NARUC Electric Vehicles State Working Group

MANAGED CHARGING/ RATE DESIGN

April 30, 2024, 3:00 - 4:30 PM ET

Welcome

EV SWG Chair

Commissioner Katherine Peretick, Michigan Public Service Commission

EV SWG Vice Chair

Commissioner Milt Doumit, Washington Utilities and Transportation Commission

EV Commission Staff Leads

Ryan Cheney, North Carolina Utilities Commission

Steve Olea, Arizona Corporate Commission

NARUC Staff

Danielle Sass Byrnett and Robert Bennett

Agenda

Feel free to enter questions into chat at any time

3:00 PM	**Welcome and Announcements – Commissioner Katherine Peretick** • Agenda review
3:10 PM	**Noel Crisostomo, U.S. DOE** **Brennan Borlaug, National Renewable Energy Laboratory** **Chuck Moran, Kevala**
3:25 PM	**Mathias Bell, WeaveGrid**
3:40 PM	**Erin Monroe Nye, Madison Gas and Electric**
3:50 PM	**Speaker Q&A**
4:15 PM	**Peer Sharing Discussion**
4:30 PM	**Adjourn**

EV Fact of the Week:

Plug-in Electric Vehicle Battery Replacements Due to Failure Have Been Very Rare Since Model Year 2015

For more info and other facts, visit DOE FOTW webpage.

Presentations on Managed Charging

Moderator: Commissioner Katherine Peretick, Michigan Public Service Commission

Guest Speakers

- Noel Crisostomo, DOE; Brennan Borlaug, National Renewable Energy Laboratory; Chuck Moran, Kevala
  - Multistate EV Grid Planning analysis
- Mathias Bell, WeaveGrid
  - Data from managed charging pilots across different states
- Erin Monroe Nye, Madison Gas and Electric (MGE)
  - MGE Charge Ahead program

U.S. DEPARTMENT OF ENERGY

Transportation Electrification Impact Study (TEIS)

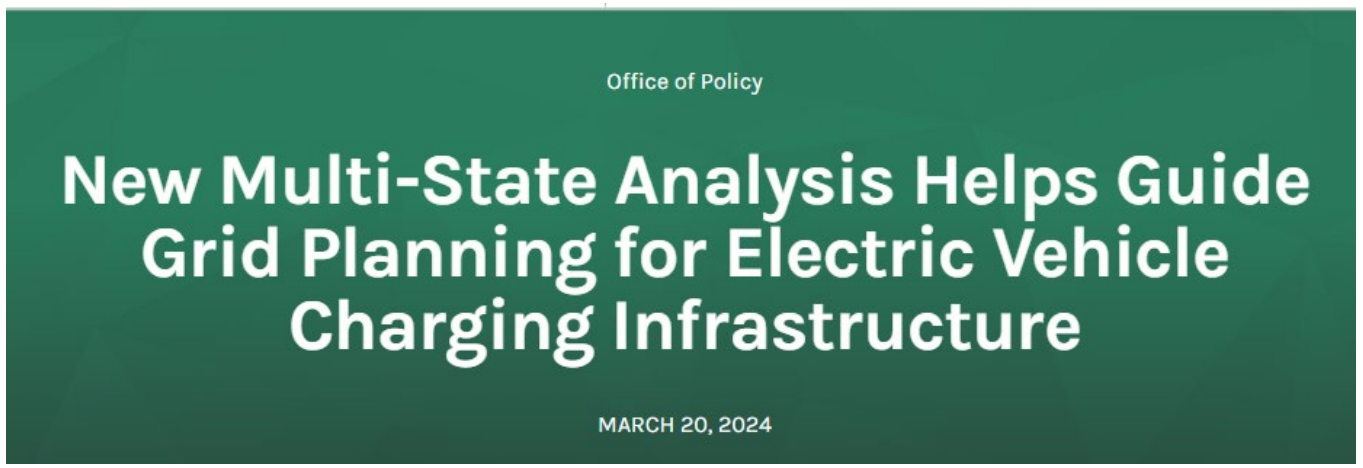
April 30, 2024

NARUC Electric Vehicles State Working Group

Presenters: Noel Crisostomo (DOE), Brennan Borlaug (NREL), & Chuck Moran (Kevala)

Background

- Consumer and fleet demand for plug-in electric vehicles (EVs) is expected to rise—requiring new charging networks and clean electricity infrastructure to power it.
- EV charging deployment planning is location-specific, with estimates requiring data on network design, charging flexibility, and the distribution grid.
- To guide utility plans for this new infrastructure, researchers assessed EV adoption in five U.S. states illustrative of the nation's diverse urban/rural populations, state-level EV policies, freight travel demands, and electrical grid composition.
- The TEIS estimates the investments in charging and electrical infrastructure needed to support EV adoption, and explores strategies to integrate load, and the overall benefits to consumers.



NREL Transforming ENERGY

BERKELEY LAB

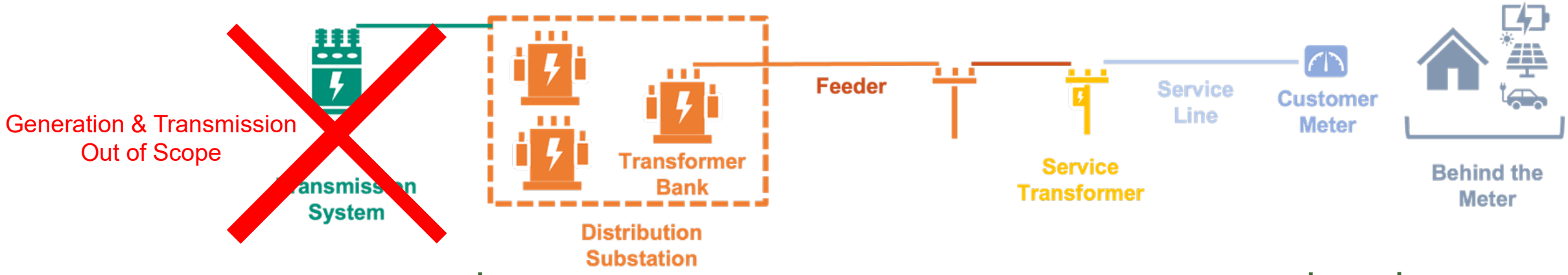
kevala

Conclusions

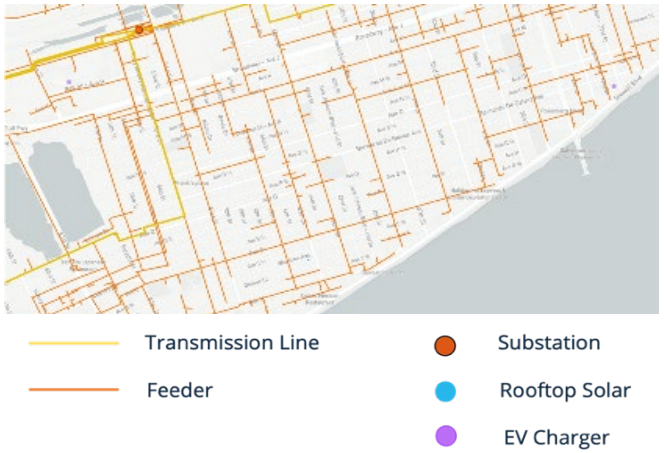
For the EV adoption scenario in five states (California, Illinois, New York, Oklahoma, Pennsylvania) projected between 2027 and 2032:

1. Installations of **needed charging infrastructure** could modestly increase 3% per year
2. Result in an incremental **distribution grid investment** that roughly equals 3% of current annual utility investments,
3. Managed charging can **decrease these distribution grid investment needs by 30%** (including avoiding tens of thousands of service transformer upgrades), illustrating the potential for significant additional savings from optimizing PEVs and other loads locally, and
4. Overall, **consumers benefit in the fuel savings from vehicle electrification, which significantly outweigh the investments required** for charging and grid infrastructure.

Scope



Snapshot of Kevala Data Platform



Distribution Grid

Includes: substations, feeders, and service transformers (aggregated by feeder)

EV Charging Infrastructure

Includes: EVSE, labor, panel upgrades, conduit, wiring, and site prep/construction work (including trenching)

EVSE: Electric Vehicle Service Equipment

Methodology: Distribution Upgrades

Objective

Methodology / Tools

Parcel-Level Base Load and Existing PV

Residential | Commercial | Industrial | PV

ResStock | ComStock | Sunspot

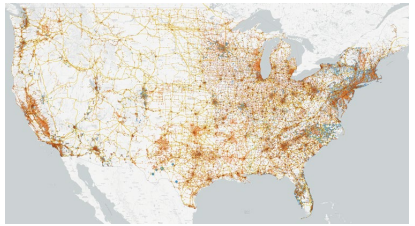
Demand Modifier Forecast

EV/EVSE | NREL Transforming ENERGY | BERKELEY LAB

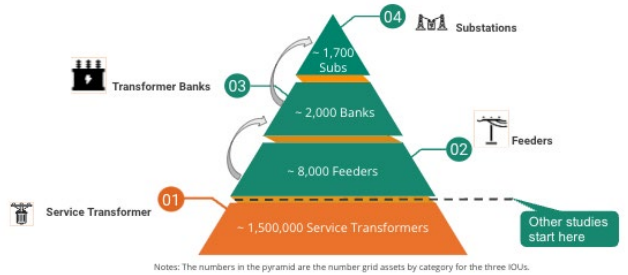
Bottom-Up Propensity Adoption to Disaggregate County-Level EVI-X and HEVI-LOAD

Size | Behavior | Adoption | Target

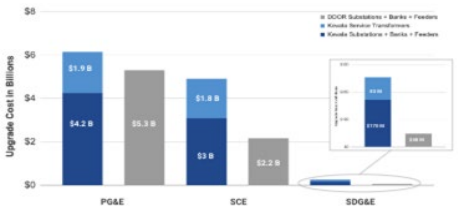
Kevala National Grid Data



Stepwise Grid Infrastructure Needs Assessment



Capacity Expansion Needs & Cost Estimates



Unit Cost Assignment and Aggregation

$X + $Y + $Z

Major Steps for EV Load & Infrastructure Forecasting

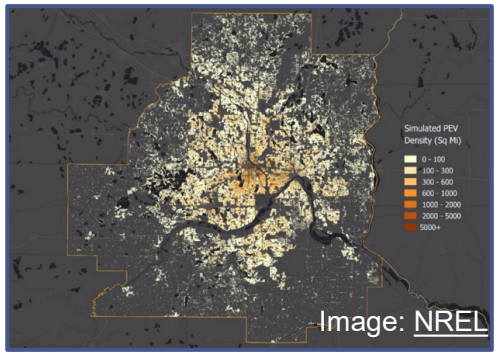


Image: NREL


Image: Wood et al.

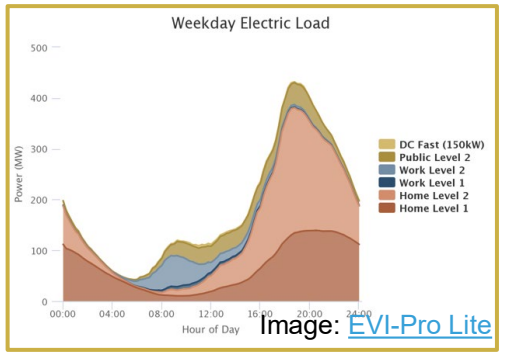


Image: EVI-Pro Lite

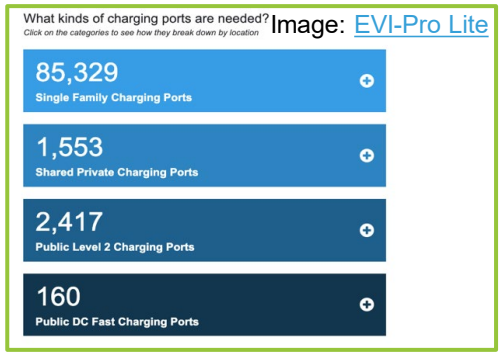


Image: EVI-Pro Lite

When/Where/Which EVs are adopted

- Which regions, communities, households are likely to adopt EVs?
- What types of EVs will be adopted?
- How quickly will EVs be adopted?

How EVs are operated

- How do driving requirements vary by region or household?
- Where are EVs parked during the day?
- Do EV travel patterns differ from ICE vehicles?

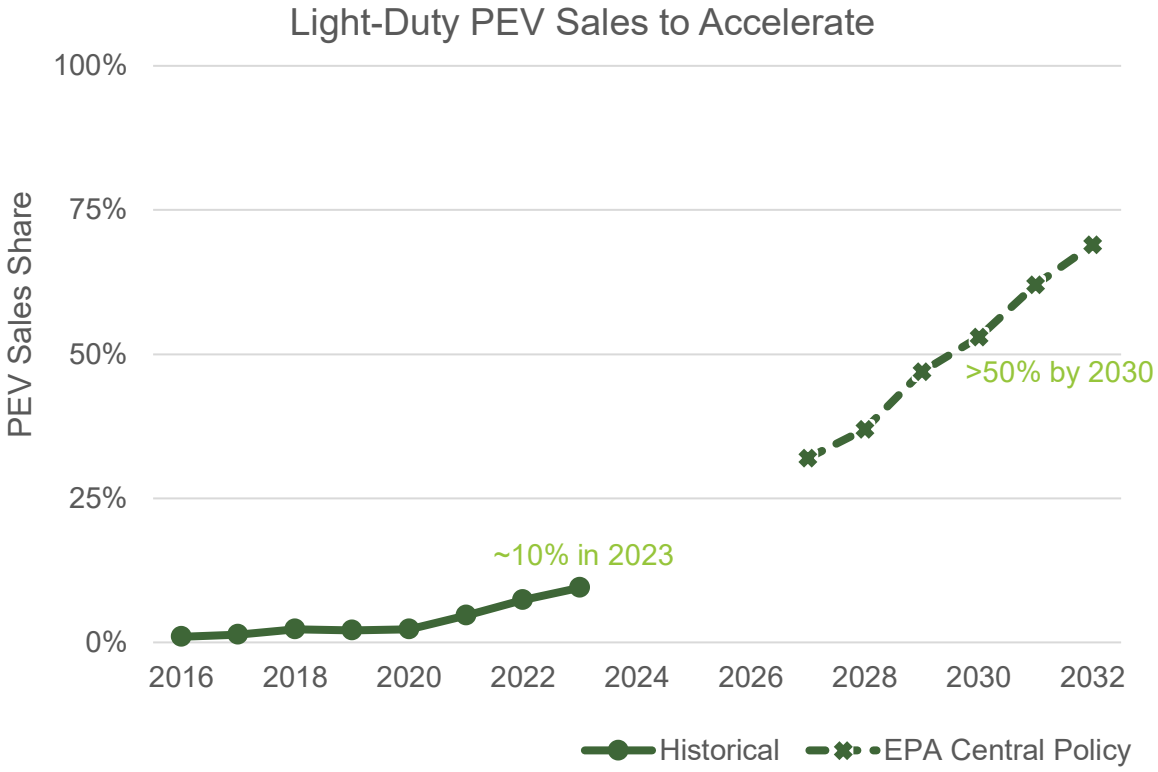
How EVs are charged

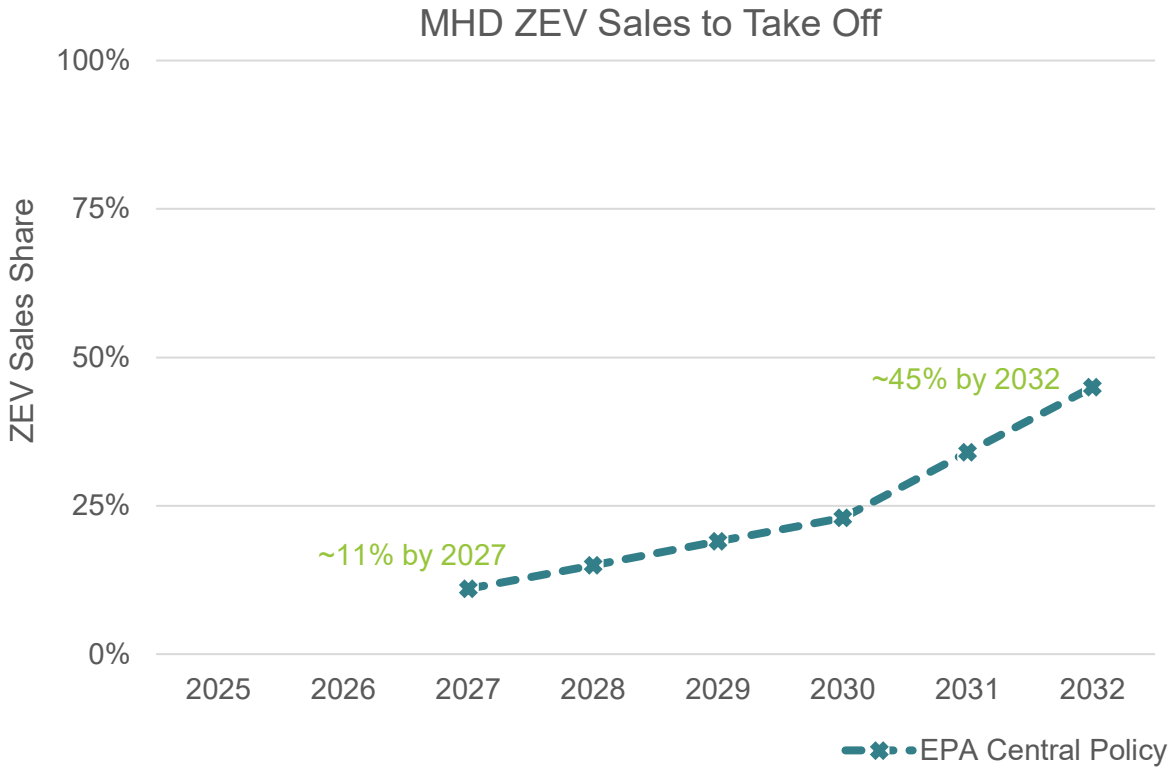
- Can EVs charge while at home, work, or in public?
- How do EV drivers prefer to charge, and will this change over time?
- Can EVs shift (in time) or modulate their loads?

What charging infrastructure is required

- What are realistic utilization levels for charging stations?
- Which deployment strategies will EVSE operators take?
- Will EVSE operators employ ”idle” fees to incentivize throughput?

EV Forecasts: Accelerated Adoption in All Classes

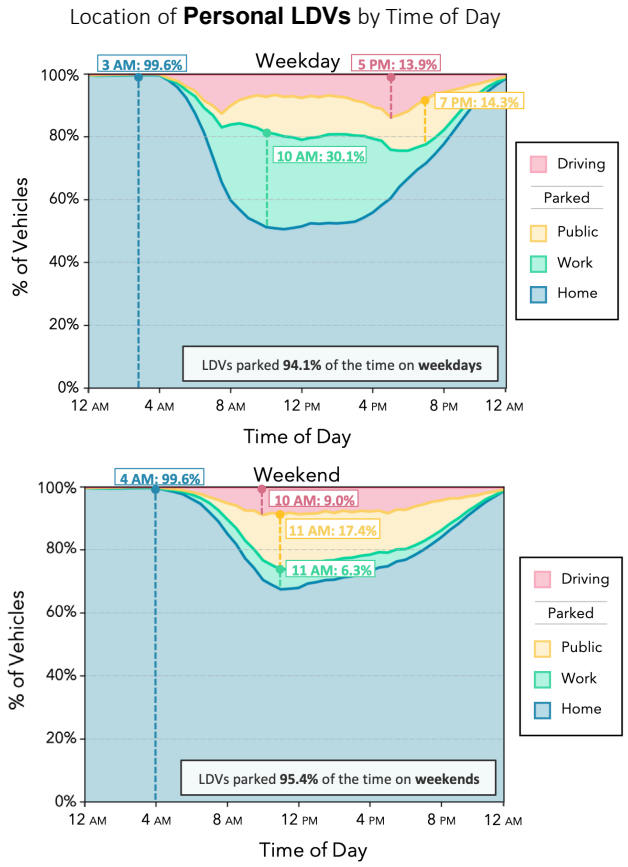




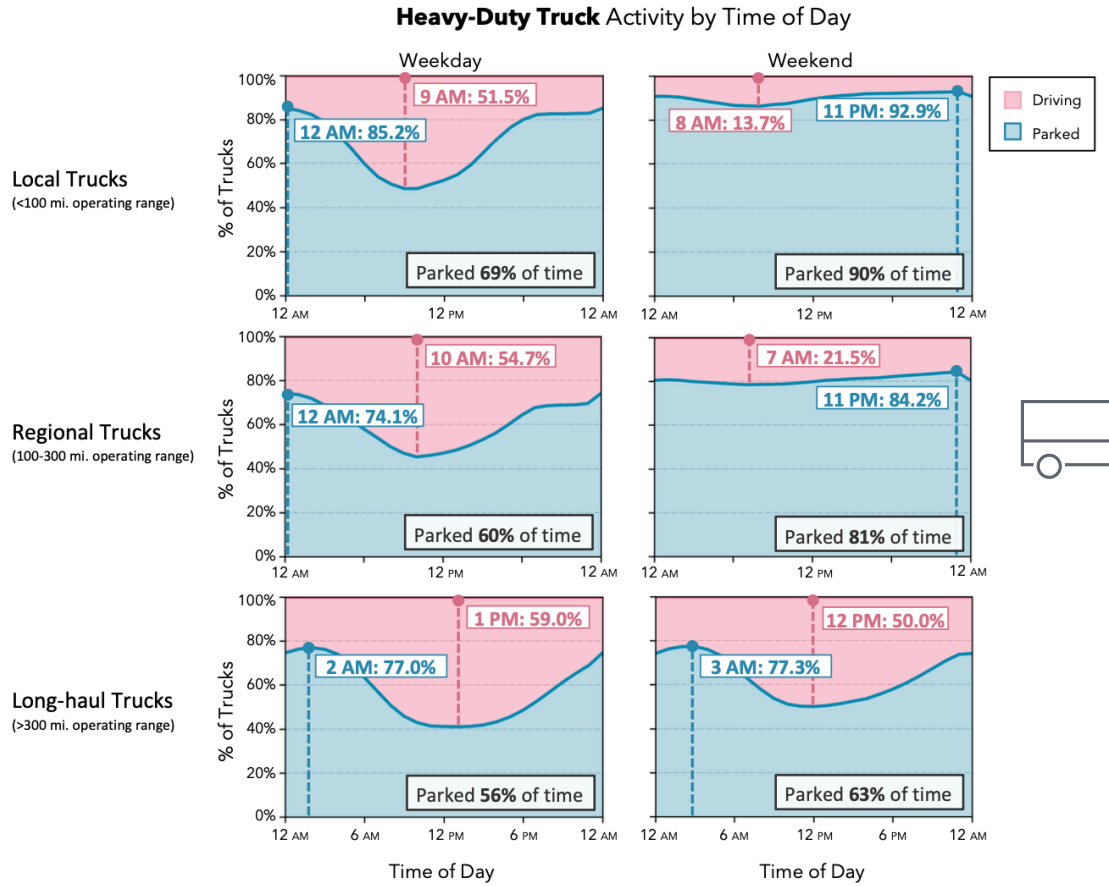
Managed Charging: Doing more with less!

Vehicles are parked most of the day…

Significant opportunity for **managed charging**!



Light-duty vehicles parked **95%** of the time

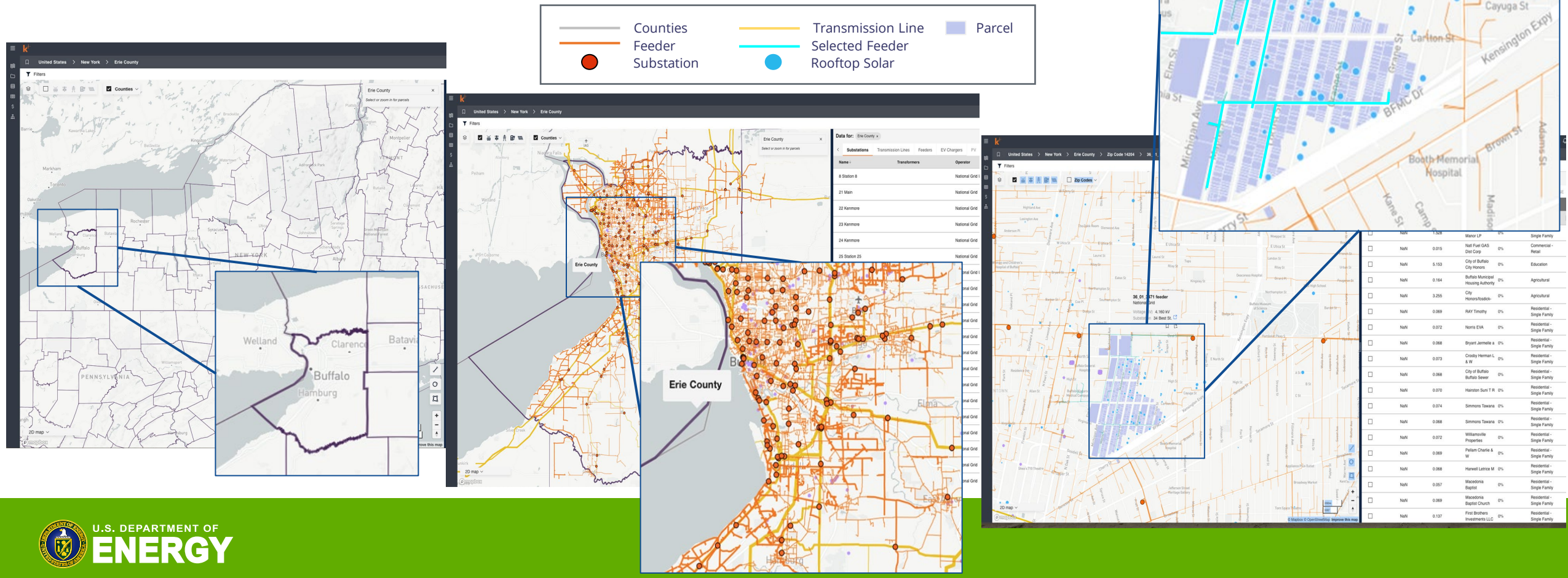


Heavy-duty trucks parked approx. **60%** (long-haul) to **75%** of the time (local)

https://www.nrel.gov/docs/fy24osti/87021.pdf

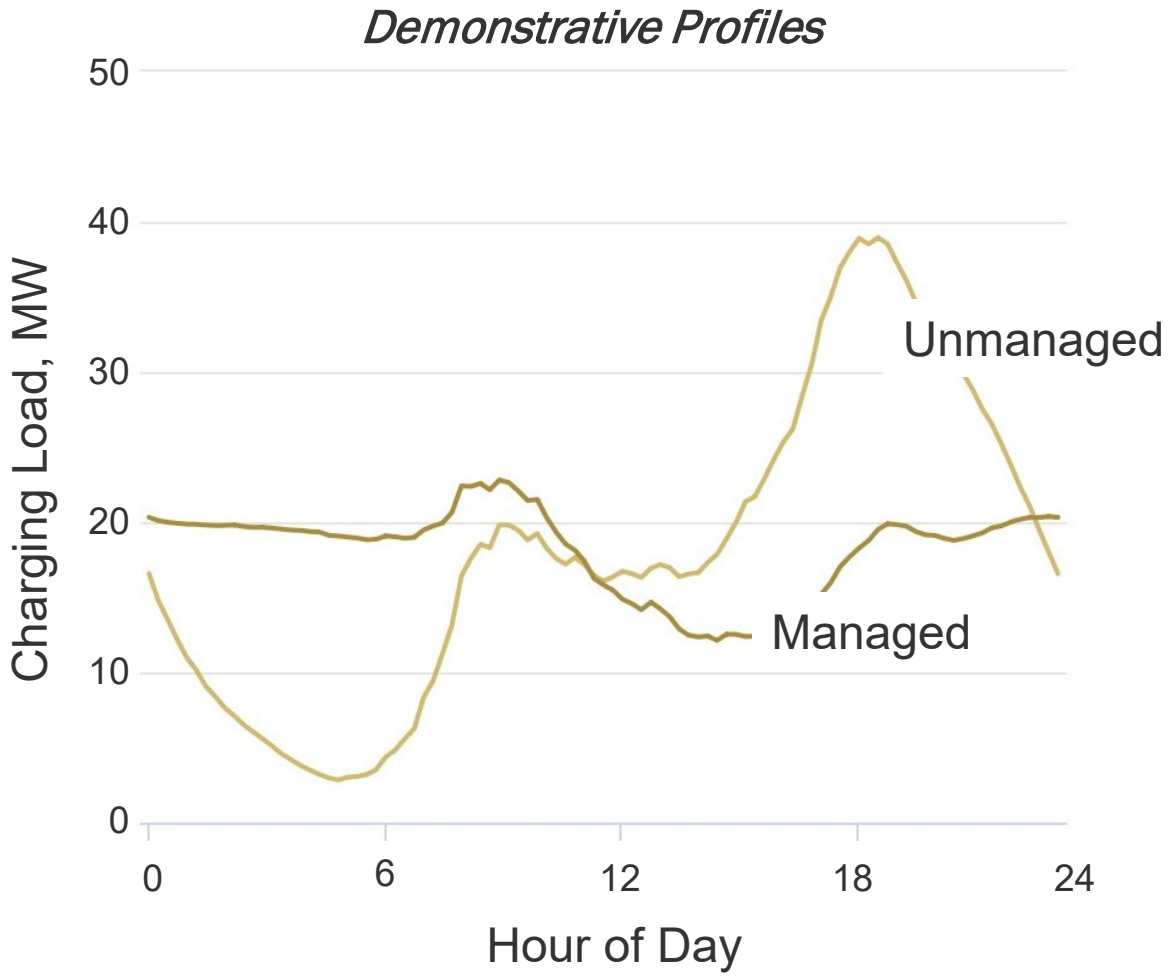
Spatial Charging Allocation

- Each parcel has a ResStock and ComStock Profile + existing rooftop PV
- NREL and LBNL EVSE port counts and profiles for all counties disaggregated to the parcel



Managed Charging Scenario

- Estimating potential for distribution cost savings
  - Charge management **only implemented at home/depot** locations
  - Arrival/departure times are **not adjusted** to facilitate charge management
- "Capacity unaware" heuristic produces a static profile to minimize PEV charging peak
  - Implementation is **ignorant to non-EV load**;
  - might be incentivized by (e.g.) a simple TOU rate structure
- Further savings could be realized with **additional technology deployment** (i.e. VGI to enable local "capacity awareness")



Thank You!

Citation:
National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Kevala Inc., and U.S. Department of Energy. Multi-State Transportation Electrification Impact Study: Preparing the Grid for Light-, Medium-, and Heavy-Duty Electric Vehicles. DOE/EE-2818, U.S. Department of Energy, 2024.

WeaveGrid

NARUC EV State Working Group

April 30, 2024

Today's Agenda

1. Introduction to WeaveGrid & Managed Charging
2. Why EVs are Different than Other Loads
3. How Distribution Optimization Works
4. How Charging Technologies Vary
5. Why System Integrations Can Create More Value

WeaveGrid

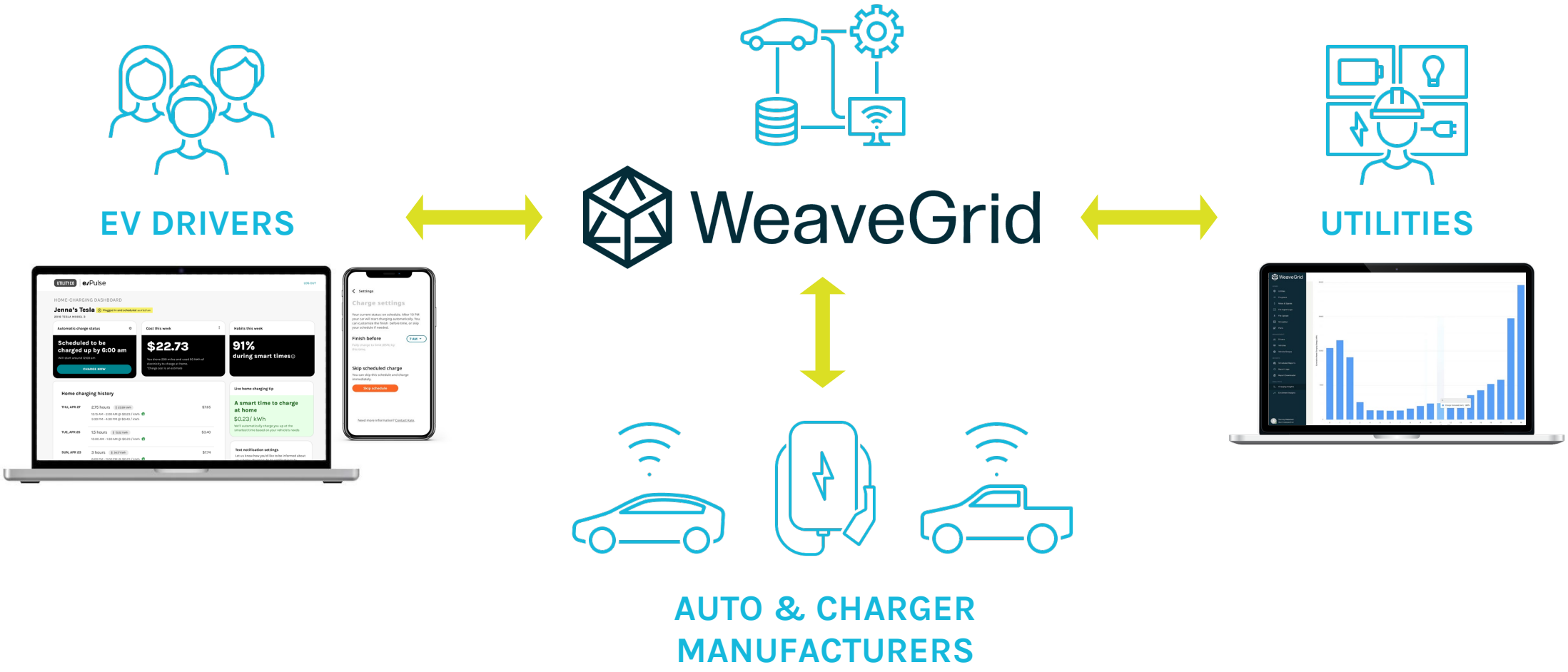
WeaveGrid

WeaveGrid & Managed Charging

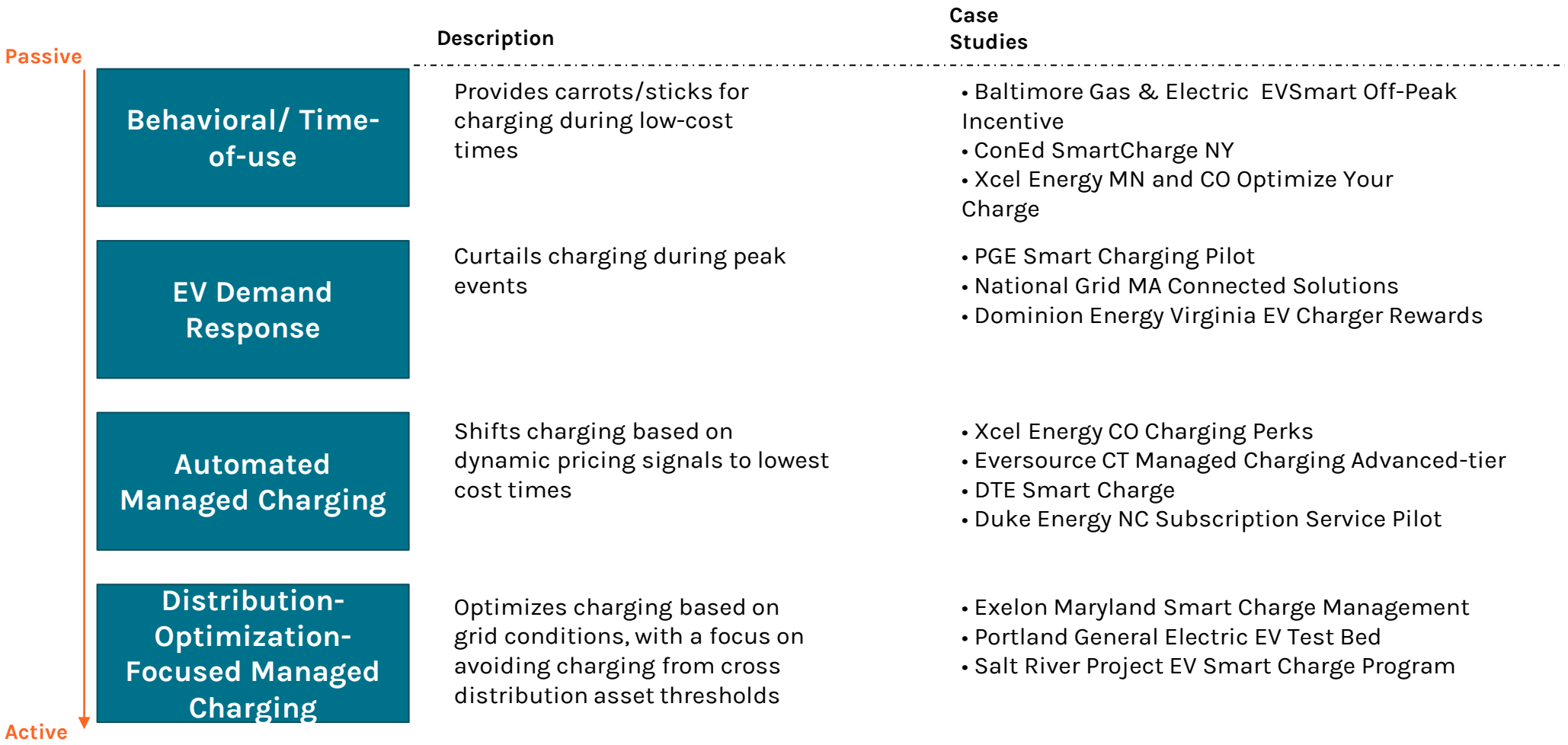
Introduction

Introduction

WeaveGrid helps utilities integrate EVs by transforming them into dynamic grid resources with software



Managed charging programs come in many flavors



Active Managed Charging Pilot Overview

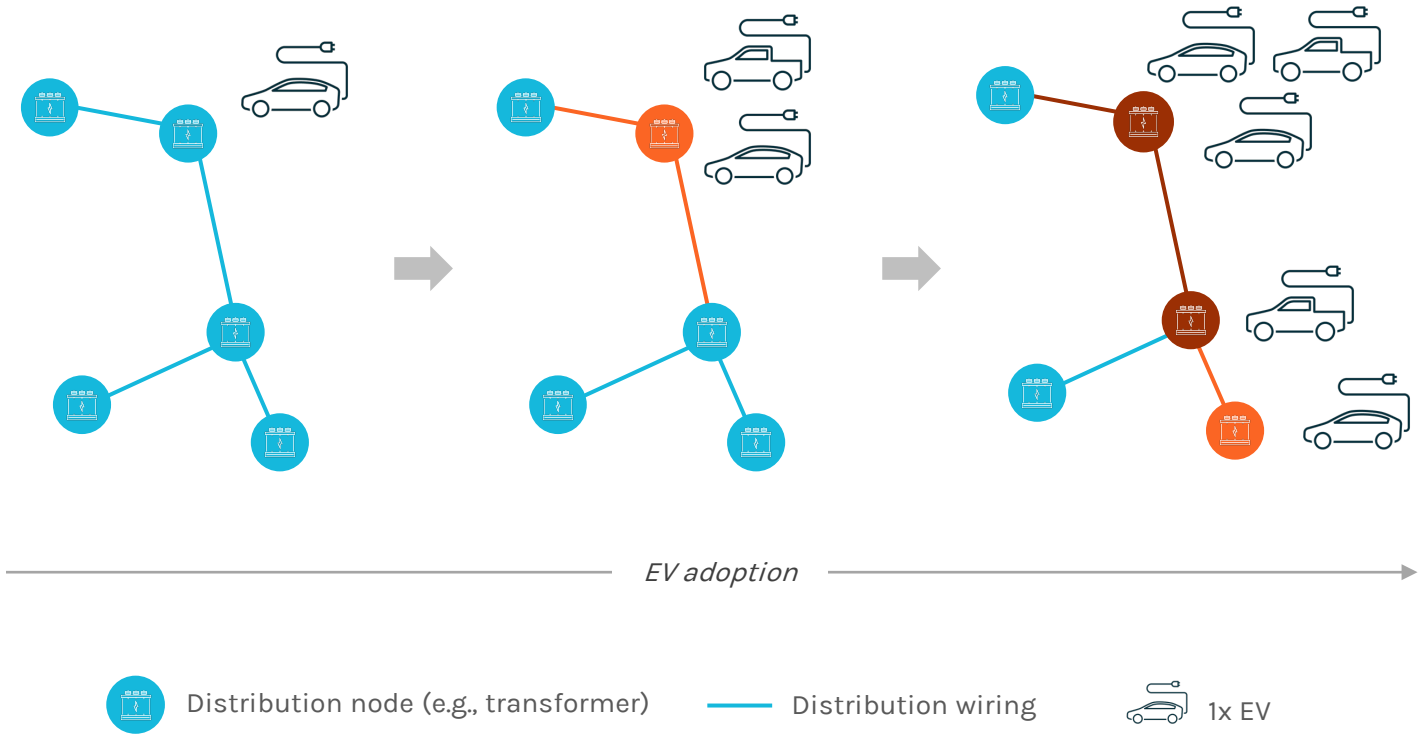
Why EVs are different

WeaveGrid

The Case for Distribution Optimization

The distribution system was not built to accommodate high levels of new EV load

OVERLOADING FROM EVs LEADS 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

EVs are different from other loads utilities manage

TRADITIONAL LOADS

Existing. Flat or declining

Low Powered. Home loads rarely go above 2 kW

Peak-coincident. Affects peak disproportionately

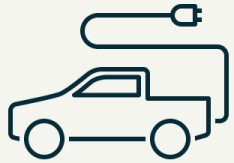
Uni-directional. Electricity flows one way

Constant. Consumed consistently, with little long-duration flexibility

Stationary. Used at home

Unconnected. Slowly shifting but generally needs new device for control

EV LOADS



New. Doubling every 2-3 years

High Powered. L2 chargers often >8 kW

Non-coincident peak. Charging mostly occurs outside system peaks but taxes distribution system

Bi-directional. Potential to flow both ways, back to the home or the grid

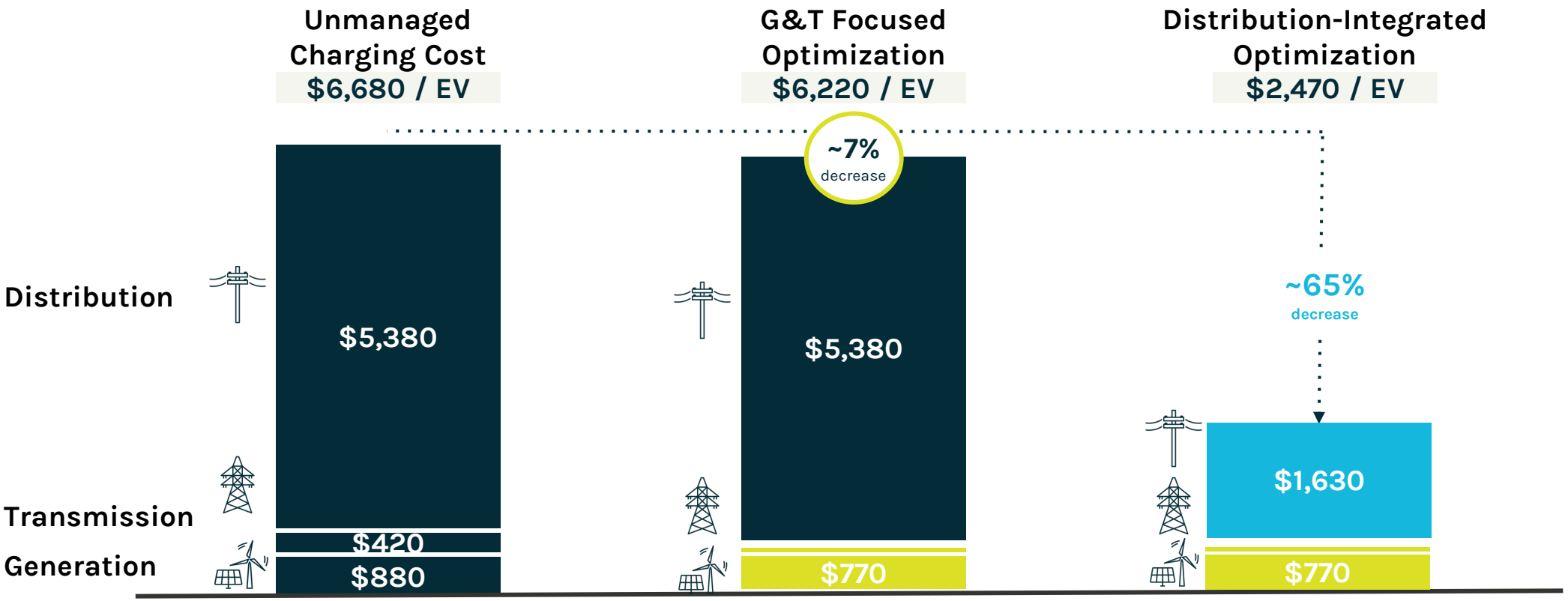
Flexible. Drivers typically charge for 2 hrs during 10 hr session

Mobile. Home charging common (~80%) and public charging impacts commercial class

Hyperconnected. ~85+% of customers have capable vehicles or chargers

Preparing the grid for EVs will require distribution-focused optimization

Cost or Investment per EV through 2030 ($)



Sources: BCG, WG Analysis

The Case for Distribution Optimization

How advanced managed charging can work

EV flexibility enables optimal response to grid conditions

Unmanaged Charging

12 hrs Parked

10 hrs Plugged in

2 hrs Charging

EV Flexibility

Charging

*Residential L2 example

EV flexibility enables optimal response to grid conditions

Unmanaged Charging

12 hrs Parked

10 hrs Plugged in

2 hrs Charging

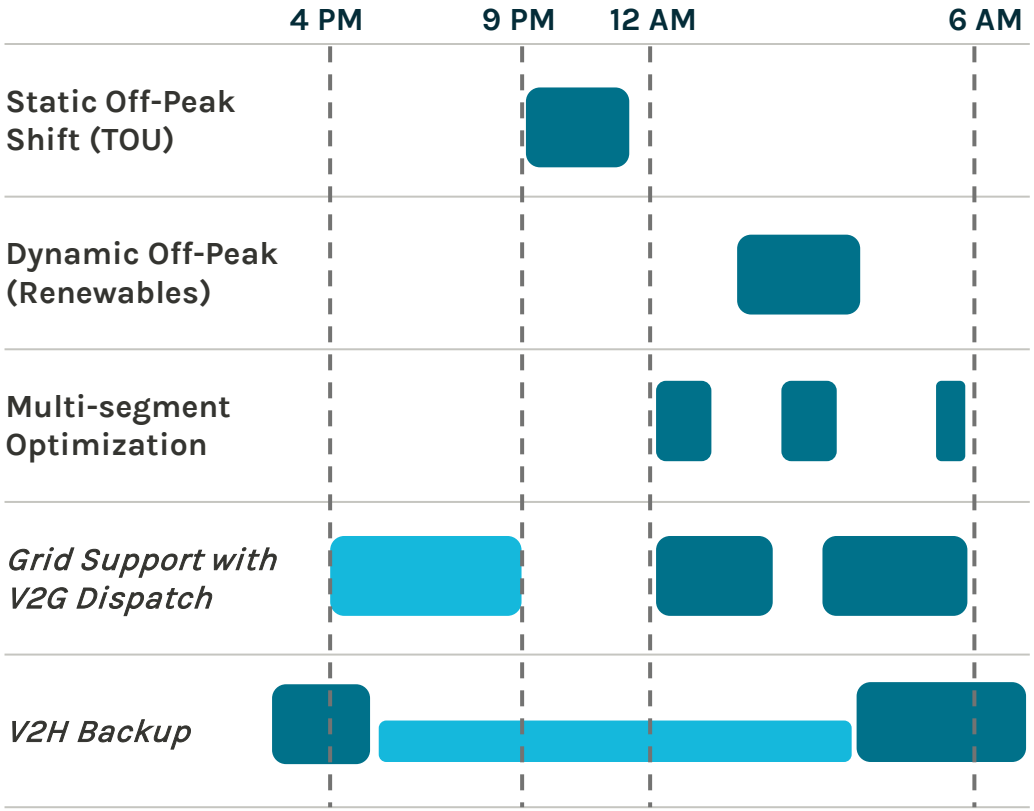
EV Flexibility

Charging

Discharging

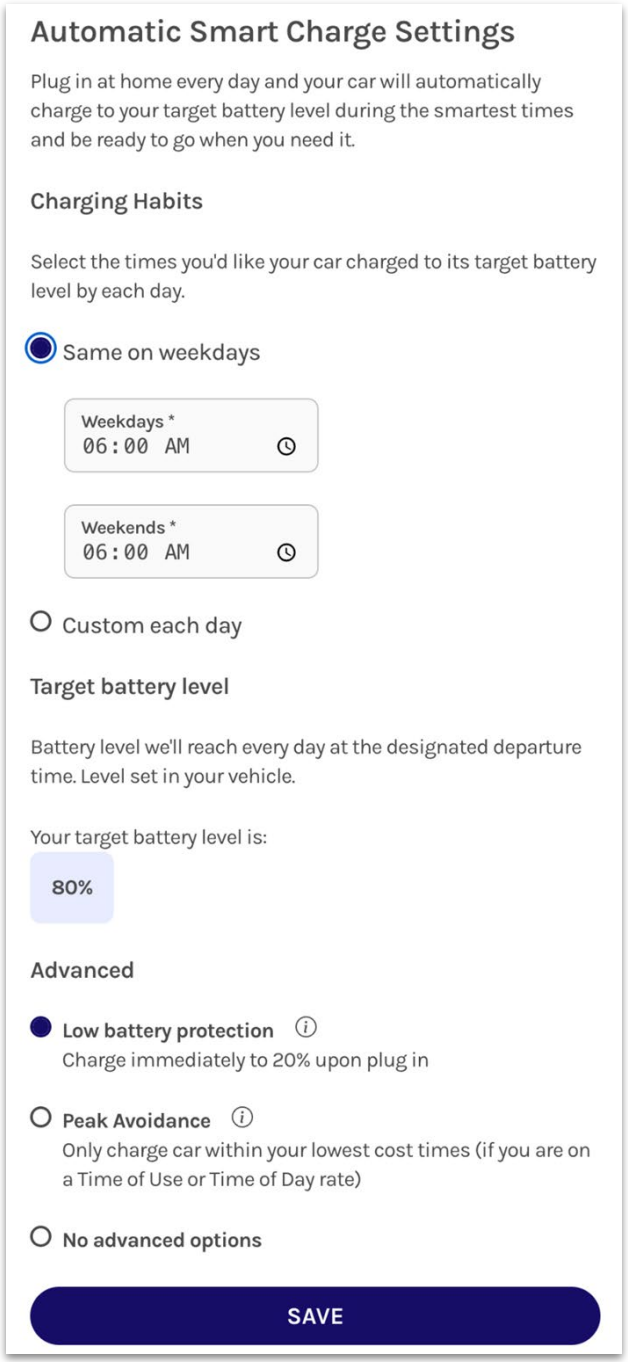
*Residential L2 example

Charging with Optimization



Smart Charging Fundamentals

- ✓ Software has **direct control over EV charging scheduling** for **enrolled customers** who are **plugged in at home**
- ✓ Schedules are designed to **prioritize driver needs,** then meet grid needs - *see preference settings snapshot*
- ✓ Drivers always have the **option to override** smart charging schedule if they want to charge now
- ✓ Schedules **start and stop charging**, charging speed is not altered
- ✓ Drivers can be on **flat or TOU rate**
- ✓ Program design **removes the need for a costly separate meter**



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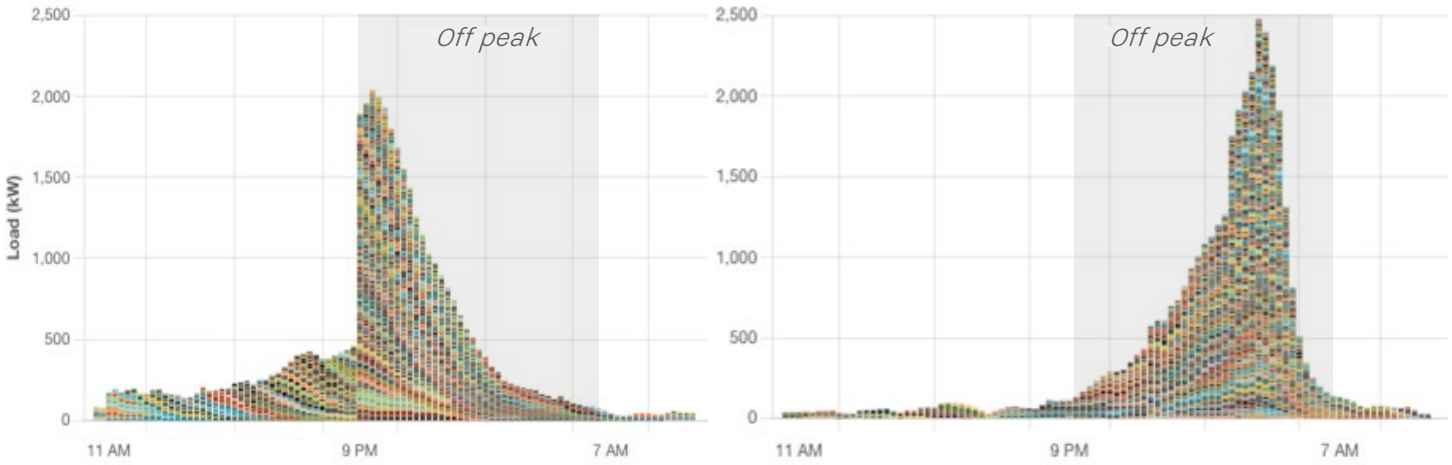
Residential Active Managed Charging Scenario Evolution



1. TOU Rate

Align charging with off-peak period

2. RTO/ISO Forecast

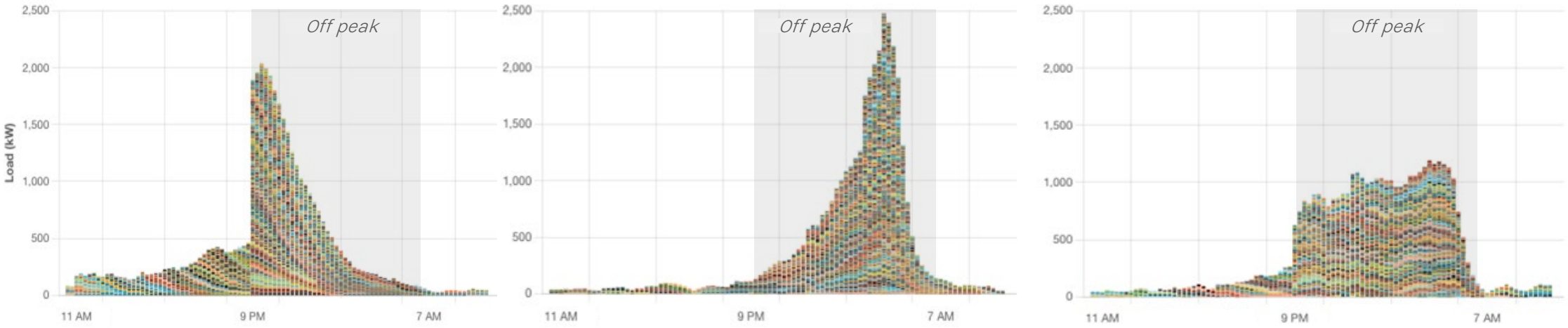
Schedule charging based on the forecasted cost of electricity to capture bulk system benefits

These approaches successfully shift charging, but leave value on the table for the utility and customers.

Shifting load can create peaks which may negatively impact distribution infrastructure as clustered EV adoption grows.

**Graphics are visual representations of home charging with each color indicating a unique vehicle.*

Residential Active Managed Charging Scenario Evolution



1. TOU Rate

Align charging with off-peak period

2. RTO/ISO Forecast

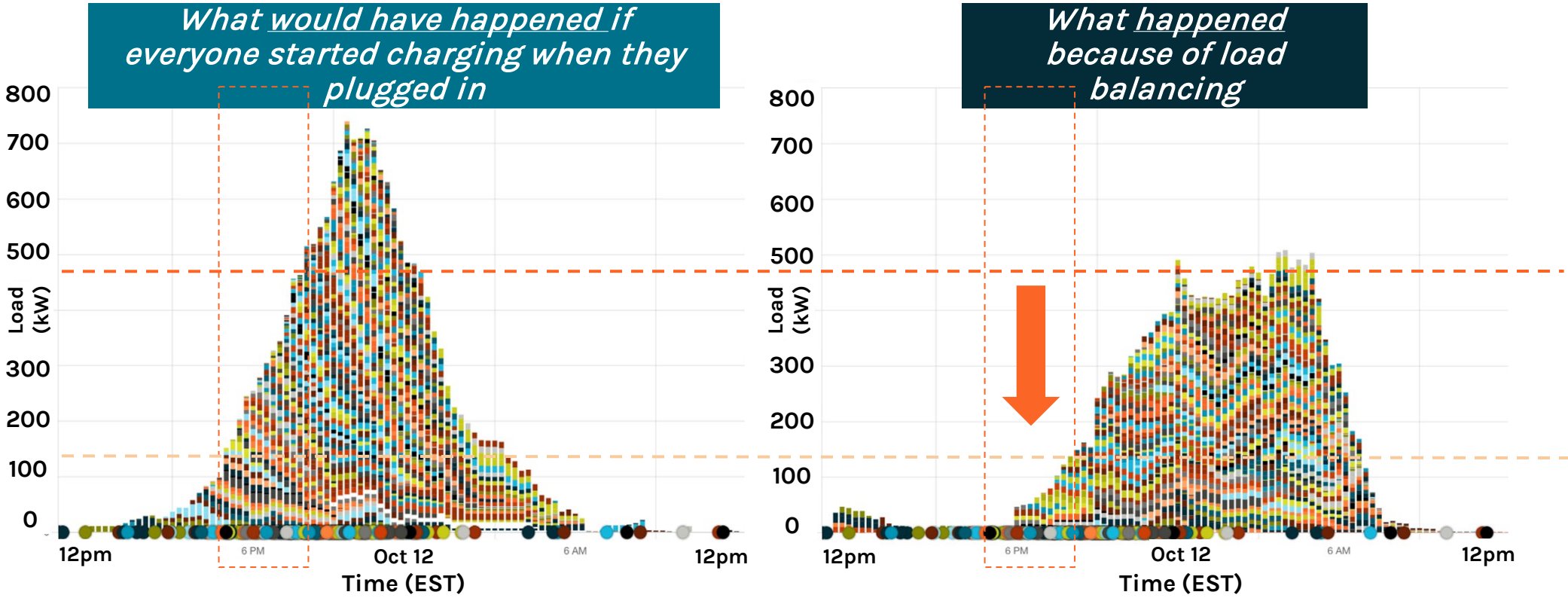
Schedule charging based on the forecasted cost of electricity to capture bulk system benefits

3. Distribution Optimization

Optimize charging to protect assets by grouping vehicles to simulate distribution asset capacity per type (e.g. circuit)

**Graphics are visual representations of home charging with each color indicating a unique vehicle.*

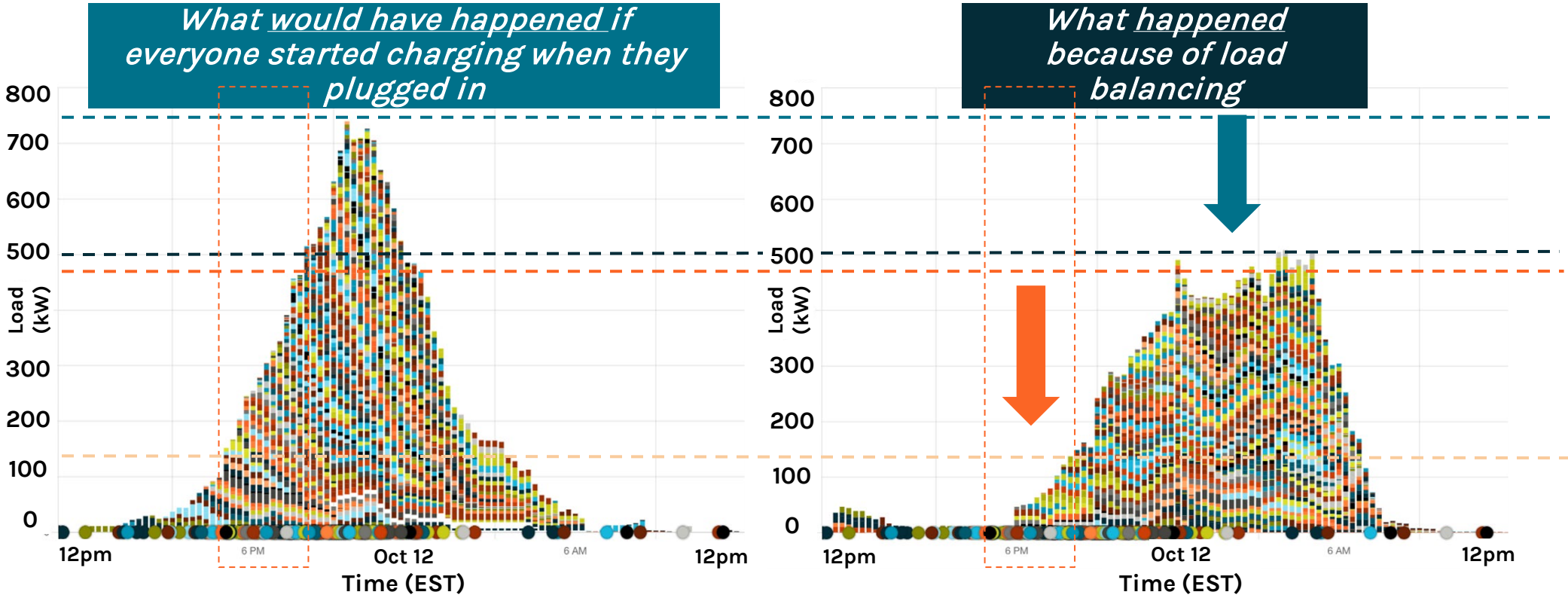
Distribution optimization can consistently shift load & substantially reducing peaks



Graph shows the peak reduced from 750 kW to 500 kW through Load Balancing. Similar results are observed on other days and with various group sizes. This analysis was completed 10/12/203 and shows a BGE Feeder group with 880 vehicles assigned. However, large group sizes like this group generally demonstrate more consistent and substantial load balancing results.

WeaveGrid

Distribution optimization can consistently shift load & substantially reducing peaks



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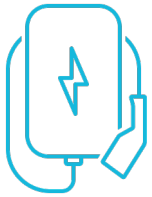
WeaveGrid

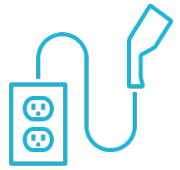
Approaches to technology

A Myriad of Solutions Exist to Support Managed Charging

AMI Disaggregation



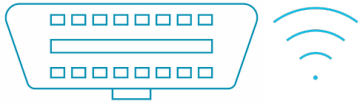
Networked EVSE



Smart Connectors

Telematics Options

Pathway 1: Direct Telematics Integration via OEM-facing Application

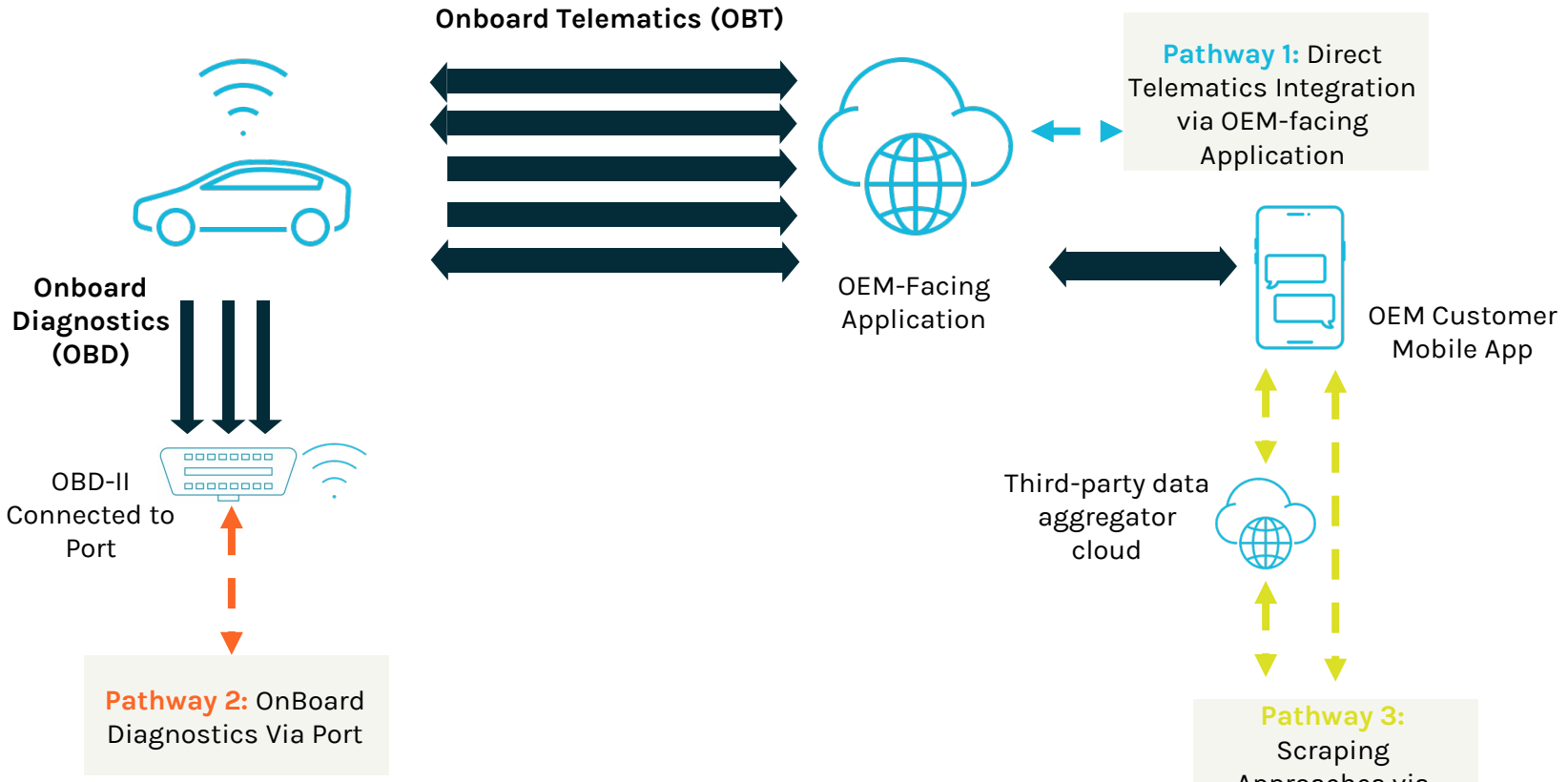


Pathway 2: OnBoard Diagnostics Via Port

Pathway 3: Scraping/Snapshot Approach via OEM Customer Mobile App

The Various Telematics Data Collection Pathways

Telematics refers to the data, communications, and (sometimes) controls from the vehicle



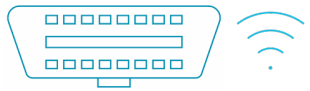
Implications

- **Direct Telematics Integrations (Pathway 1)** provide the most robust data conveyance, communications and controls
- **Onboard Diagnostics (Pathway 2)** are generally supported by a different head-end and only provide data (no control)
- **Scraping/Snapshot Approaches (Pathway 3)** are often more limited as the data, communications, and controls available via the customer mobile app is much more limited than the OEM-facing applications

Need for Focus on Direct Integrations with OEMs

Pathway 1: Direct Telematics Integration via OEM-facing Application

- **Leverages full OEM telematics** that the automakers have available
- **Full data set available**, including information from all monitoring equipment and sensors in the car
- **Complete charging history data,** including both kWh consumption and state of charge (SOC)
- **Enables reliable, dynamic managed charging programs**
- **Additional app services not required** for customers participate
- **Support for Pathway 1 varies by automaker**



Pathway 2: OnBoard Diagnostics Via OBD-II Port

- **Intended for data capture**, where the port was developed largely for ensuring California Clean Air Reg Compliance
- **Does not enable control,** so managed charging capabilities are limited
- **Requires customer to install a device** and keep the device connected in the port
- **Challenges for submetering**, since OBD does not capture auxiliary energy consumption when plugged in and battery isn't being used

Pathway 3: Scraping/Snapshot Approach via OEM Customer Mobile App

- **Connection and controls vary widely,** based on capabilities in each OEM's mobile app API
- **Data capture based on snapshots,** where car is pinged via mobile app every 15-60 min for location/charging status/state of charge
- **Uncertain long-term viability of this approach**, as OEMs may not continue to allow third-party access to their mobile apps
- **Limited data often untested for quality** can be accessed via this approach for most OEMs today
- **Reliability concerns,** due to relying on apps not intended for this purpose

Data Needs

Charging data and controls can enable new services for utilities

DRIVER MARKETING

Reaching all EV drivers within a utility's service territory

EV DETECTION

Locate EVs within territory for enrollment in EV rates and programs

PREDICTIVE INSIGHTS

Understanding how EVs impact the load shape and coincident peak now and in the future

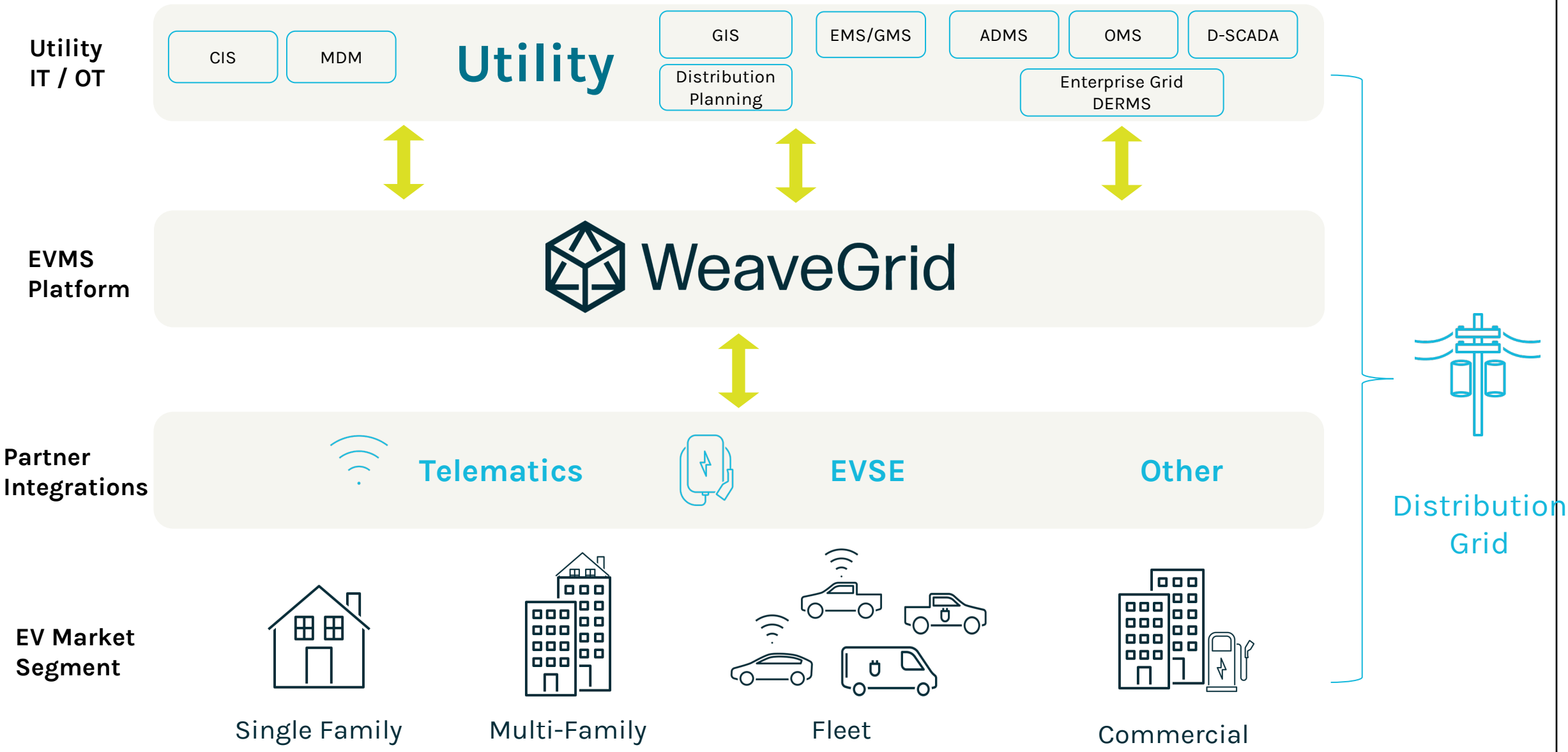
AUTOMATED MANAGED CHARGING

Shifting the time and location of EV charging to manage the grid impacts of EV charging

EV DISTRIBUTION OPTIMIZATION

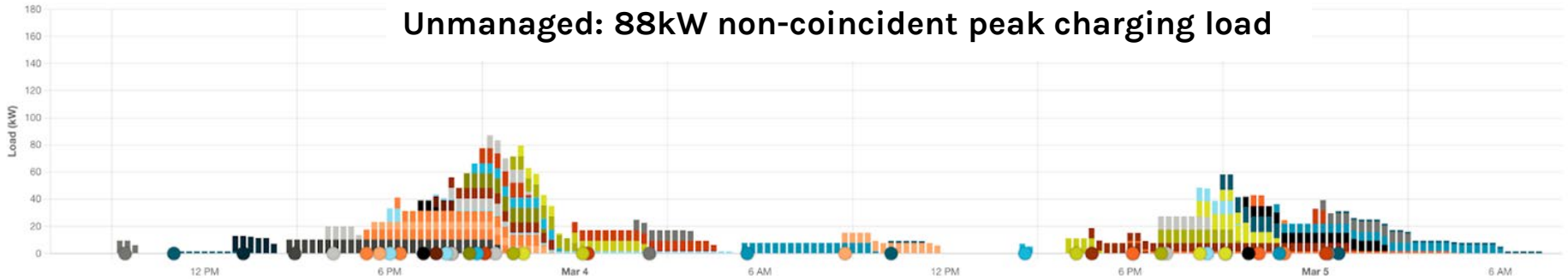
Leveraging and modeling optimized EV charging to predict infrastructure needs

EVs are unique, but can be integrated with utility operations

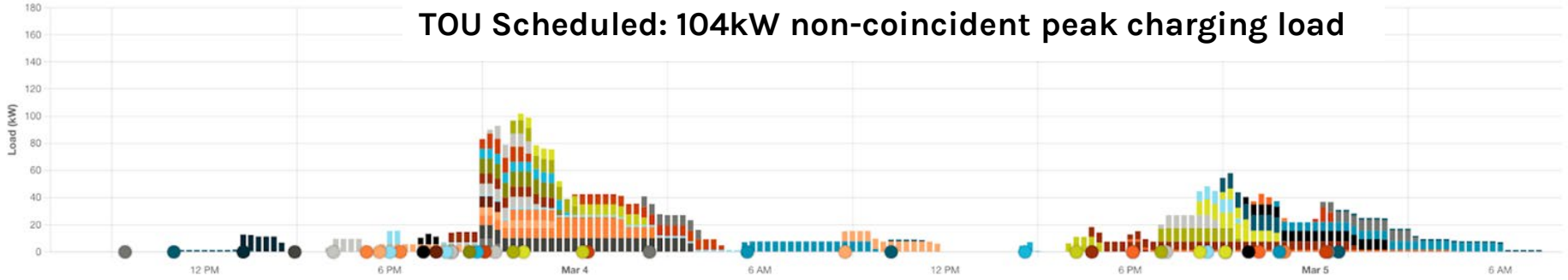


Significant results with minimal data

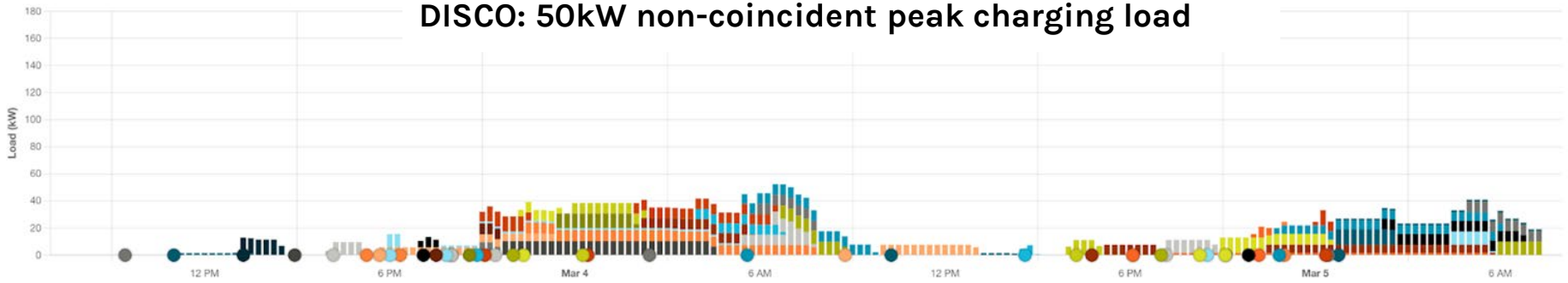
Unmanaged: 88kW non-coincident peak charging load



TOU Scheduled: 104kW non-coincident peak charging load



DISCO: 50kW non-coincident peak charging load



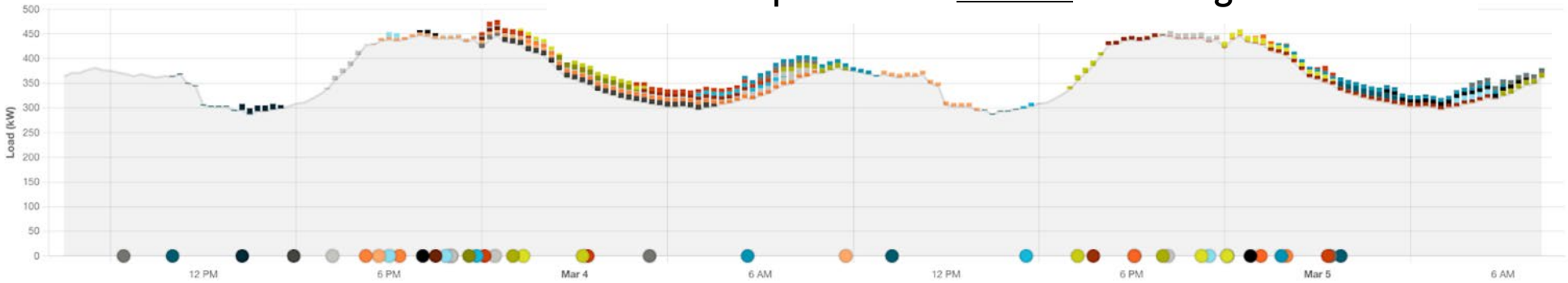
Scenario:

- 48 hour period (Fri-Sat)
- Segment of a high EV penetration feeder
- 53 total EVs
- 32 active EVs in period
- 44 charging sessions

~50% peak charging load reduction via automated optimization

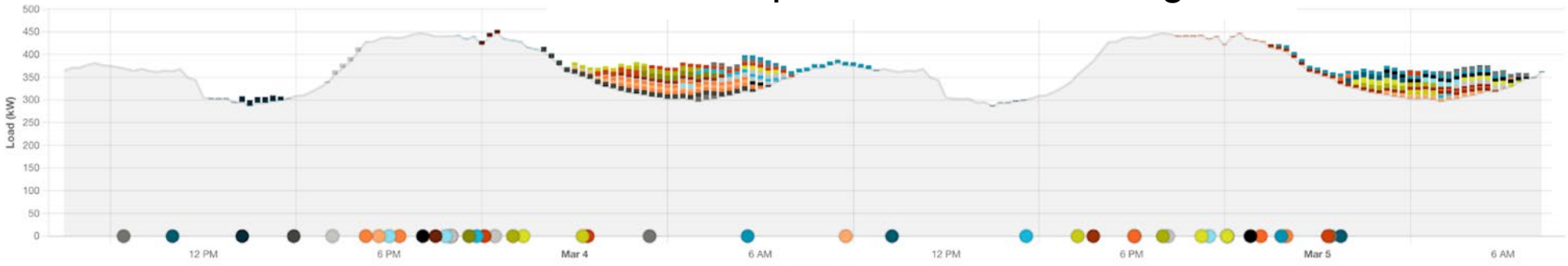
More data enables more optimization

Distribution optimization <u>without</u> load integration



EVs may still contribute to local peaks if other load is not considered

Distribution optimization <u>with</u> load integration



~95% reduction in net peak contribution via automated optimization

Thank you!

Questions?

Mathias Bell
Sr. Director, Market Development
mathias@weavegrid.com

WeaveGrid

MGE Charge Ahead

Managed Charging Program

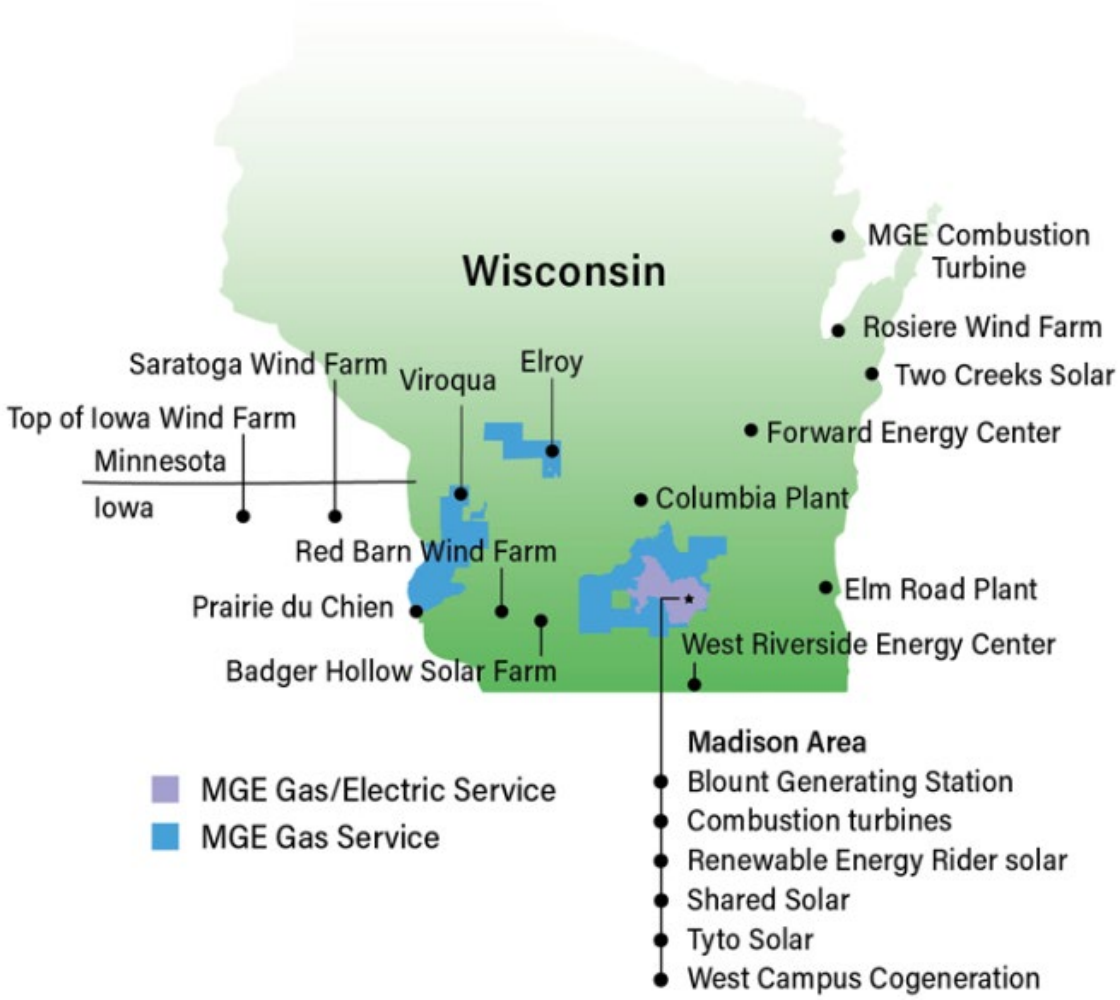
Erinn Monroe-Nye
Energy Services and Policy Manager

80% reduced carbon emissions by 2030 | Net-Zero carbon electricity by 2050

mge®
your community energy company

About MGE

- Population in the service area totals 501,000
- Primarily in the Madison Metropolitar area
- MGE provides electricity to 163,000 customers in southern Wisconsin
- MGE provides natural gas service to 176,000 customers in central and southern Wisconsin



MGE's Sustainability Commitments

- **80% reduced** carbon emissions by 2030
  Net-Zero carbon electricity by 2050
- **Net-Zero** methane emissions from our natural gas distribution system by 2035
- **2/3** coal-fired capacity eliminated by end of 2026
  Coal as a backup fuel by end of **2030**
  Zero ownership of coal by end of 2032
- **> $1 billion** in clean energy investment estimated through 2028*
- **100%** all-electric or plug-in hybrid light-duty MGE fleet vehicles by 2030

*Since 2015

Under our commitment, by 2030, every MGE electric customer will have 80% fewer emissions associated with their electricity use simply by being an MGE customer.

By 2050, MGE will have eliminated the carbon footprint associated with every MGE customer's electricity use under our net-zero carbon goal.

80% reduced carbon emissions by 2030 | Net-Zero carbon electricity by 2050

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EV Programs

Charge@Home

Public Charging Network

- EV-owners group
- Pole-mounted chargers

Charge Ahead

Apartment and Workplace Charging

Fleet Advisory Services and Rate

Program Description

Small scale demonstration project started in 2020

Commission Approval in 2022 for expanded pilot (up to 200 participants)

Drivers earn rewards (or save money) for allowing MGE to shift EV charging to off peak times

- TOU customers benefit from bill savings
- Standard rate customers earn rewards ($4 in winter and $8 in summer months)

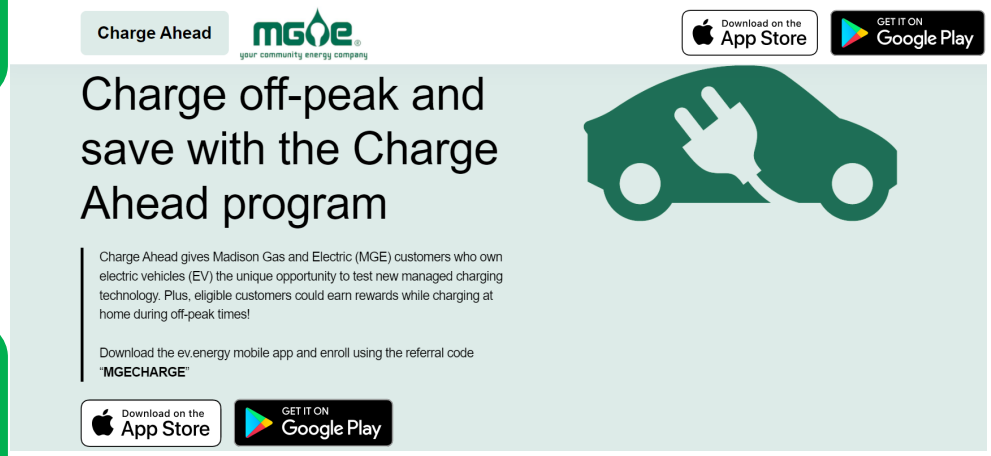
Program Description (con't)

Charging is managed through vehicle telematics

- No additional equipment needed
- Can be managed through some chargers if vehicle isn't qualified

Current qualified vehicles/Chargers

- Chevy
- Audi
- BMW
- Tesla
- ChargePoint Home and Home Flex chargers



Marketing

Slow rollout as we monitored customer enrollment experience

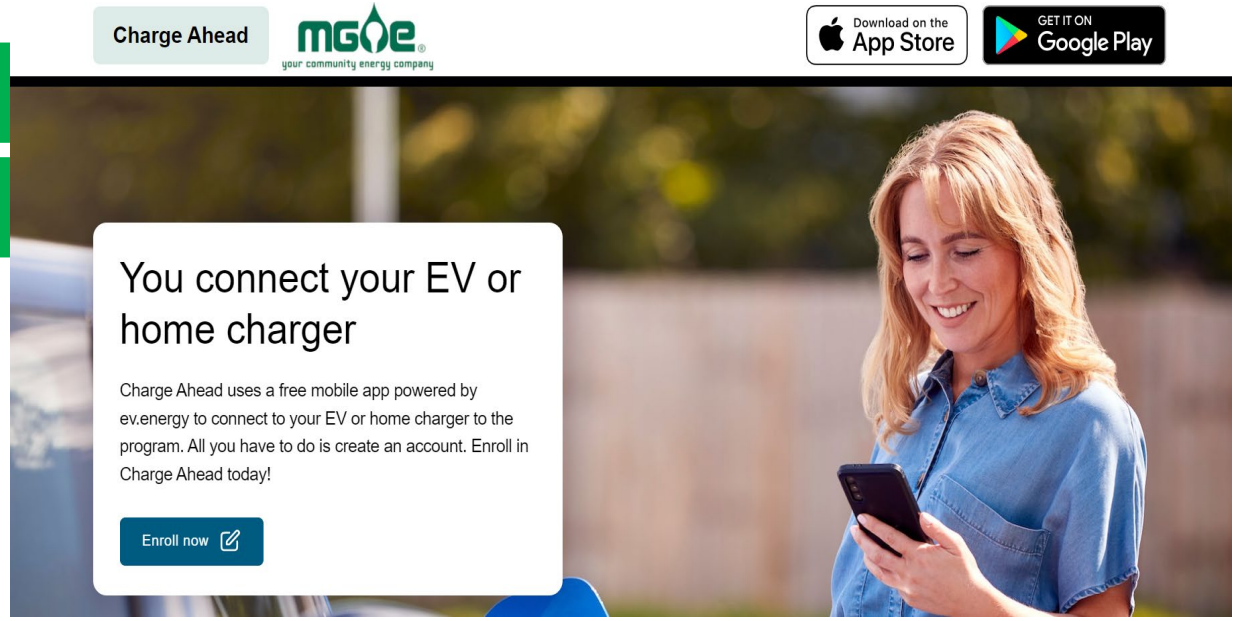
Recruitment emails

- Participants in Charge@Home (MGE's home charger program)
- Members of MGE's "EV Owners Group" – Self-identified EV owners that receive a discount at MGE's public charging network

Website

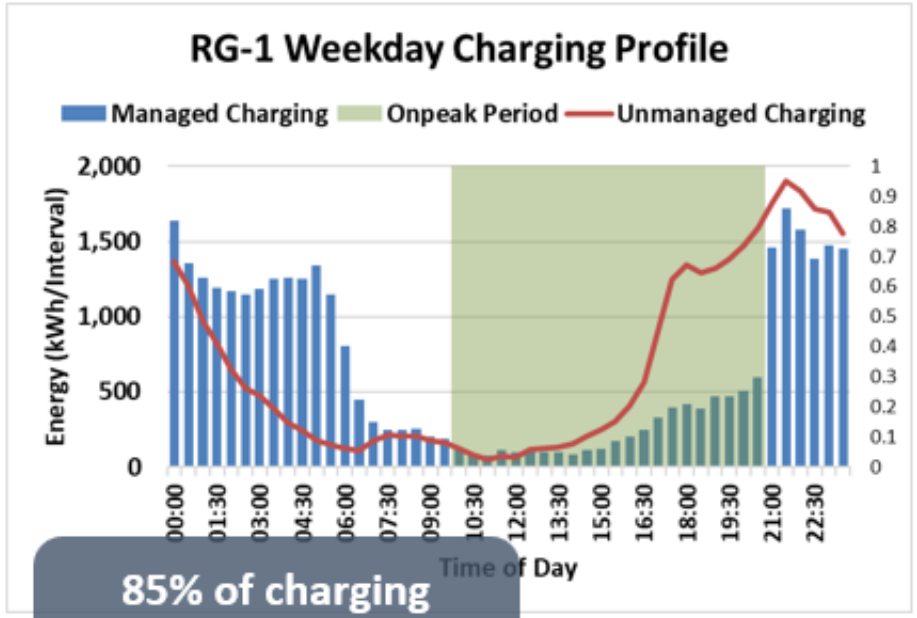
EV events

- National Drive Electric Week
- EV 101 – local libraries and community centers

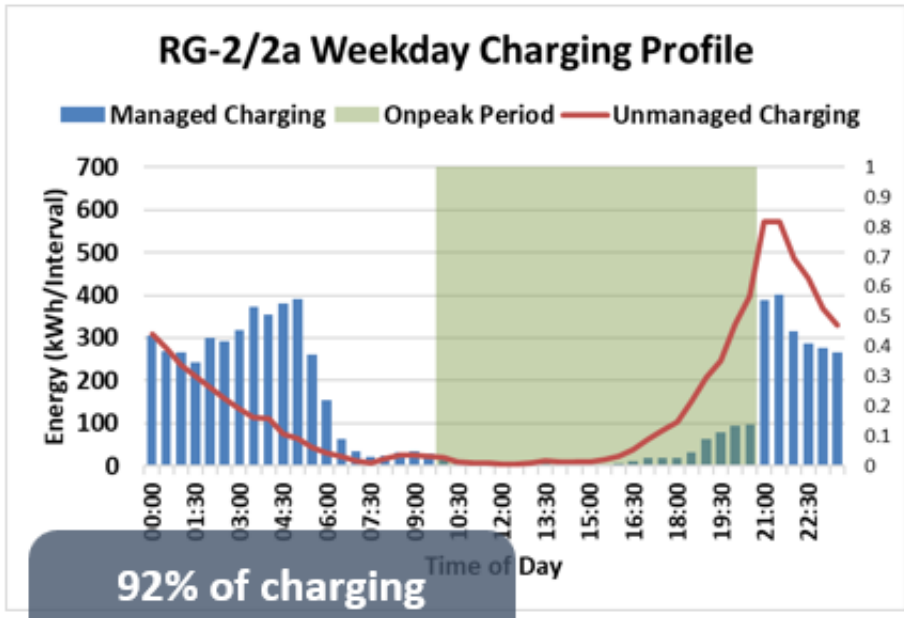


Results & Findings

83% of participants are on standard rate



85% of charging shifted to off-peak.



92% of charging shifted to off-peak.

Challenges

Recruitment

- Initial slow start
- Changing the way we talk about the program; less about “testing a new technology”
- Exploring referral bonuses

Limited vehicle eligibility

- Requires open API

Looking Ahead

Continue to increase marketing & Recruitment

Optimize charging behavior

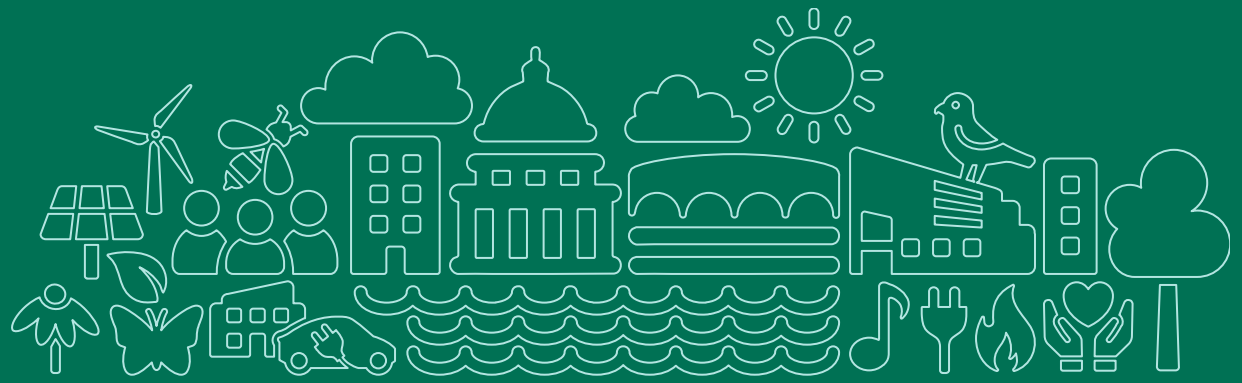
- Example: Level 1 may need to charge more frequently

Expand eligibility

Provide excellent customer experience

Thank you

Erinn Monroe-Nye
erinn.monroenye@mge.com



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Questions

Moderator: Commissioner Katherine Peretick, MI PSC

Guest Speakers

- Noel Crisostomo, DOE; Brennan Borlaug, National Renewable Energy Laboratory; Chuck Moran, Kevala
- Mathias Bell, WeaveGrid
- Erinn Monroe-Nye, Madison Gas & Electric

Member EV Roundtable

Moderator: Ryan Cheney, NC Utilities Commission

Please speak up and share the situation from your perspective:

1. Are there managed charging pilots in your state?
2. What data have you seen / do you expect to see / do you want to see on managed charging when considering utility proposals?
3. Do you expect full-scale roll out of managed charging for any of your utilities / customer classes in the near future?

NC managed charging approach evolving with EV adoption growth

Program types

1) Providing Access to Charging Infrastructure

Building the charging infrastructure needed for ensuring equitable EV access, and for meeting NC's EV adoption goals.

2) Managed Charging

Full spectrum of rate designs for driving EV adoption, and the utility controls needed for optimizing charging behavior.

3) Grid Planning for Vehicle Electrification

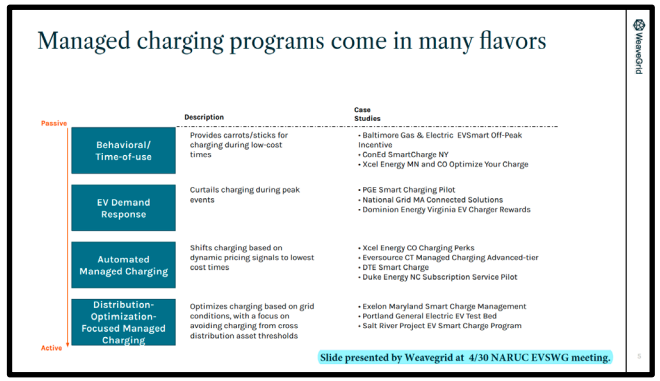
Locational and temporal EV adoption forecasting, and the grid investments needed to mitigate local distribution impacts.

1/30/24 - NCUC requested an MC update

Docket No. E-7, Sub 1195 & No E-2, Sub 1197
NCUC order: January 30, 2024, pages 5-7

Duke Energy has been investigating various MC methods

- NCUC requested an update on Duke's managed charging strategy, including passive, active, and other programs.



January 30, 2024 order – "Duke shall include in its March 5, 2024 filing details about Duke's managed charging work thus far and its plan for managed charging going forward."

Duke's MC strategy comes in 4 flavors

Docket No. E-7, Sub 1195 & No E-2, Sub 1197
Duke filing: March 5, 2024, pages 15-18

Passive

Active

1) TOU Rates – approved – TOU-CPP rates preceded EV managed charging and, although more sophisticated than off-peak programs, apply to overall usage and thus allow residential customers to benefit from TOU adoption for both general consumption and EV charging.

2) Off Peak Charging Pilot - proposed **-** would introduce a simple programmatic structure to promote passive managed charging to NC EV drivers, with Duke demonstrating success in SC, FL, and now implementing a similar program in IN.

3) Active Managed Charging Pilot – approved - most sophisticated means of managed charging whereby Duke will actively control charging based on system conditions while balancing grid and customer needs.

4) Enhancements to Managed Charging Approaches - approved

- Subscription rate pilot – active MC pilot also tests customer appetite for a flat rate for large amount of monthly kWh
- V2G pilot – beyond active managed charging, Duke elects when to deploy bidirectional charging capability of participants.

This slide was created by Ryan Cheney, a DOE Innovation Fellow working on electric transportation for the North Carolina Utilities Commission.

Upcoming 2024 EVSWG Topic

Date (Last Tues of the month)	Future 2024 EV SWG Topics (through June)
May 28, 2024	Distribution infrastructure needs
June 25, 2024	Equity and access to charging

The following topics will soon be on the calendar:
Right-sizing chargers, infrastructure investments, Ways to energize faster (interconnection, service load requests), Using alternative technologies to energize chargers and meet grid constraints, EV load forecasting/planning.

Next EV SWG meeting: May 28, 3:00-4:30 pm ET via Zoom

WWW.NARUC.ORG/CORE-SECTORS/ENERGY-RESOURCES-AND-THE-ENVIRONMENT/ELECTRIC-VEHICLES/