2022 ENERGY SYMPOSIUM DAY 1
THURSDAY, MARCH 3, 2022

TEA
2022 ENERGY SYMPOSIUM
THE FUTURE IS NOW

BENEFICIAL ELECTRIFICATION & EV INTEGRATION

GARRETT FITZGERALS, PHD, SENIOR DIRECTOR, ELECTRIFICATION, SEPA

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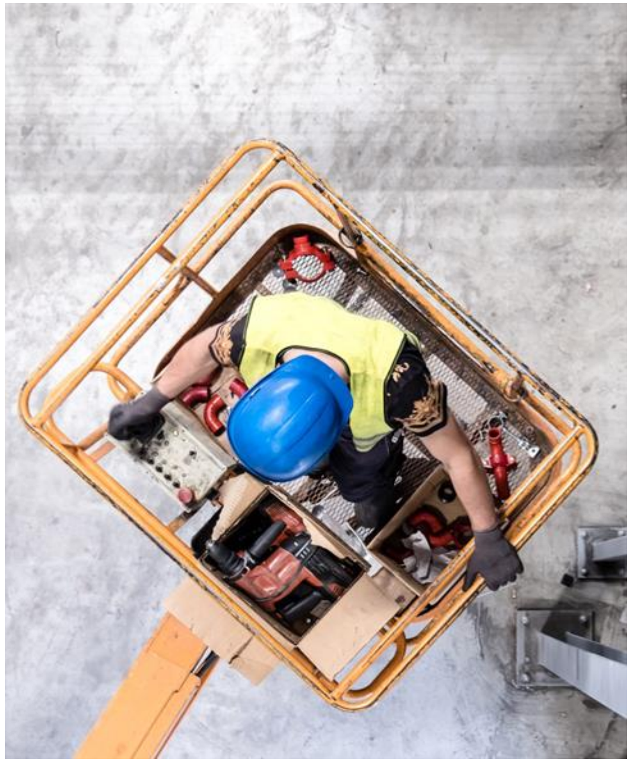
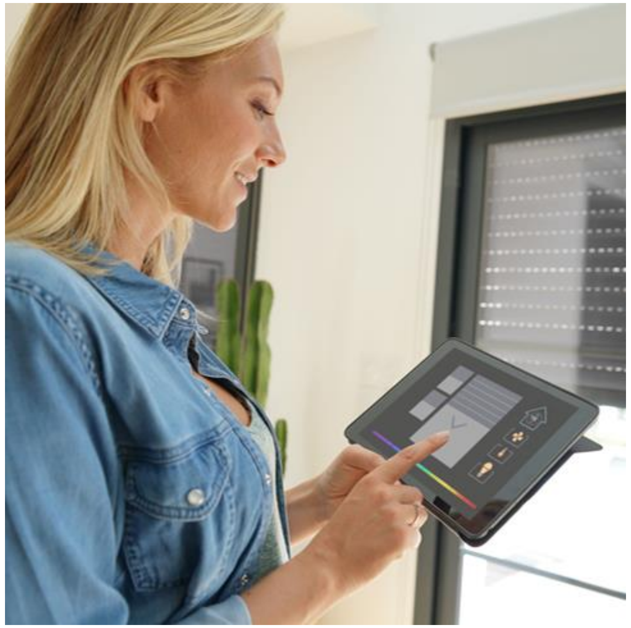
SENIOR DIRECTOR, ELECTRIFICATION
SEPA





Who Are We?

Smart Electric Power Alliance

A membership organization

Staff of ~50

Based in Washington, D.C.

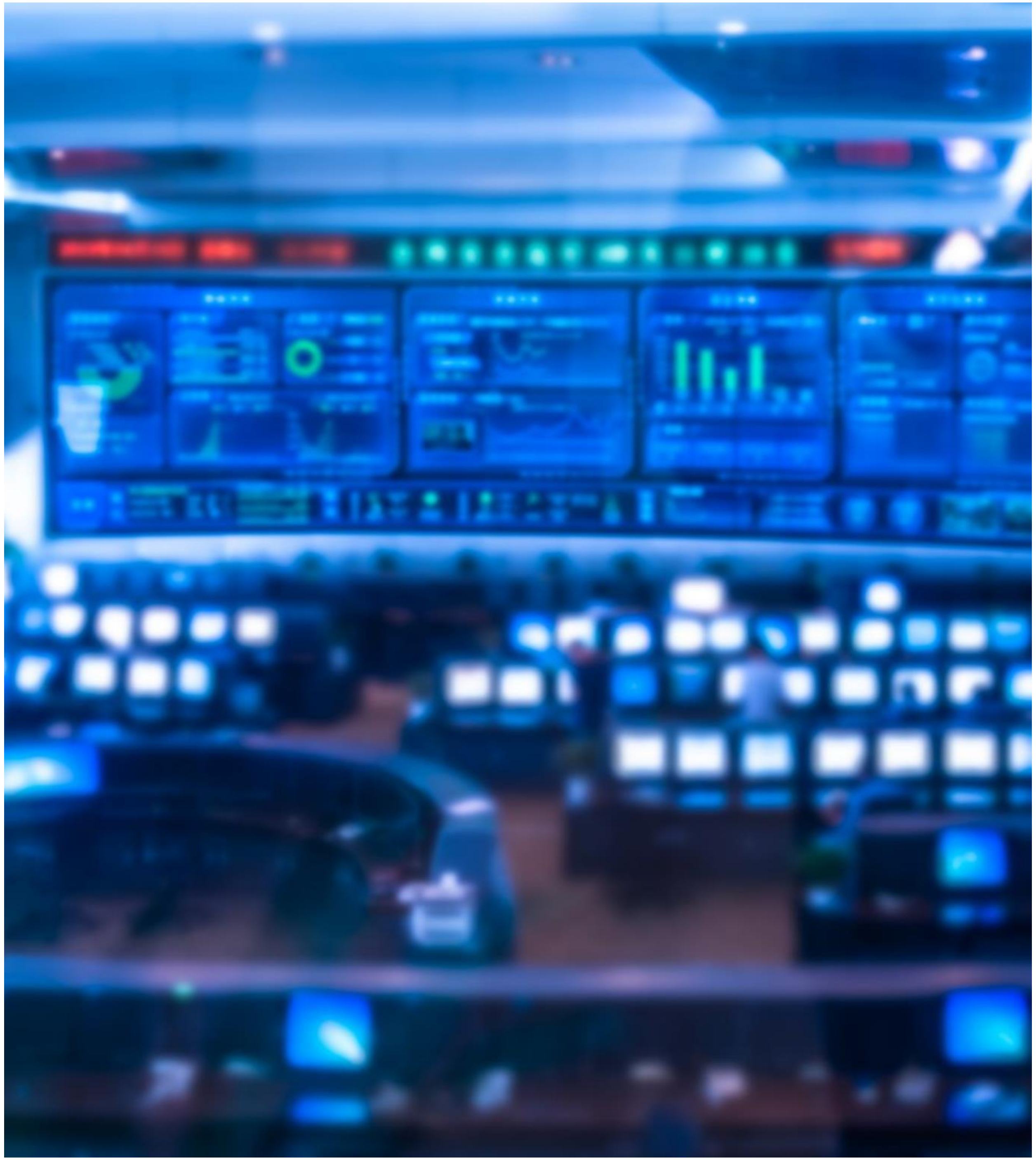
No Advocacy – 501c3

Founded in 1992

Research, Education, Collaboration & Standards

Unbiased

Technology Agnostic



Smart Electric Power Alliance

Vision

A carbon-free energy system by 2050

Mission

To facilitate the electric power industry's **smart transition** to a clean and modern energy future.

Smart Electric Power Alliance

SEPA Research & Education

- Advisory Services
- Workshops
- Research Reports
- Webinars
- Conferences

UTILITY CONFERENCE

Grid Evolution Summit

EXECUTIVE FACT FINDING MISSION SEPA

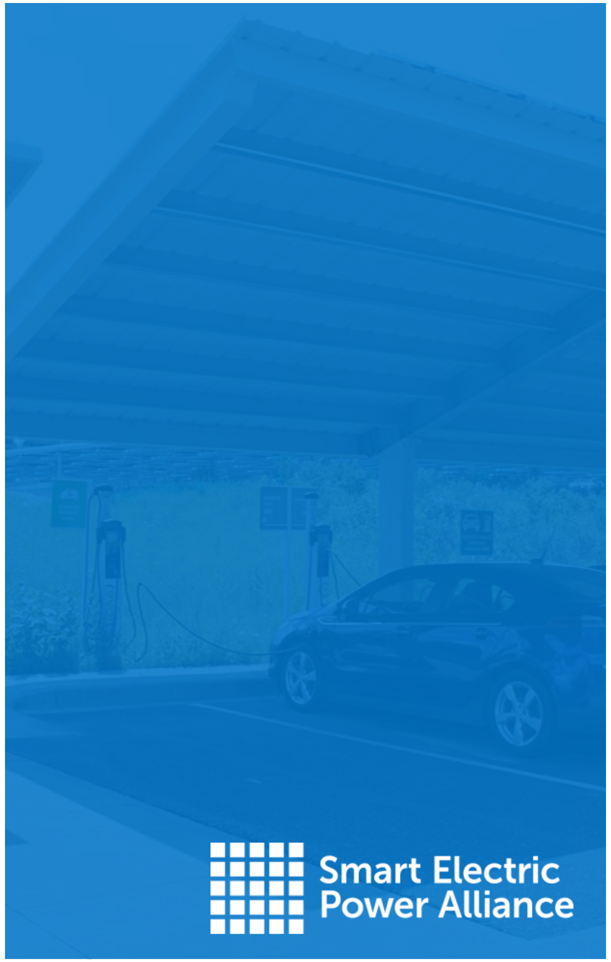
RE+

SEPA Utility Transformation CHALLENGE

SEPA POWER PLAYERS

SEPA TV

Collaborative teams of member SMEs addressing important industry issues



Working Groups

- Community Solar
- Cybersecurity
- Electric Vehicle
- Energy Storage
- Grid Architecture
- Microgrids
- Testing and Certification
- Transactive Energy Coordination

Pathways

Regulatory and Business Innovation

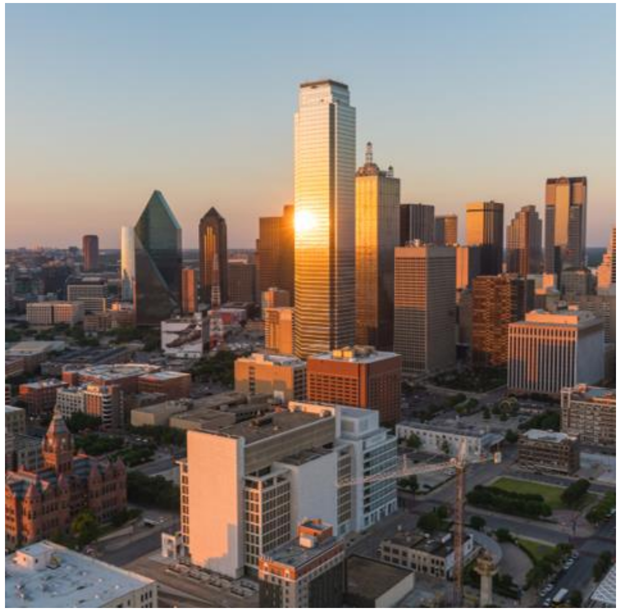
Facilitates sustainable utility business models and the state regulatory processes needed to achieve a carbon-free energy future.

Grid Integration

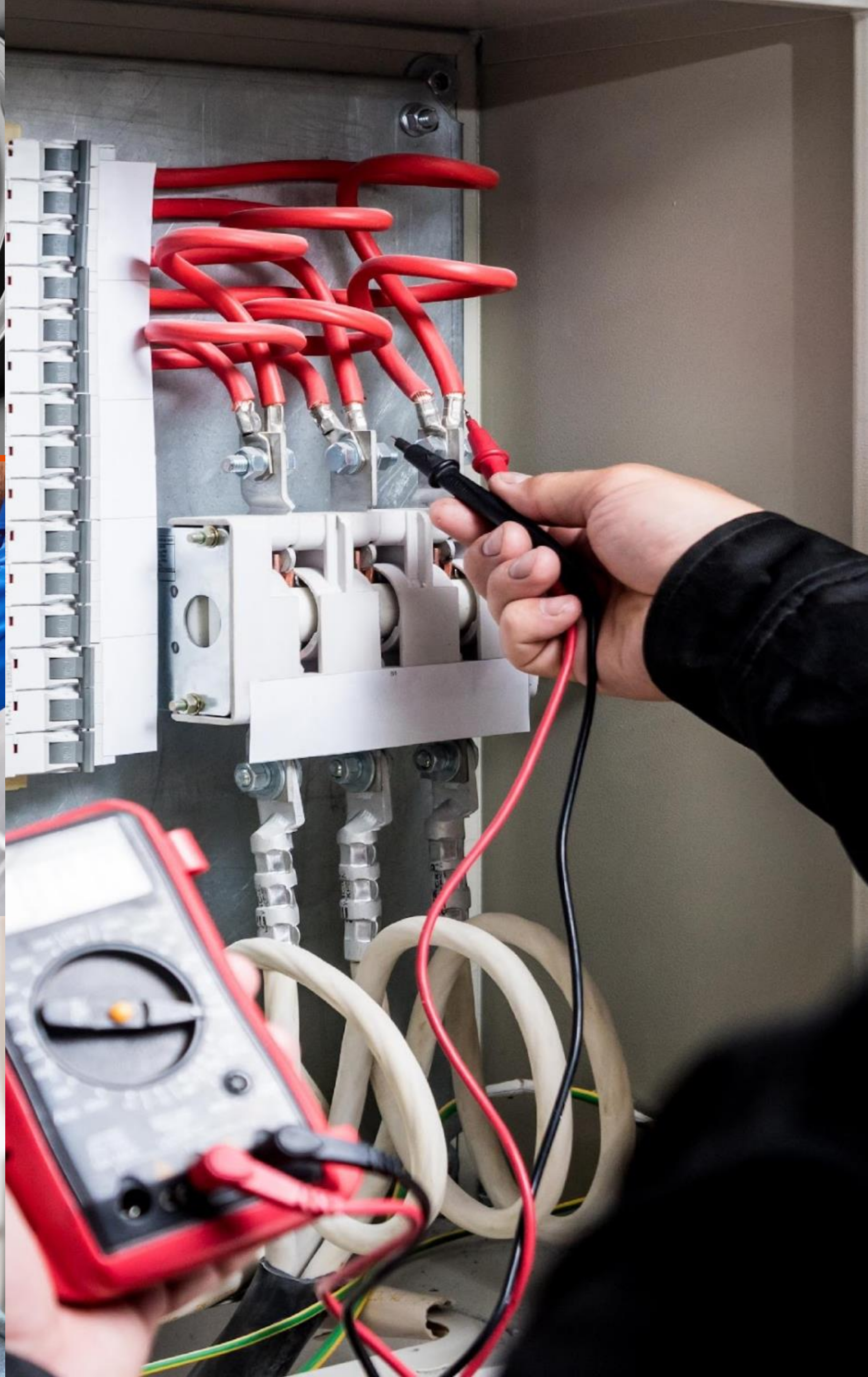
Enables carbon-free energy to be easily integrated with positive impact to affordability, equity, safety, security, reliability, resilience, and customer satisfaction.

Electrification

Facilitates the transition of the nation’s vehicles and buildings to be powered by carbon-free electricity.

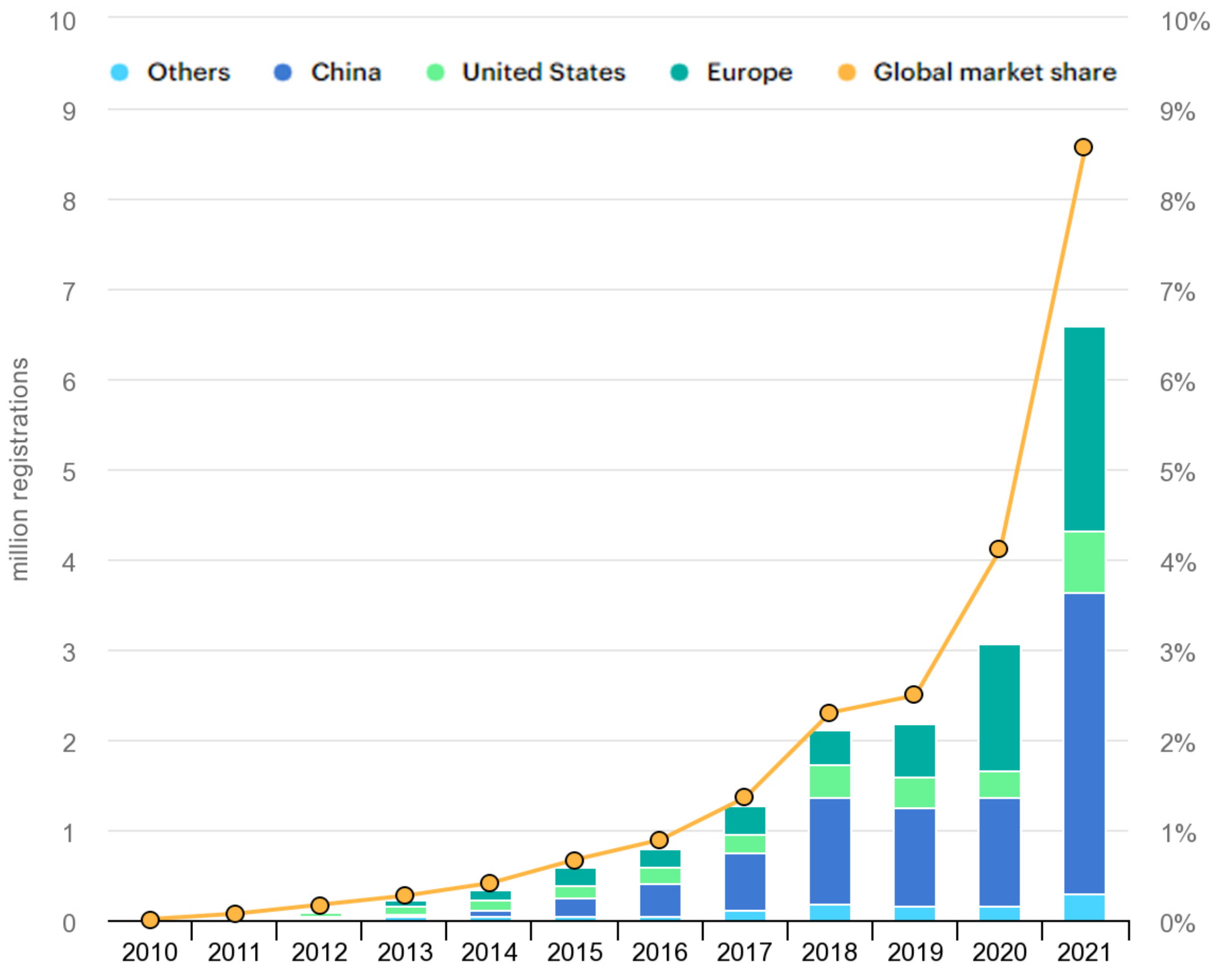


Market Trends



Global EV sales rise 80% in 2021

- 7 million EV sold in 2021 compared to 3 million in 2020
- 1 in ten vehicles sold globally is electric
- 1 in twenty vehicles sold in the US today is electric



Source: Green Car Reports (from IEA report)

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Gas phase out around the world

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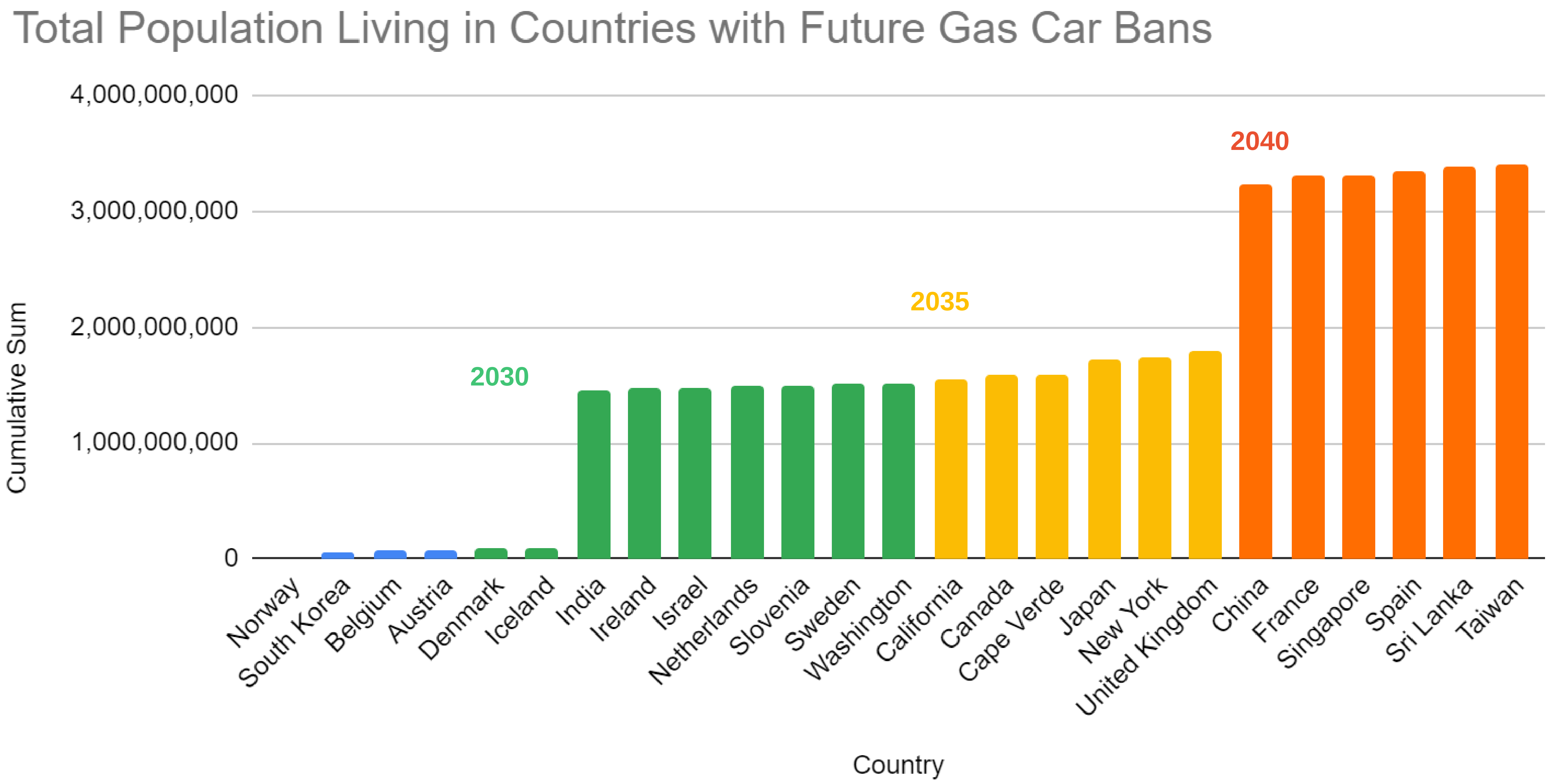
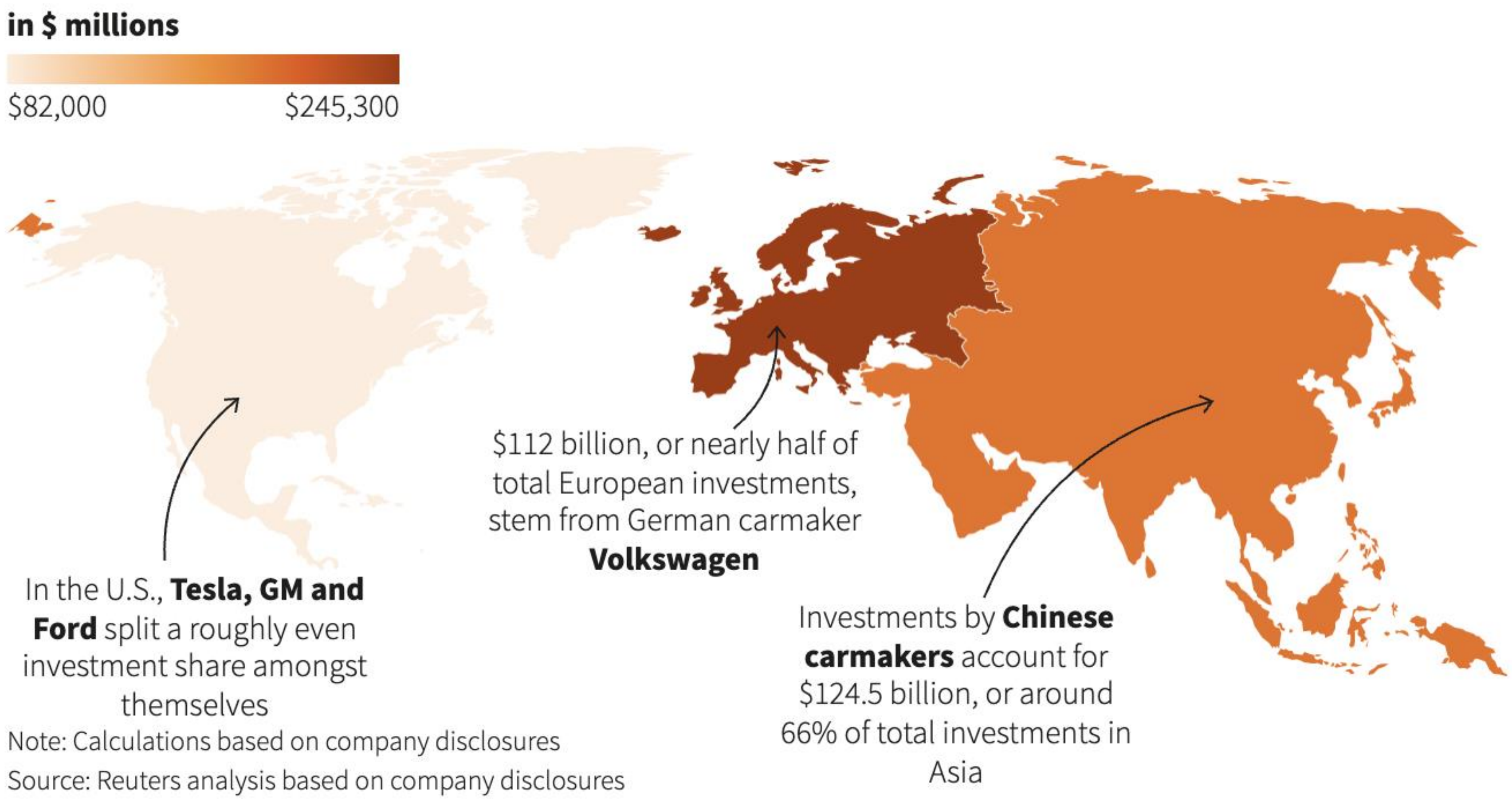


Auto makers target $515 billion for EVs (globally)



Source: Reuters, Nov 2021

EV Registrations in the US (2021)

EV sales jumped by nearly 70% while overall car sales fell by 13% in 2021

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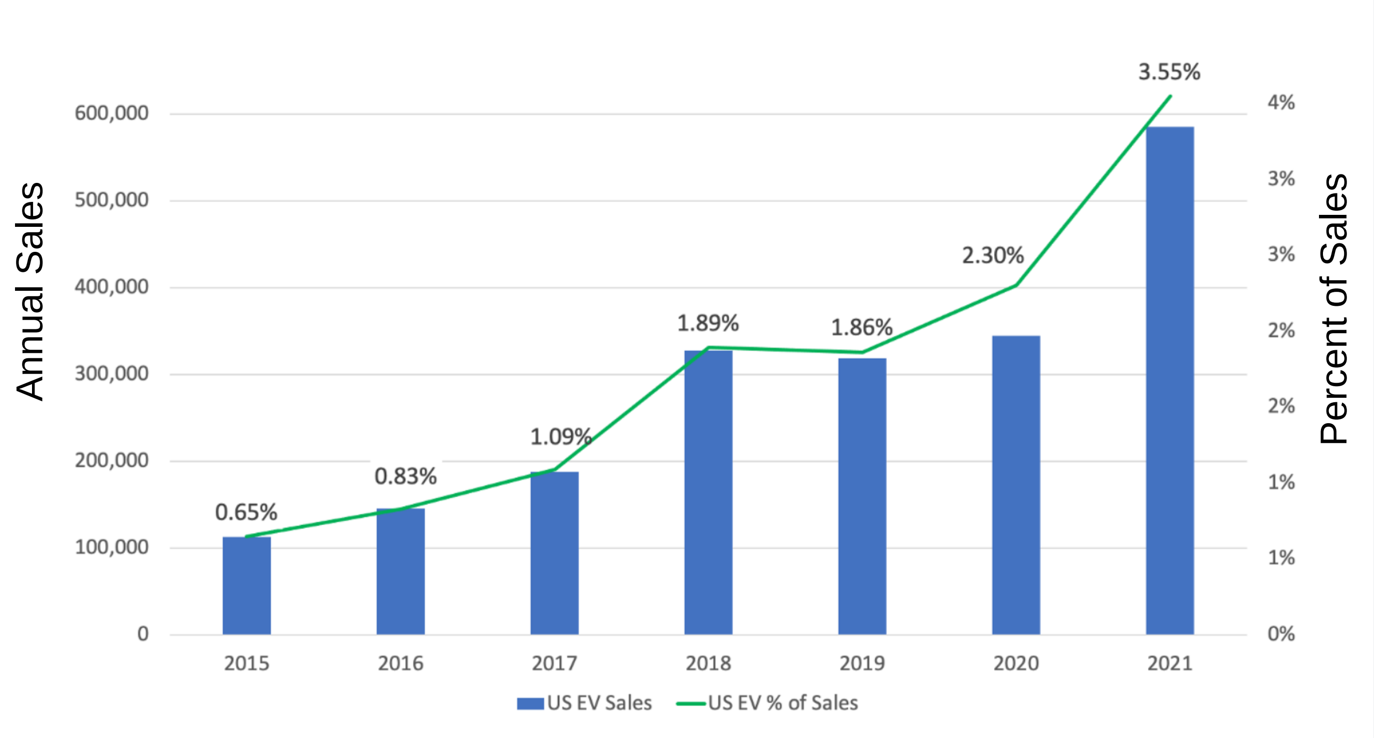
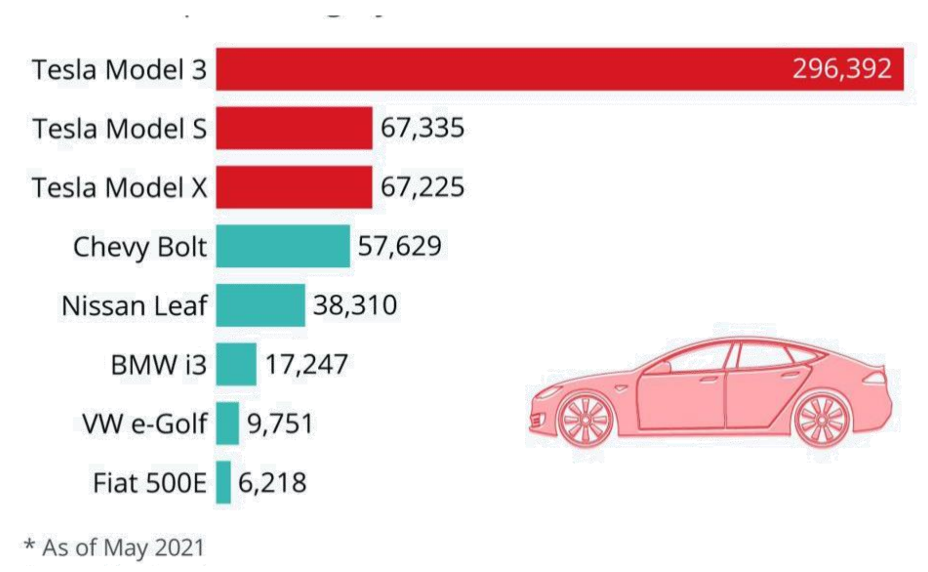
Electric Vehicle Sales: US



Total Sales by Model (2018-2021)



Electric Pickups: On the horizon (US)

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Spring 2022

Ford F150 Lightning
Rivian R1T

Ford - $40 - 70,000+

Rivian - $67,500+

Fall 2022

GMC Hummer EV

$110,000+

2023

GMC Sierra EV
Chevy Silverado

GMC - $60,000 (est.)

Chevy - $50,000 (est.)

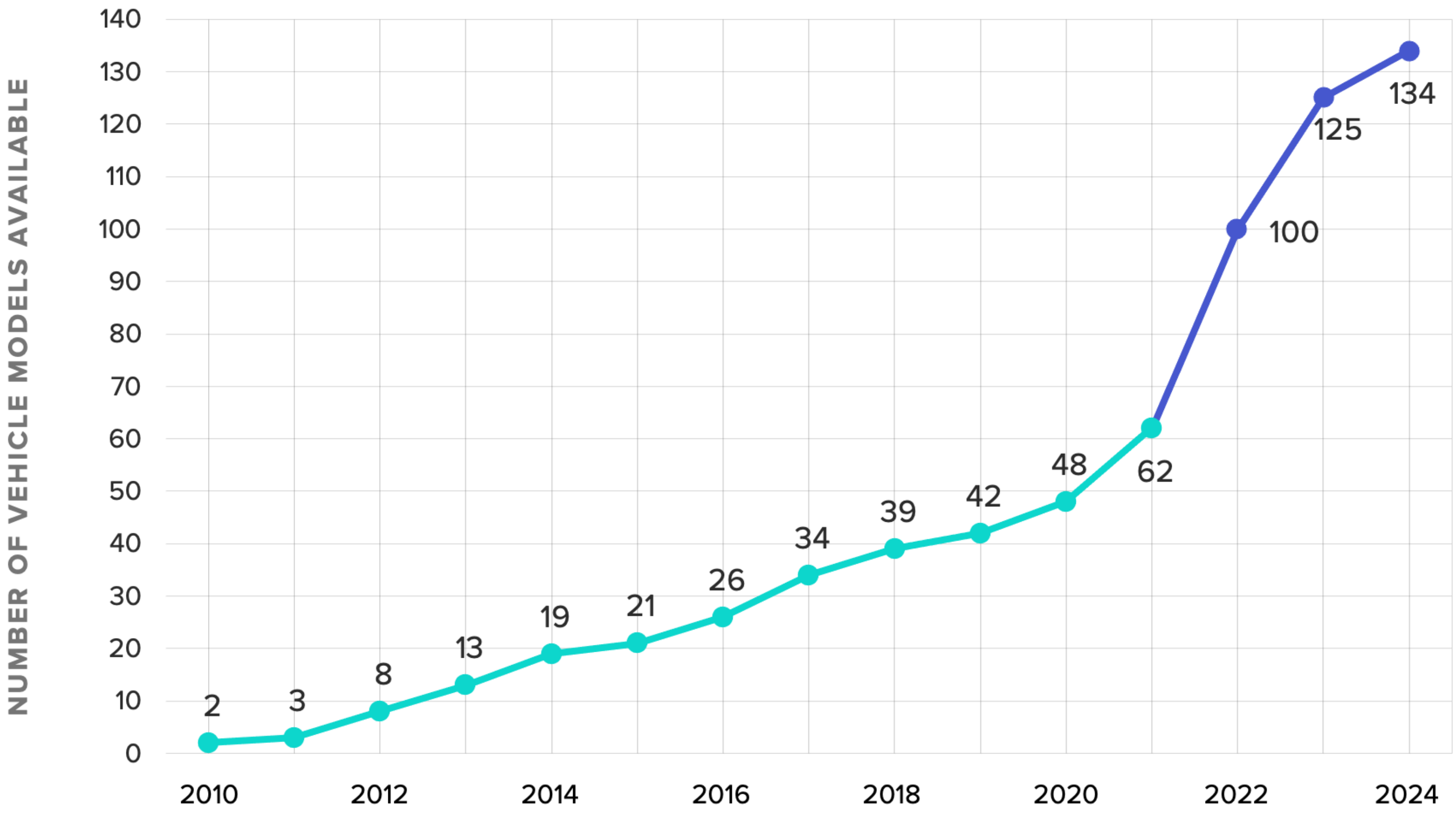
202?

Tacoma EV
Tesla Cyber Truck

Delivery rollout not yet announced

Greatly increasing model availability

Total number of electric vehicle models (historic and projected) in the U.S. market



Source: Morning Consult

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Sales penetration expected to reach 25% by 2030

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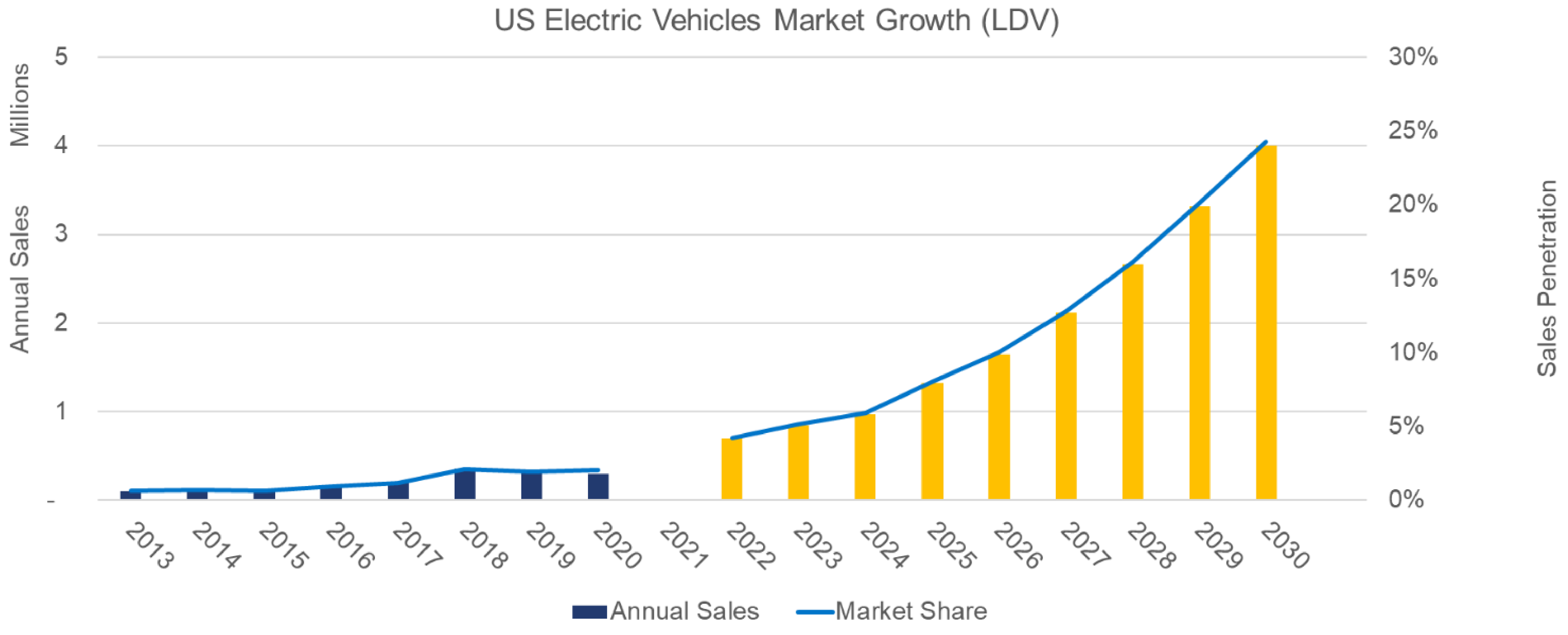

Source: 1) Update on electric vehicle adoption across U.S. cities, ICCT, August 2020; 2) Deloitte Insights Electric Vehicles; 3) SEPA analysis

Large fleet operators going electric

- FedEx announced that **by 2040, 100% of their parcel** pickup and delivery fleet (PUD), equaling about 100,000 vehicles, will be zero-emissions vehicles
- By 2025, **50% of FedEx Express vehicle purchases** will be electric, rising to 100% of all purchases by 2030.
- Amazon has announced plans to reach net-zero emissions across all operations by 2040 and **has ordered 100,000 electric delivery vehicles**.
- UPS has purchased **10,000 electric vans** purpose-built by the UK start-up Arrival to meet their specifications.
- The U.S. Postal Service has announced plans for an initial **order of 5,000 electric vehicles** for its new fleet of mail trucks

Planning for fleet electrification

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If **All Cars were electric** and charged at 7kW they would need 2,000 TW – twice todays grid capacity. (They won’t do this)

They would need a total of 1,106 TWh, or 27.6% of what we produced in 2020

- 1 City truck = 125,000 kWh / day or equivalent to 21 homes

- A depot of 25 trucks may draw ~**1-2MW+** depending on charging speed
- 1 long haul truck = **220,000 kWh / day** or equivalent to 37 homes

1) source: NREL

Planning for fleet electrification

Source: Black and Veatch, 2021, SEPA EV working group presentation

Industrial or commercial parks will see major asymmetric load increases as they electrify.

A single industrial park in Portland could see **60 MW of new load in the next 5-10 years**

Improving load predictability

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Improving Load Predictability

Solution Providers

Be proactive in finding appropriate locations for fleet electrification from grid capacity perspective.

Fleet Operators

Identify key contact person to interact with utility on electrification and master planning.

Utilities

Make strategic accounts for fleet operators.

Fast charging is getting faster

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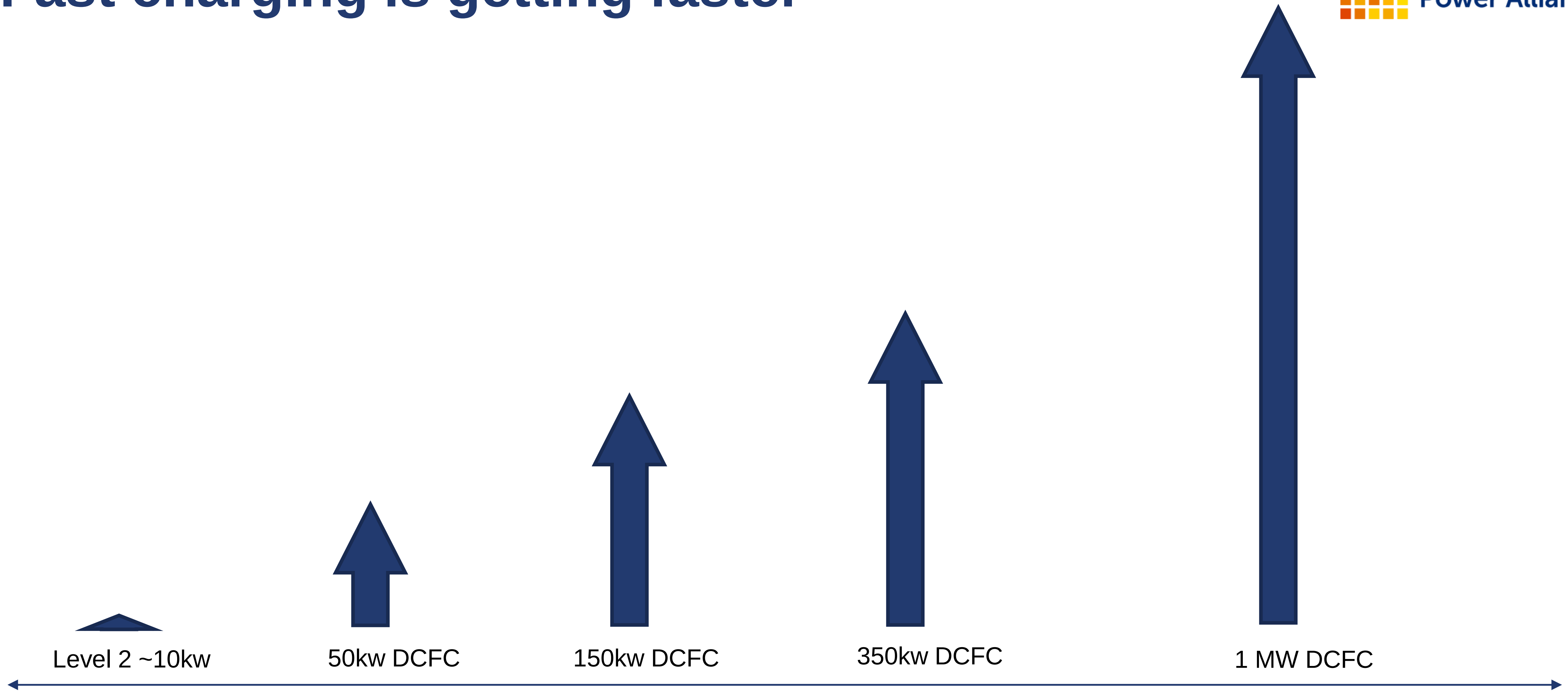

DC Fast Charging in 2018 ~50kW

DC Fast Charging in 2021 ~150kW

A new standard under development for high power charging of trucks, buses, aircraft or other large BEVs **beyond 1 MW**

Charging varies by vehicle type and use case

	Level 1 (120 V outlet)	Level 2 (3.6kw – 20kw)	DCFC (50kw – 350kw)	DCFC (350kw- 2 MW)
Light Duty Personal	Residential, workplace	Residential, workplace, retail	Corridor charging, MUD, as needed, etc.	
Light Duty Commercial		Duty Cycle Dependent		
Buses		Overnight depot	Depot, on-route, on-demand, etc.	
Fleet – Short Haul		Duty Cycle Dependent		
Trucking – Long Haul			Duty Cycle Dependent	

Key metrics in EV and EV charging

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Annual Sales

- 400,000+ sold in 2021 ~4% of annual car sales
- 17M gas vehicles sold annually

EV Charging Deployment (public and private)

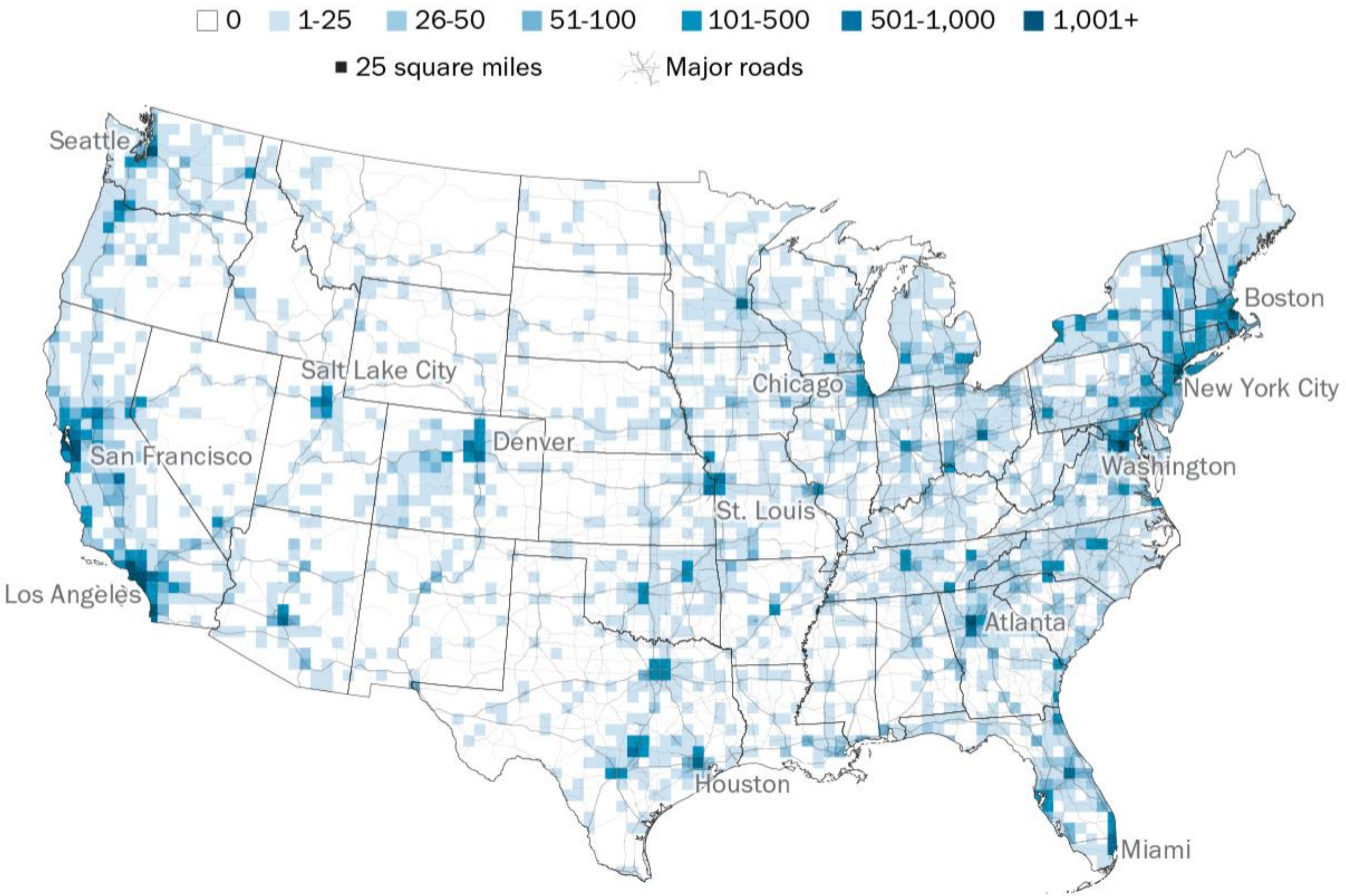
- Level 2: 100,000 ports, 45,000 locations
- DCFC: 22,000 ports, 6,000 locations

EV Model Availability (in the US)

- ~30 fully electric models available today
- Expect 135+ models by 2024
- 8 electric pickup models expected by 2023/24

Electric vehicle charging outlets mostly concentrated in large U.S. cities

Number of public charging outlets, May 2021



Source: 1) RMI, 2021 ; EVadaption, 2021, PEW Research Center, 2021

National Electric Highway Coalition

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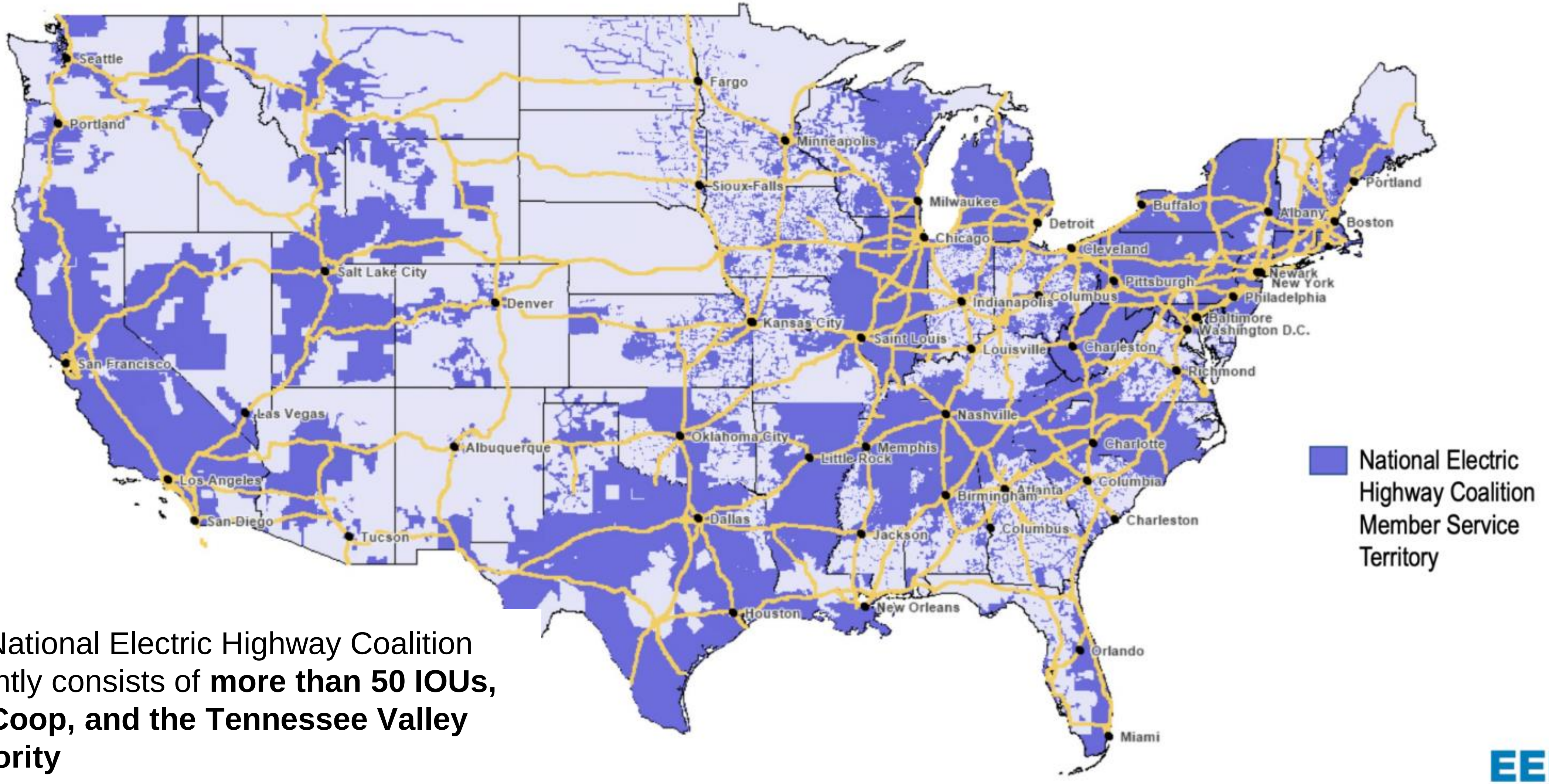

The National Electric Highway Coalition currently consists of **more than 50 IOUs, one Coop, and the Tennessee Valley Authority**

EEI

7,500 new EV chargers installed PER DAY

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20 to 30 Million EVs on the road in 2030

2 Million public and workplace L2

200,000 DC Fast Chargers

15 - 20 Million home L2

22 Million EVs Charge Ports

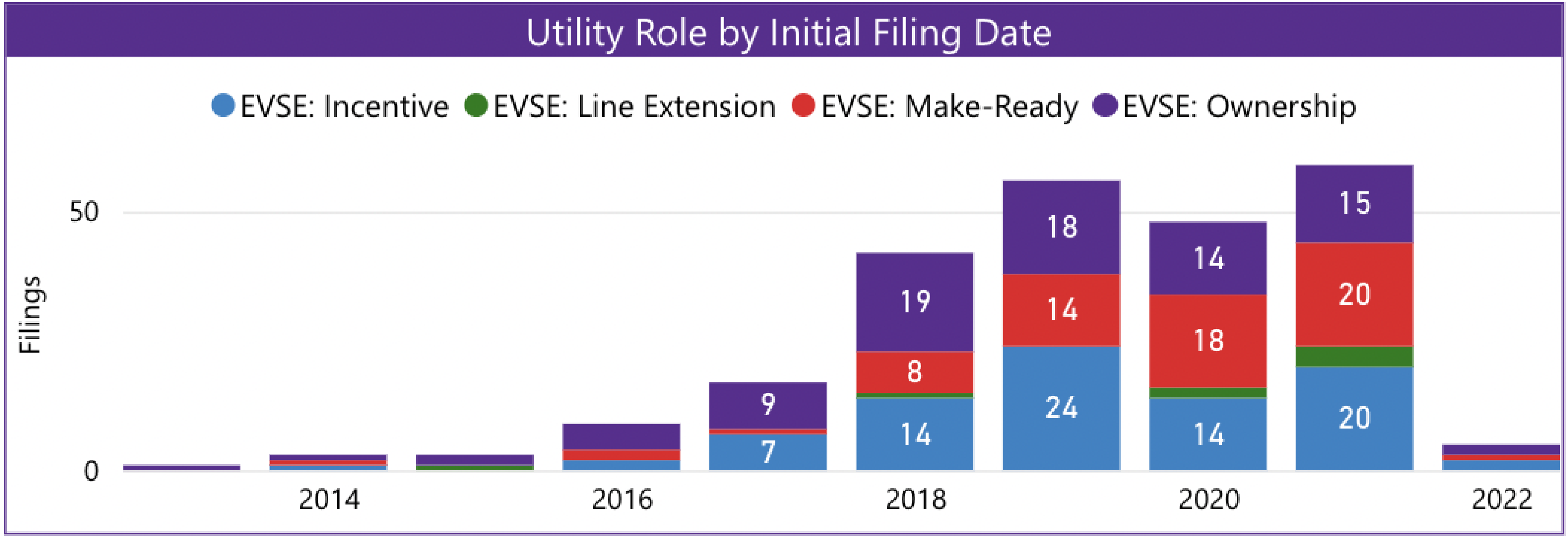
(2,800 days)

7,500 L2 chargers per day

One DCFC every other day

Source: ICCT, Utility Dive, SEPA

Filings and approvals are increasing



Source: 1) Atlas Policy,<AtlasEVhub.com>, accessed Feb 2022

$3.5 Billion dollars in approved utility spending

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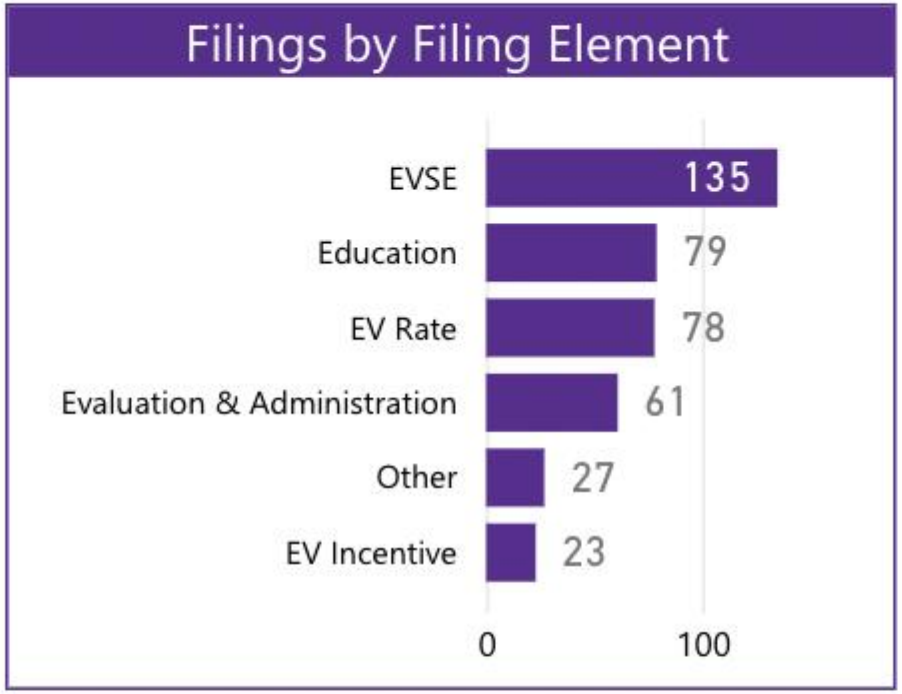
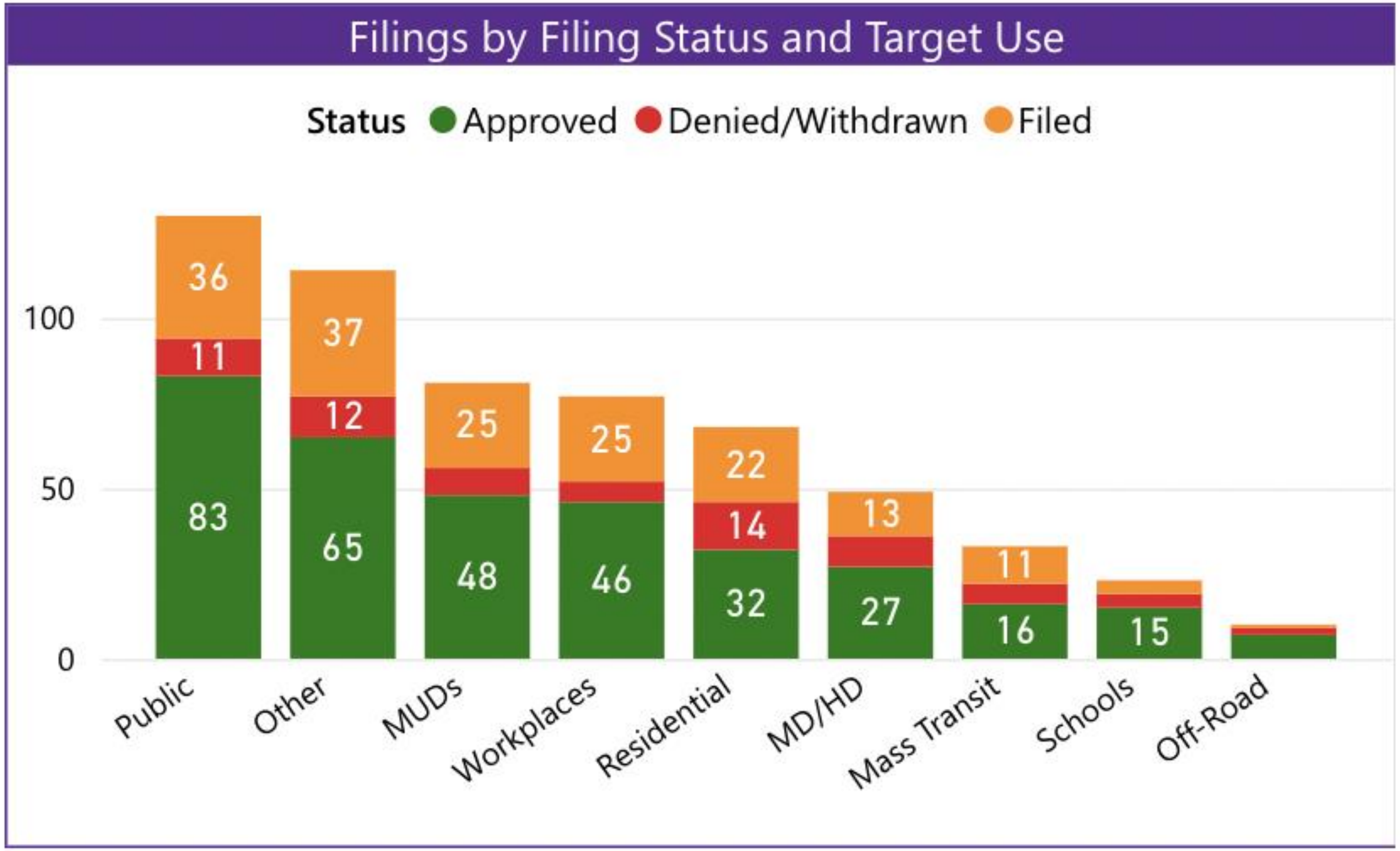
Approved	
34 States	124 Filings
53 Utilities	$3,498,634,782 Investment
7,541 DC Fast Charging Stations	300,665 Level 2 Charging Stations



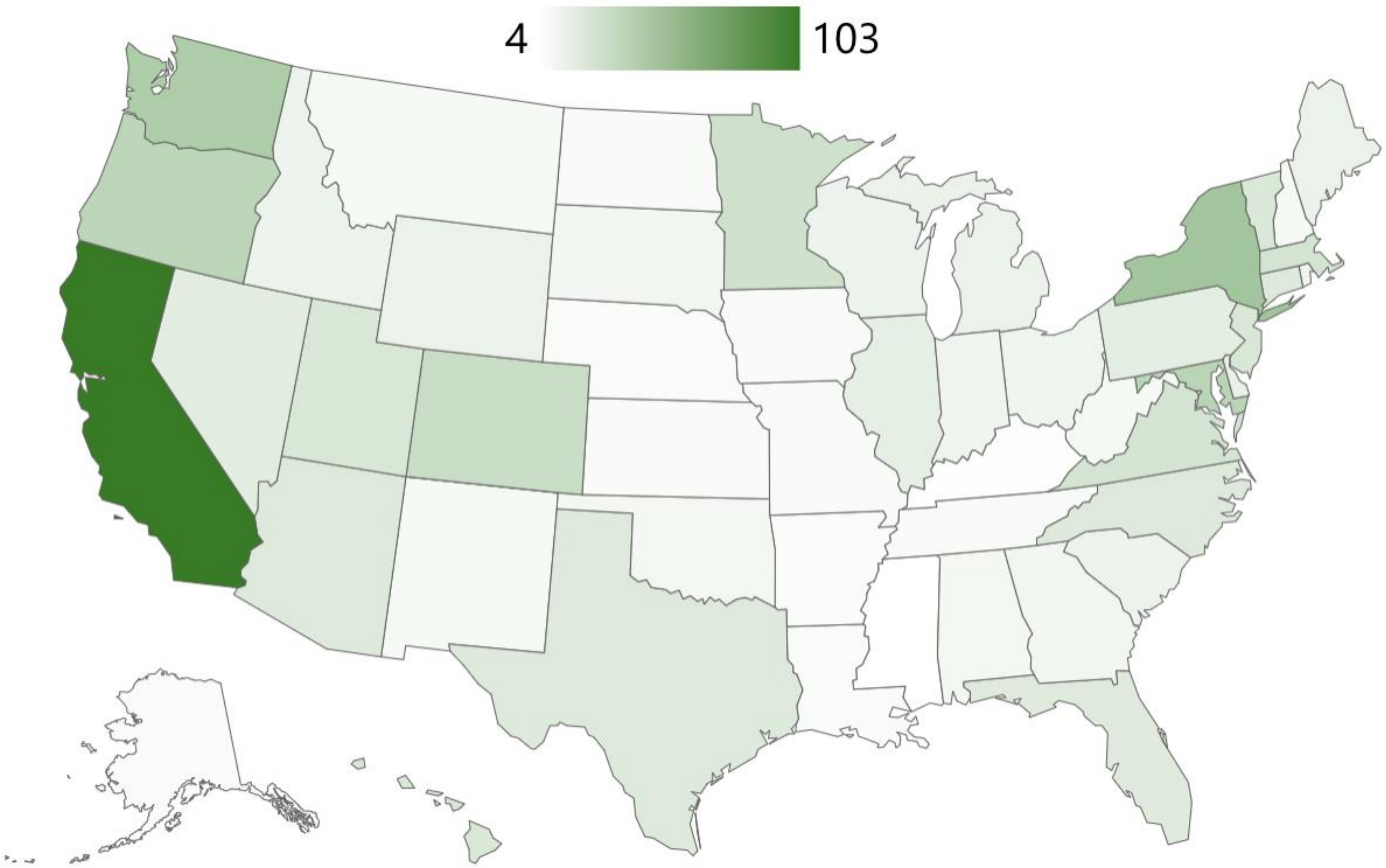
Source: 1) Atlas Policy,<AtlasEVhub.com>, accessed Feb 2022

Public, Multi-unit-dwelling, and workplace



Source: 1) Atlas Policy,<AtlasEVhub.com>, accessed Feb 2022

Proposed Legislation and Enacted Policies



Source: 1) Atlas Policy,<AtlasEVhub.com>, accessed Feb 2022

Infrastructure Investment and Jobs Act (IIJA)

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$8	$31.8	$10.5	$50.3
Dedicated to ZEVs ($ Billions)	"Clean" Vehicle Eligible ($ Billions)	Grid and Batteries ($ Billions)	Total EV-Eligible Funds ($ Billions)

"Clean" investments mean some dollars could go to EVs but other fuel types are eligible for funding. DOE refers to the Department of Energy. DOT refers to the Department of Transportation. EPA refers to the Environmental Protection Agency.

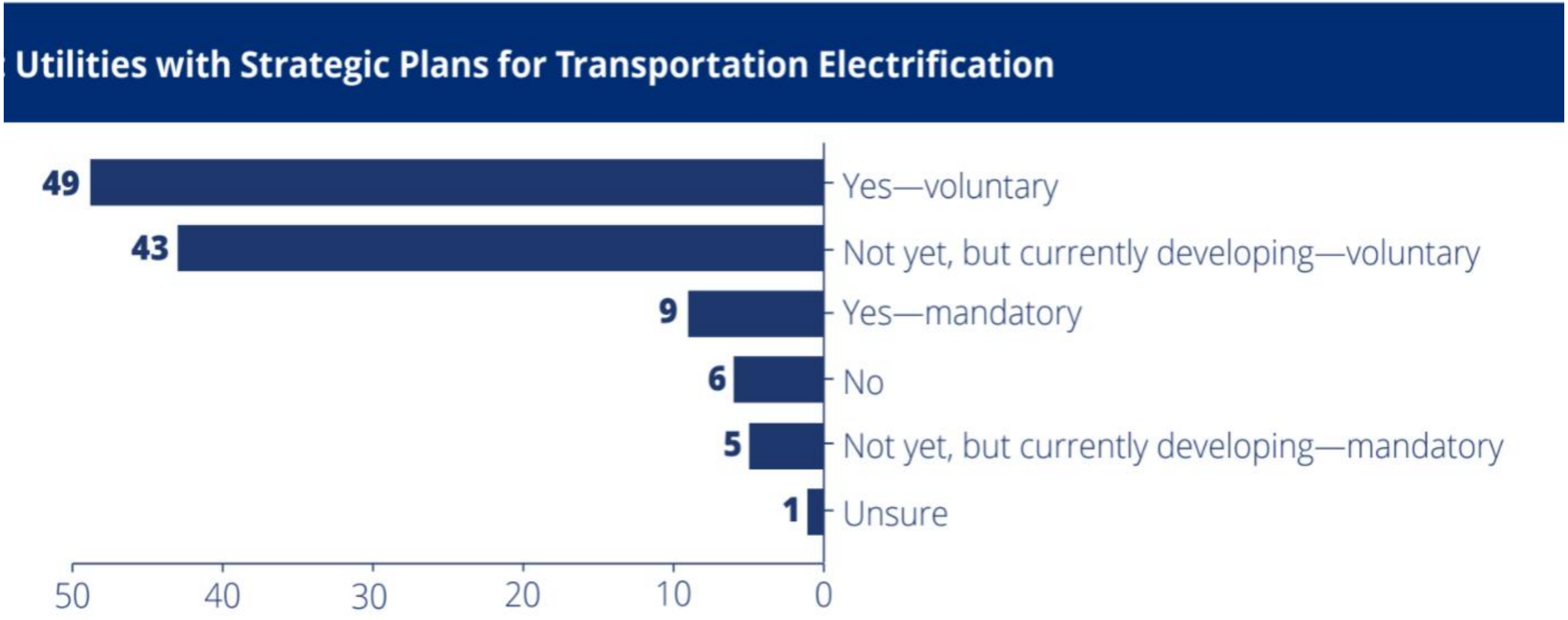
- New Joint Office of Energy and Transportation
- $7.5 billion in new federal funding for charging infrastructure
- Creates two new federal EV charging station programs intended to establish a national network of 500,000 EV chargers.

Source: 1) Atlas Policy,<AtlasEVhub.com>, accessed Feb 2022

Utility Activity

Planning, Preparation, Implementation

Strategic planning for electrification



Building Transportation Electrification teams

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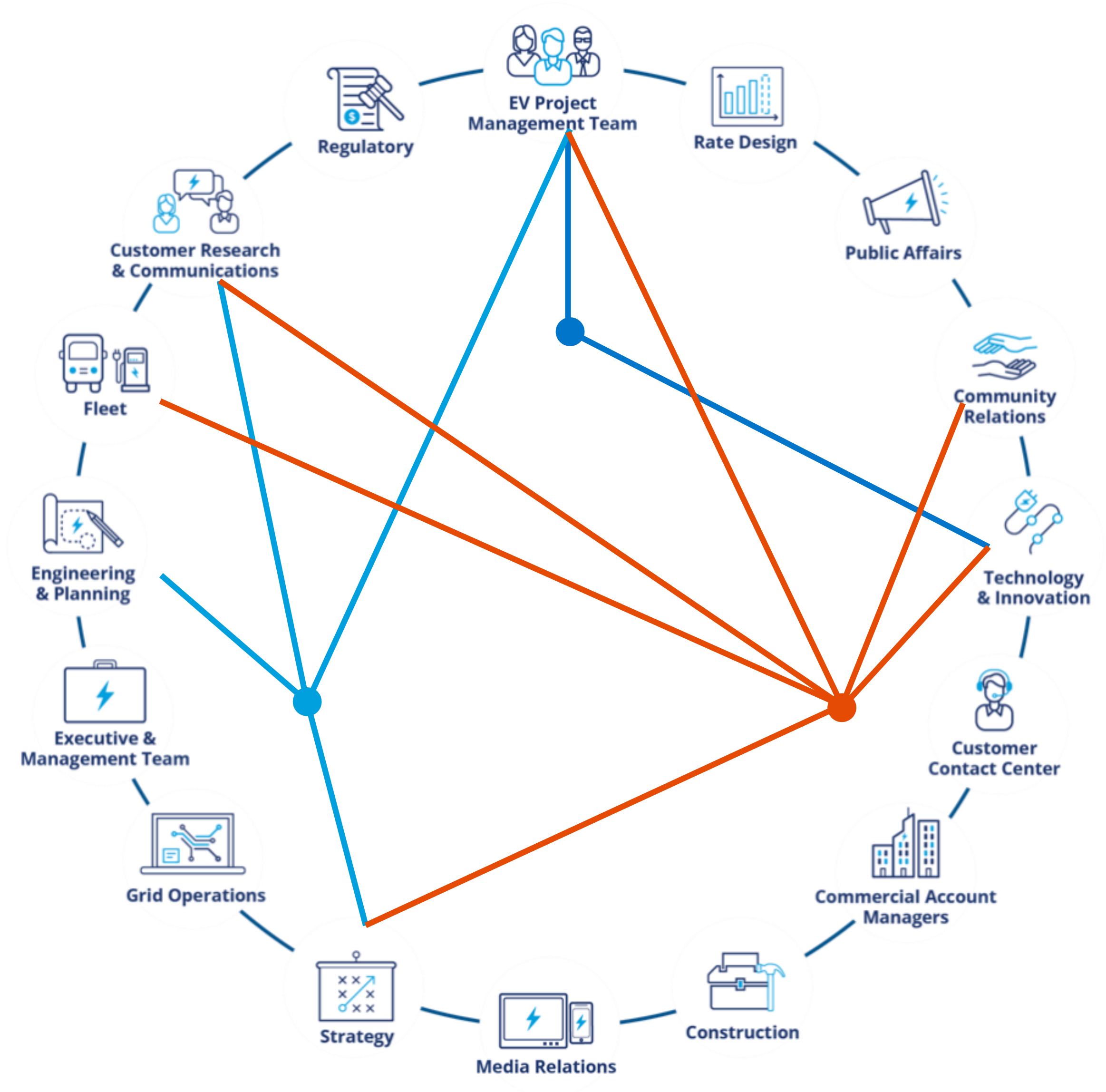
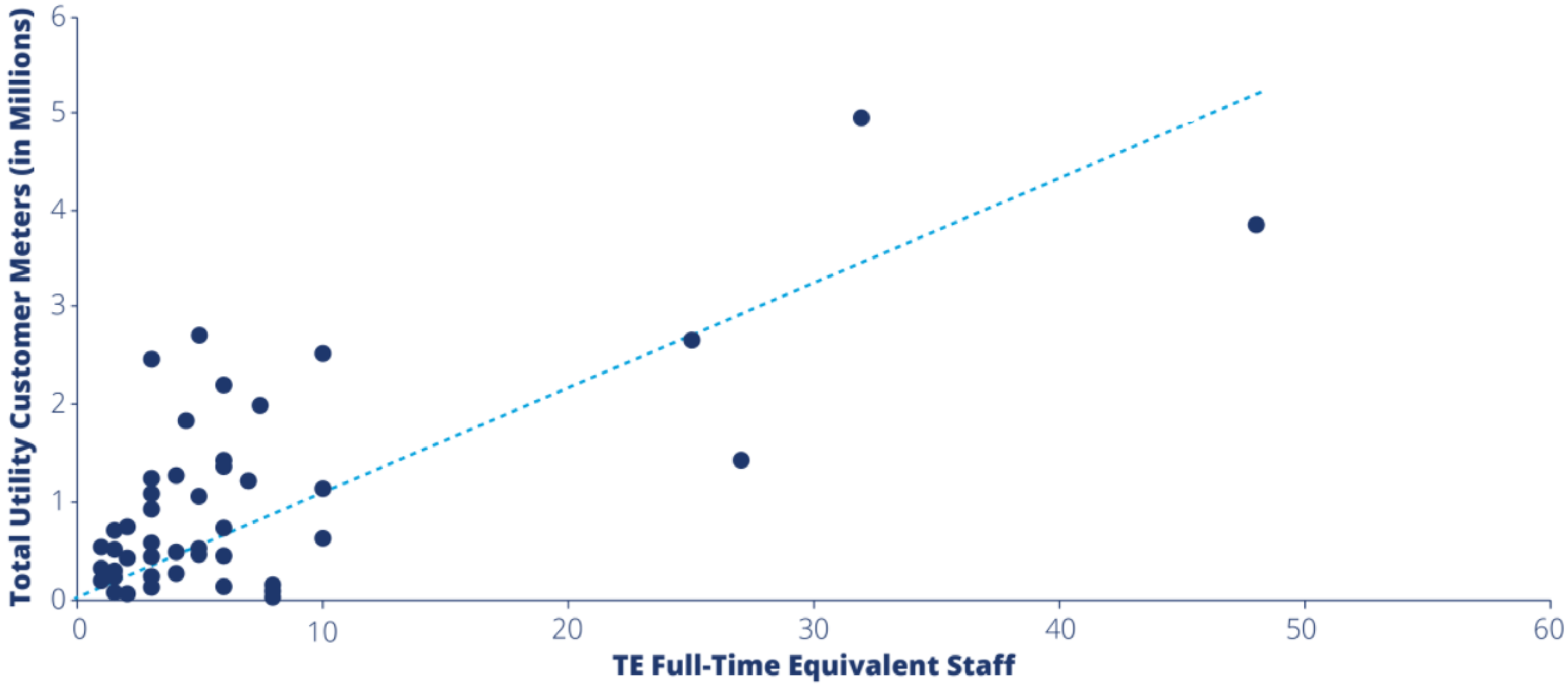
Transportation Electrification requires a cross-functional team

- Rates
- Regulatory and public affairs
- Key accounts
- Engineering and planning
- Program management
- Leadership
- Etc..



Staffing a Transportation Electrification team



Source: Smart Electric Power Alliance, 2020. N=48

A spectrum of utility engagement

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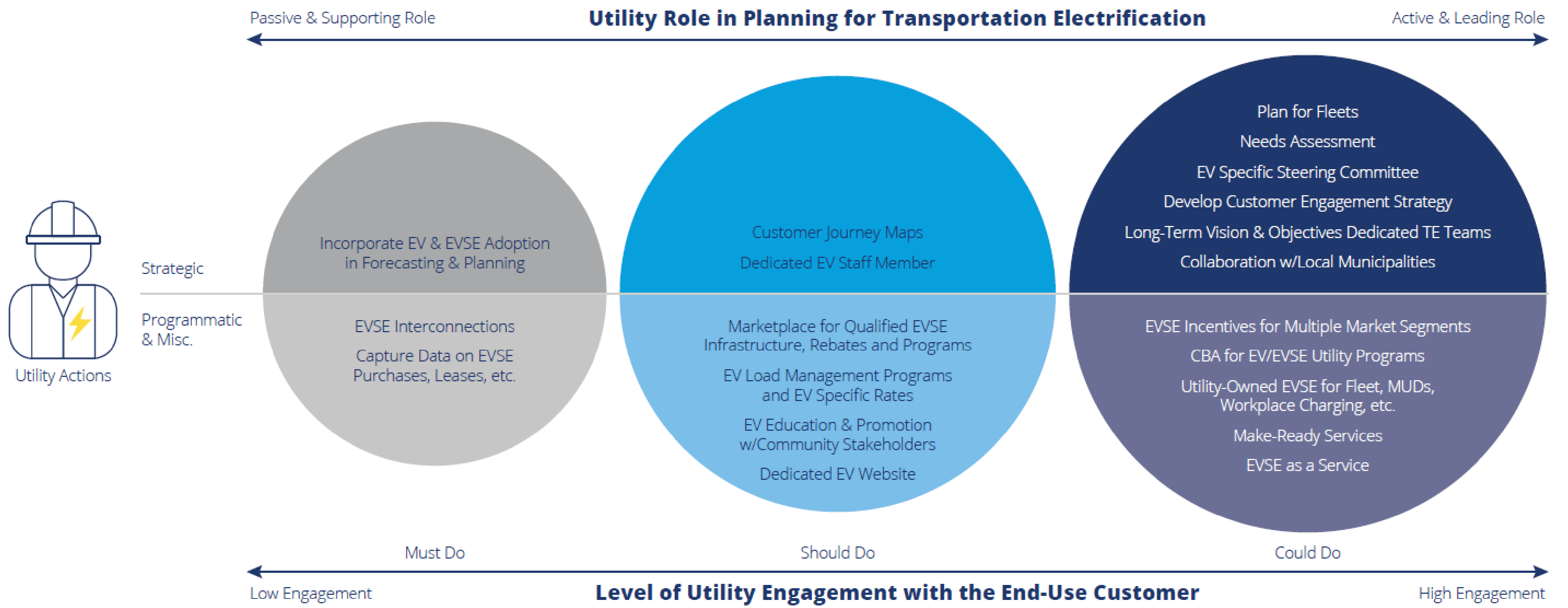
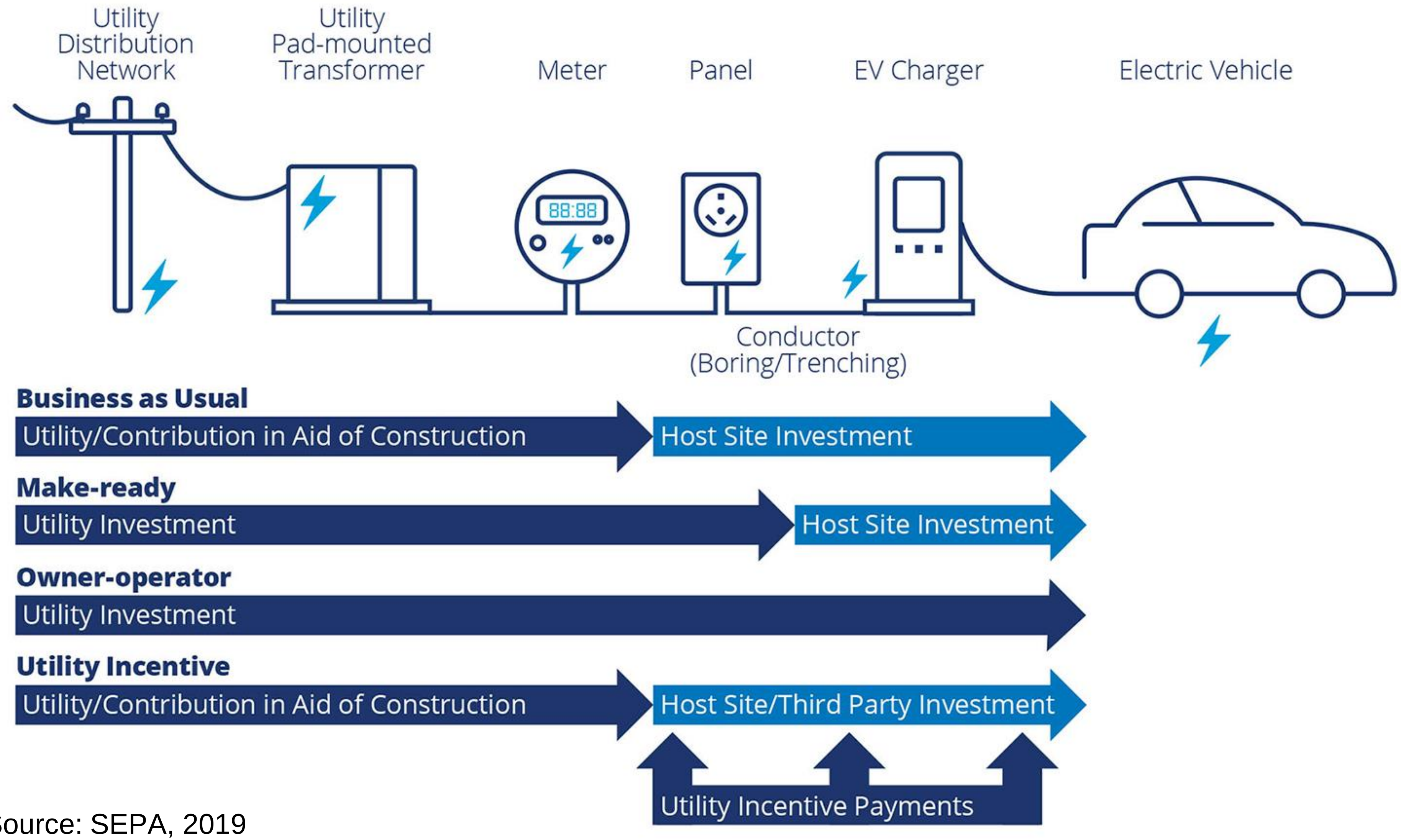


Source: Smart Electric Power Alliance, 2021

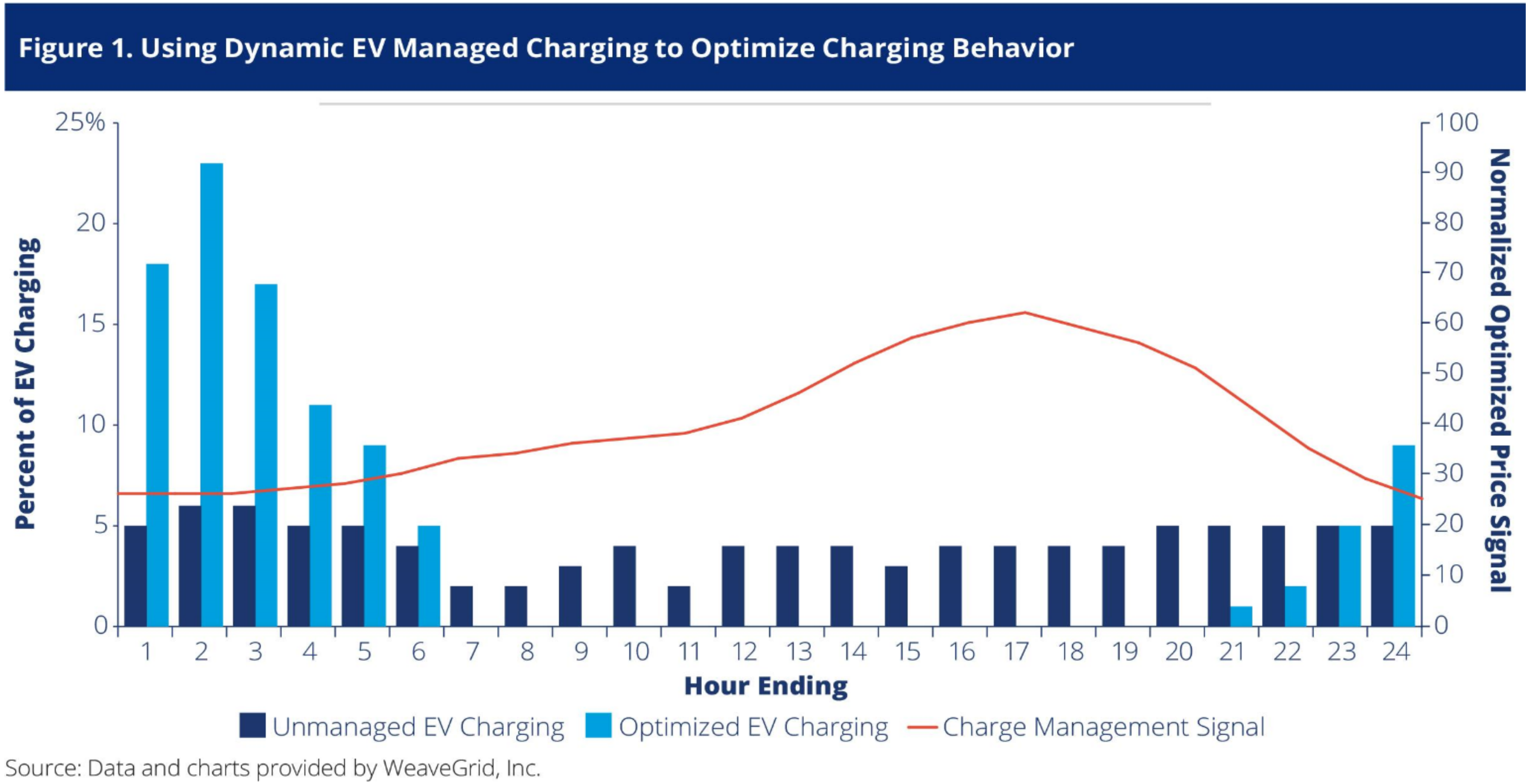
For additional information on the role of the utility in TE strategic planning see SEPA's report, Utility Best Practices for EV Infrastructure Deployment.

A variety of ownership roles



Source: SEPA, 2019

Managing EV load



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Passive (behavior) and Active (direct control)

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Passive

Relies on customer behavior to affect charging patterns. For example, EV time-of-use rates provide predetermined price signals to customers to influence when they choose to charge their vehicles

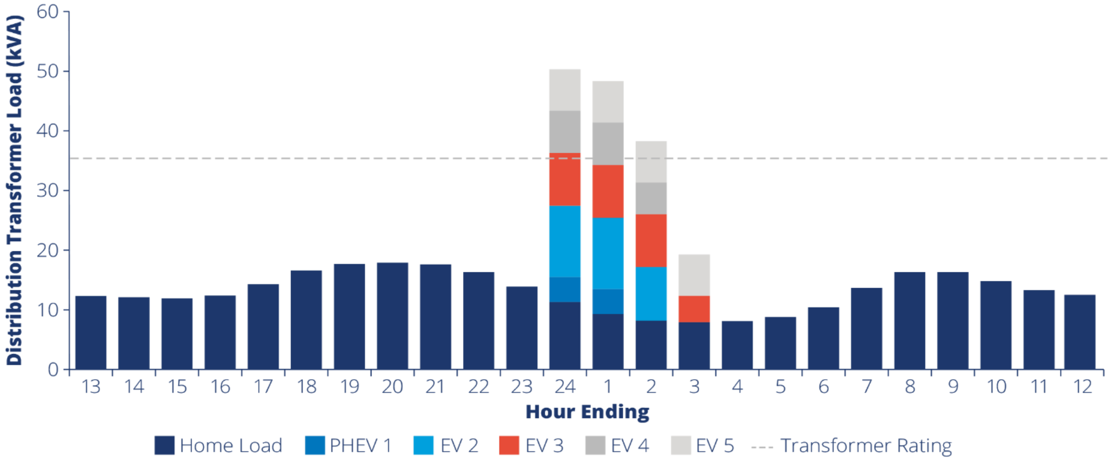
Active

Relies on dispatch signals originating from a utility or aggregator to be sent to a vehicle or charger to adjust the time and/or rate of charge (both load curtailment and load increase)

Source: "A Comprehensive Guide to Electric Vehicle Managed Charging" (SEPA, 2019)

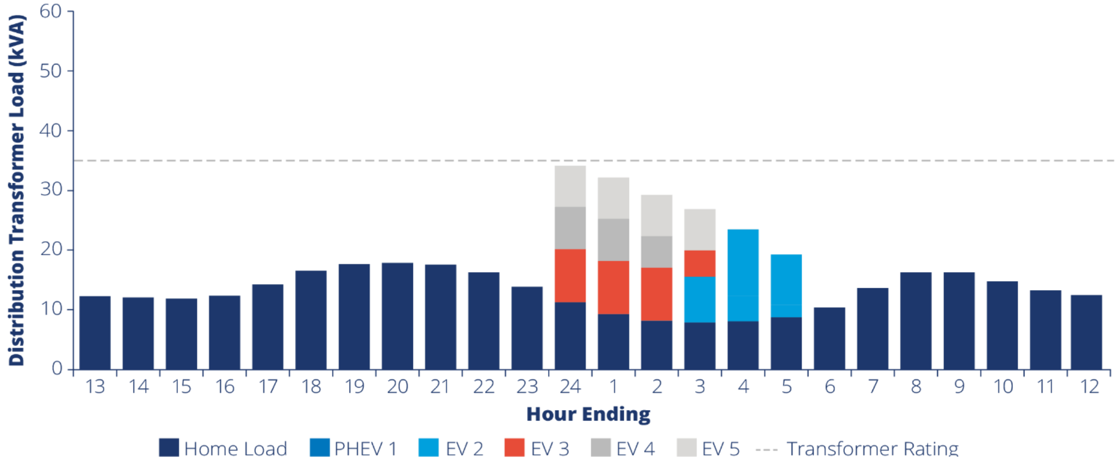
Multi-Level Optimization: Bulk and Distribution

Figure 2. Illustrative Example of How Time-of-Use Optimization at the Bulk System Level can Create Overload Situations at the Distribution Transformer Level



Source: Data and charts provided by WeaveGrid, Inc.

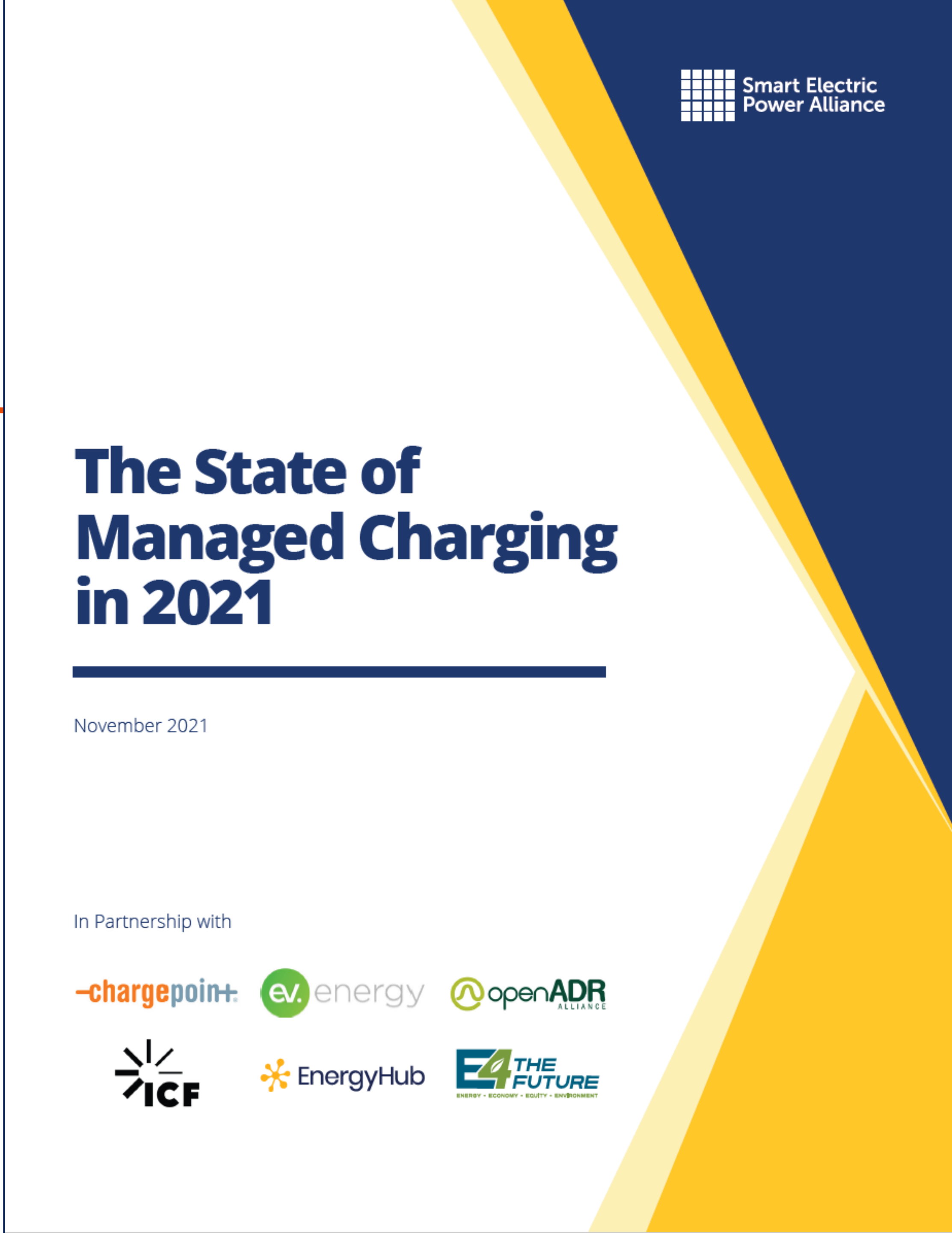
Figure 3. Illustrative Example of How Multi-Layer Optimization can Co-optimize for Bulk System Time-of-Use Signals and Distribution Level Constraints and Maintain Driver Charging Needs



Source: Data and charts provided by WeaveGrid, Inc.

State of the Industry

- **Survey results** from 51 utilities with managed charging programs
- **Recommendations for program design**, rollout, implementation, and evolution
- Six utility-led **case studies** and one customer fleet initiated managed charging program.
- Early observations of the **impacts of COVID** on EV charging
- **Trends in EVSE** and Network Service Providers (NSP)
- Appendix containing a comprehensive guide to utility managed charging programs, EVSE vendors and NSP providers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The State of Managed Charging in 2021

November 2021

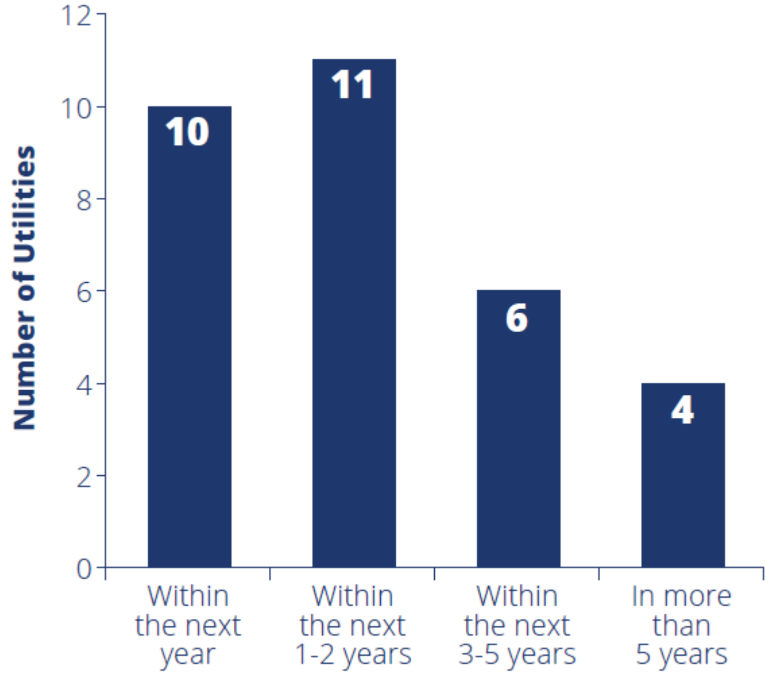
In Partnership with

chargepoint
ev.energy
openADR Alliance
ICF
EnergyHub
E4 THE FUTURE

Planning for managed charging is universal

Most utilities without a program today plan to implement soon

Figure 7. Utility Outlook on Implementing New Managed Charging Programs



N=31.

Source: SEPA, 2021

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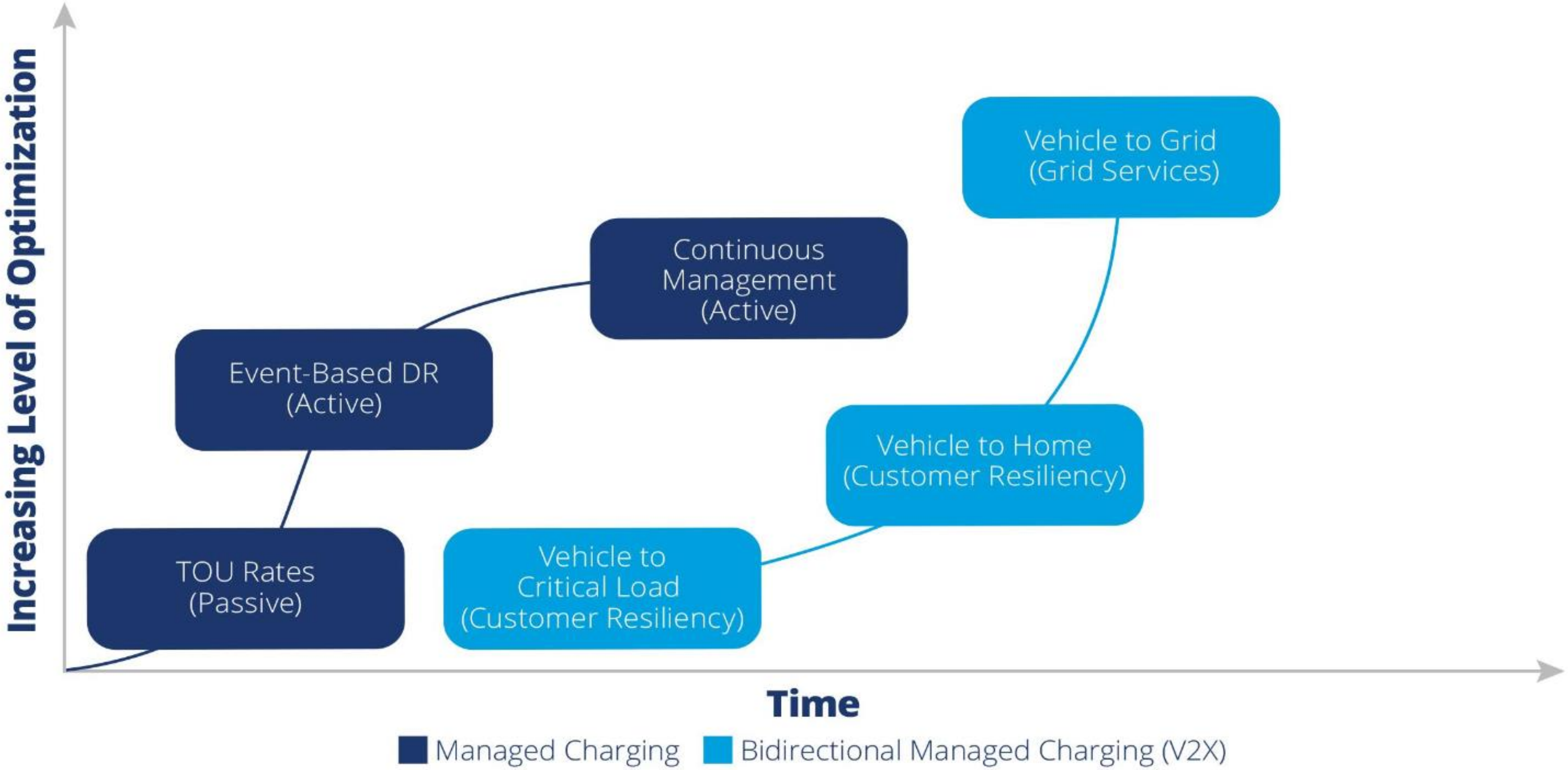
Passive → Event Based → Continuous



Source: SEPA, 2021

Vehicle to Grid (V2G, V2H, V2L) – getting closer

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Ford Intelligent Power can use the truck to power homes during high-cost, peak-energy hours.

Ford is also teaming up with Sunrun, to facilitate easy installation of the 80-amp Ford Charge Station Pro and home PV system.

GMC Hummer EVs Power Station Generator onboard bi-directional charger can export 25 amps of AC current.

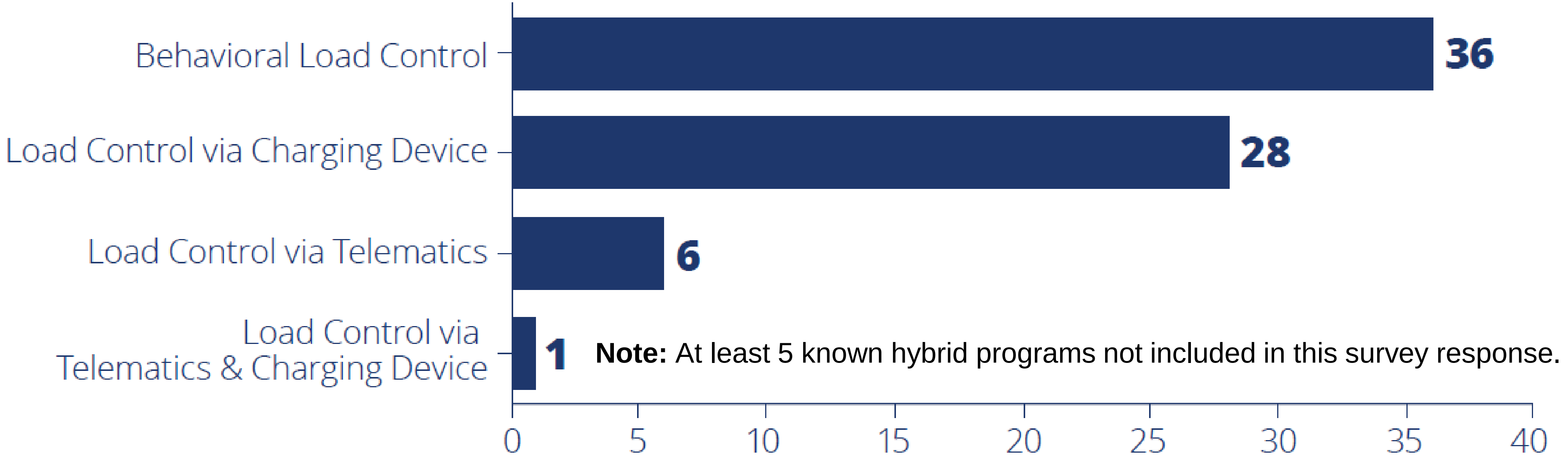
Rivian has also highlighted their Vehicle to Load and Vehicle to Vehicle Charging

From 2022 onwards, new electric vehicle models from **VW** will support bi-directional charging.

Hyundai, Kia and Lucid all have future vehicles that the companies say will include this capability.

Behavioral and active programs are growing

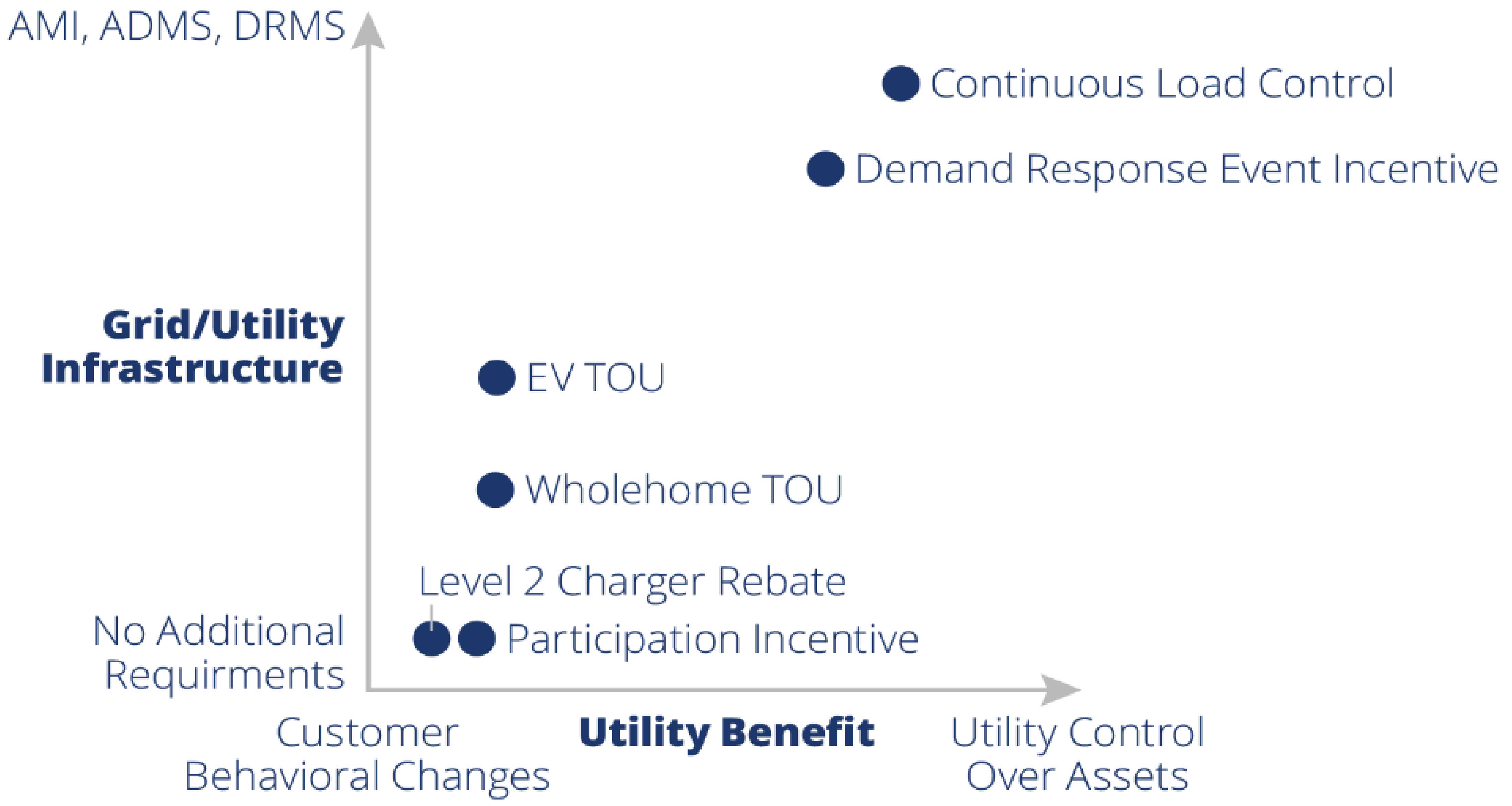
Figure 4. Ongoing Managed Charging Programs in the US



N=71. Note: Some utilities have multiple programs.

Source: SEPA, 2021.

Moving to capture greater benefits



Source: SEPA, 2021

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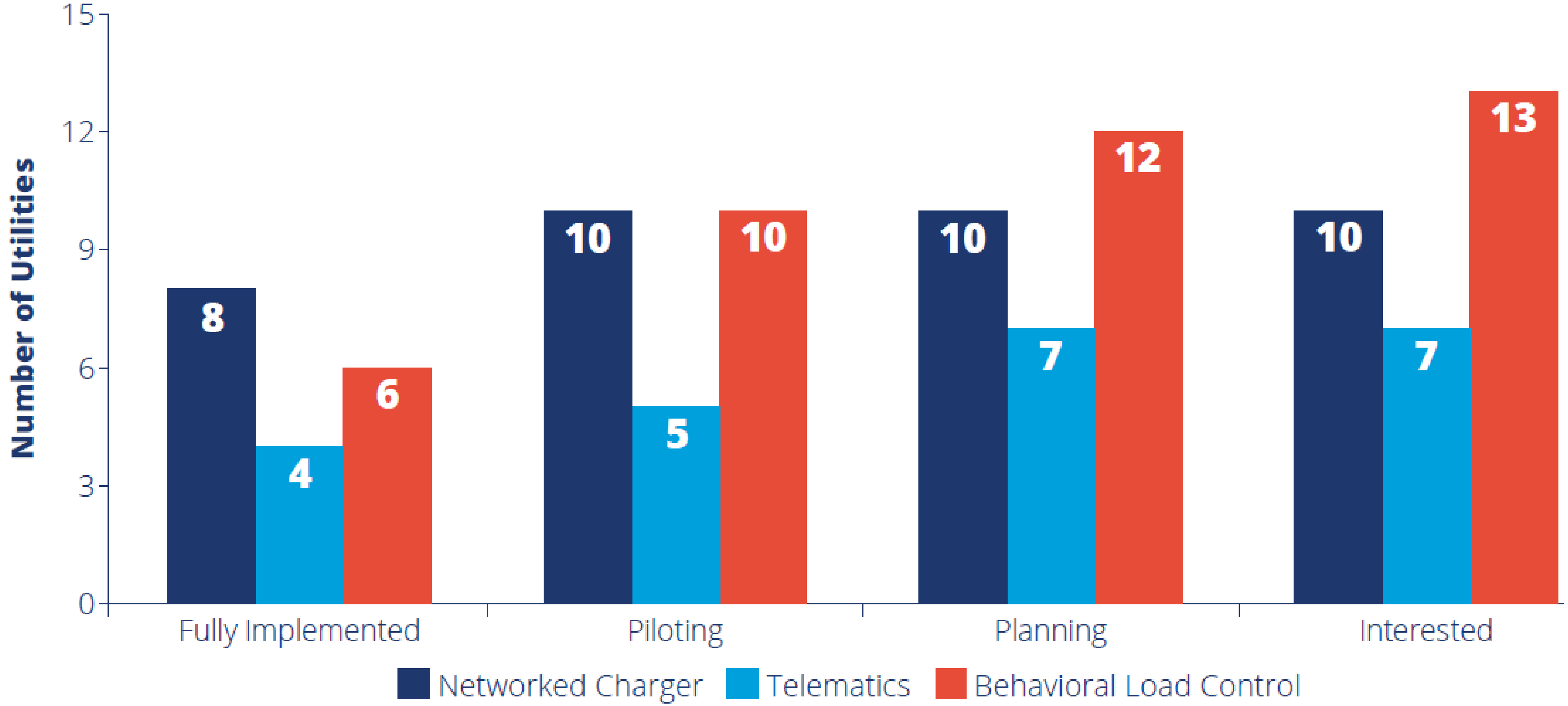
Interest in a variety of approaches



N=50.

Source: SEPA, 2021

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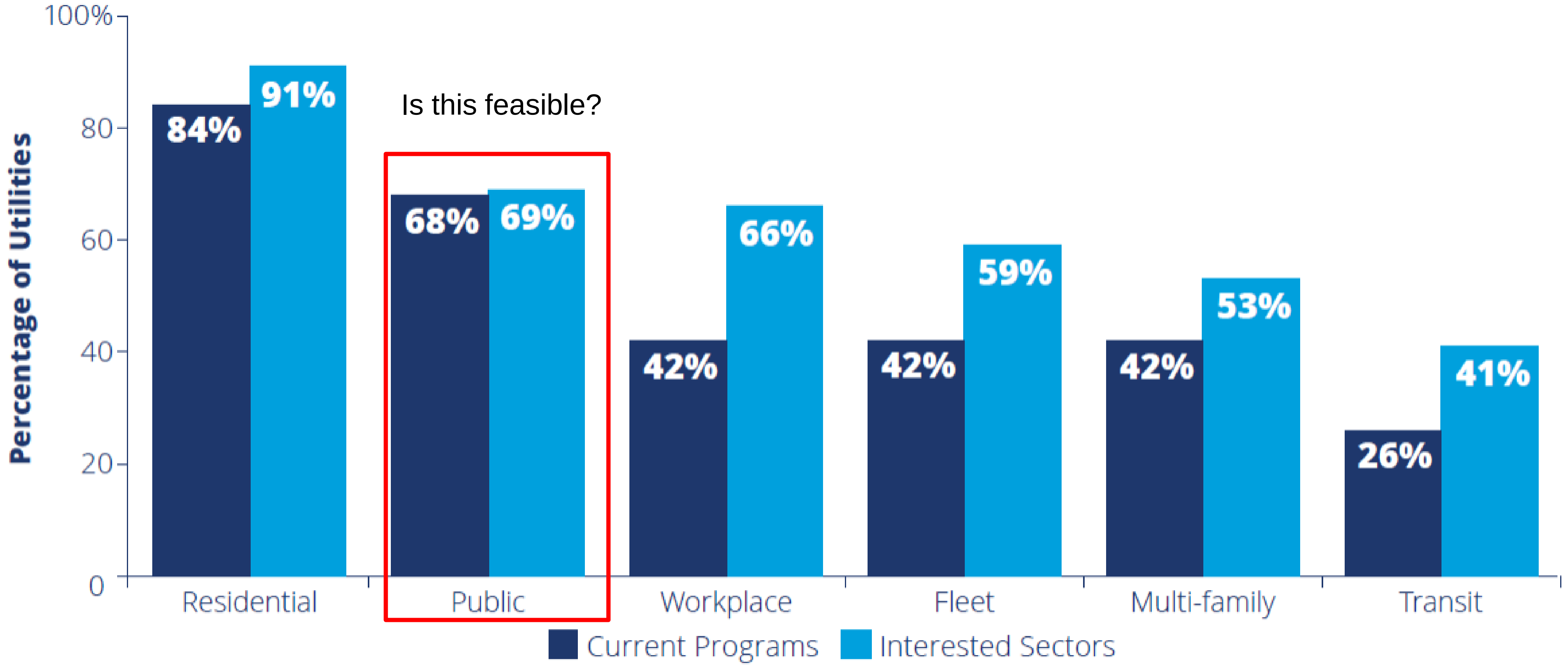
Interest across customer segment



N=50

Source: SEPA, 2021

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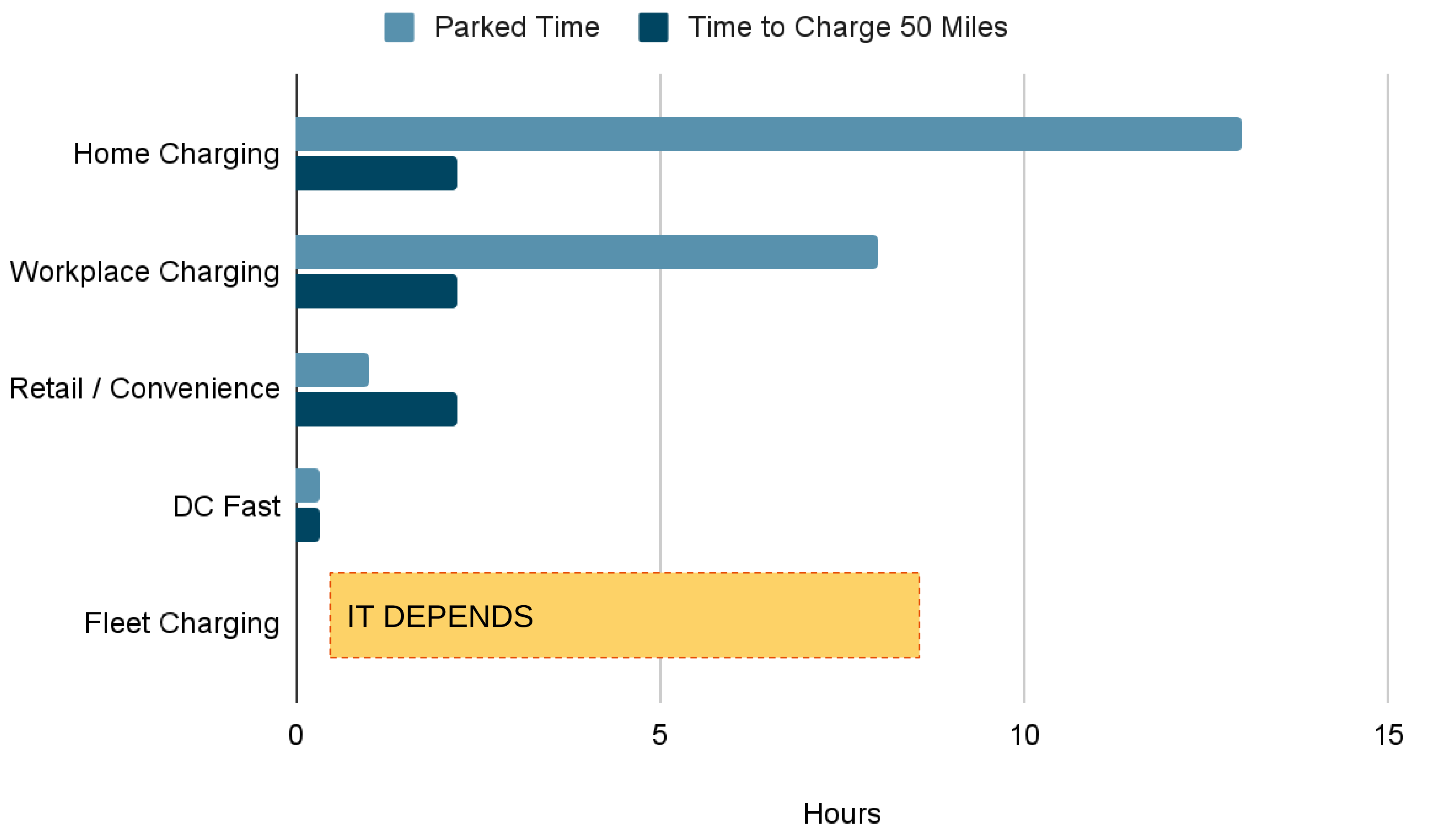
Residential charging is inherently flexible…



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…and has become more flexible in the new world of hybrid working

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Earlier plug-in time

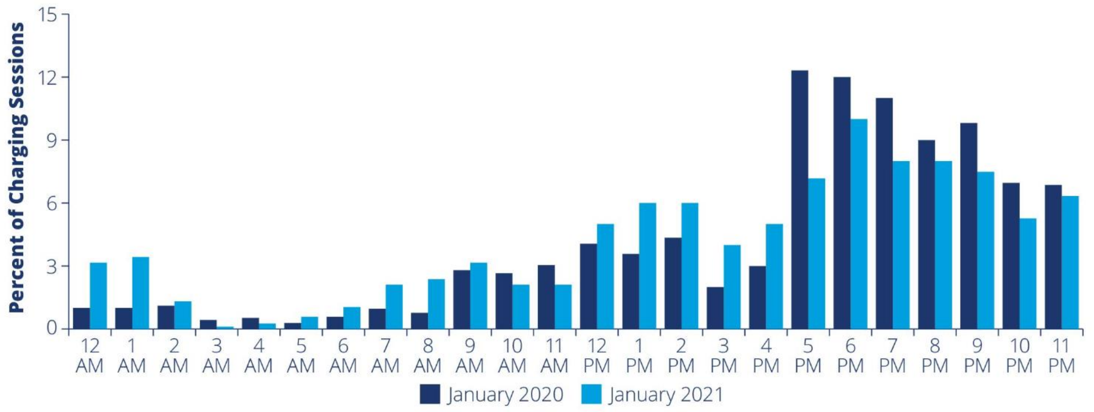
+

Delayed unplug time

↓

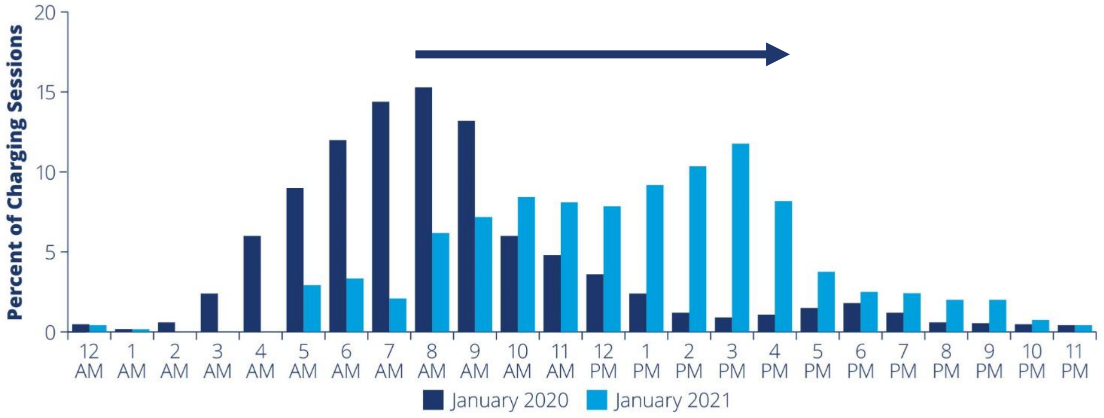
3-5 hours of increased dwell time

Figure 14. EV Plug-In Times of Residential Customers



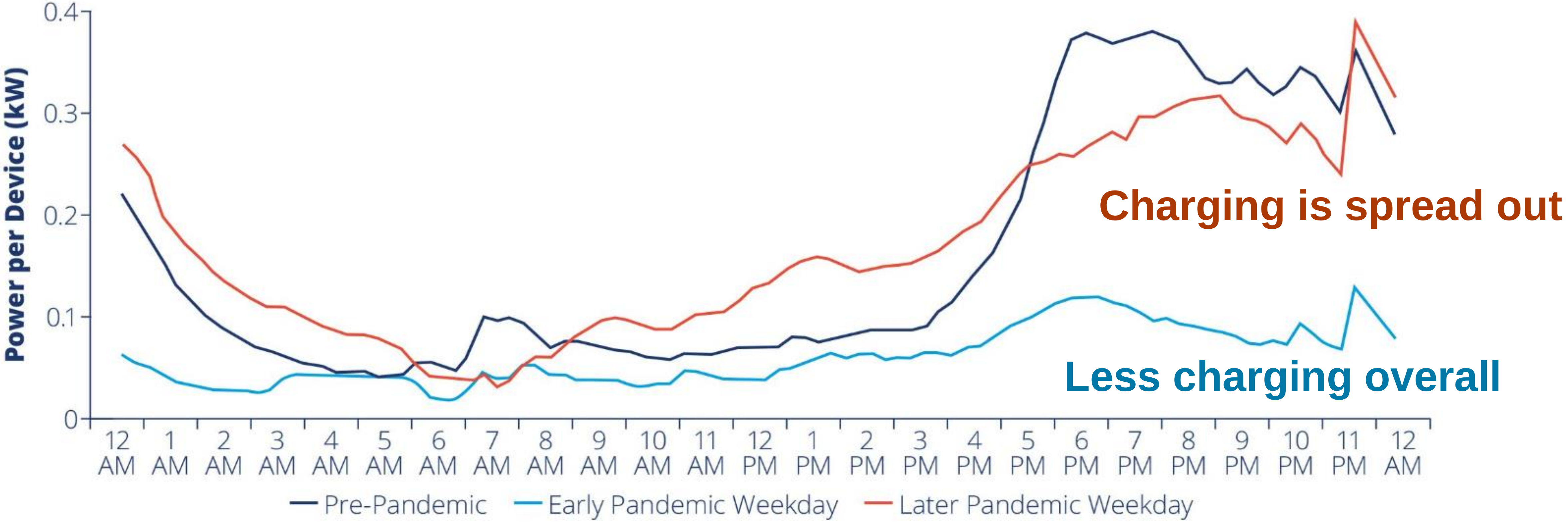
Source: ev.energy, 2021

Figure 15. EV Unplug Times of Residential Customers



Source: ev.energy, 2021

COVID 19 – work from home matters



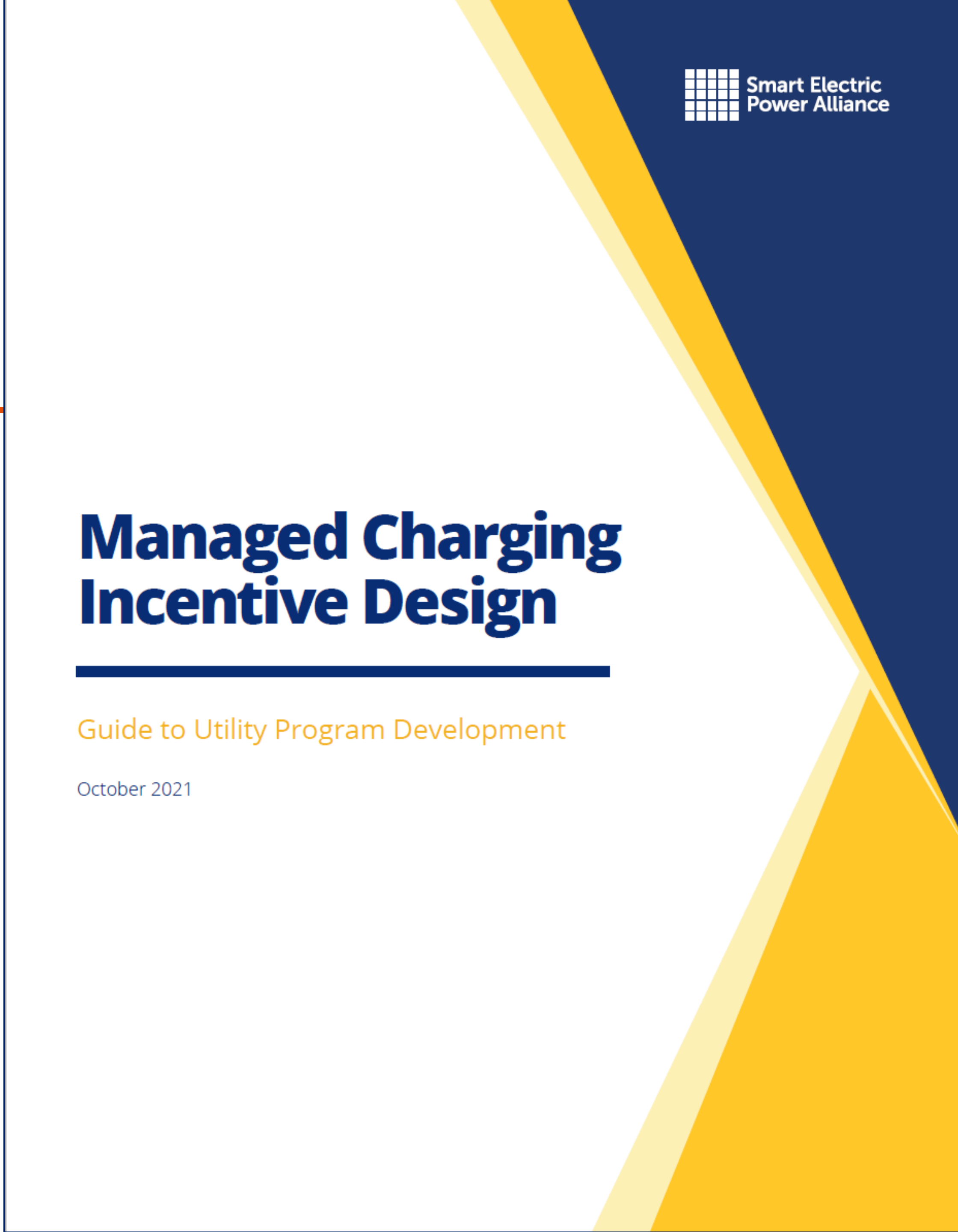
Graph recreated from original, data points are approximated.

Source: EnergyHub, 2021

Guide for Program Design

To assist utilities in their efforts, SEPA recently published a report entitled, Managed Charging Incentive Design: Guide to Utility Development.

- Six-step managed charging program design process
- Detailed case study featuring Baltimore Gas and Electric (BGE) and Potomac Electric Power Holdings (PHI)
- Analysis of forty managed charging programs and insights from twenty utility interviews
- Actionable recommendations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Managed Charging Incentive Design

Guide to Utility Program Development

October 2021

Participation uncertainty is high

Barriers to Implementing a Managed Charging Program – Utility Perspective

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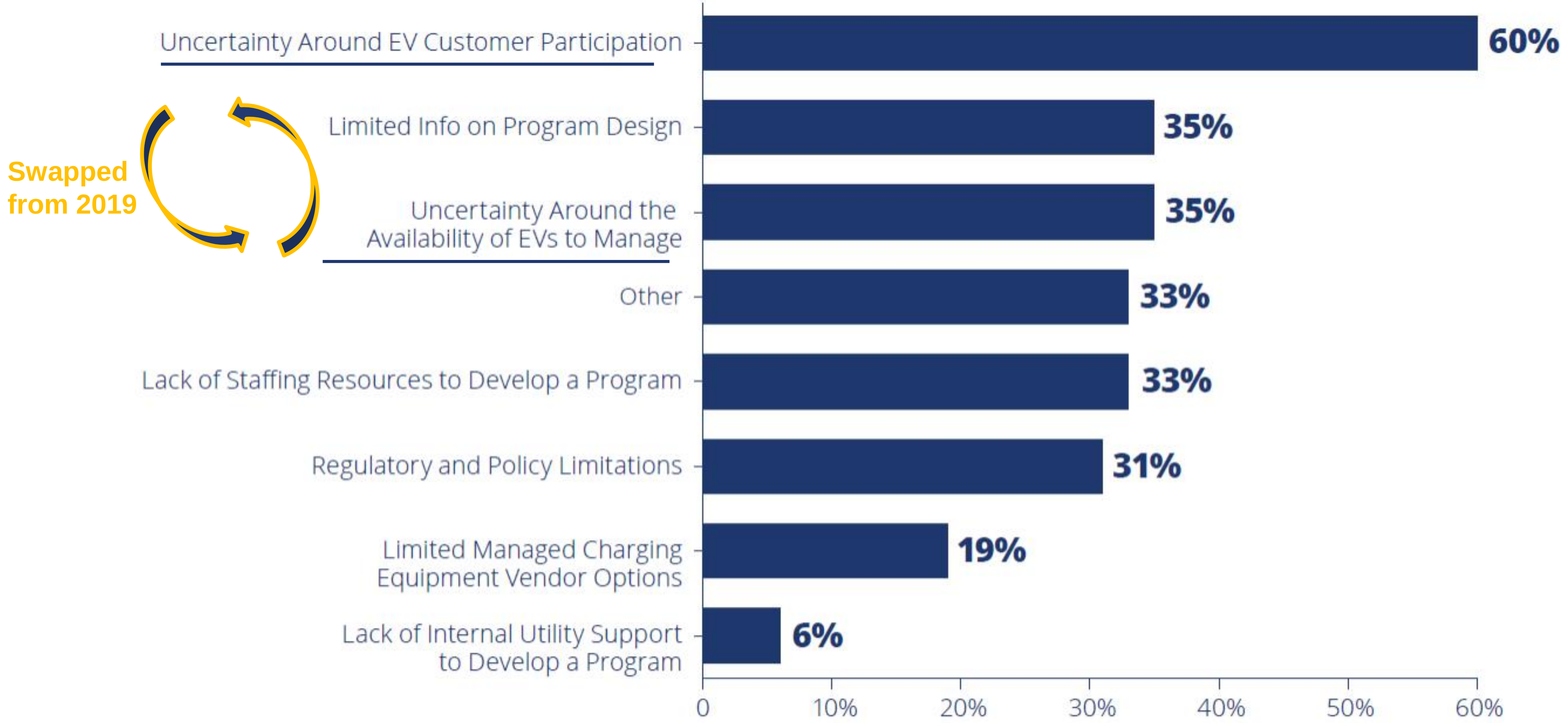
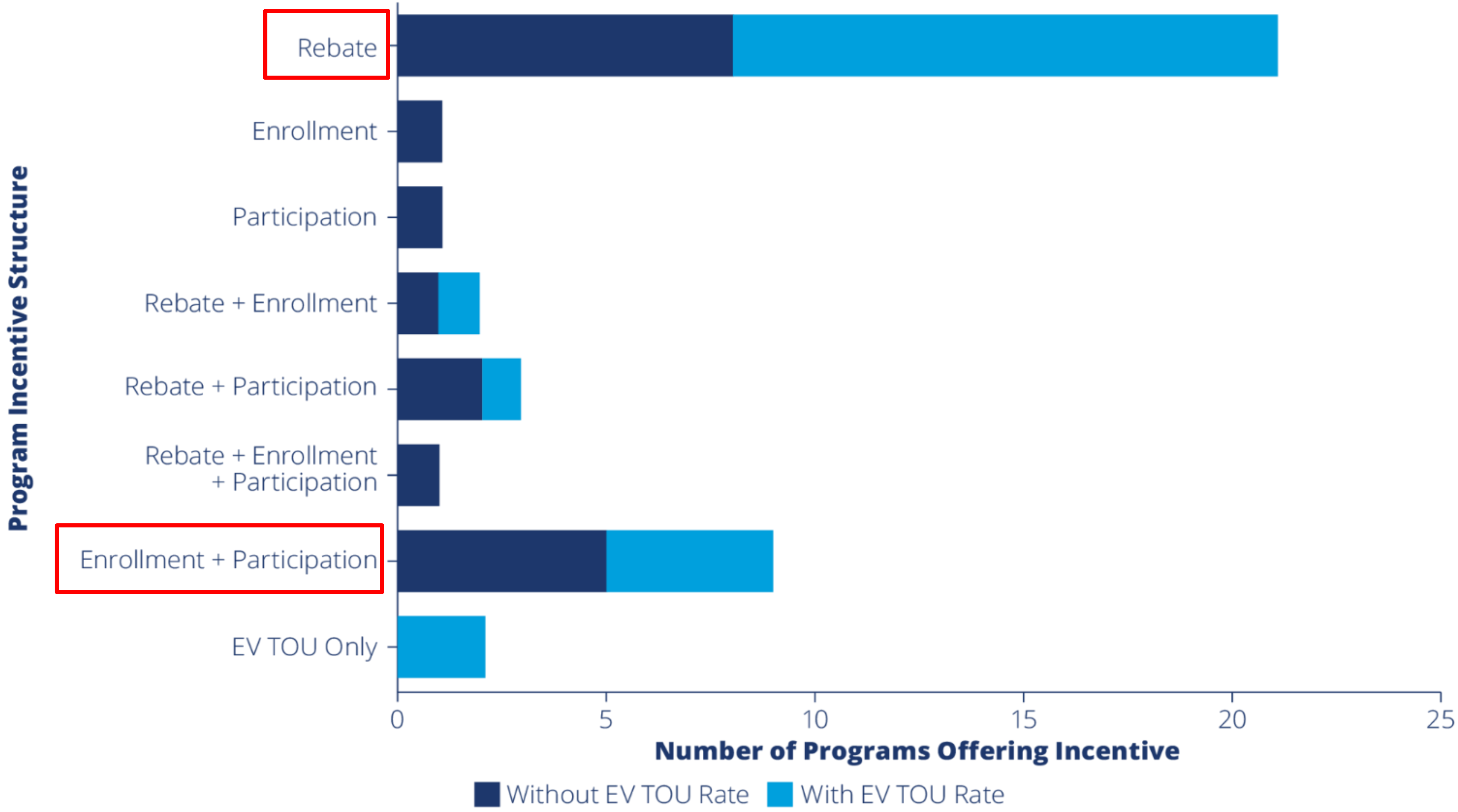


N=48. Note: Utilities selected all that applied.

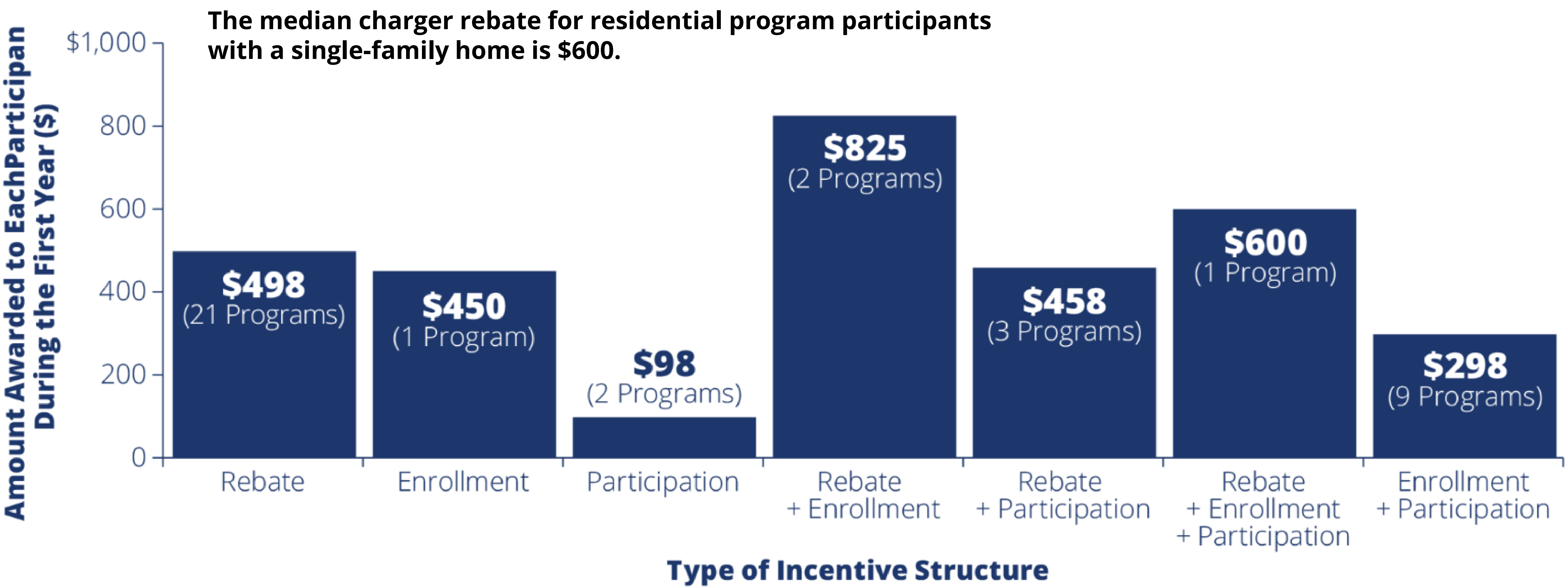
Source: SEPA, 2021

Rebates, or enrolment and participation



Source: Smart Electric Power Alliance, 2021.

Incentive offered in year one (average)



Source: Smart Electric Power Alliance, 2021.

Are utilities paying too much?

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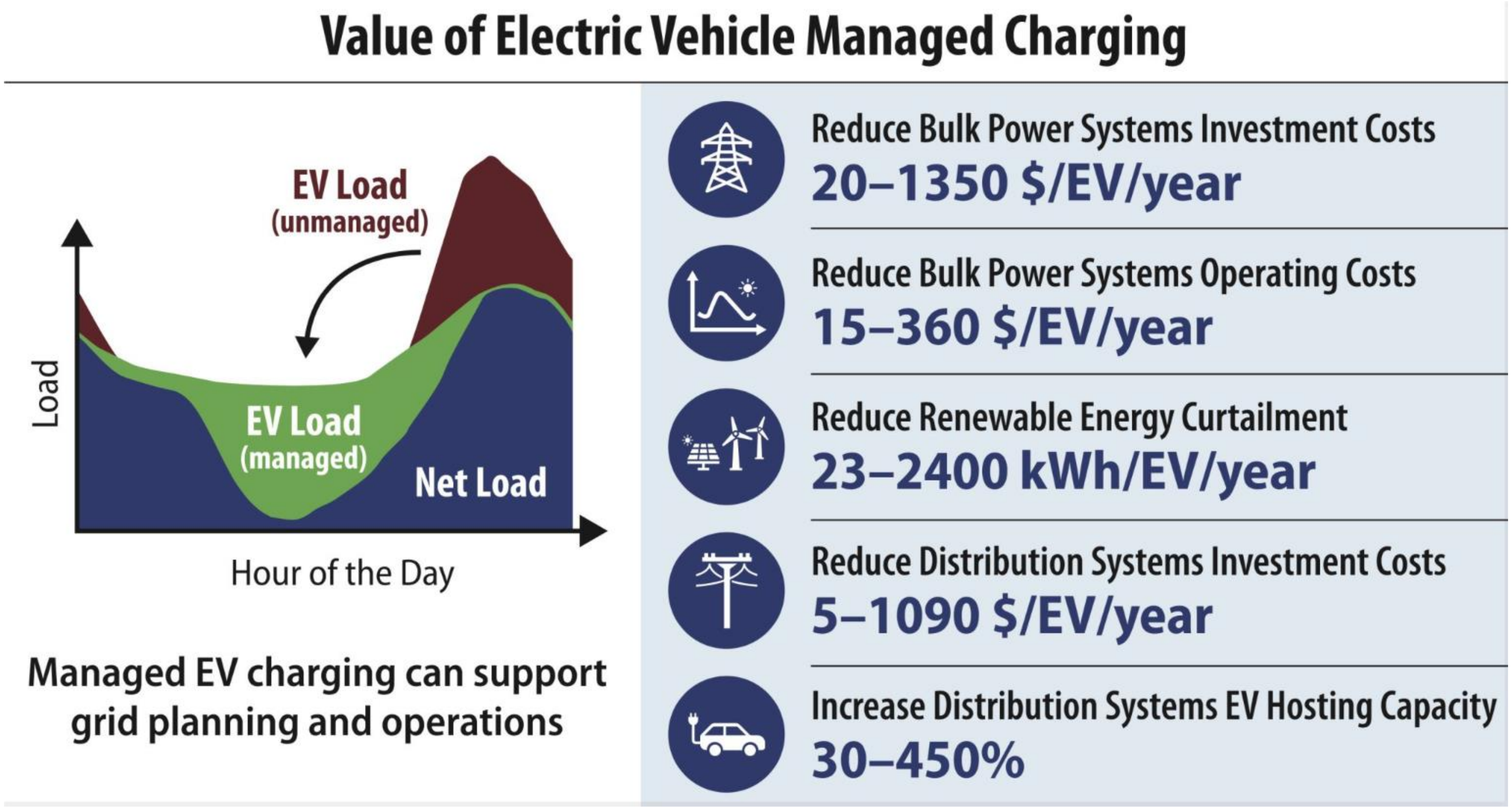
SRP + Brattle group found savings for Managed Charging to range between **$50-70/yr**

Scenario		Assumptions: Participant Compliance	Assumptions: Managed Events	Assumptions: kWh Shifted	System Costs: Energy Costs	System Costs: Peak Costs	System Costs: Total Costs	System Cost Savings: Energy Savings	System Cost Savings: Peak Savings	System Cost Savings: Total Savings	Normalized Savings: Savings per Event	Normalized Savings: Savings per kWh
Unmanaged Charging (E23)		0%	0	0	$89	$49	**$138**	---	---	---	---	---
8 Hour	All Weekdays	90%	261	939	$62	$5	**$67**	$27	$44	**$70**	**$0.27**	**$0.07**
8 Hour	Summer Peak Weekdays	90%	88	317	$71	$5	**$75**	$18	$44	**$62**	**$0.71**	**$0.20**
8 Hour	Top 20 Days	90%	20	72	$75	$5	**$80**	$14	$44	**$58**	**$2.89**	**$0.80**
4 Hour	All Weekdays	90%	261	535	$76	$5	**$80**	$13	$44	**$57**	**$0.22**	**$0.11**
4 Hour	Summer Peak Weekdays	90%	88	180	$78	$5	**$83**	$11	$44	**$55**	**$0.62**	**$0.30**
4 Hour	Top 20 Days	90%	20	41	$80	$5	**$85**	$9	$44	**$53**	**$2.66**	**$1.30**
4 Hour	Summer Peak Weekdays	80%	88	180	$79	$10	**$89**	$10	$39	**$49**	**$0.56**	**$0.27**

Source: PLMA October Meeting, Brattle Group, SRP

....or to little?



Source: **Assessing the value of electric vehicle managed charging: a review of methodologies and results,**
Energy Environ. Sci., 2022, Advance Article

Six step process for program design

Smart Electric Power Alliance

1. **Charging Behavior** – Identify the customer charging behavior that would be ideal for the grid and evaluate how that ideal charging load shape compares to unmanaged charging.
2. **Program Objective** – Consider what the objective of the program should be and what tools are at the utility's disposal to achieve those objectives.
3. **Regulatory Considerations** – Identify any regulatory considerations related to managed charging. These may impact the design of the program.
4. **Incentive Design** – Design an incentive structure and choose incentive values to best meet the program objectives and adhere to the budget.
5. **Program Size & Customer Segment** – Determine program size according to the budget and create strategies to identify potential program participants within each customer segment.
6. **Marketing & Recruitment** – Choose a marketing and recruitment strategy to inform customers about the program and influence potential participants to enroll.

Source: Smart Electric Power Alliance, 2021

Key Learnings

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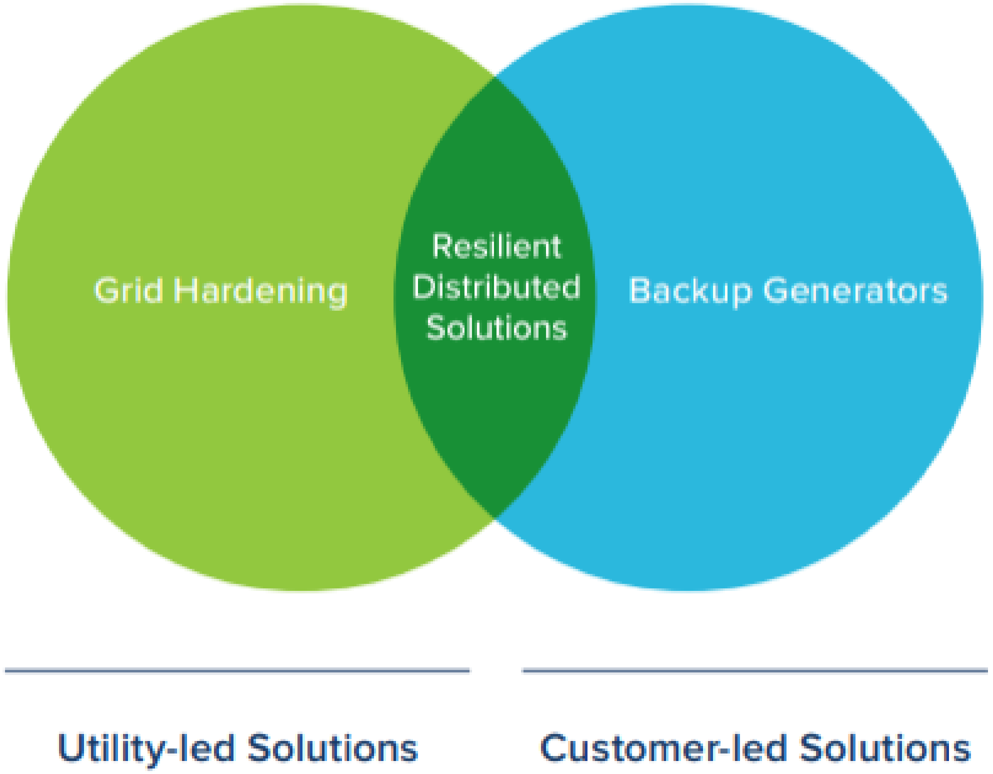
- ✓ Plan for programs that can **evolve** to meet system needs
- ✓ Design programs that maximize **customer eligibility** & participation
- ✓ Structure programs such that the default behavior **benefits the grid**
- ✓ Use the opportunity to become a **trusted advisor** to your customers
- ✓ Budget for **cost-effective programs** that optimize hardware rebates and incentive pay-outs

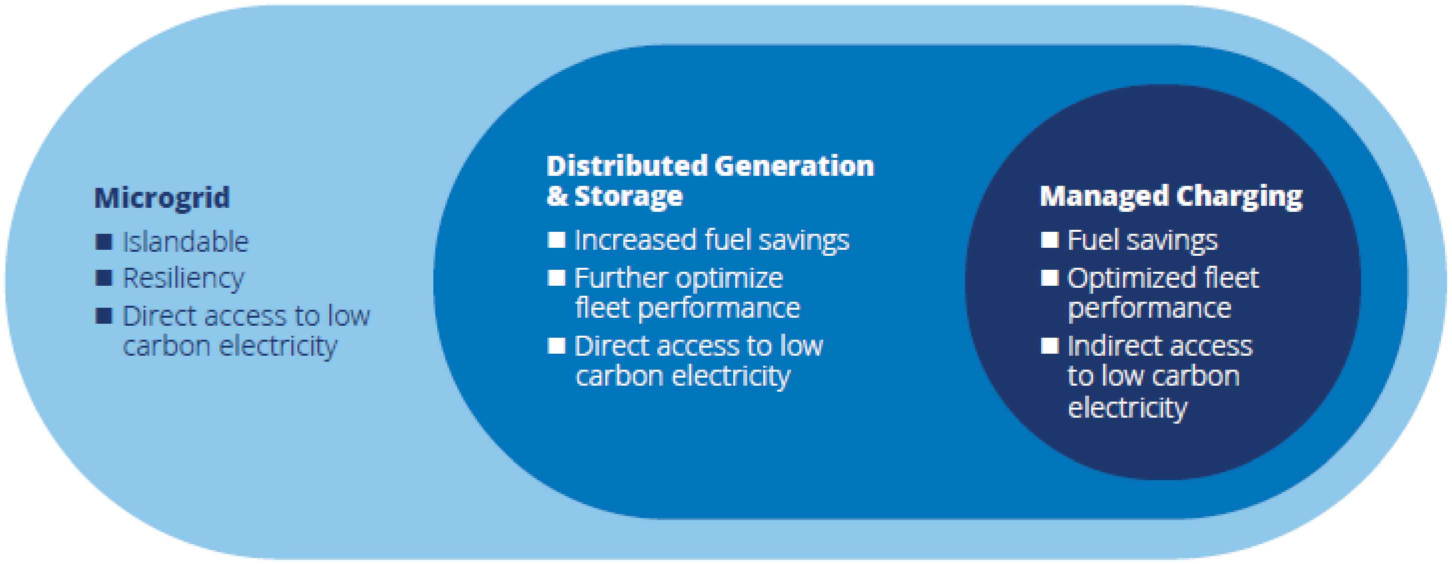
Resilience Solutions



Microgrids, DG, Managed Charging → Integrated

Smart Electric Power Alliance

Figure 1. Illustrative Relationship Between Managed Charging and Microgrids

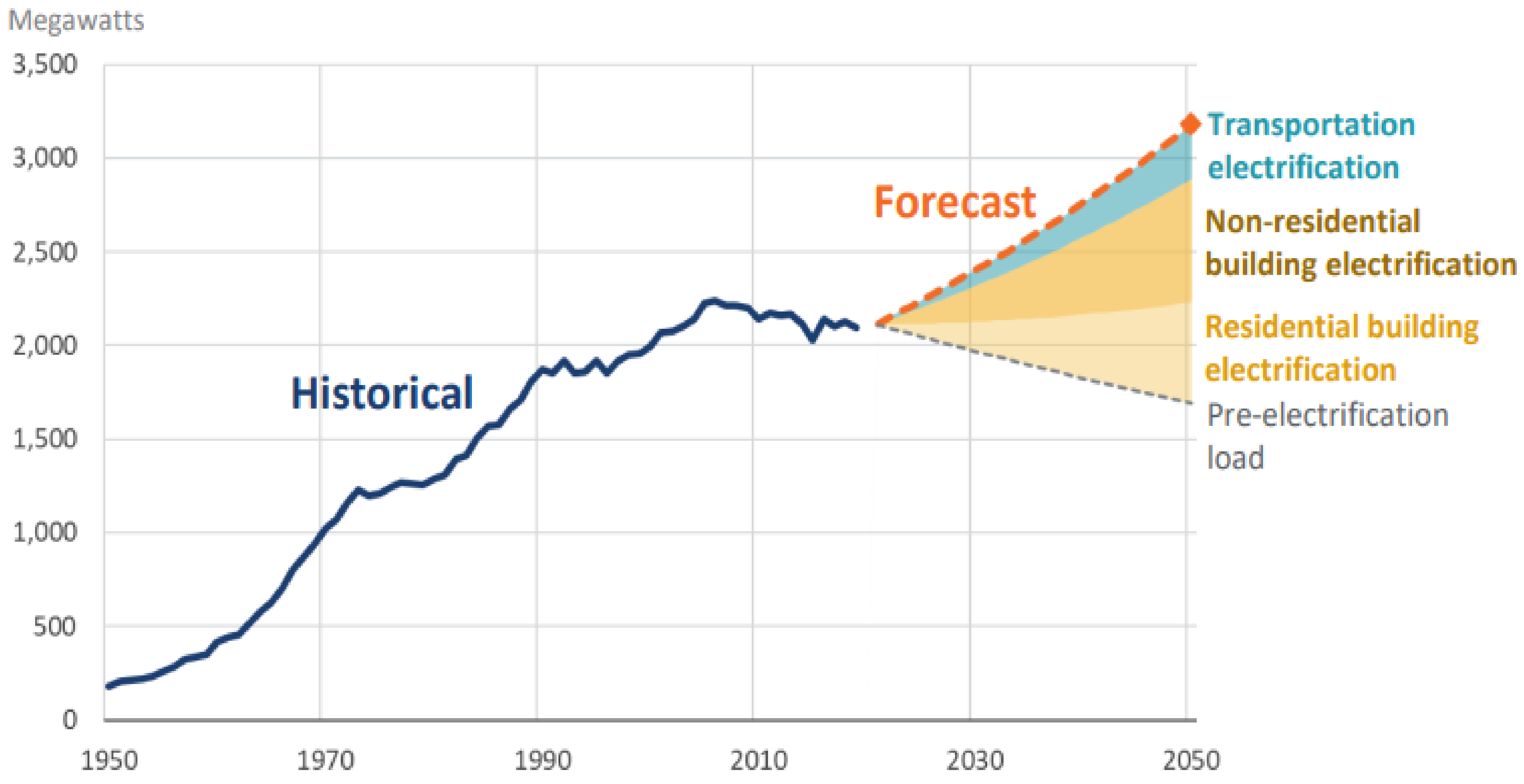


Source: SEPA, 2021.

Building Electrification – the next frontier

Smart Electric Power Alliance

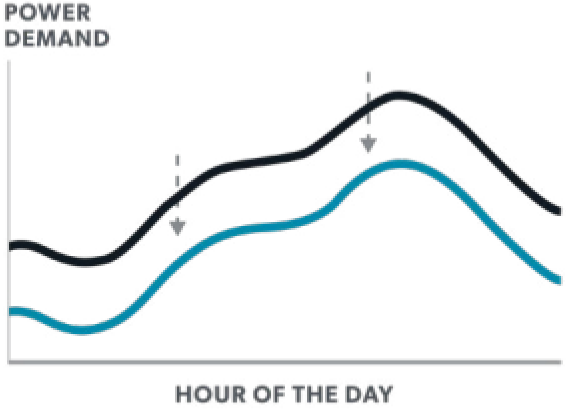
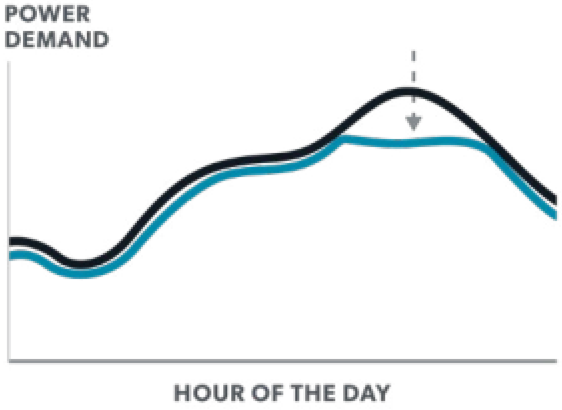
Pepco DC System Peak Demand
Before EE and Load Flexibility



Source: An Assessment of Electrification Impacts on the Pepco DC system Brattle, 2021

Grid Efficient

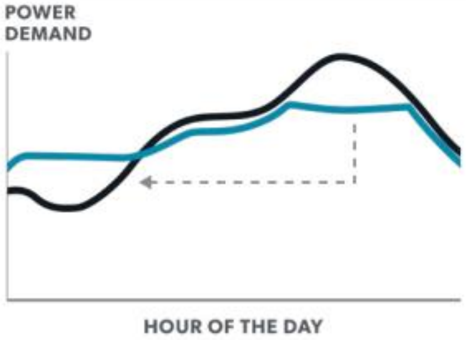
Smart Electric Power Alliance

	LOAD IMPACT	EXAMPLE MEASURE	EXAMPLE BENEFIT
Efficiency		Building has an insulated, tight envelope and an efficient HVAC system to reduce heating/cooling energy needs	Reduced costs of burning fuel to satisfy energy demand, and reduced emissions associated with lower fuel use
Shed Load		Building dims lighting system by a preset amount in response to grid signals while maintaining occupant visual comfort levels	Reduced investment in generation and transmission capacity due to lower peak demand

Grid Interactive

Smart Electric Power Alliance

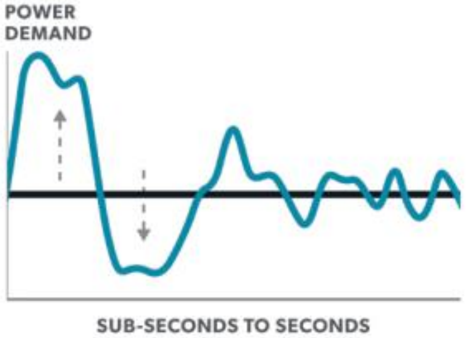
Shift Load



Connected water heaters pre-heat water during off-peak periods in response to grid signals

Reduced energy costs due to shifting consumption to cheaper hours of the day; avoided curtailment of renewables during off-peak periods

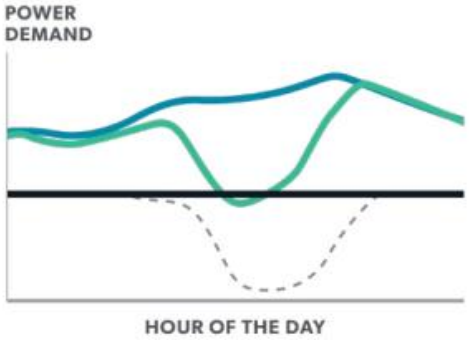
Modulate



Batteries and inverters autonomously modulate power draw to help maintain grid frequency or control system voltage

Reduced ancillary services costs, improved integration of variable generation resources (e.g., wind, solar)

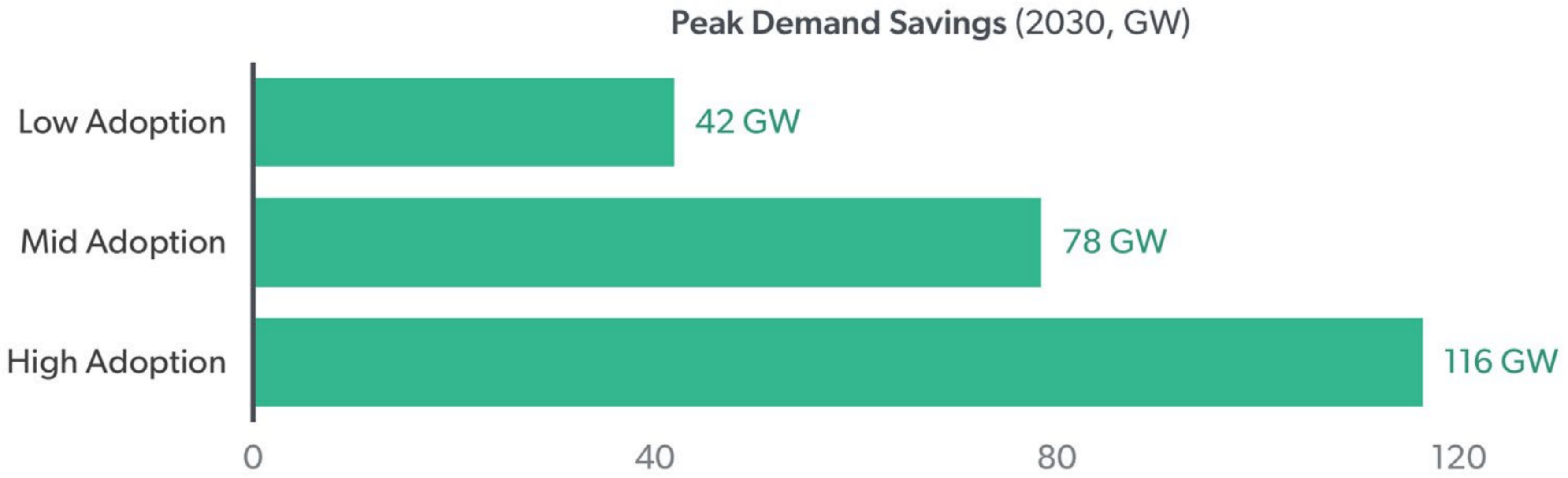
Generate



Rooftop solar PV exports electricity to the grid

Reduced T&D losses due to on-site consumption; avoided need for grid-scale generation

Grid Interactive Efficient Buildings

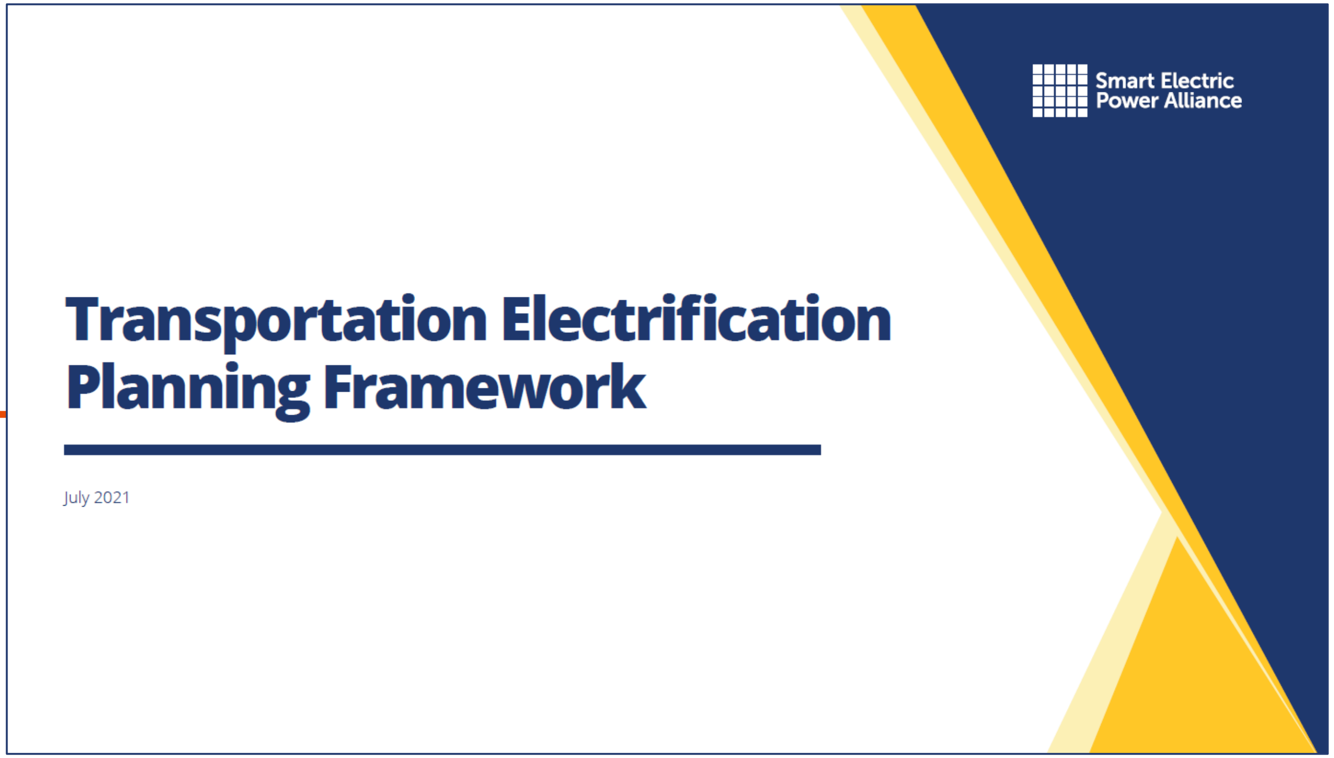


Source: A National Roadmap for Grid-Interactive Efficient Buildings, DOE 2021

Strategic Planning

This planning framework provides a simple and easy-to-navigate resource for utilities to use as they begin defining a utility-specific strategic plan.

The framework employs a sequenced approach to planning, beginning with defining the utility’s role and objectives and ending with program design recommendations.



Planning Framework - Free to SEPA members

Smart Electric Power Alliance

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Transportation Electrification Planning Framework

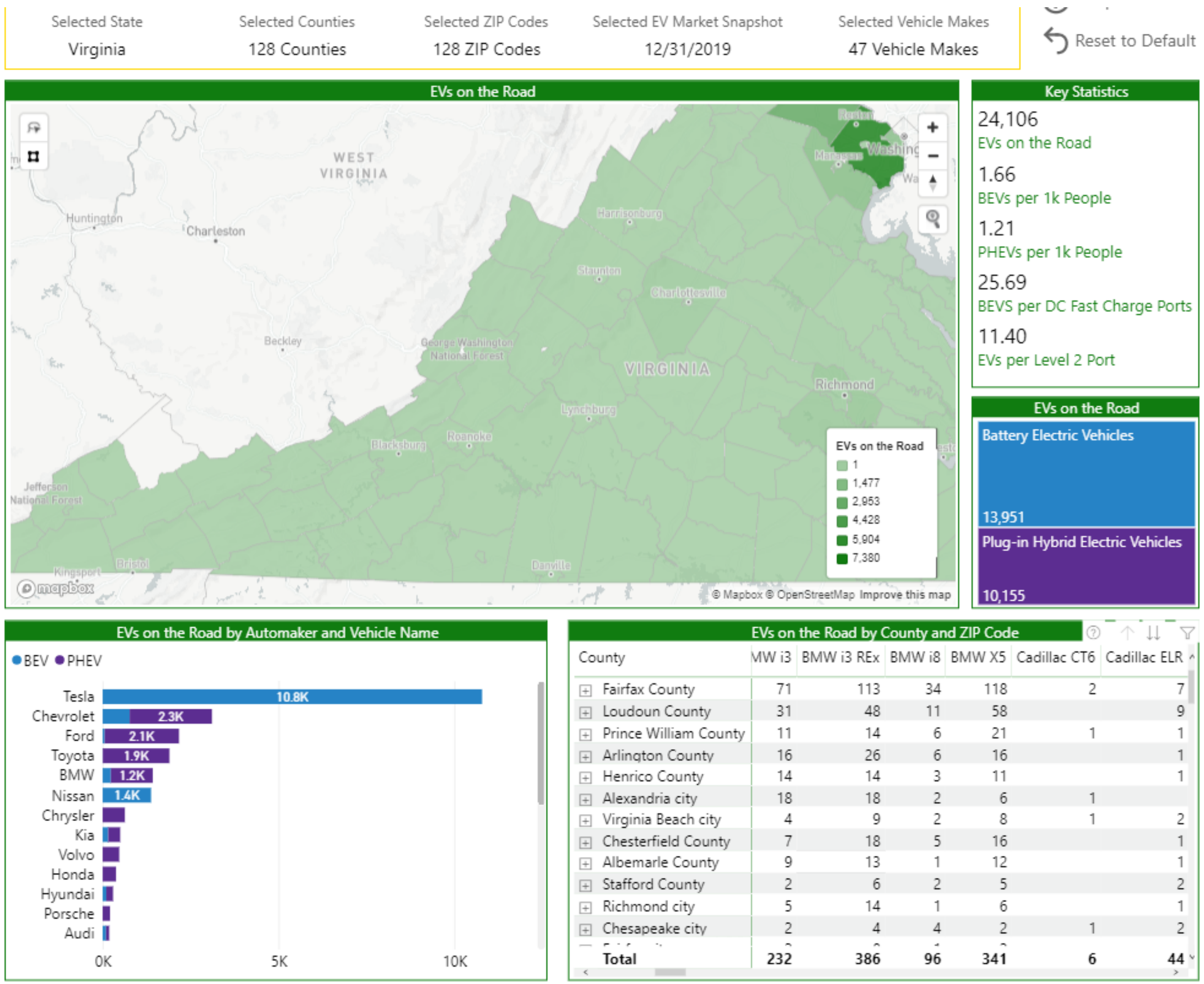
Planning Phase

Understanding Today's Market: Zip code level

Smart Electric Power Alliance

Atlas EV HUB hosts:

- State level granularity for all states
- County or zip code level for select states* (expanding)
- EV charging financial analysis tool
- Public policy, laws, regulation, and market data



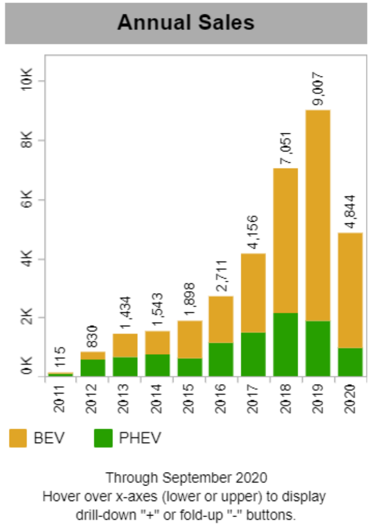
*Currently, Atlas EV Hub has state EV registration data from Colorado, Connecticut, Florida, Montana, Michigan, Minnesota, New Jersey, New York, Oregon, Texas, Vermont, Virginia, Washington, and Wisconsin

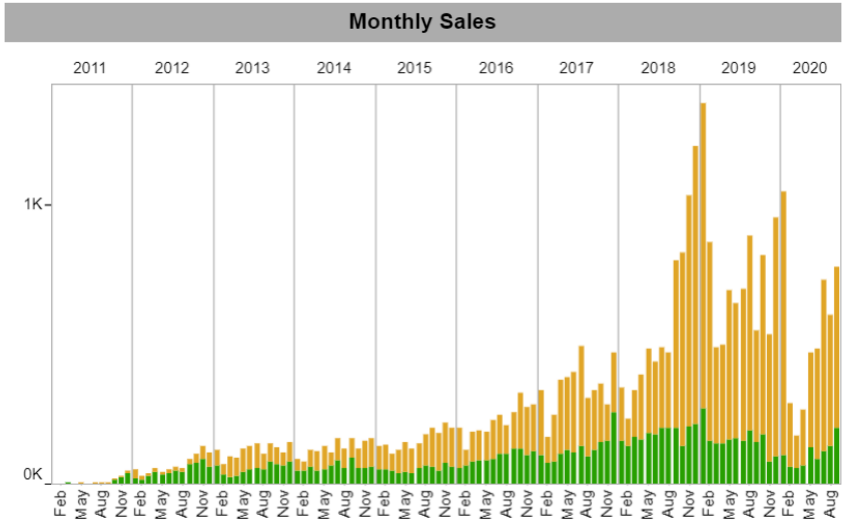
Understanding Today's Market: State level sales

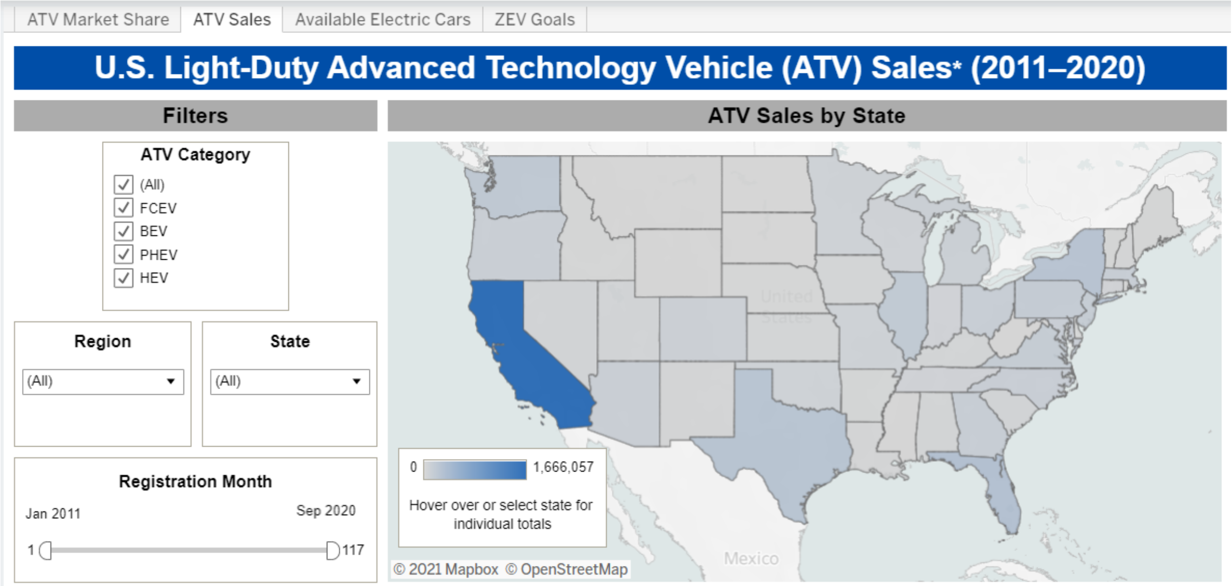
Smart Electric Power Alliance

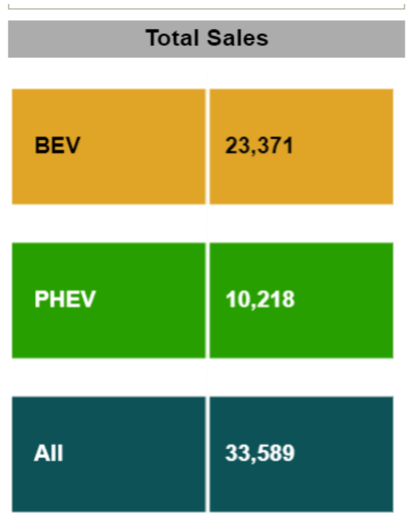
Auto Alliance Sales Dashboard host:

- State level annual and monthly EV sales
- State level sales penetration
- State by state EV model availability









Public Policy Map – Atlas EV Hub

Smart Electric Power Alliance

Selected Policies	Selected States	Selected Policy	Map Description
29	28 States	Annual Fee	An annual fee on EVs. Often this is done to cover lost revenue that would have been collected through a motor fuel tax.

Policy Map Selection (Select One)

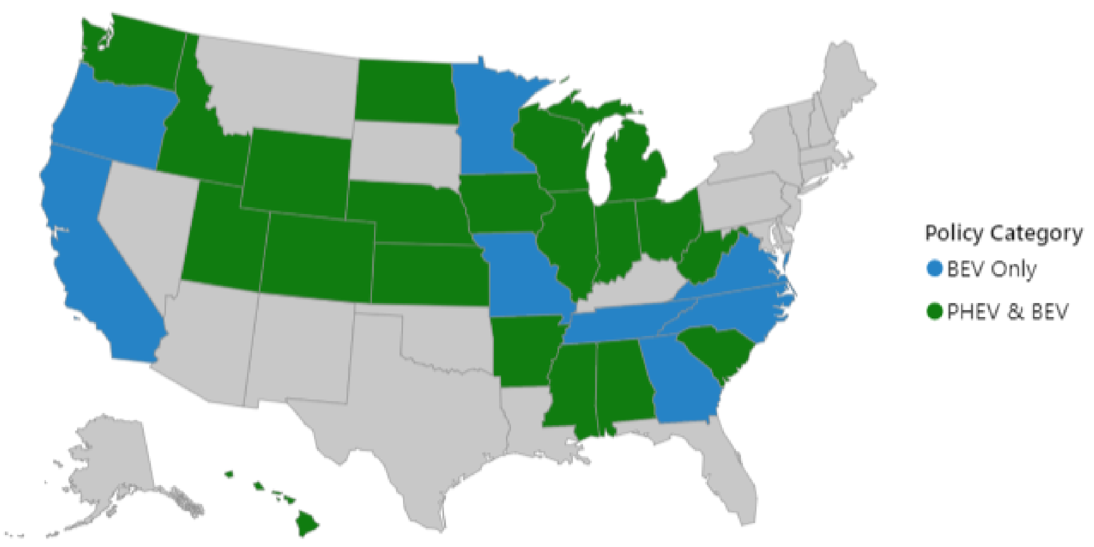
Annual Fee	Building Codes
Charging Incentive	Charging Service Provider
Charging Standards	Direct Sales
EV Charging Rate	HOV Incentive
Low Carbon Fuel Standard	MD/HD Incentive
MD/HD Sales Requirement	NGO Incentive

EV Sales	BEV Sales	PHEV Sales	EVs per 1k	BEVs per 1k	PHEVs per 1k
1,679,785	1,054,374	625,411	5.20	3.27	1.94

Policy Descriptions

State	Title	Enacted Date	Policy Category	Description	Source
AL	Plug-In Electric Vehicle (PEV) Fee	3/12/2019	PHEV & BEV	Effective January 1, 2020, PEV owners must pay an annual fee in addition to standard registration fees. All-electric vehicle owners must pay an annual fee of $200 and plug-in hybrid electric vehicle o...	
AR	Plug-In Electric Vehicle (PEV) Fee	3/5/2019	PHEV & BEV	PEV owners must pay an annual fee in addition to other registration fees. The fee is $200 for all electric vehicles and $100 for plug-in hybrid electric vehicles. Fees contribute to the State Highway ...	
CA	Zero Emission	4/28/2017	BEV Only	Effective July 1, 2020, ZEV	

Annual Fee



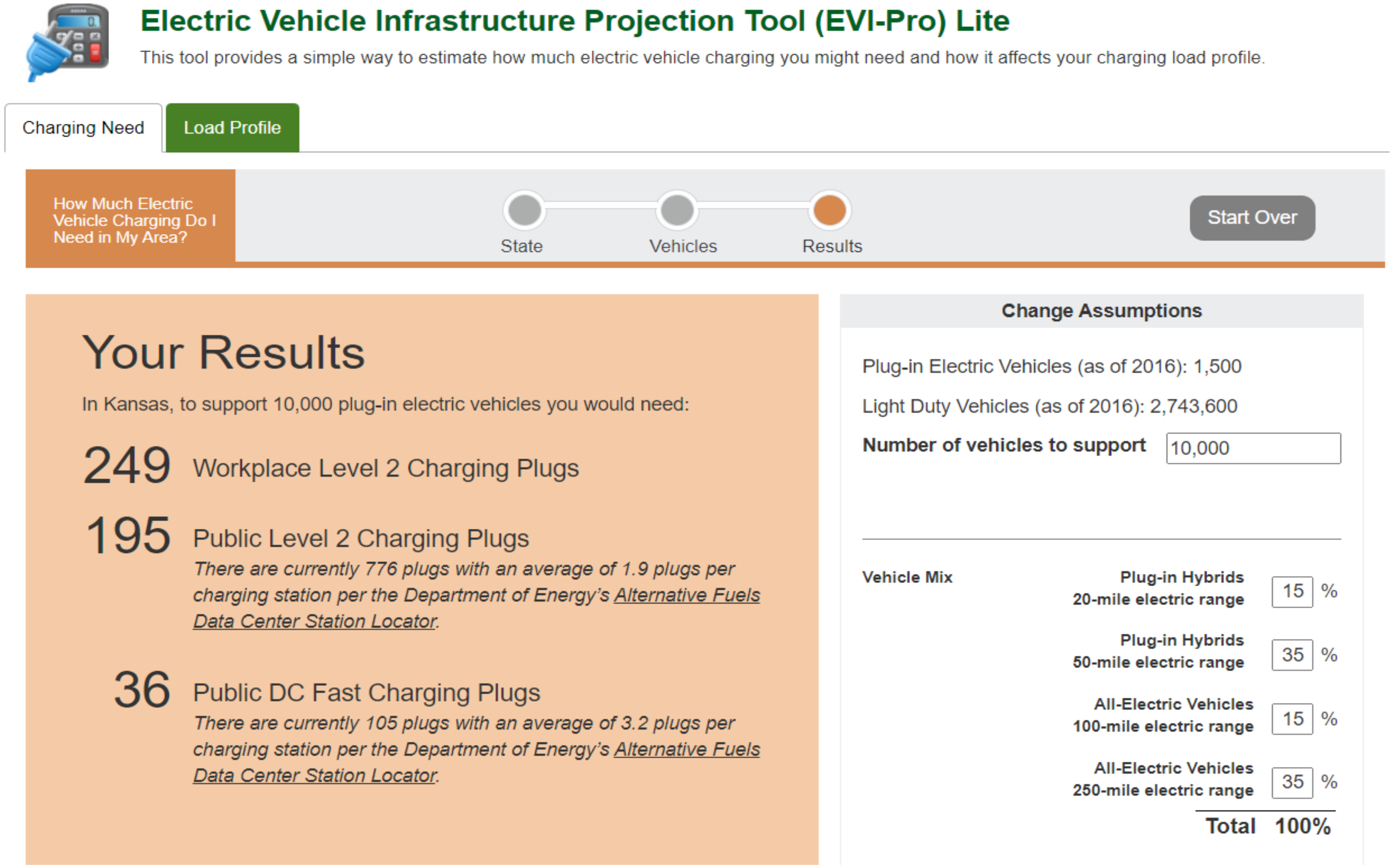
BEV Only	PHEV & BEV
8	20

Estimating Charging Infrastructure Needs

Smart Electric Power Alliance

EV Pro Lite offers:

- Estimated charging needs based on EV forecasts, by charging type
    - Workplace,
    - Public L2,
    - Public DCFC
- State level granularity
- Options to adjust vehicle mix
- Guidance on cost

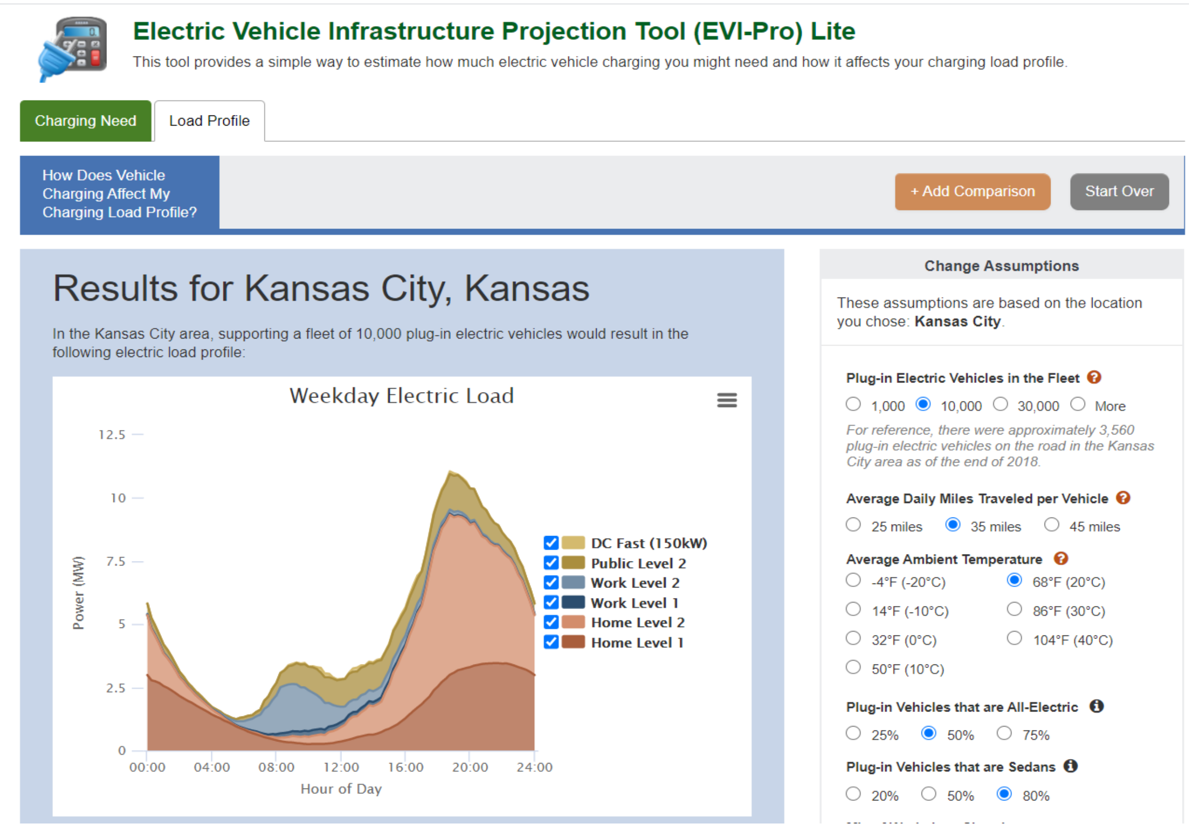


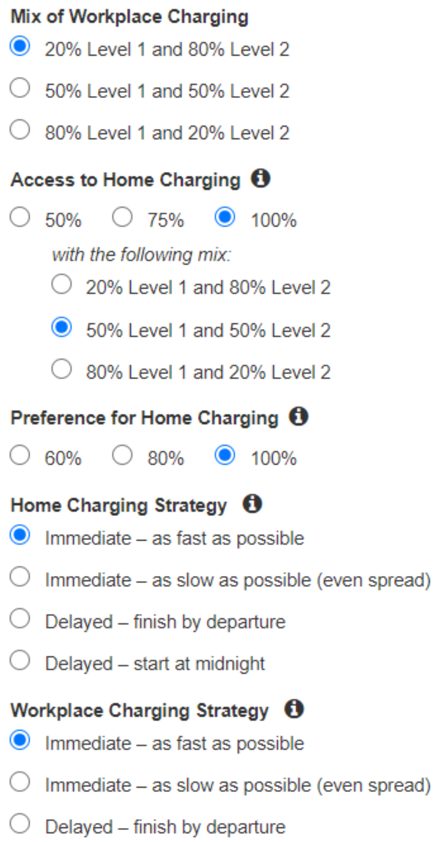
Estimating Load Impacts: System Level

Smart Electric Power Alliance

EV Pro Lite offers:

- Impact to hourly load shape by charging method
- Options to adjust charging behavior
  - Workplace vs home
  - L1 vs L2
  - Simplified managed charging options
- Options to adjust travel distance
- Temperature sensitivity





Additional SEPA Resources for TE Planning

Smart Electric Power Alliance

Preparing for an Electric Vehicle Future: How Utilities Can Succeed	Needs Assessment Stakeholder Engagement Principles and Approach	This report describes typical utility and industry practices today and outlines how utilities can prepare for increasing EV charging infrastructure deployment.
A Comprehensive Guide to Electric Vehicle Managed Charging	Stakeholder Engagement Portfolio Structure Program Design	This report has six sections to help readers understand what managed charging is and how it could be beneficial, provides an overview of the current managed charging industry, outlines what utilities want from managed charging programs, defines how managed charging communication pathways can relay signals, and defines the current managed charging vendor landscape.
Residential Electric Vehicle Rates That Work: Attributes that Increase Enrollment	Portfolio Structure Program Design	This report provides a comprehensive overview of residential EV time-varying rates and draws conclusions about next steps for residential EV rate design and programs based on the results of a utility survey and a customer survey
Guidelines for Selecting a Communications Protocol for Vehicle-Grid Integration	Portfolio Structure Program Design	This white paper is written for utility EV program managers and IT experts who are thinking about how to scale their vehicle-grid integration programs from early stage pilots or demonstration projects to full deployments. It is also useful for vendors making communications technology decisions.

Source: Smart Electric Power Alliance, 2021.