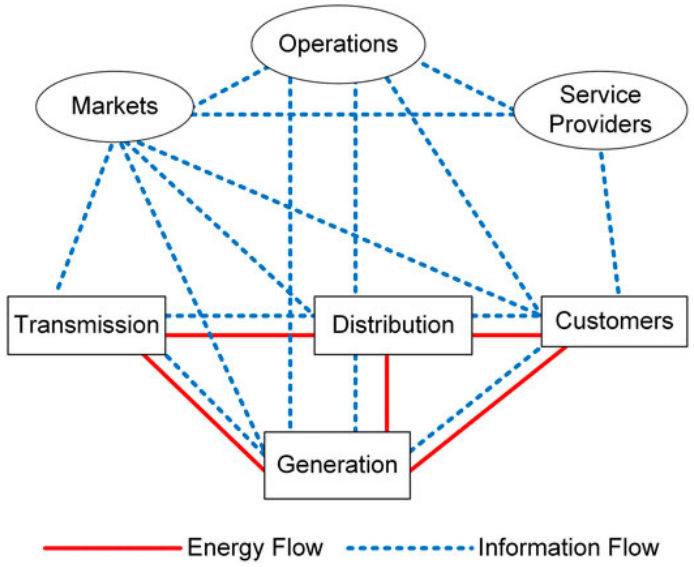


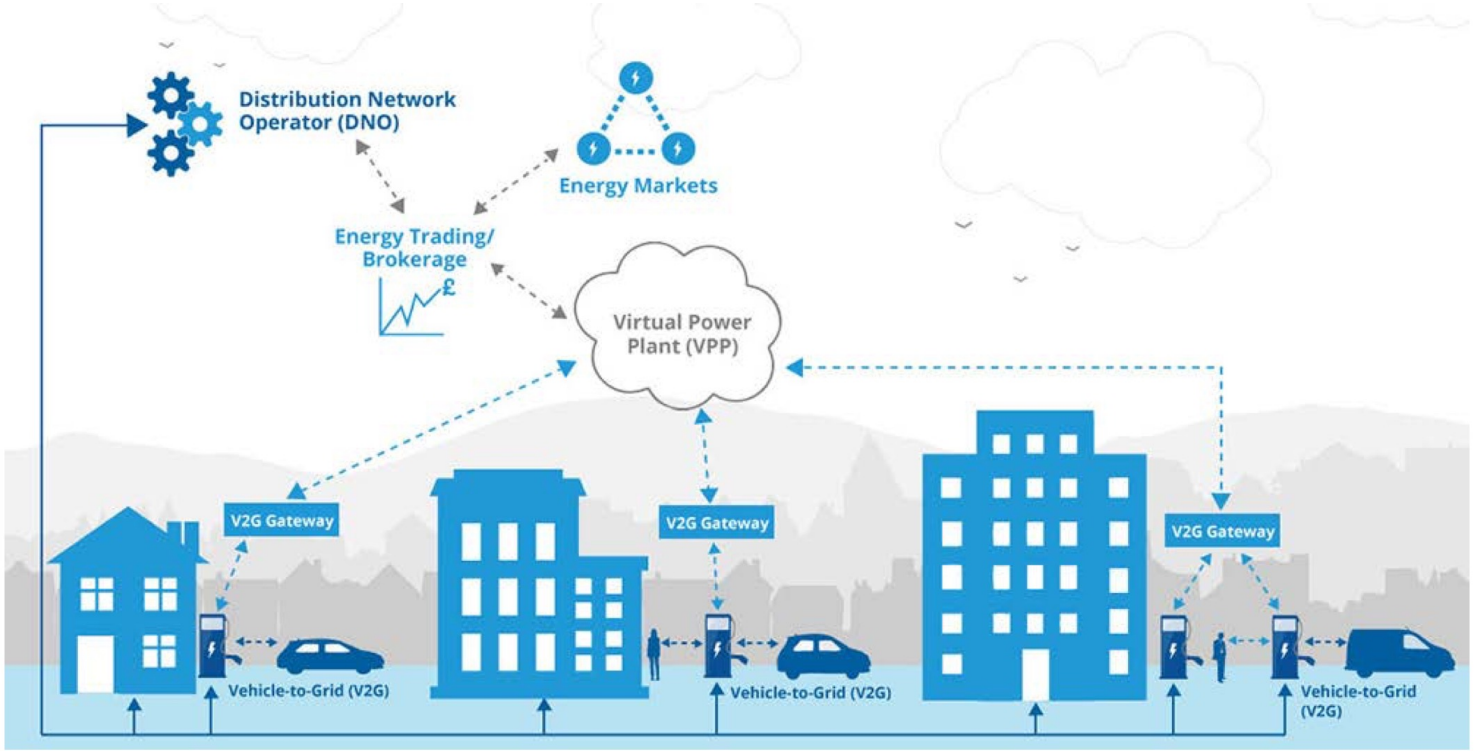
$28B cumulative spending on energy storage forecasted 2019-2025E

Source: Wood Mackenzie Energy Transitions Practice, Inside EVs

The Vision for V2X & VPPs

Enable **transportation and energy networks** to work together as a single **symbiotic system** capable of delivering transport and energy storage services to the grid (e.g **Virtual Power Plants**) and serve as **a catalyst to help modernize the grid and evolve to a Smart Grid**



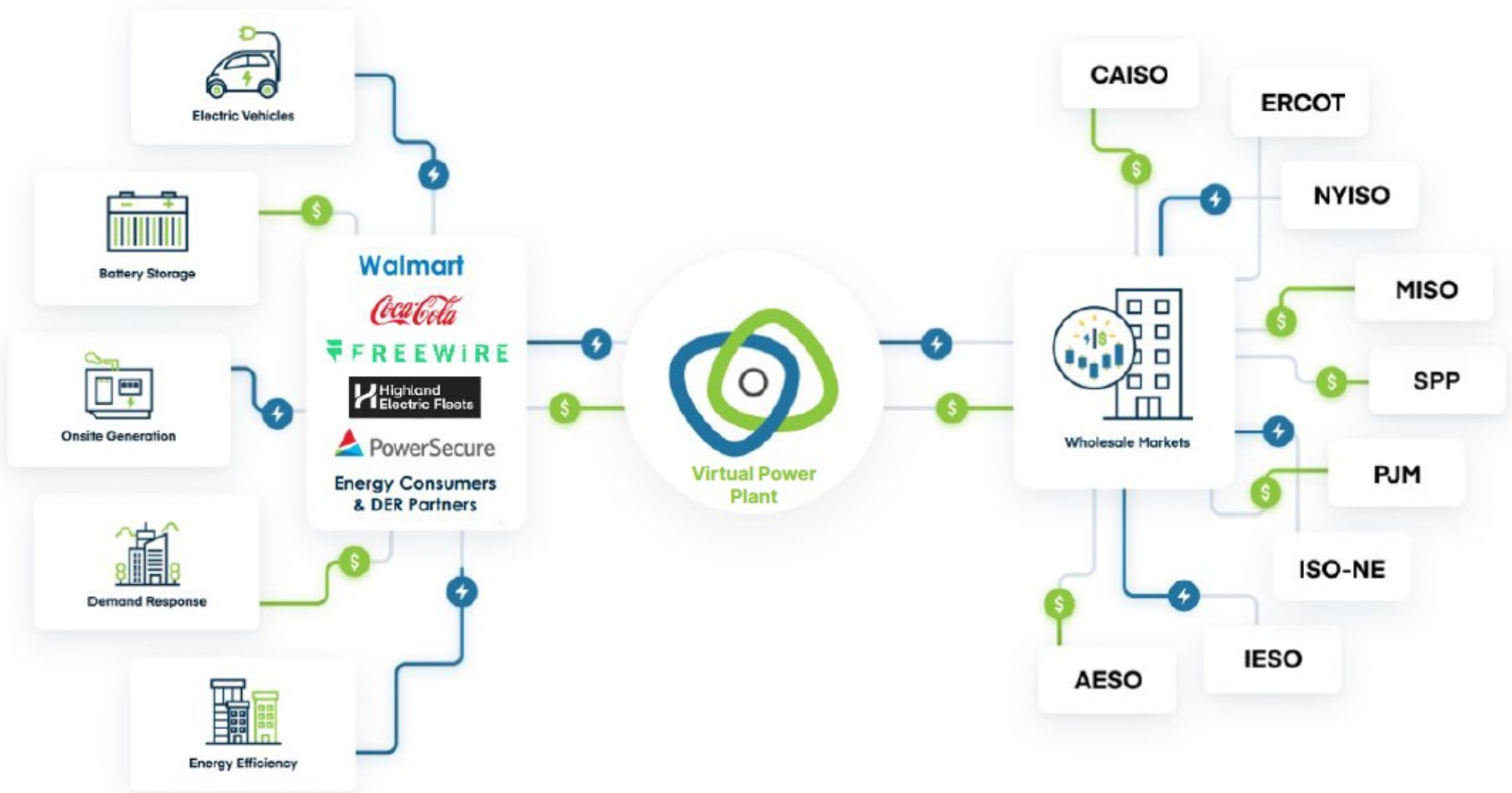


Schematic Representation of V2G Operations

Source: National Renewable Energy Laboratory

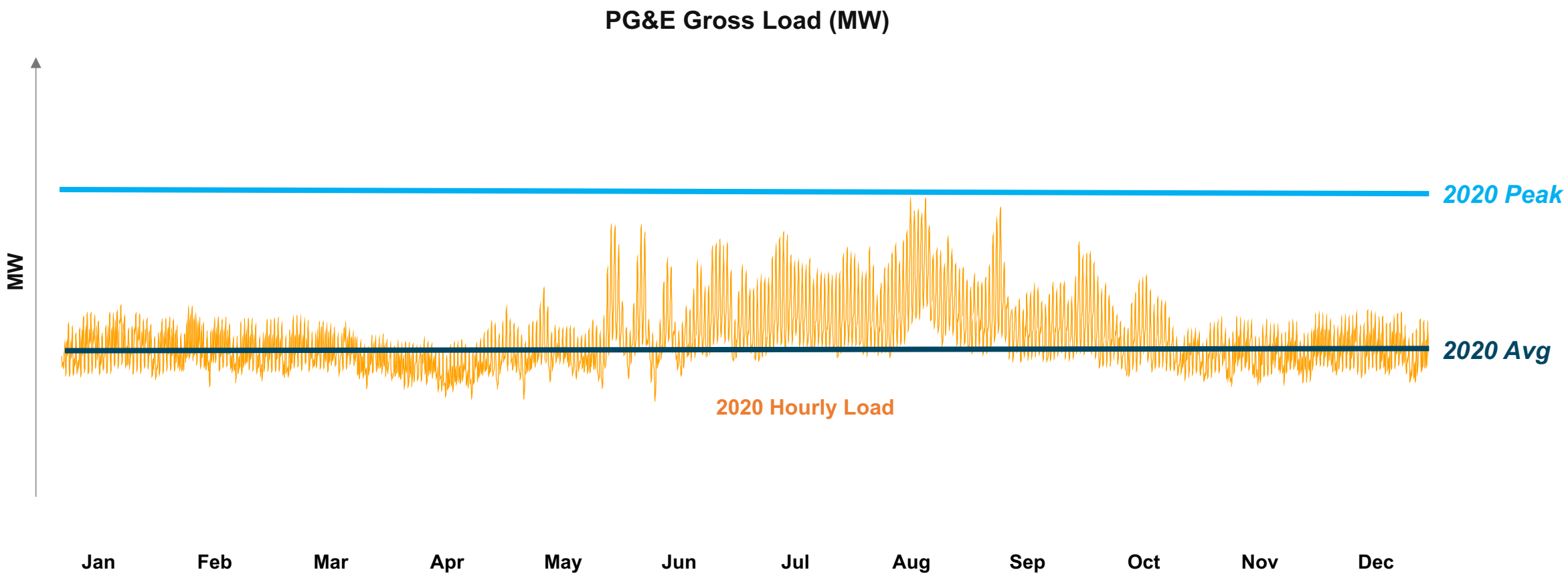
Enabling customers & partners to monetize their DERs

"Machines to markets to money": The Voltus platform aggregates DERs into VPPs and sells their services (energy, ancillary services, capacity) to grid operators; Voltus shares a portion of that cash with its partners.



Electric Vehicles Can Improve System Economics for All Customers

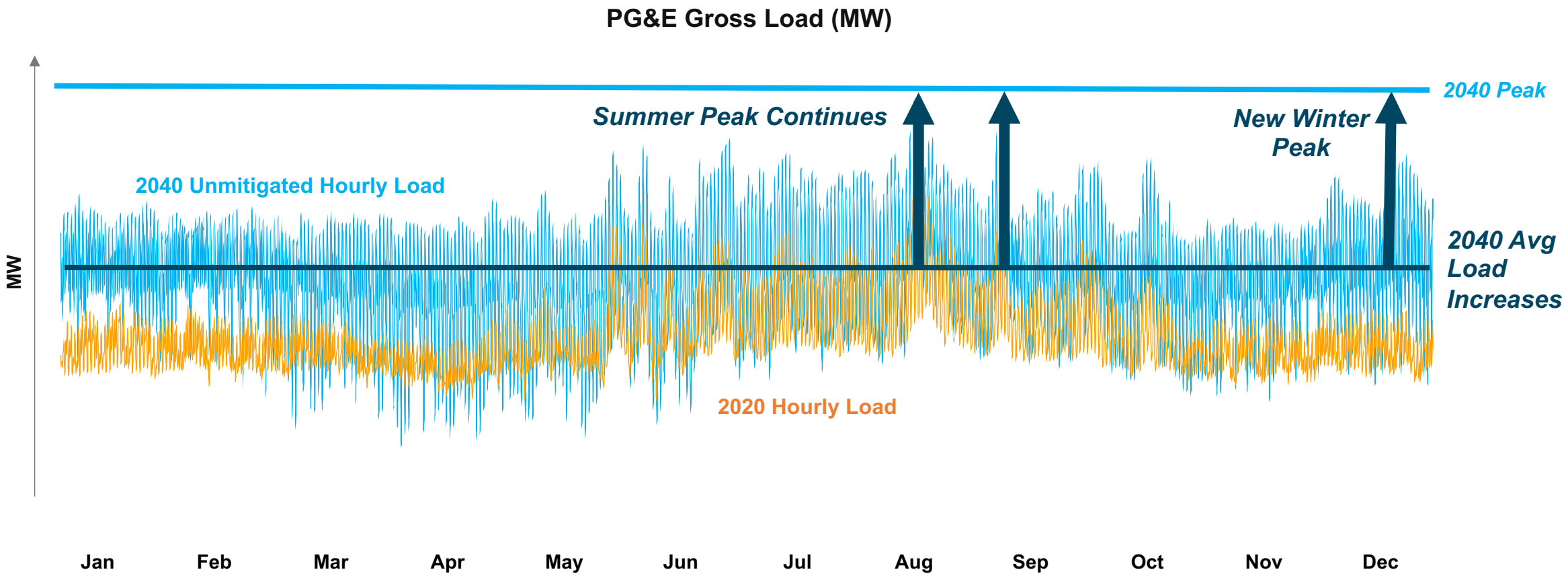
As power plants built to serve peak demand retire, we can use EVs to utilize excess capacity, reduce unit prices, and provide power back to the grid in lieu of building replacement fossil fuel power plants



Source: *Internal, not an approved forecast*
PG&E Hourly Energy Management System Load Data, 2022

Electric Vehicles Can Improve System Economics for All Customers

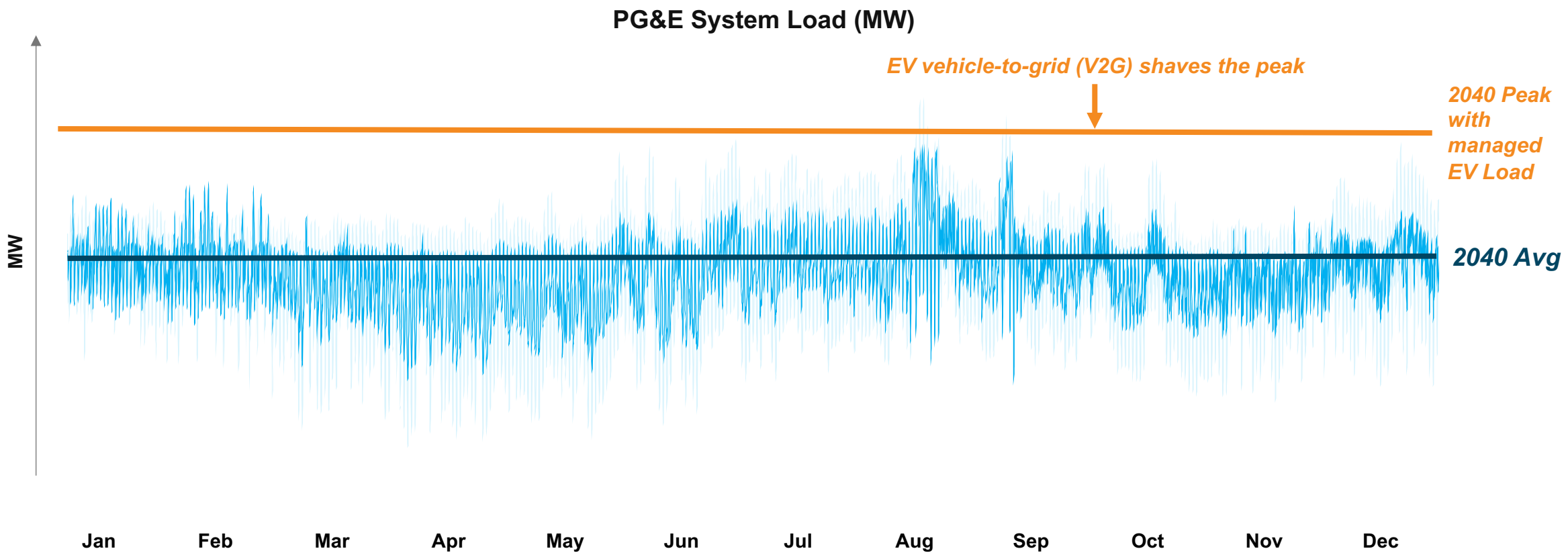
By 2040, increasing energy sales requires a **significant build out of new energy supply** and a grid that can accommodate its delivery to customers. A wider range of high and low loads and the emergence of a second peak in the winter also necessitates more flexibility in the supply mix and demand-side optimization.



Source: *Internal, not an approved forecast*
PG&E Hourly Energy Management System Load Data, 2022

Electric Vehicles Can Improve System Economics for All Customers

Optimizing EV charging enables us to realize a future where EV charging is inexpensive and carbon free. Without optimization, natural gas peaker plants would need to be maintained to meet unmitigated peak demand, adding cost and emissions.



Source: *Internal, not an approved forecast*
PG&E Hourly Energy Management System Load Data, 2022

Unlocking the Full Potential of EVs

PG&E's goal is to accelerate adoption of affordable clean transportation fueled by affordable clean energy, leveraging EVs to decarbonize society at the lowest societal cost

If properly managed, EVs can provide the triple value stack of emissions, reliability, and resiliency benefits.

Reliability
Reduces peak demand on a hot summer day

Resiliency
Provides backup for medium-long duration outages

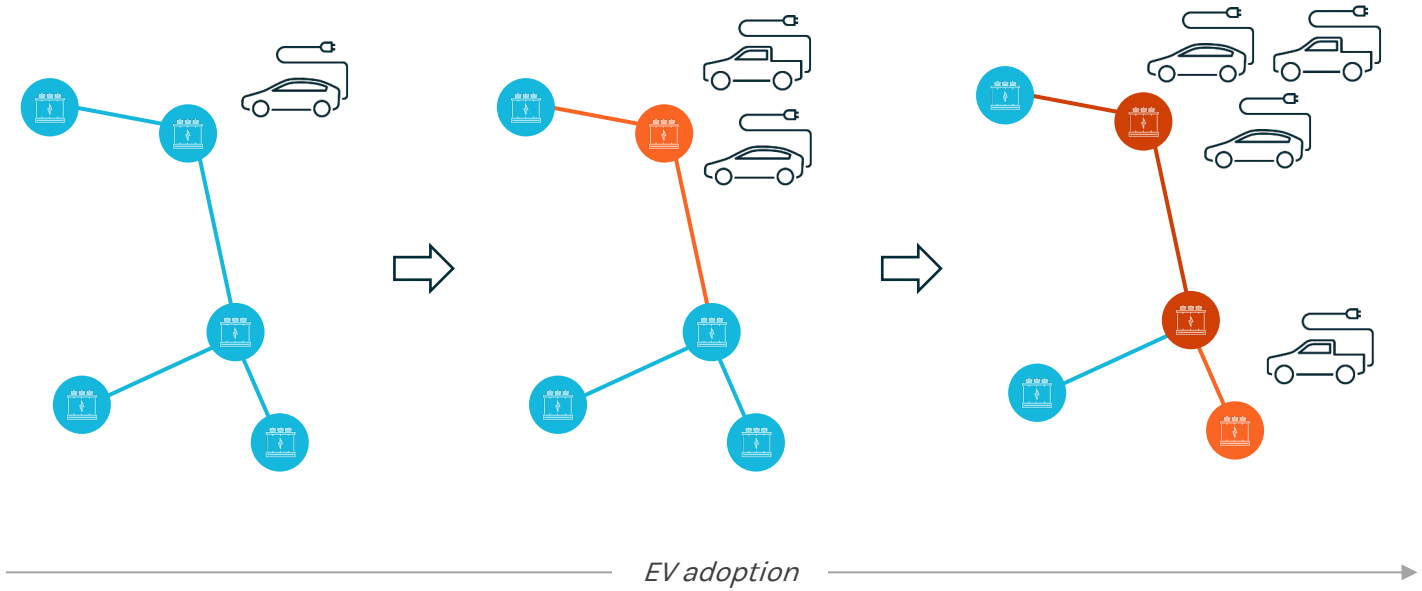
GHG Reduction
Significantly reduces California's largest source of emissions (40%)[1]

1. CARB GHG Inventory (2021 Edition)

WeaveGrid connects two industries undergoing once-in-a-century transformations

Increased EV adoption creates a need for more sophisticated distribution planning

OVERLOADING FROM EVs COULD LEAD TO DISTRIBUTION ASSET AGING AND FAILURE



80% of charging happens at home

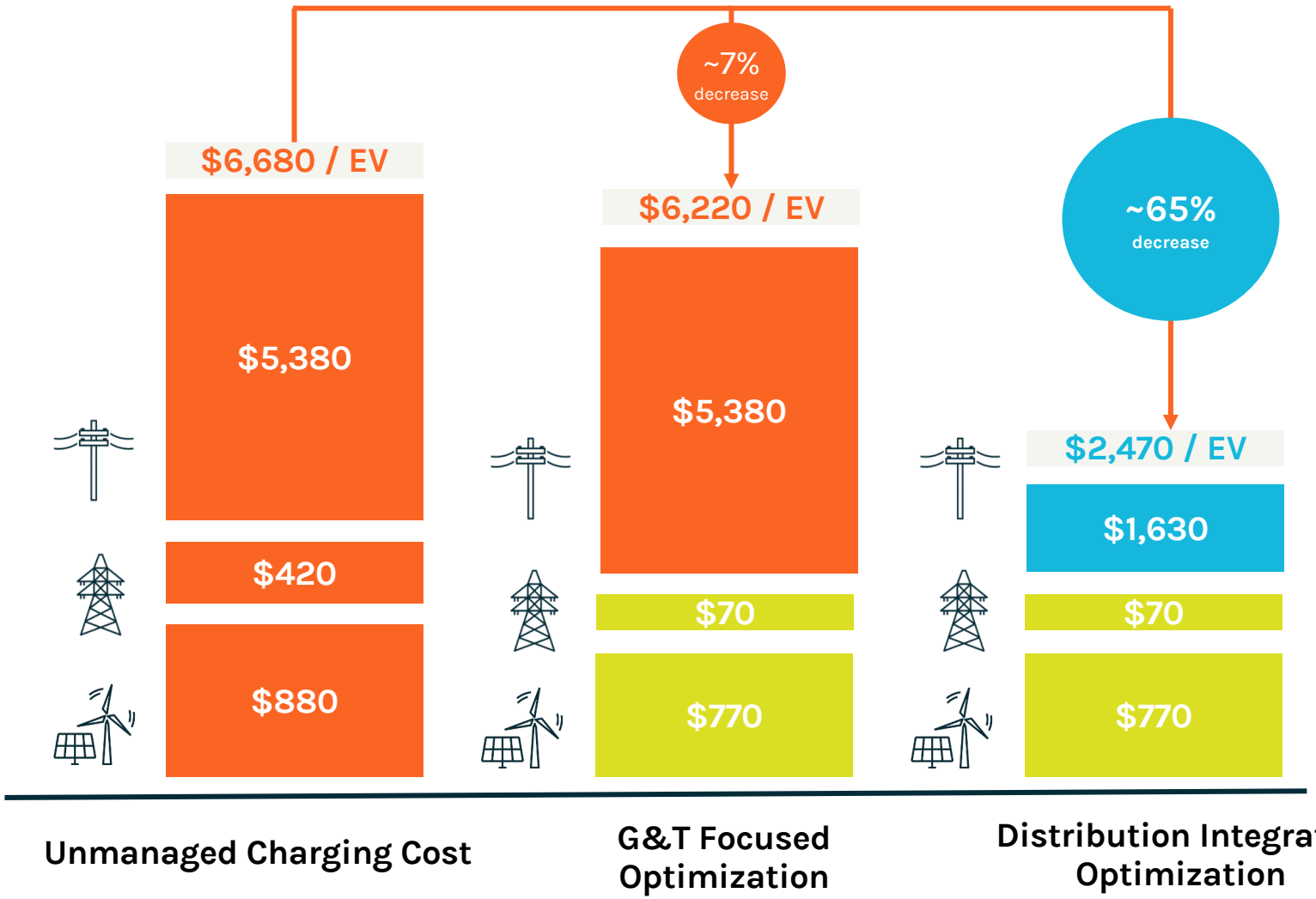
Level 2 charger = 2-3 homes' demand

EV adoption is very clustered

Local transformer supports 4-8 homes

WeaveGrid

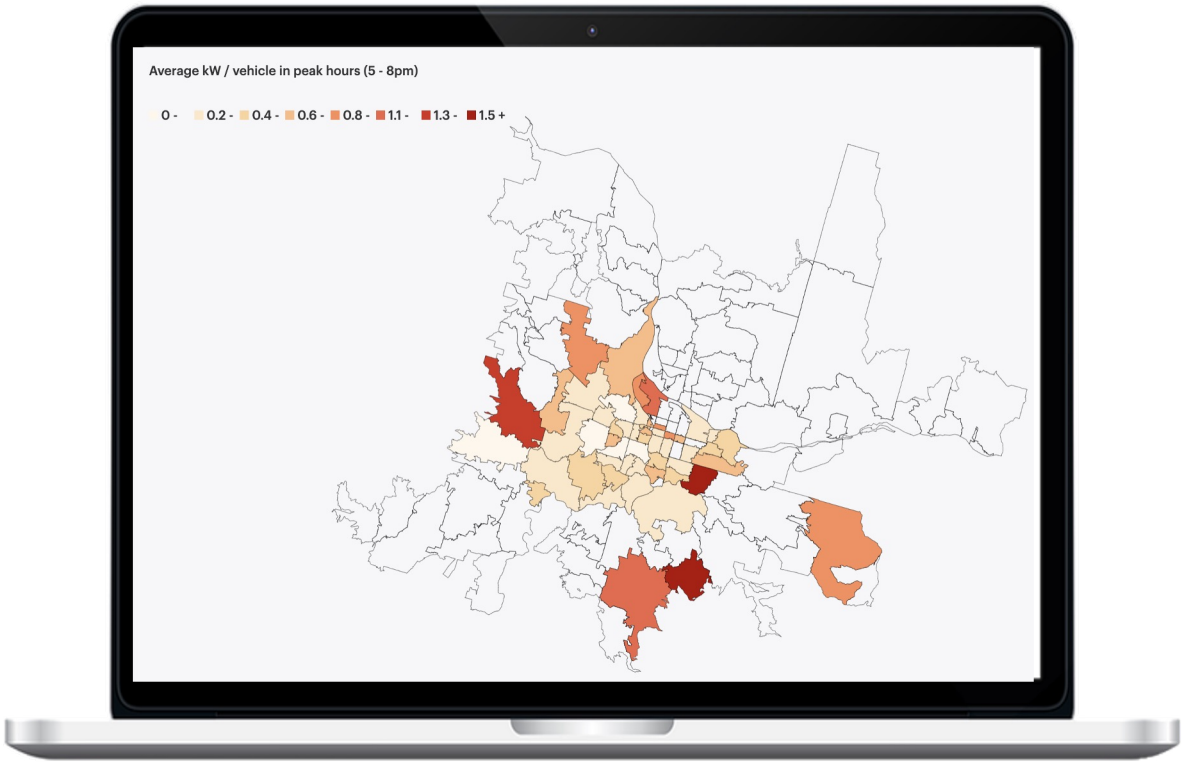
Preparing the grid for EVs will require Distribution focused optimization



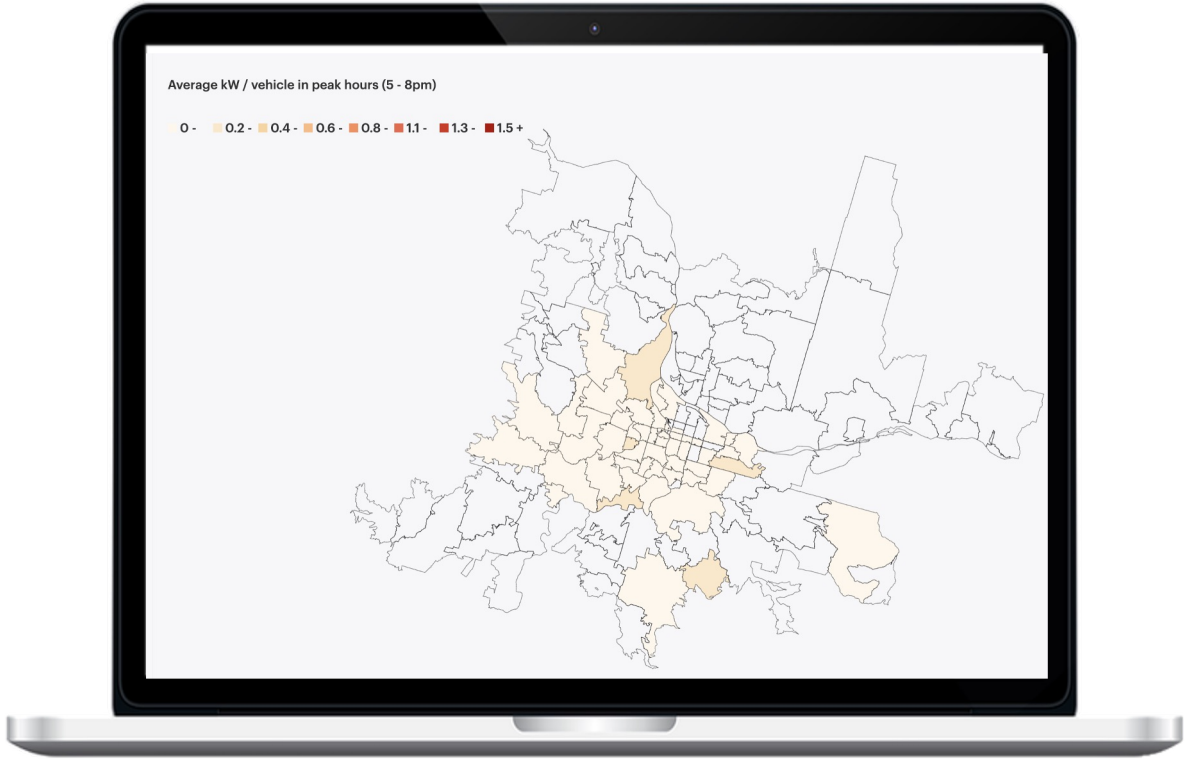
WeaveGrid

Charging optimization value is maximized by solving across time AND location

On-Peak Charging Load
with no management



On-Peak Charging Load
with Managed Charging



Drafting the Blueprint: What Utilities Need to Know and Need to Build to Begin Taking Advantage of the VPP Opportunity

3:15 – 4:00 pm

Moderator:
Yok Potts, Director, Regulatory and Business innovation, SEPA

Featuring:
Matt Schuerger, Commissioner, Minnesota Public Utilities Commission

Pearl Donohoo-Vallett, Senior Manager, Strategy, Exelon

Kevin Brehm, Manager, Carbon-Free Electricity, RMI

Seth Frader-Thompson, President, EnergyHub

Smart Electric Power Alliance

RMI's Virtual Power Plant Partnership (VP3)

Members

Ford, gm, Nest, leap, olivine, OhmConnect, SPAN, SUNPOWER, sunrun, switchDin, Virtual Peaker

VP3 Priorities

- Convening
- Direct Support
- Education

Website: vp3.io

VP3 VIRTUAL POWER PLANT PARTNERSHIP

VPPs help advance power system performance across multiple objectives

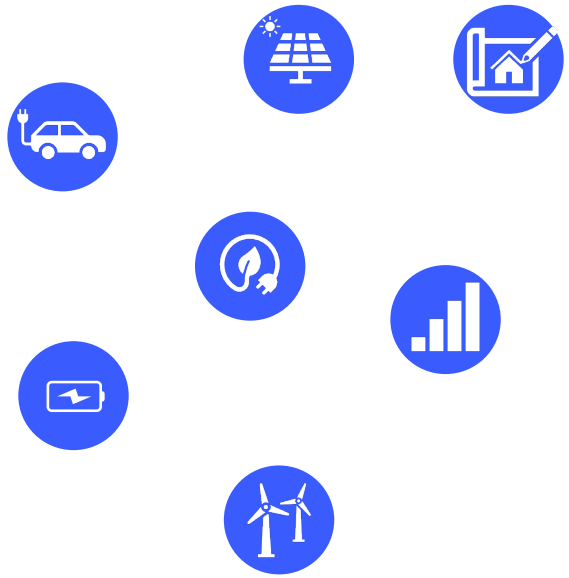
VPP BENEFITS

- RELIABILITY
- AFFORDABILITY
- DECARBONIZATION
- ELECTRIFICATION
- HEALTH AND EQUITY
- CONSUMER EMPOWERMENT

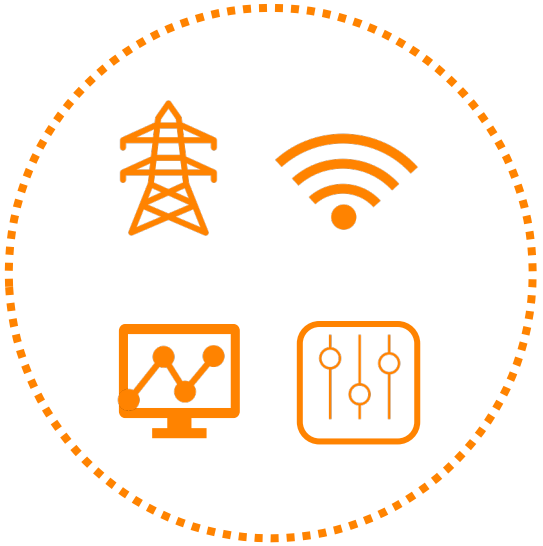
VP3
VIRTUAL POWER PLANT PARTNERSHIP

Creating Interactive Distribution Systems

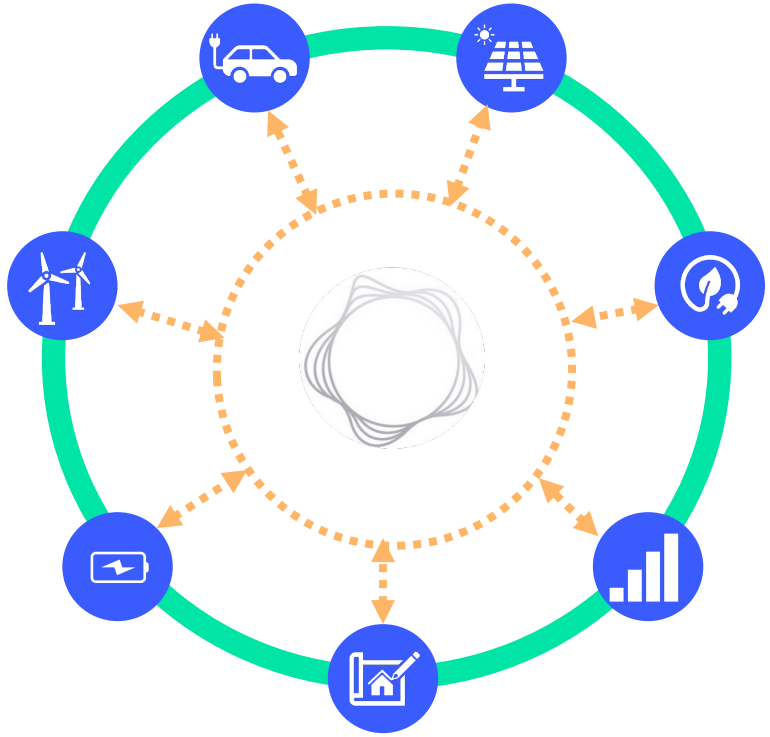
Customer Adoption of Climate Solutions



Communications, Monitoring and Control Infrastructure



Active Platform of Climate Solutions



pepco holdings℠
AN EXELON COMPANY

Elk Neck Virtual Power Plant

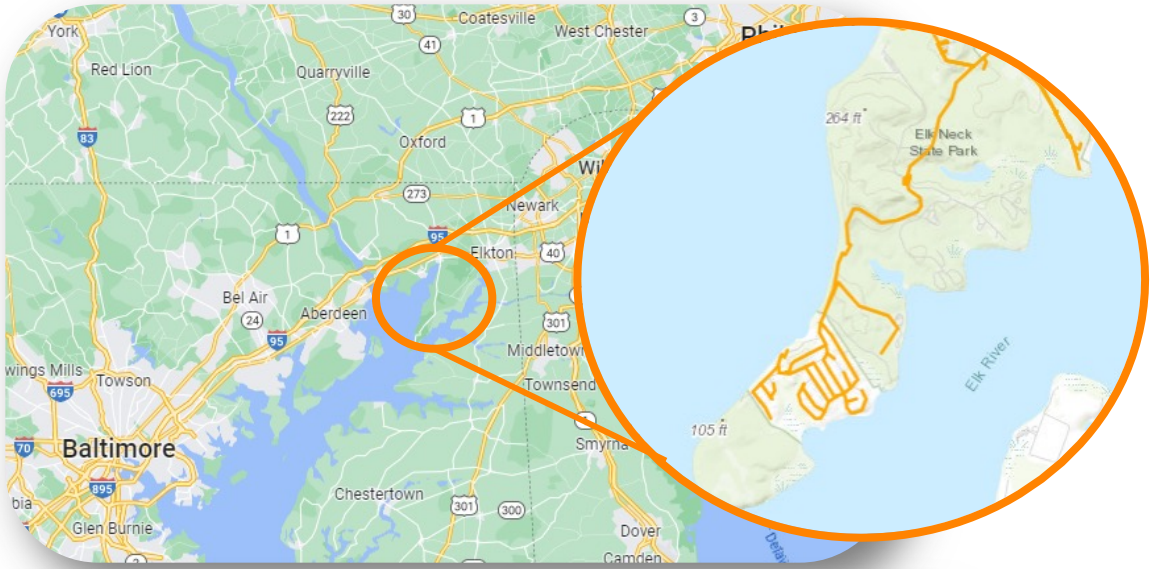
delmarva power℠
AN EXELON COMPANY

VPP Profile

- 110 residential customers
- Behind the meter storage (0.5 MW / 1.5 MWh)

VPP Services

- Ancillary services
- Distribution services
- Customer backup generation



pepco holdings℠
AN EXELON COMPANY

The largest and fastest-growing multi-DER portfolio

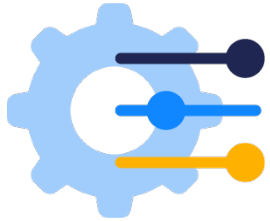
Working with over

60 utilities

to manage nearly

1 million DERs

(distributed energy resources)



1,300 MW

of flexible dispatchable capacity

EnergyHub

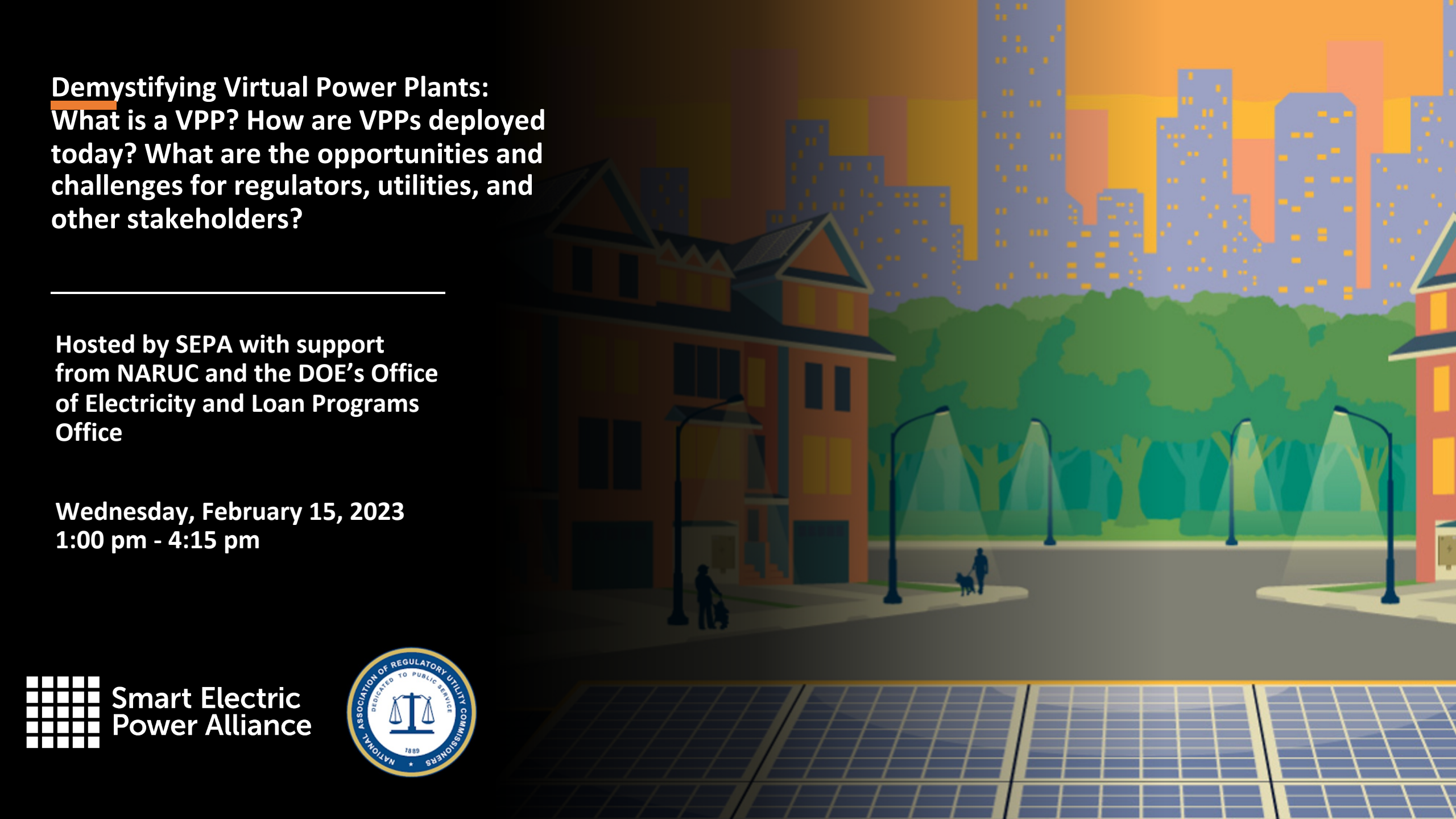
The US will need 500 GW of flexibility

US capacity needed to decarbonize

Demystifying Virtual Power Plants: What is a VPP? How are VPPs deployed today? What are the opportunities and challenges for regulators, utilities, and other stakeholders?

Hosted by SEPA with support from NARUC and the DOE's Office of Electricity and Loan Programs Office

Wednesday, February 15, 2023
1:00 pm - 4:15 pm



Smart Electric Power Alliance