Will EV's Crash the Grid?

Mason Griffin, Bynne Harris, Dan Raudebaugh, Ryan Stanton, Jen Szaro

Transportation Electrification

Overview

October 2024

ICF provides support across the spectrum of utility transportation electrification analysis, planning, and implementation

Market Research

- Market overview and forecasts
- Potential studies
- Benefit cost analysis
- Climate + air quality assessments

Advisory Services

- Electrification policy
- Regulatory strategy + support
- Program design
- T&D system impacts
- DER integration
- Supplemental funding

Program Implementation

- Program management
- Marketing + creative services
- Customer outreach
- Trade ally engagement
- Technical support
- Site assessments
- Fleet advisory services
- IT platforms
- Rebate processing
- Evaluation support

Strategic Planning

Potential studies

- Top-down EV adoption forecasting
- Future load and infrastructure cost analysis
- Technical potential
- Economic potential
- Alternative scenarios
- Data for investment and planning
- National to county granularity

Implementation Analysis

Load siting and impact studies

- Bottom-up fleet and vehicle analysis
- Territory-specific adoption and charging load forecast
- Impact on specific grid assets
- Adoption and impact scenarios
- Equipment siting opportunities, including charging bases
- Planning recommendations

Fleet Studies + Program Design

Optimizing customer-program fit

- Subject matter expertise
- Territory, fleet, and vehicle digital twins
- Program cost tests and activity simulations for investment decision-making
- Collaborative program design workshops
- Complete perspective on major fleets and their EV plans

Analytics

Integrated, purpose-driven data

- User-driven EV adoption and load forecasting scenarios hosted on-line
- Projected metrics including fuel use, electric use, and GHG emissions
- Load profiling with 15-minute interval data
- Fleet ownership profiles and contact lists for outreach

Implementation Support

Program delivery and customer success

- Station Operations: EVSE activity, load profiling and health monitoring
- Fleet Assessment: fleet engagement and TCO analysis
- Site Assessment: EVSE installation and managed charging support
- Performance Manager: comprehensive program metrics reporting

ICF

Fleet Advisory Services 2020-present

Challenges

- Need to engage public fleets and educate those on the financial and environmental benefits of fleet electrification
- Need to provide models and analysis to determine possible areas of improvements for existing fleets

Solution

- Deliver 100 fleet electrification assessments to municipal, state, and federal governments and transit fleets
- Contracted with ICF to provide turnkey implantation services, tailored modeling, and technical assistance

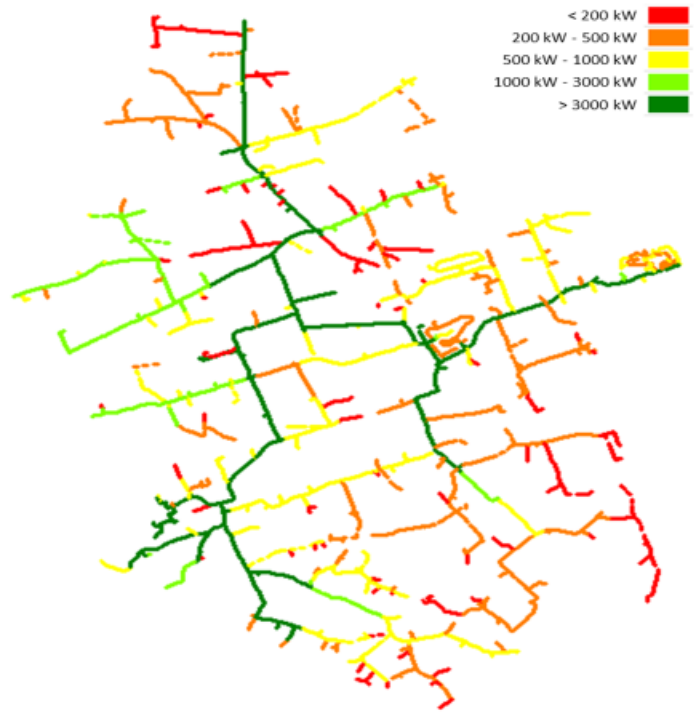
Results

- 14,000 total vehicles in fleets assessed
- 4,446 vehicles identified as electrifiable
- 693,000 tons of potential GHG emissions reductions recommended
- 79% of customers located in or serving EJ communities
- $154 million determined in total cost ownership savings

Forecast Distribution Constraint Analysis

Determine baseline net load impact of DER and electrification on a distribution grid

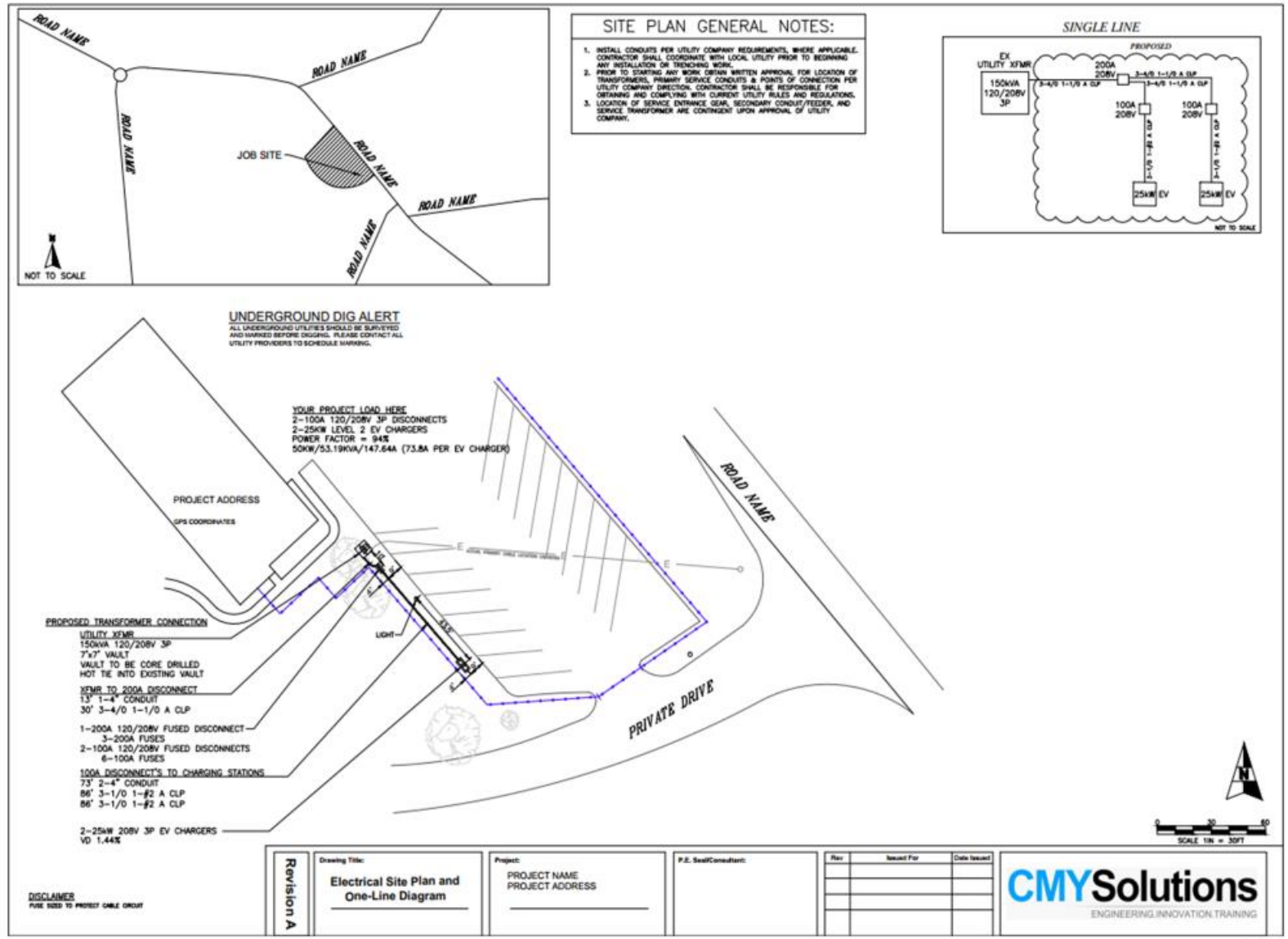
- Conduct forecast hosting capacity analysis.
- Select a representative distribution substation and associated feeders (~6-8) to evaluate the operational requirements for DER portfolios and their orchestration to mitigate forecast constraints.
  - Apply various plausible DER, load forecasts (incl. effects of temperature rise due to climate change) & existing rates/programs
  - Identify physical and planning level design criteria violations across the selected network (distribution operating envelope)
  - Define grid needs in terms of specific distribution assets that become constrained from service transformers to the substation transformer.



Node Id	IC Max (kW)	IC Loading (kW)	IC Volt Limits (kW)	IC Rev Flow (kW)
2403641.6_350632.79	2561.5	3925.9	5914.4	2561.5
2403644.811_350639.202	2561.5	3925.9	5917.4	2561.5
2403703.078_350751.851	2561.5	3926	5973.7	2561.5
2403745.061_350708.489	862	1738.4	862	1142.7
2403767.87_350884.526	2561.5	3926	6047.8	2561.5
2403815.524_350986.109	2561.5	3926	6112.1	2561.5

Accurately represent future electrification and DER adoption

- Representation of Building electrification, EVs, DERs (BTM/FTM)
- Load growth forecasts of electrification and climate-based temperature rise effects
- Account for inverter settings & capabilities
- Existing rates/programs and DER aggregations

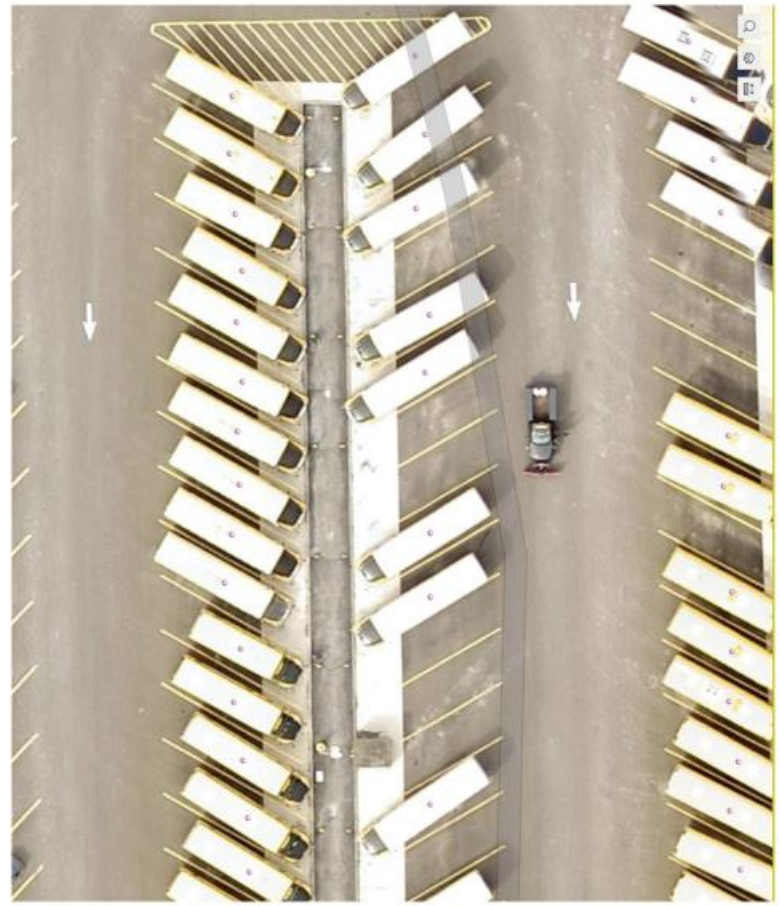


Medium- And Heavy-Duty Fleet Load Impact Study

- Challenge: 35% of the client's substations have 1 MW or less of capacity, so medium-and heavy-duty fleet electrification represents a potential load impact risk.

- Solution: Use publicly available data, aerial imagery analysis, and ICF's TE Insight data platform to find fleets. Create load impact scenarios between 2024 and 2040 for three operating company utilities in the northeast.

- Example results: Nearly 40,000 MHD vehicles were identified through aerial imagery analysis; 5,840 fleet sites were analyzed for load and linked to circuits and substations; and 1,678 locations were selected as candidates for public charging.



A school bus fleet found by ICF during aerial imagery analysis and marked for integration into the study dataset

Will EV's Crash the Grid

OUC100

A Century of *Reliability*

Bynne Harris

Company Background

Orlando Utilities Commission was founded in 1923

- OUC is a Municipal Utility
- Managed by a five-member commission
- OUC has 242,191 Electric Customers

OUC100
A Century of *Reliability*

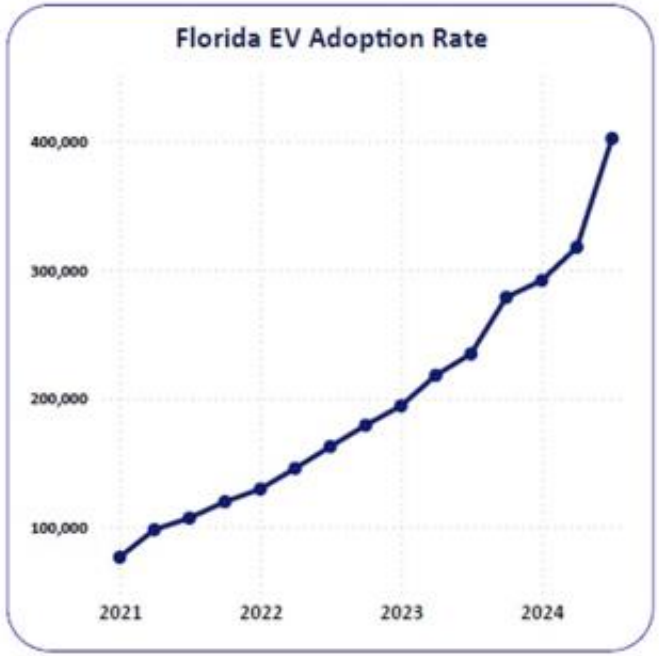
E-Transportation

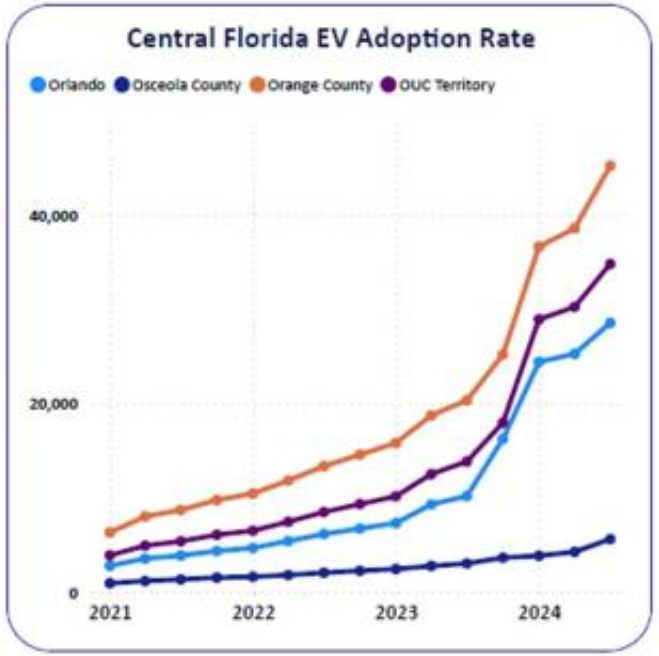
- Started program in 2014, re-imagined in 2020, and roadmap built for 2025.
- 2 DCFC hubs active, 8-20 more in plan
- CaaS on roadmap
- Lynx

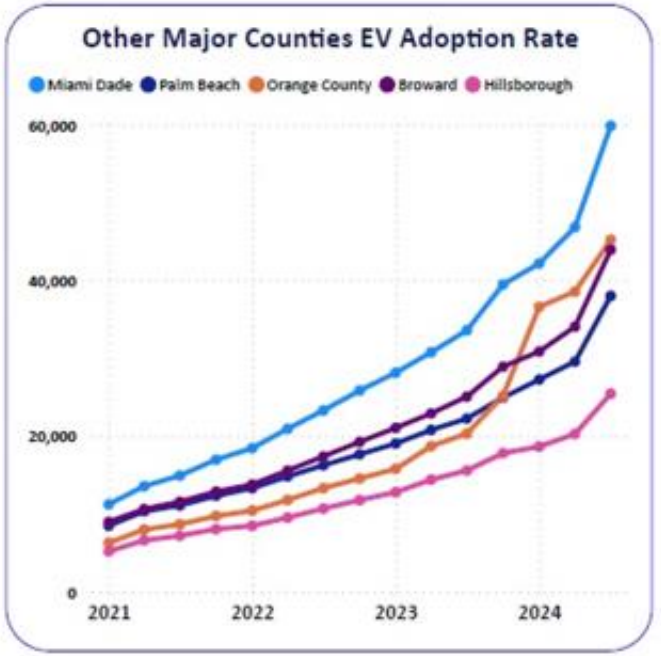
EV Growth in OUC Territory

Quarterly EV Statistics

Florida	OUC Territory	Orlando	Orange County	Osceola County
402,012	34,784	28,528	45,193	5,598
% Change to Prev. Qtr 27%	% Change to Prev. Qtr 15%	% Change to Prev. Qtr 13%	% Change to Prev. Qtr 17%	% Change to Prev. Qtr 32%
% Change to Prev. Year 71%	% Change to Prev. Year 152%	% Change to Prev. Year 181%	% Change to Prev. Year 122%	% Change to Prev. Year 86%

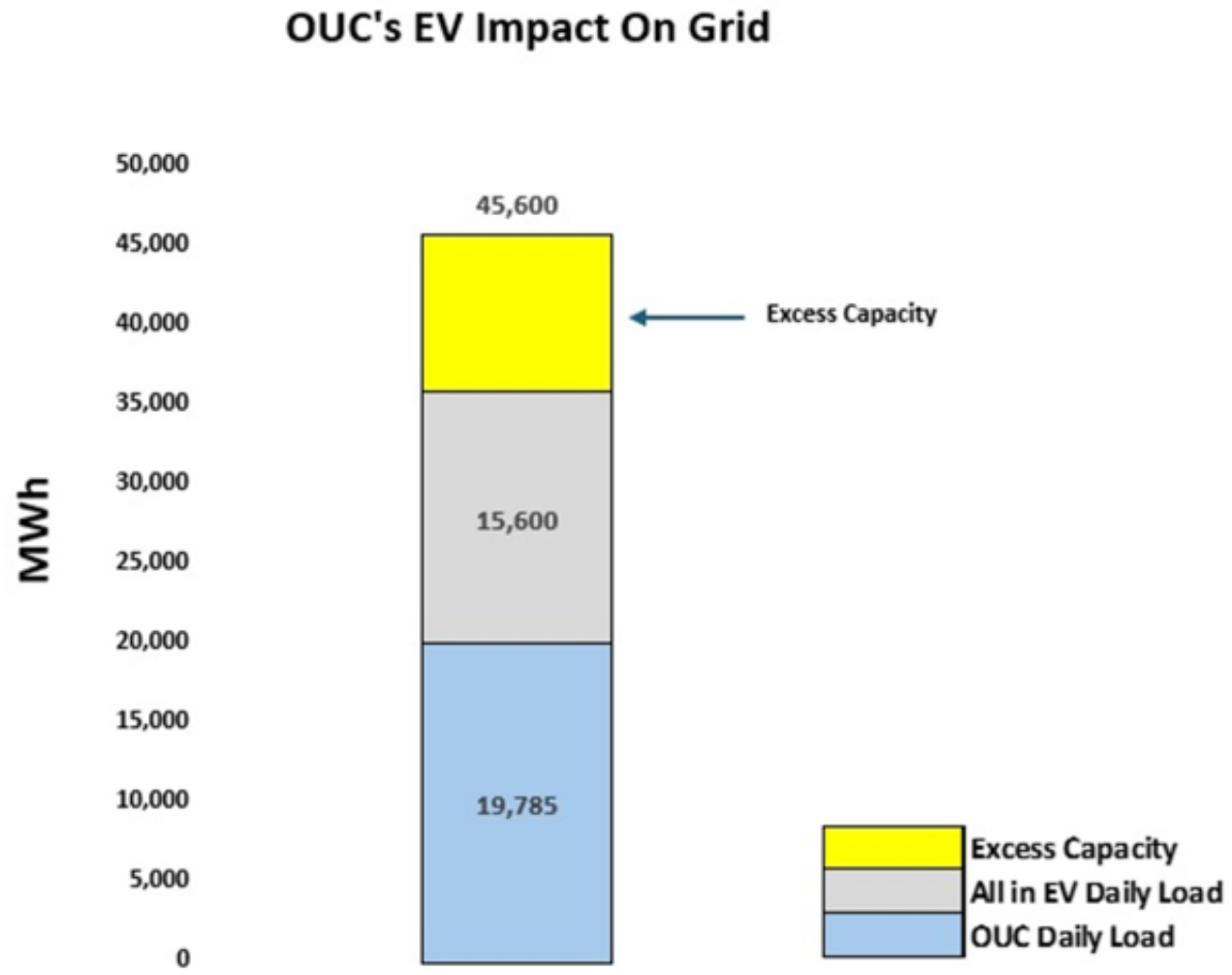






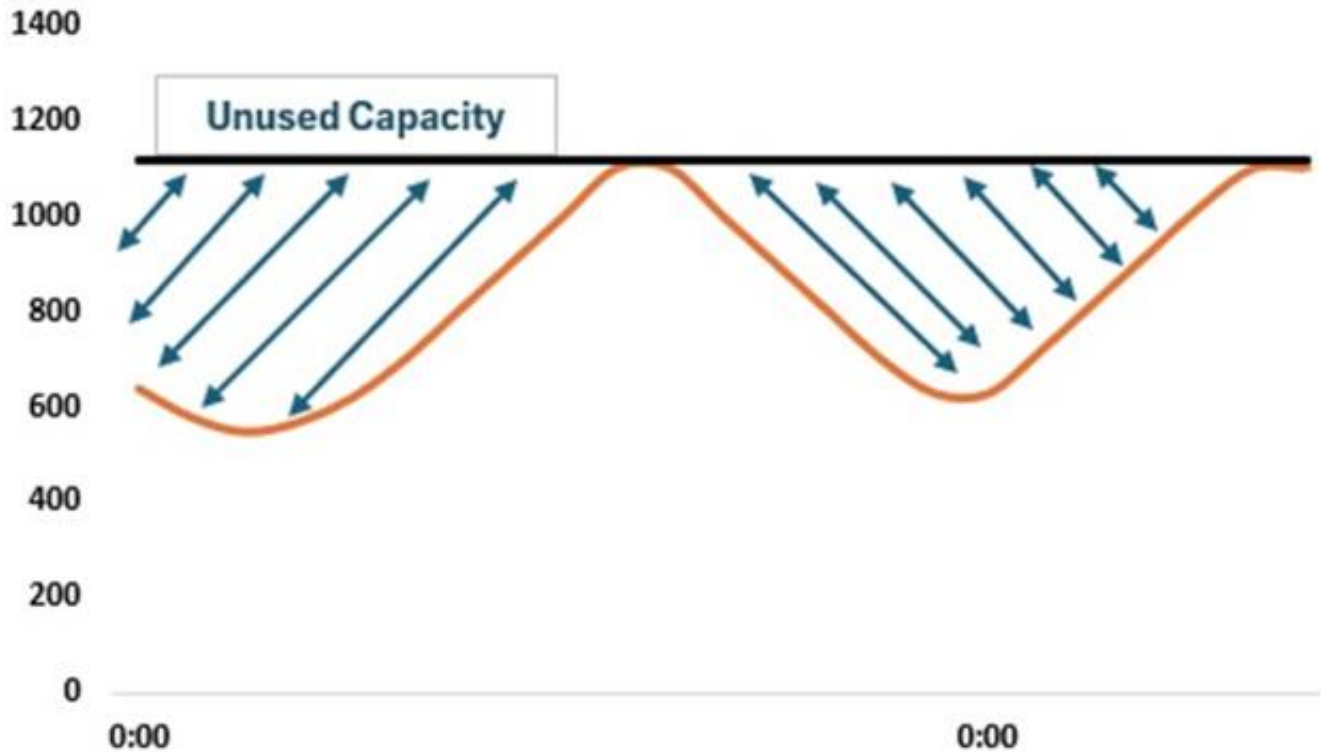
OUC EV Peak Demand and the Grid

- OUC must have enough energy to serve our peak + 15% reserve
- 1 EV uses 13kWh per day to charge
  - 13,000 miles annually
  - 35-40 miles per day
  - 3 miles per kWh
- If all 1.2 million ICE vehicles switch to EV today, total daily load would be 15,600 MWh



Shifting Charge Times

- Pushing customers to the valleys stabilizes the grid.
- OUC has a solar capacity of 90 MW
- TOU rates incentivize off-peak charging



OUC's Approach to Fleet

- Time of charge
- Site Evaluations
- Fleet Assessments
- Own It / Charge It

Conclusion

In conclusion, OUC feels there is no immediate impact to grid stability due to EV charging.

Thank You

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Will EVs crash the grid?

TVA Electric Vehicle (EV) Evolution Initiative

Ryan Stanton, Sr. Project Manager

Nov 21st, 2024

Will EVs crash the grid?

ELECTRIC VEHICLE EVOLUTION INITIATIVE MISSION

Prepare for and enable adoption of electric vehicles to benefit our communities and the grid.

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Electric Vehicle Evolution Focus Areas

Preparing for EV Impacts

Ensure our energy system is prepared for millions of EVs on Valley roadways in the future.

Understanding EVs as a Resource

Accelerating research, testing and demonstration of EV-grid technologies which improve the energy system.

Enabling EV Adoption

Collaborating with stakeholders to identify and address barriers to large-scale adoption of all EV types.

EVs in the Valley

CHARGING

42

Fast Charge Network stations

VEHICLES

65k

electric vehicles

as of Aug 2024, a 40% YoY increase

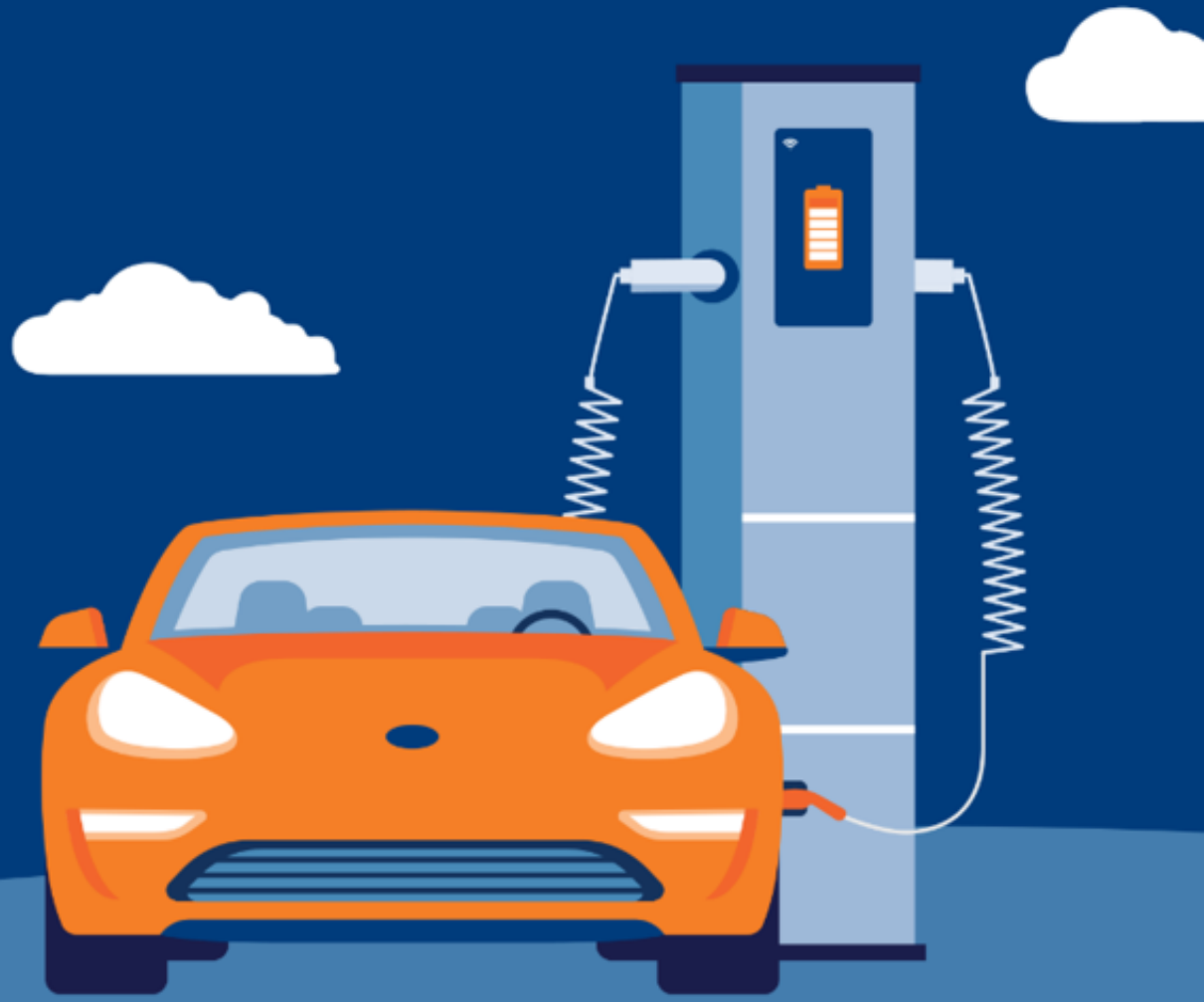
(~75% BEV)

MODELS

New

trucks and SUV

models are hitting Tennessee roads



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Will EVs crash the grid?

A look back

A look back: Chapters of load growth

1930s: Lighting + heating

1940s: War effort

1950s: AC + Refrigeration

1970s: Industrial

2000s: Datacenters + Electric vehicles

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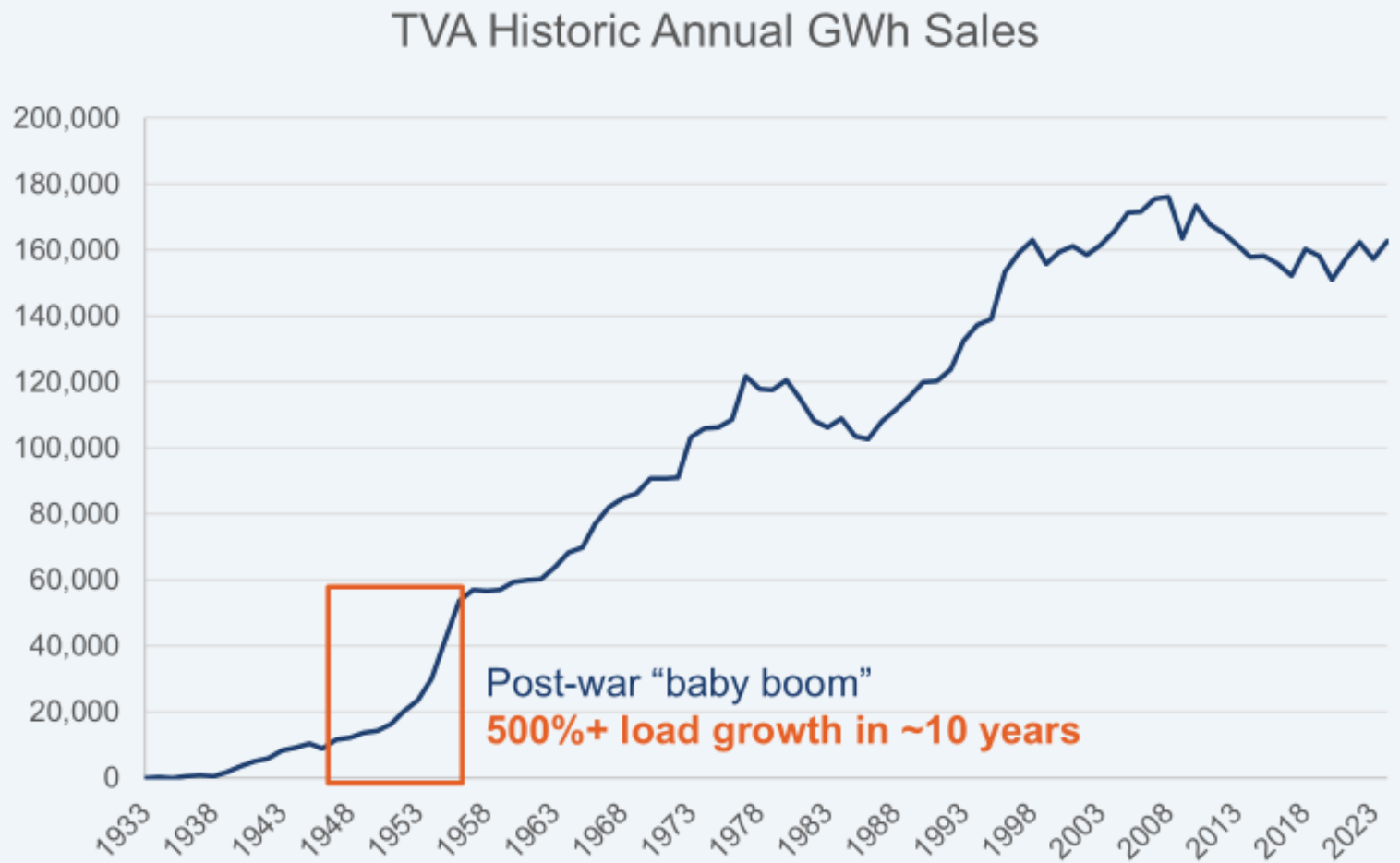
Utilities have seen load growth before and answered the call to meet customer demands



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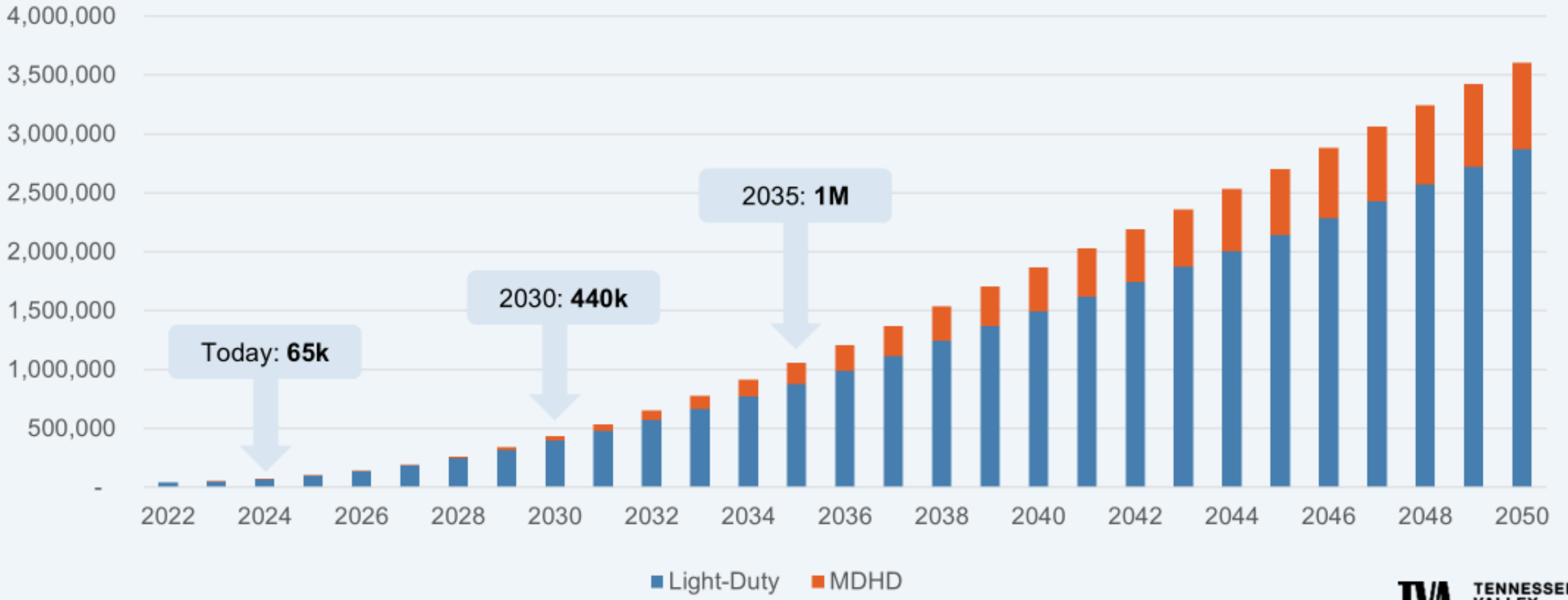
Will EVs crash the grid?

No.

What does the data tell us?

Projected EV Population in the Valley

LIGHT, MEDIUM, AND HEAVY DUTY EV POPULATION IN TN VALLEY, MEDIUM SCENARIO



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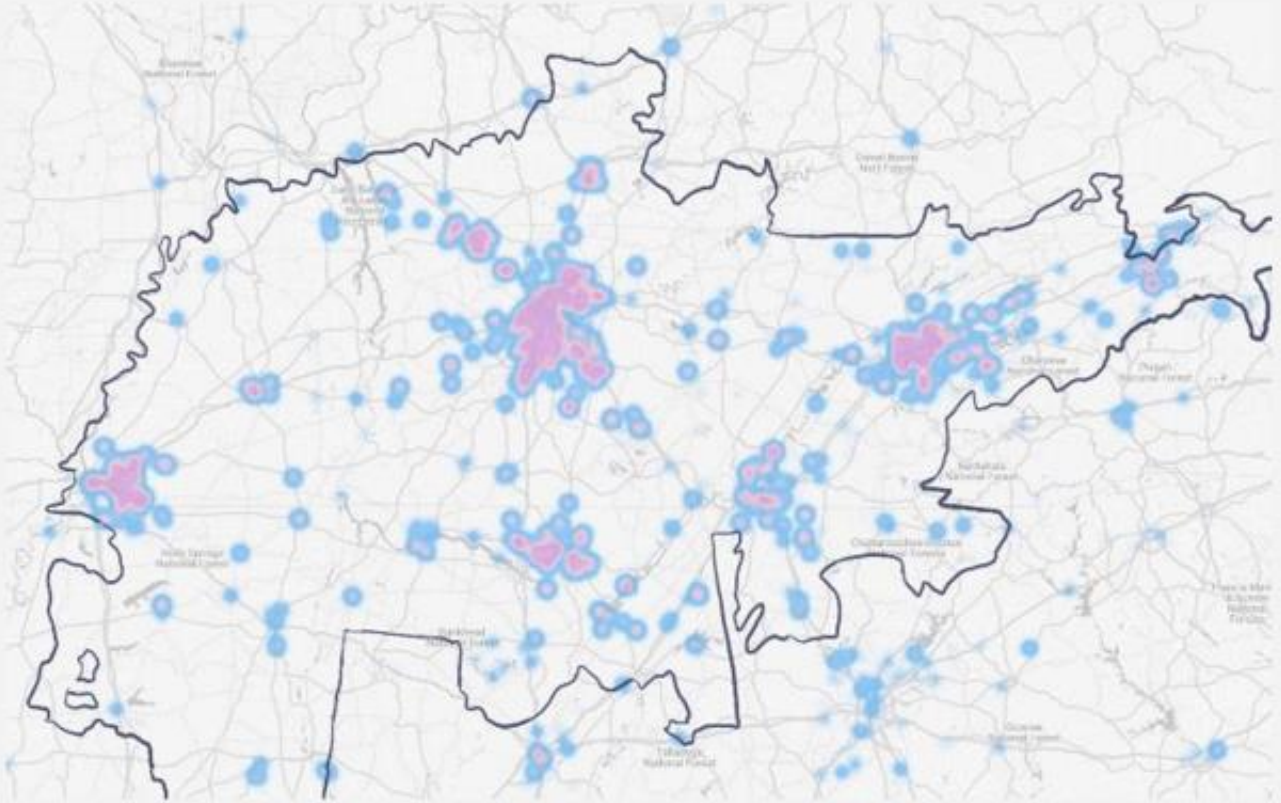
EV Charging Data Sheds Light on Charging Behaviors

600

vehicles actively charging
(~2% of EVs)

Tesla vehicles are majority
(~95% of EVs)



optiwatt

2023 TVA RFP WINNER
provided telematics data from active EVs in the Valley **since 2020**

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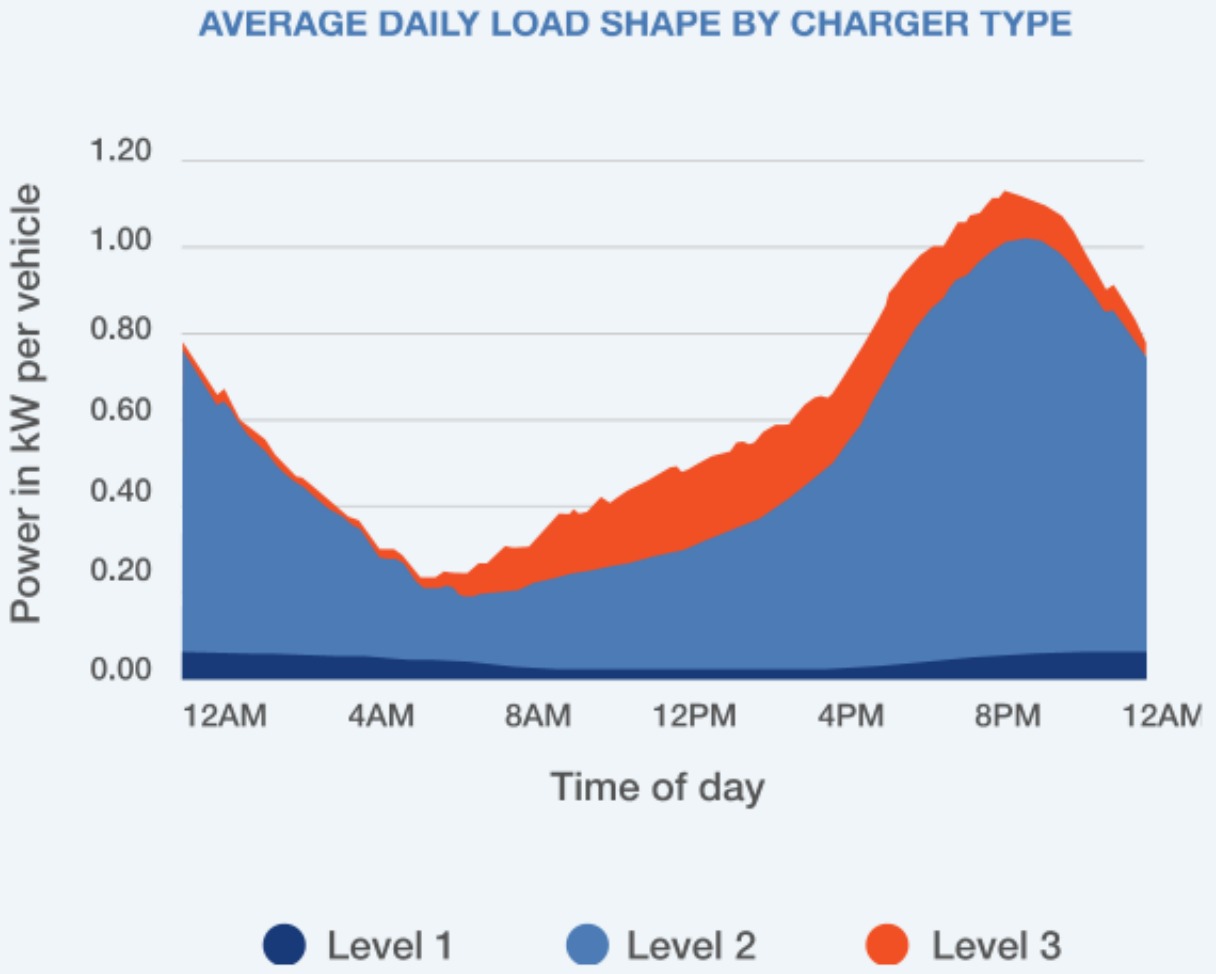
EV Charging Peaks at 8:30 p.m.

1.1 kW

added to the system
by an EV on an average day

Level 2

charging drives load shape



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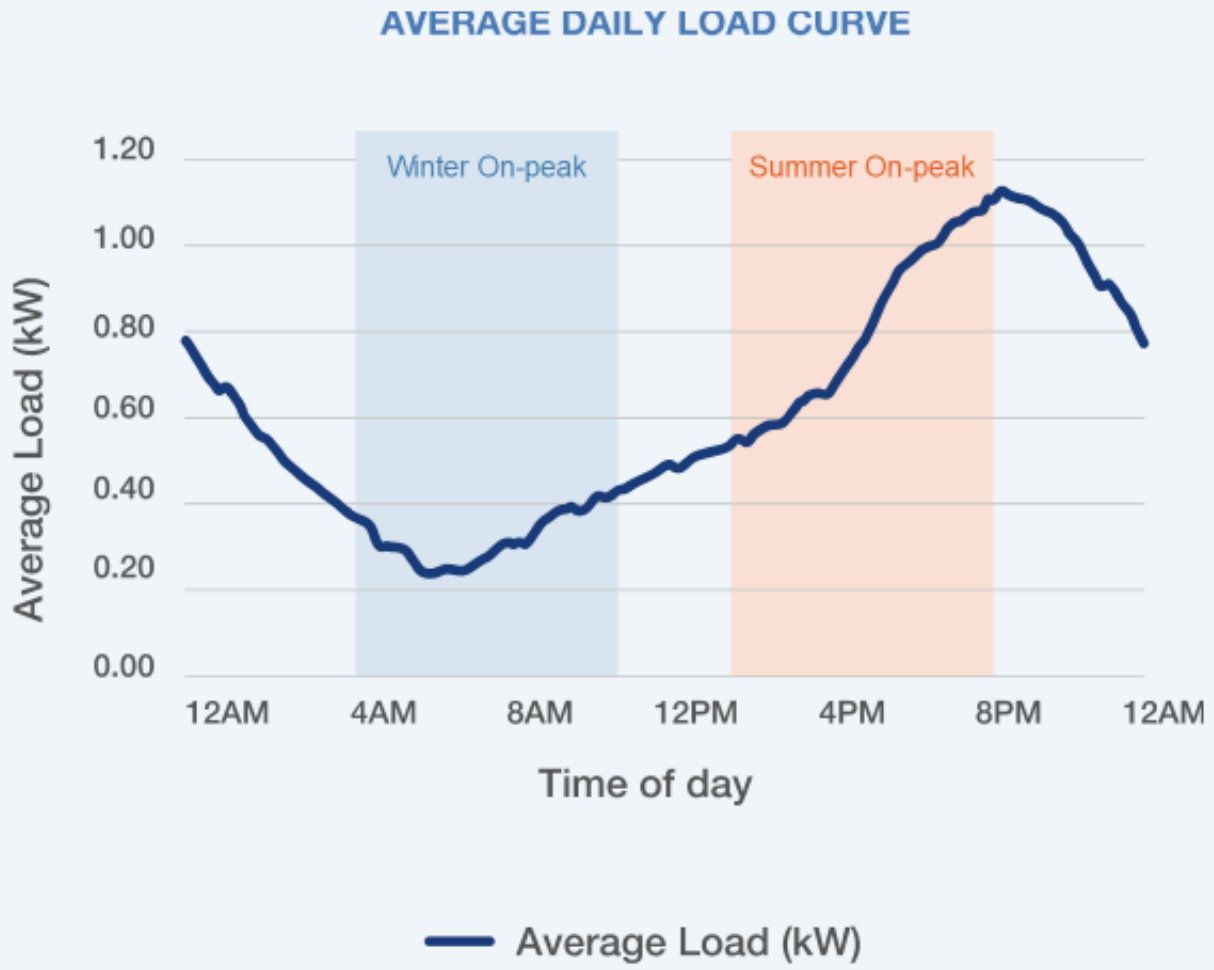
EV Charging Doesn't Contribute to Winter Peak

81%
of charging load is off-peak

76%
of residential load is off-peak

5,000 kWh
energy used by an EV per year
(similar to a residential heat pump)



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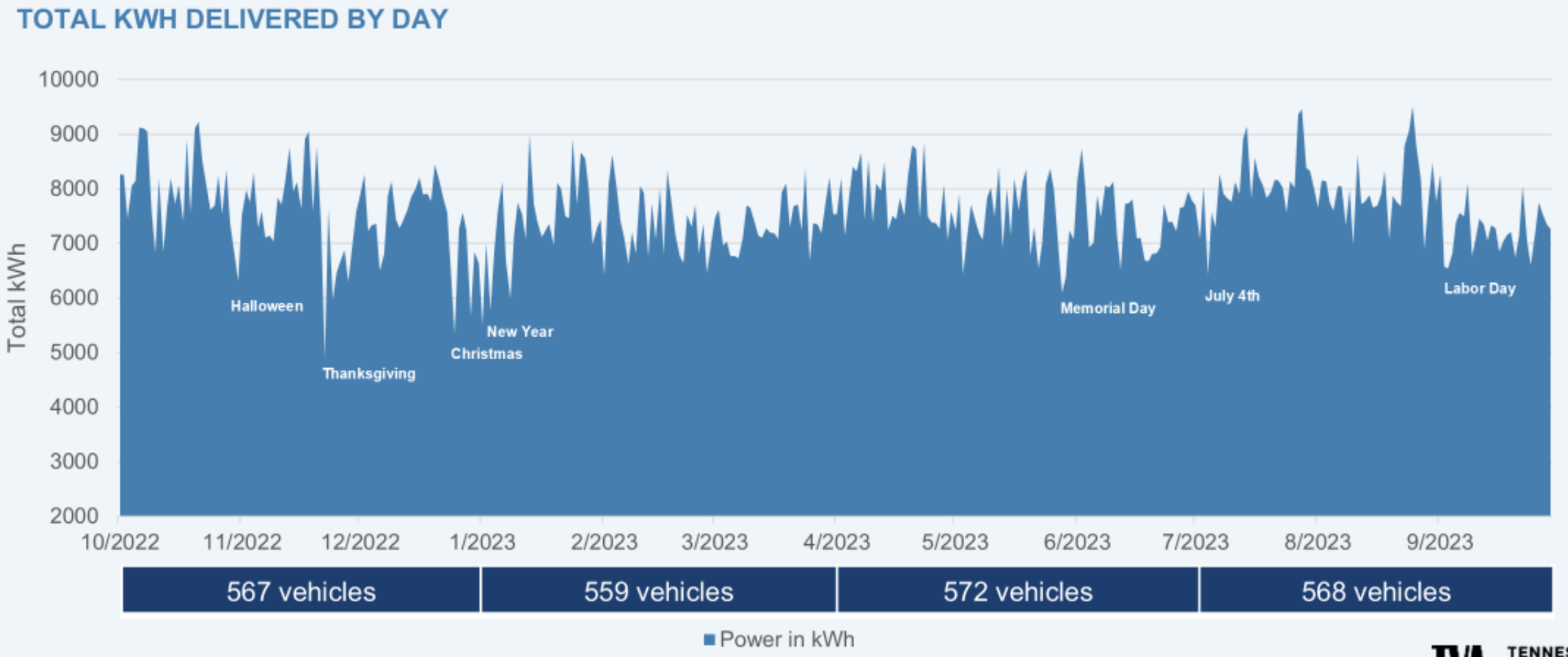
EV Charging Correlates to Travel Patterns



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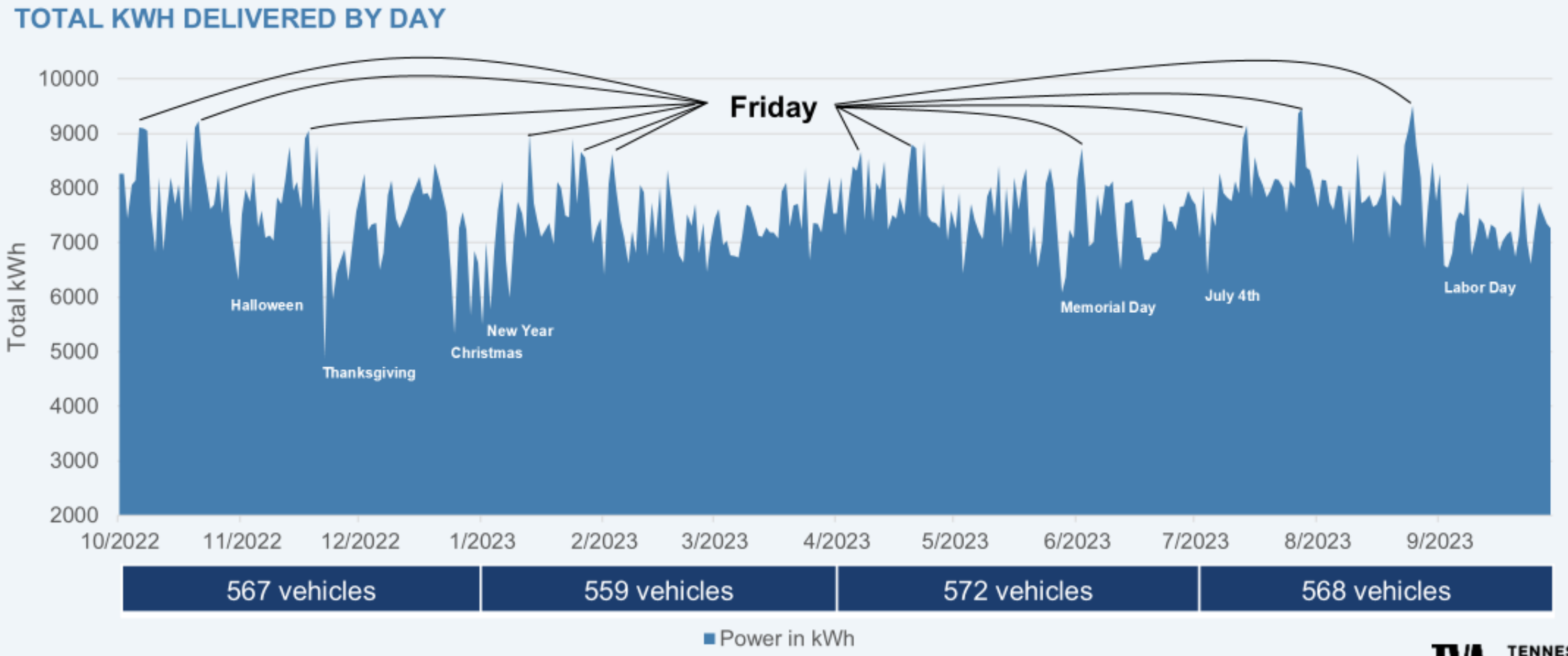
Fridays Consistently Show More Charging Load



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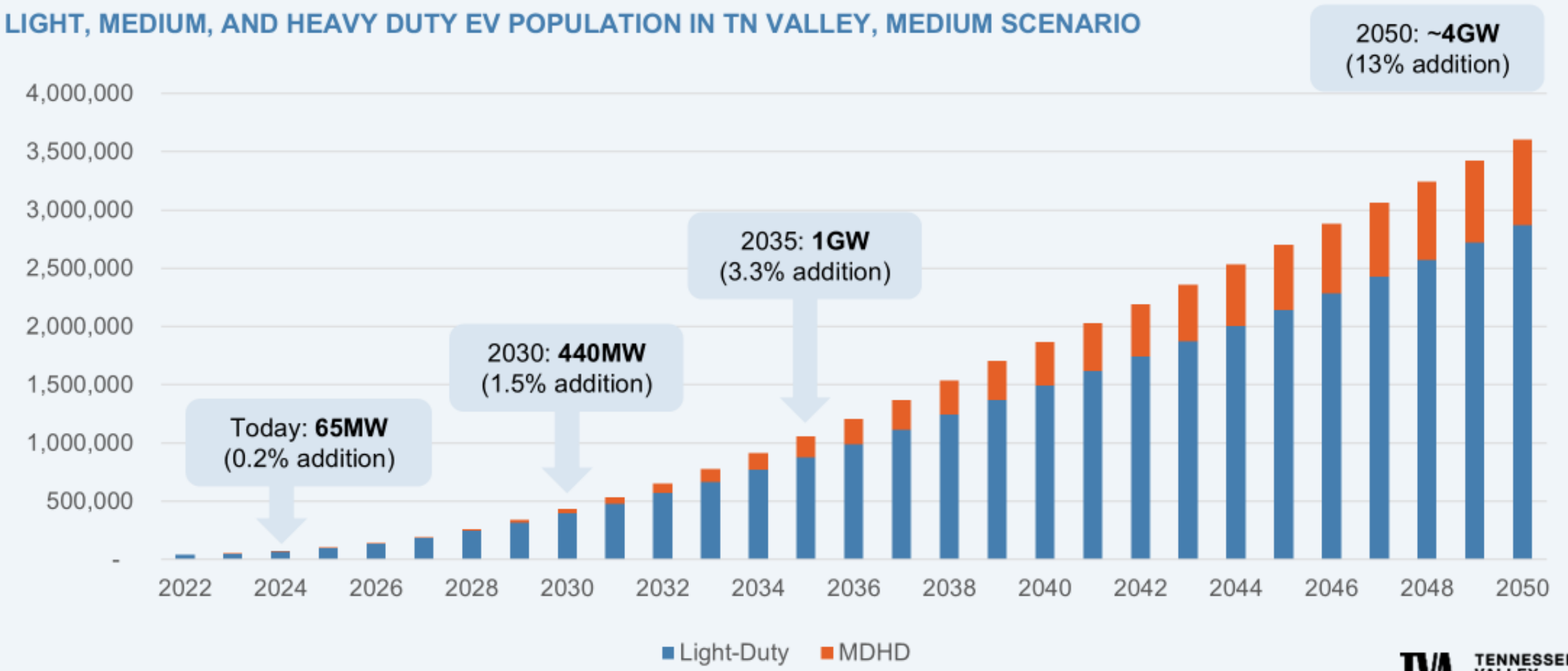
Potential EV load growth in the Valley



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What's Next?

Exploring the additional value of managed charging

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Managed Charging: flatten the peak

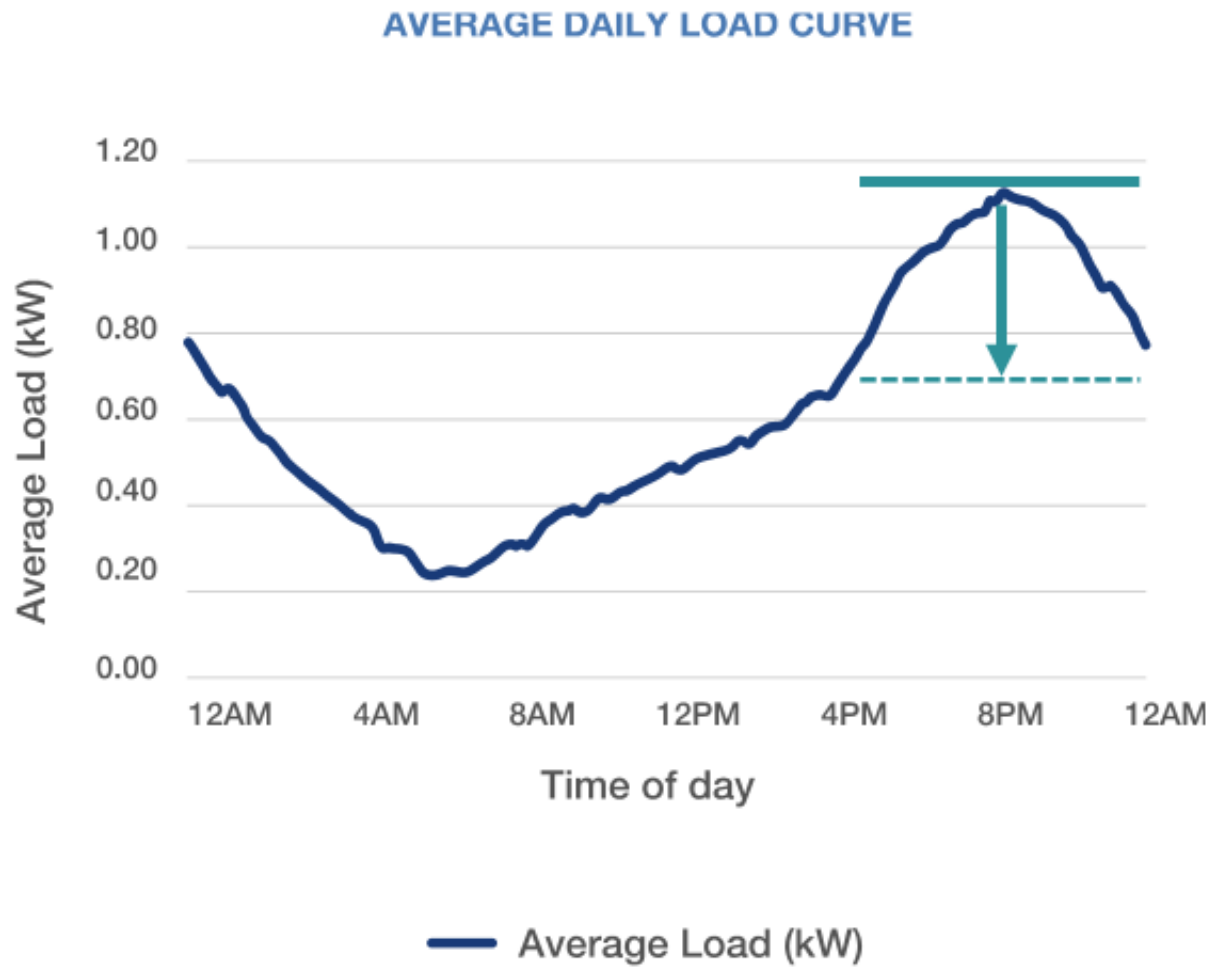
How will we manage EV charging in Valley?

Strategies available now:

- In-vehicle charging schedules
- Rates (TOU)
- Public messaging

Future:

- Dynamic control during peaks?



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Connect With Us for Resources

evevolution@tva.gov

AVAILABLE RESOURCES

- **TN Valley EV Adoption Forecast**
- **EV Charging Load Shape Data**
- **EV Program Strategy (ETIPS) Case Study**
  (Coming Soon)


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TENNESSEE
VALLEY
AUTHORITY

Fleet Transition Planning & Utility Coordination

Dan Raudebaugh

Executive Director

Center for Transportation and the Environment

About CTE

Who We Are

501(c)(3) non-profit engineering and planning firm

Our Mission

Improve the health of our climate and communities by bringing people together to develop and commercialize clean, efficient, and sustainable transportation technologies

Portfolio

$3.8 Billion+

- Research, Demonstration, Deployment
- 142 active projects totaling $756 Million+
- 50 pending projects totaling $2.6 Billion

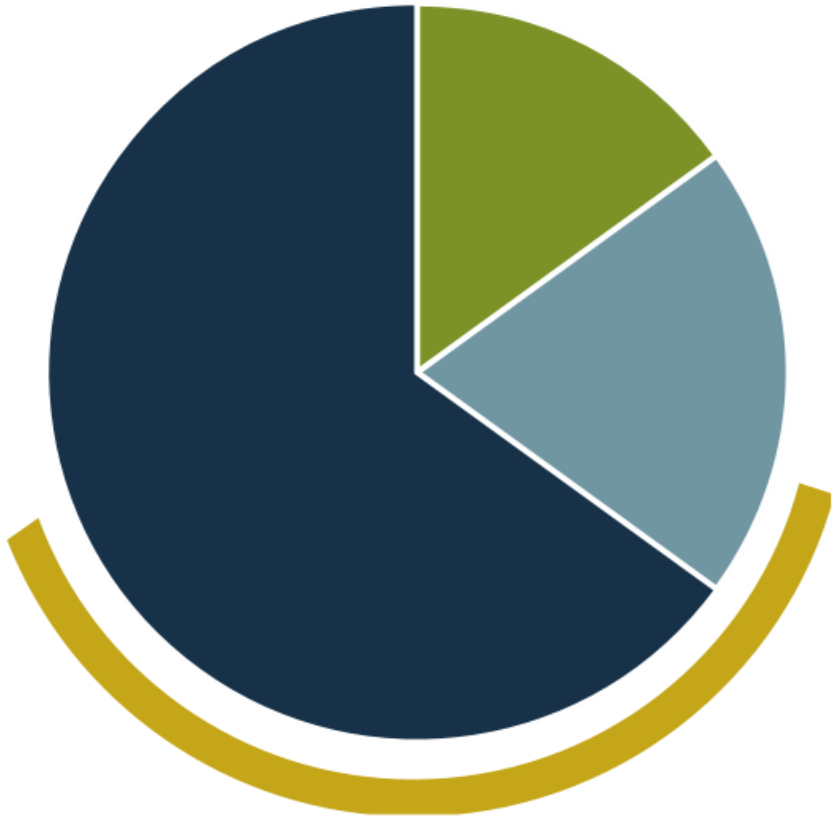
Our Focus

Zero-Emission Transportation Technologies

National Presence

Atlanta, Berkeley, Denver, St. Paul

Who We Are



Our staff has the diverse set of skills to support all aspects of transportation zero-emission goals.

15% Administration

20% Development, Policy, & Outreach

65% Professional Project Managers

40% Engineers (of total staff)

What We Do

Technology Development

Innovative pilots for pioneering tech

Smart Deployment

Technical solutions for early adopters

Transition Planning

Strategic plans for full-fleet electrification

Advocacy

Unified advocacy for a zero-emission future

Grant Writing as a Service

Comprehensive support for team building and project planning

Technology Development Projects

1994

1996

2018

2019

1994 — 1995 — 1996 — 2008 — 2018 — 2018 — 2019 — 2021

Hybrid Battery Electric Hydrogen

Smart Deployment

We support early adopters by providing the best technical solutions for initial deployments.

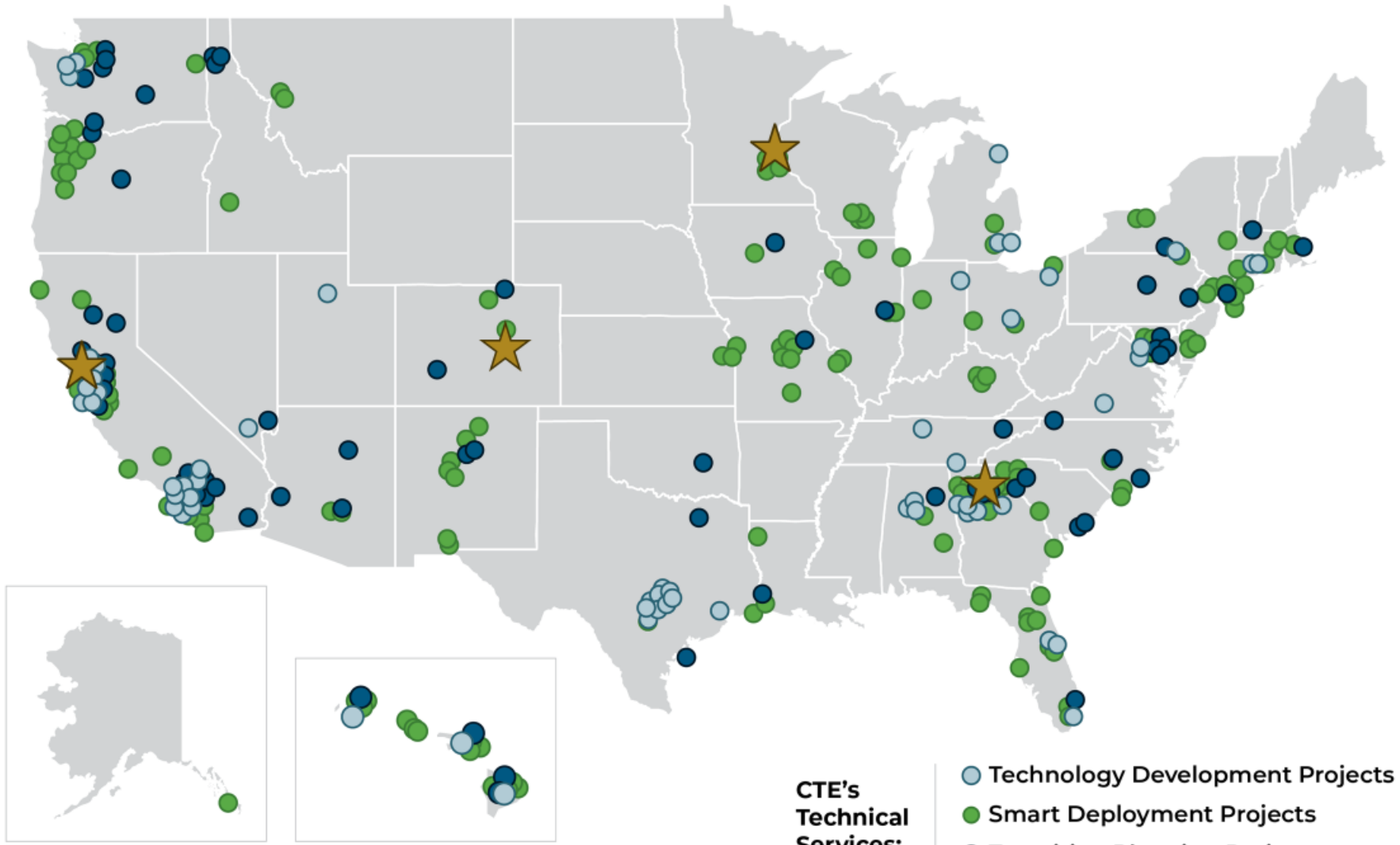
CTE has assisted **more than 250** operators that have either deployed, or will soon deploy, **more than 1,400** zero-emission vehicles.

Transition Planning

We help fleet operators implement strategic plans for a full zero-emission fleet.

CTE has managed or participated in **80** transition planning projects across the country.

31 Years. 142 Active Projects



Advocacy

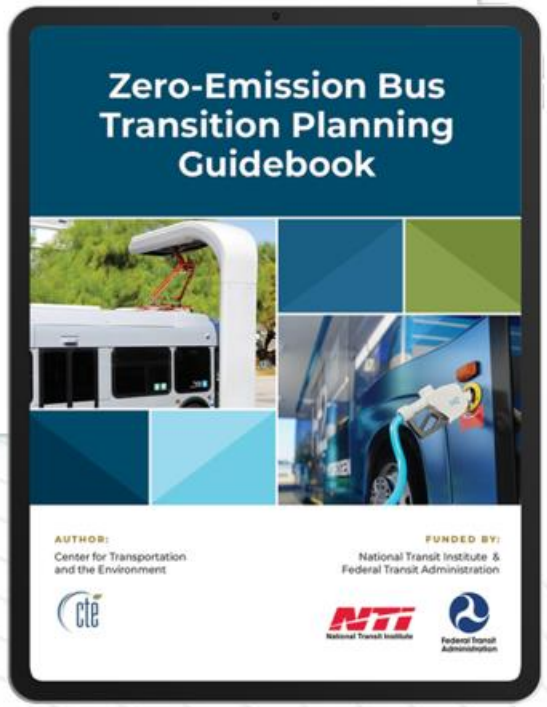
We help amplify the zero-emission industry's collective voice.

Grant Writing as a Service

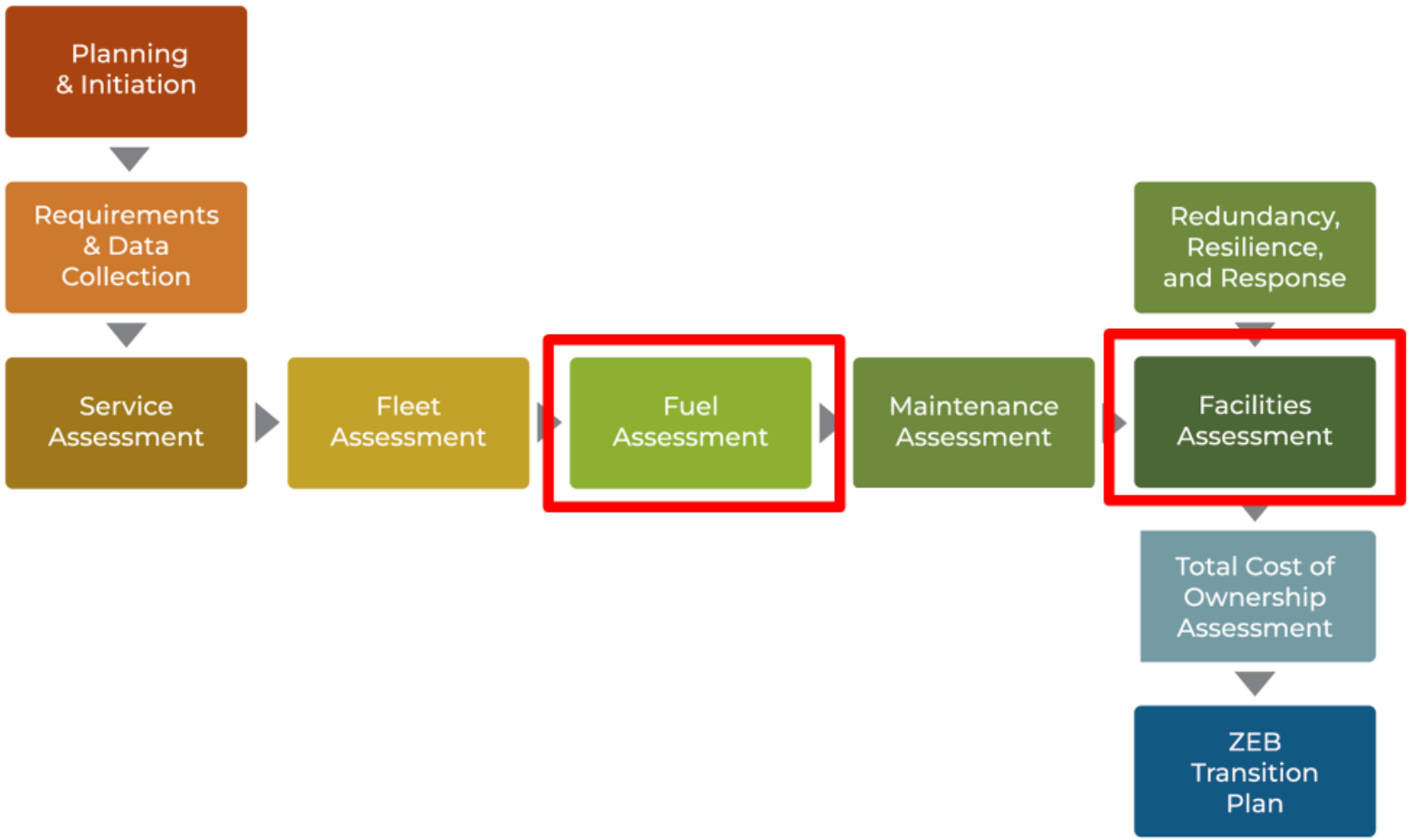
We provide comprehensive support for team building and project planning.

ZEB Deployment Guidebook

ZEB Transition Planning Guidebook



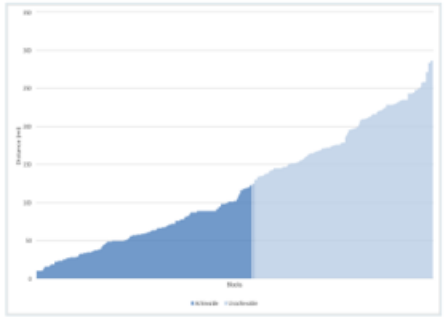
Transition Planning Approach Highlighting Steps with Utility Tie-In



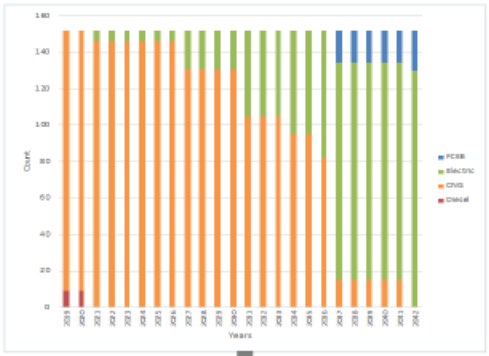
CTE's Transition Planning Methodology

Modeling

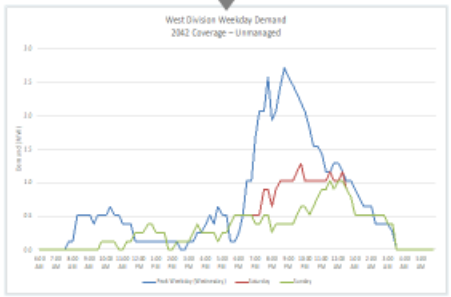
Feasibility Analysis



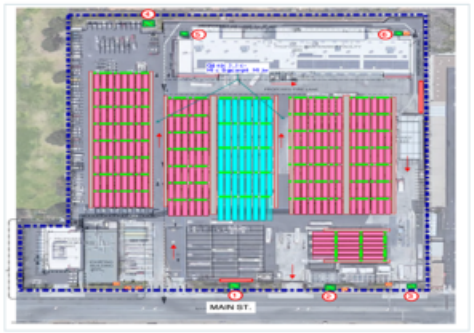
Procurement Plan



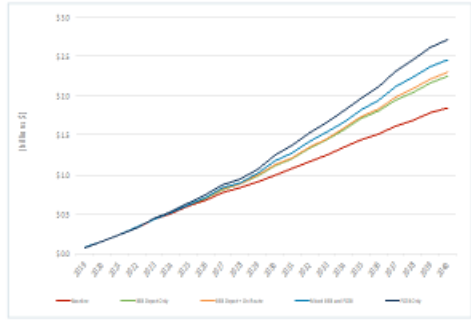
Energy Analysis



Infrastructure Plan



Total Cost of Ownership

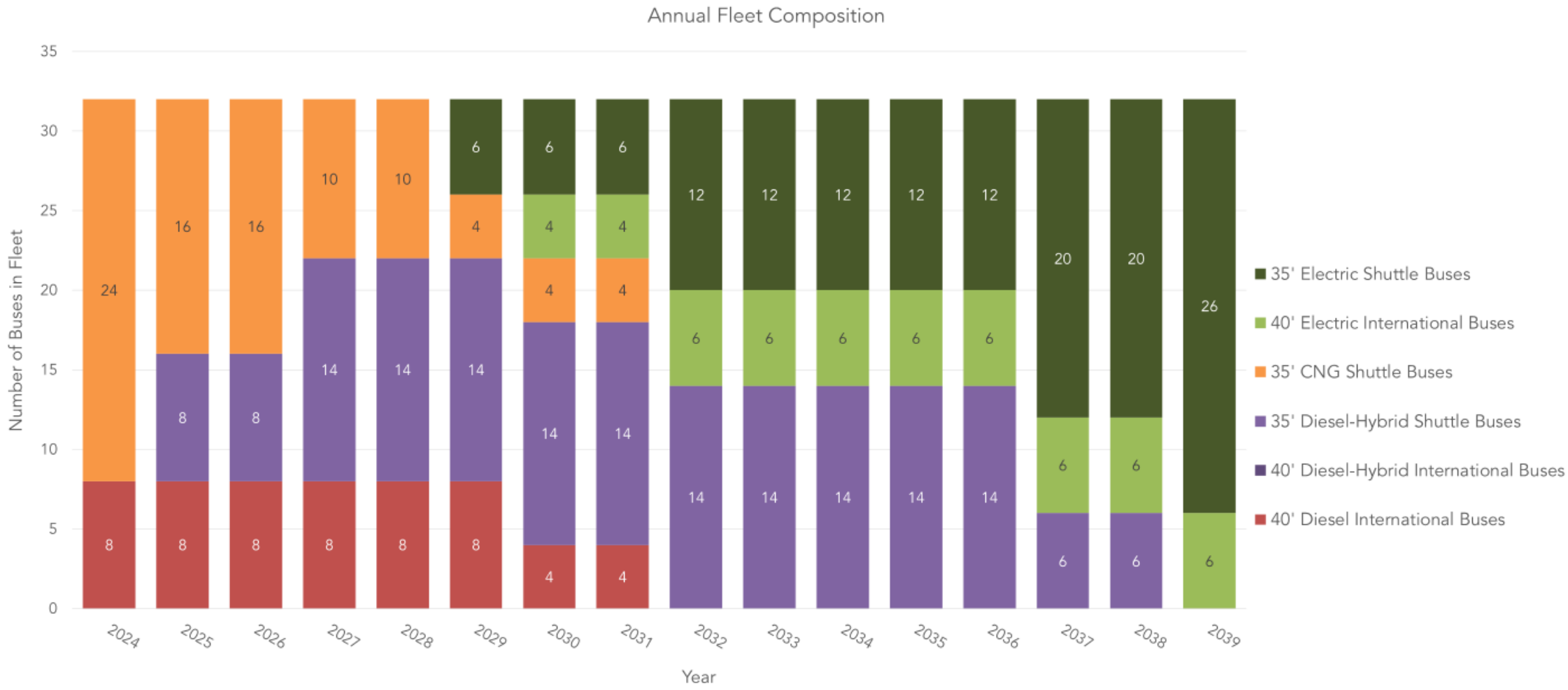


Sample of CTE's work with PDX

Conducting a ZEB Transition Plan

- Develop BEB Only, Mixed Fleet, and FCEB Only transition scenarios that meet service requirements
- Estimate fleet, fuel, facilities and maintenance costs for these scenarios over this period
- Provide an understanding of capital and operating challenges for BEBs and FCEBs
- Provide an understanding of the power requirements to support utility coordination

BEB Only: Fleet Composition



Charging Assumptions

Number of chargers

- One 150kW depot charger with three dispensers/pantographs is purchased for every three buses.
- Two 350kW opportunity chargers are purchased in 2029 in BEB Only Scenario.

Charging behavior

- The buses depot charge during the off-peak period.
- Up to half of the fleet can charge at any given time.
- The 35’ buses use two opportunity chargers as needed during operation, including charging during on-peak and off-peak times.

Charger Power

- Off-duty (slower) chargers are 150 kW
- Opportunity (faster) chargers are 350 kW

Utility Impacts

PDX was informed by utility that power upgrades for current depot would cost them $3M-$4M

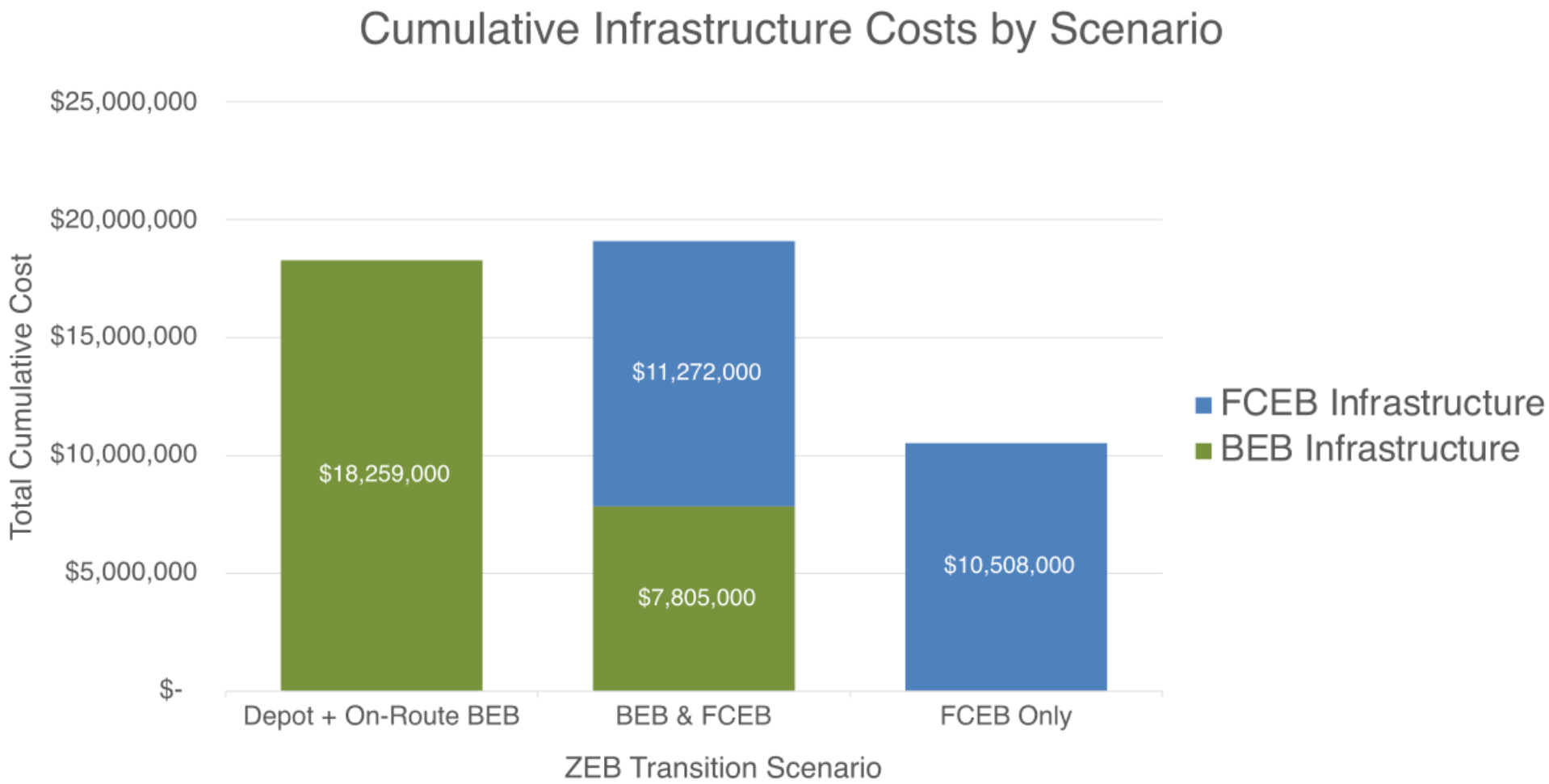
- Utility informed PDX that upgrading their maintenance facility to have sufficient power, but moving vehicle fueling there would create significant operational challenges

CTE provided the utility with a timeline for how PDX's demand would increase over time as more chargers are added at the depot

Cumulative Fuel Cost Summary

Scenario	Total Cost	Incremental Cost of ZEB Transition	Percent of BEB	Percent of FCEB
Baseline	$15.0M	$0	0%	0%
1: BEB	$12.0M	-$3M	100%	0%
2: BEB + FCEB	$18.5M	$3.5M	13.3%	86.6%
3: FCEB	$18.1M	$3.1M	0%	100%

Cumulative Facilities Cost Summary



Facilities Map

PDX Maintenance Facility
Where all buses are maintained and CNG buses currently fuel.

PDX Parking (Depot)
Where all buses are parked and where operators currently take their breaks.

Fuel Cell vs. Battery Electric Bus

Infrastructure Investment