TRANSPORTATION ELECTRIFICATION

EPIC POLICY + INNOVATION COORDINATION GROUP

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PowerFlex Systems

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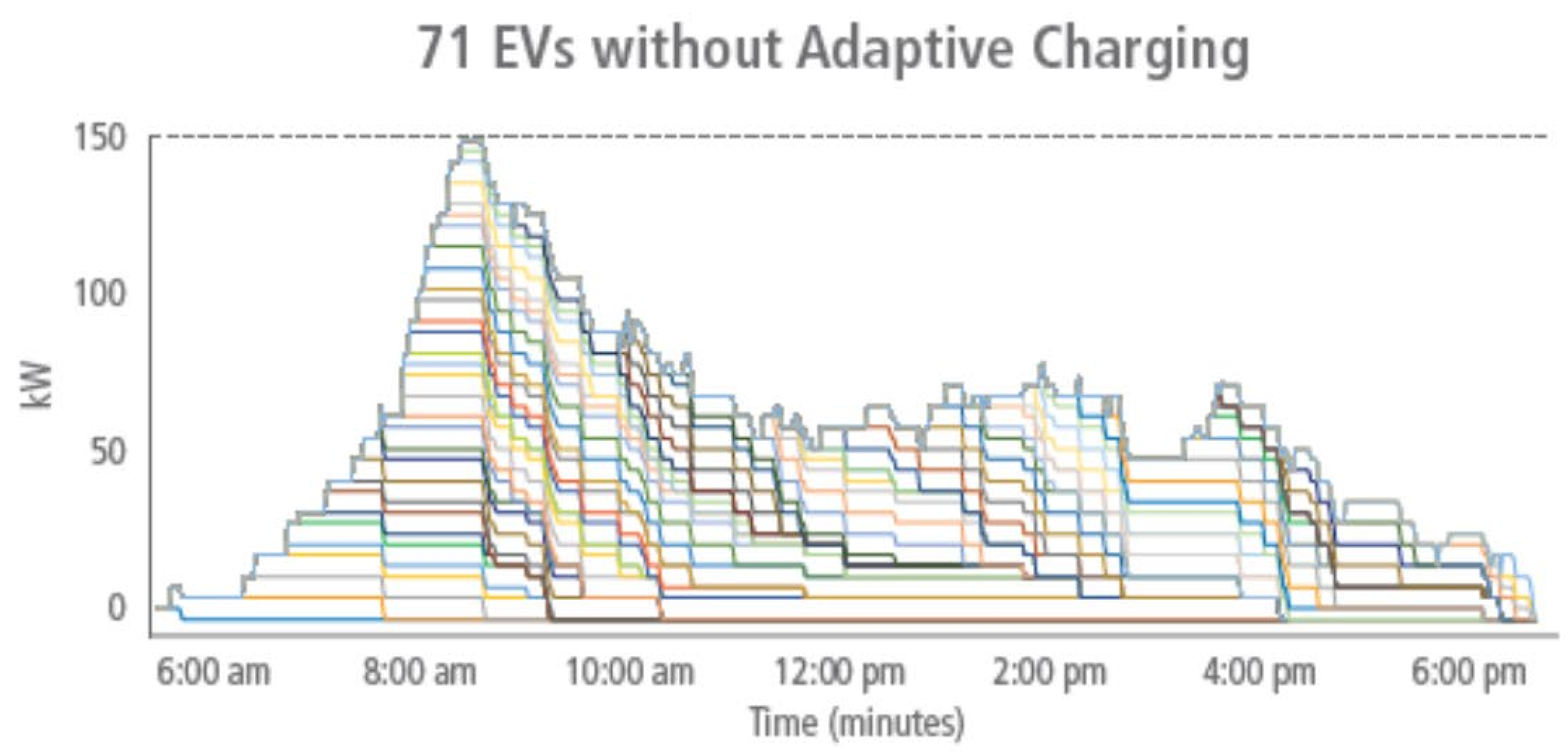
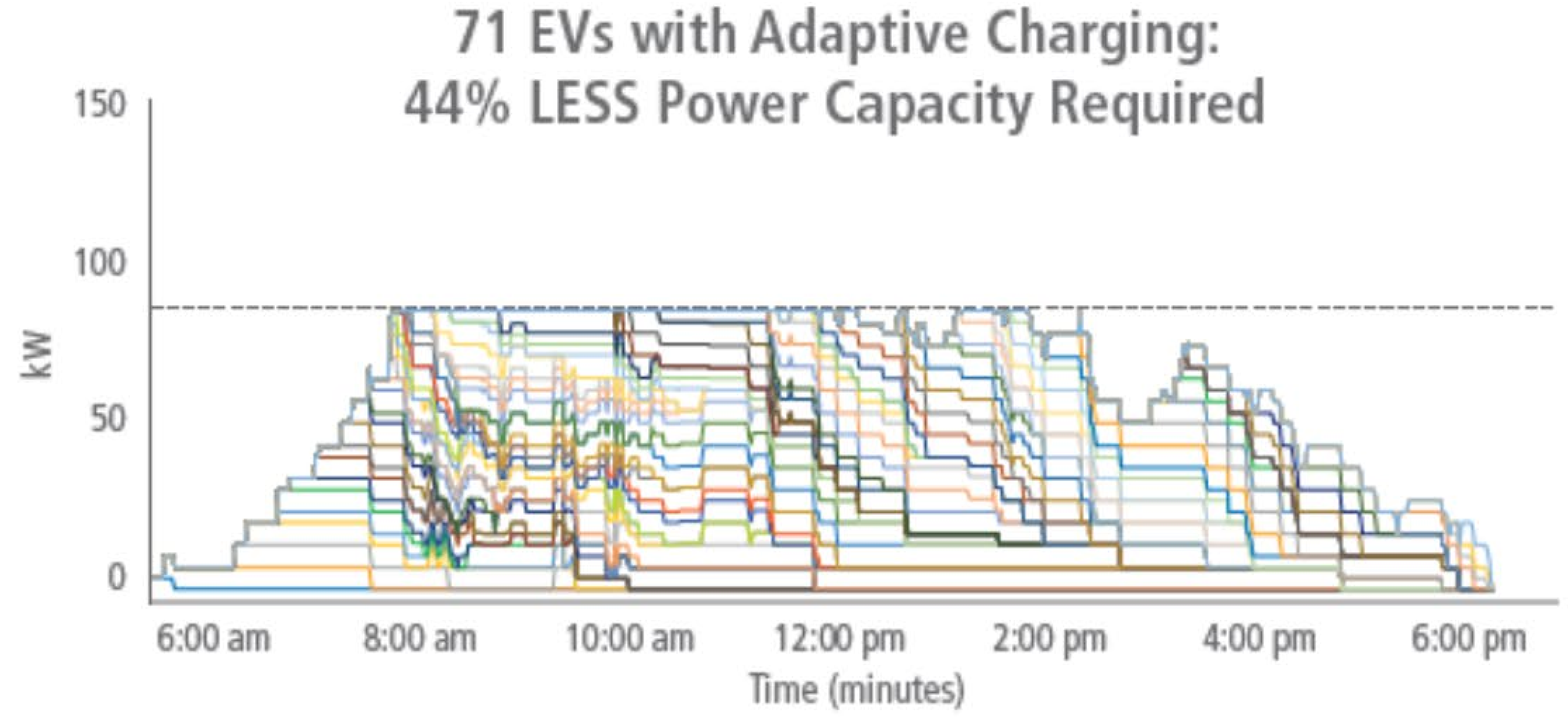
Software solutions can reduce grid infrastructure upgrades costs in installing EV infrastructure.

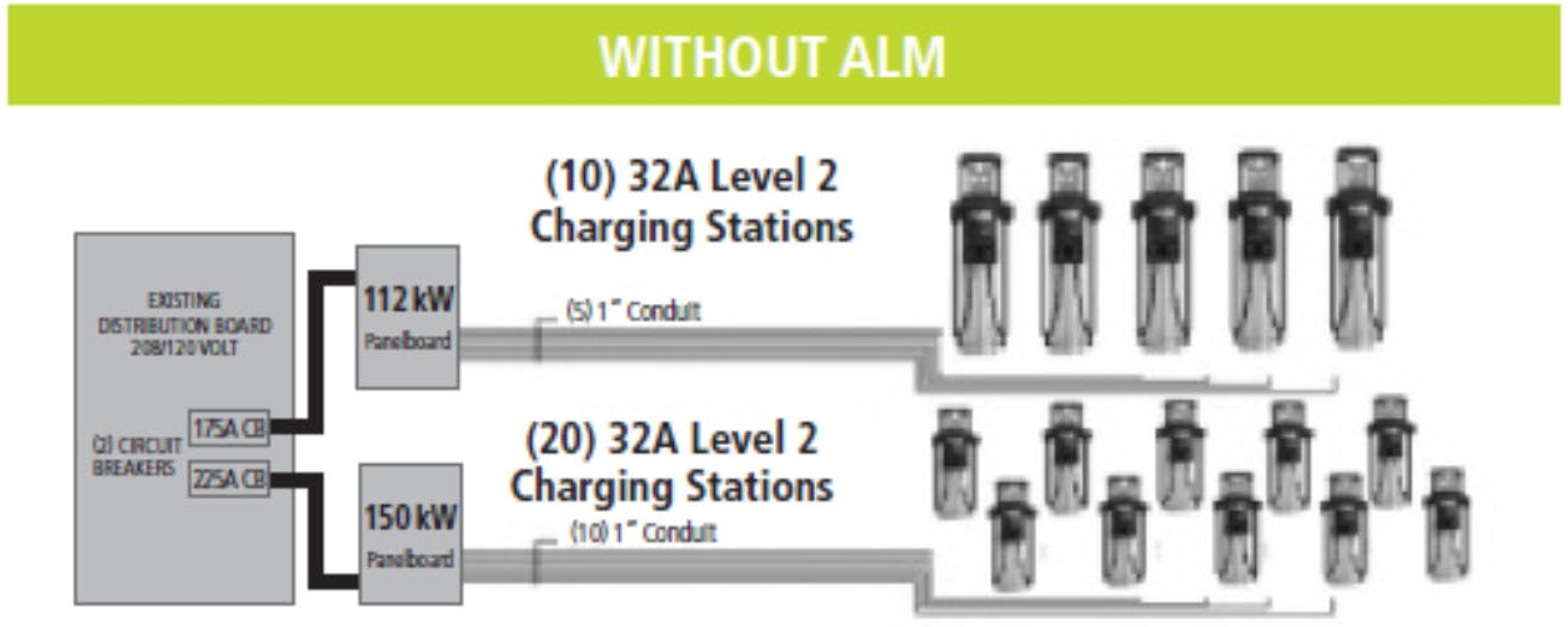
EPIC projects participating in the workstream identified that software-based energy management systems, which can limit the maximum charging level of a fleet of vehicles on the customer side of the service, have strong potential to avoid the need for additional and costly service upgrades and/or customer side electrical capacity upgrades.

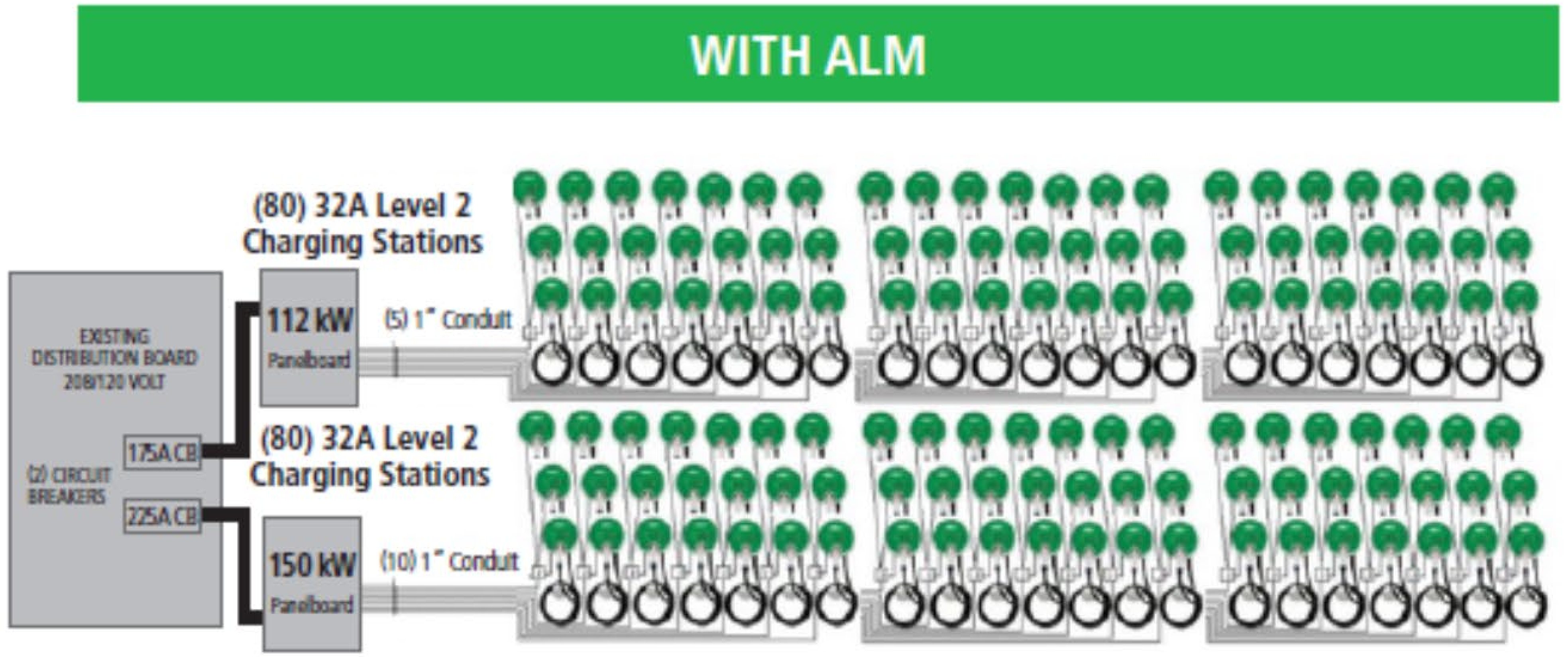
Adaptive Load Management at Scale





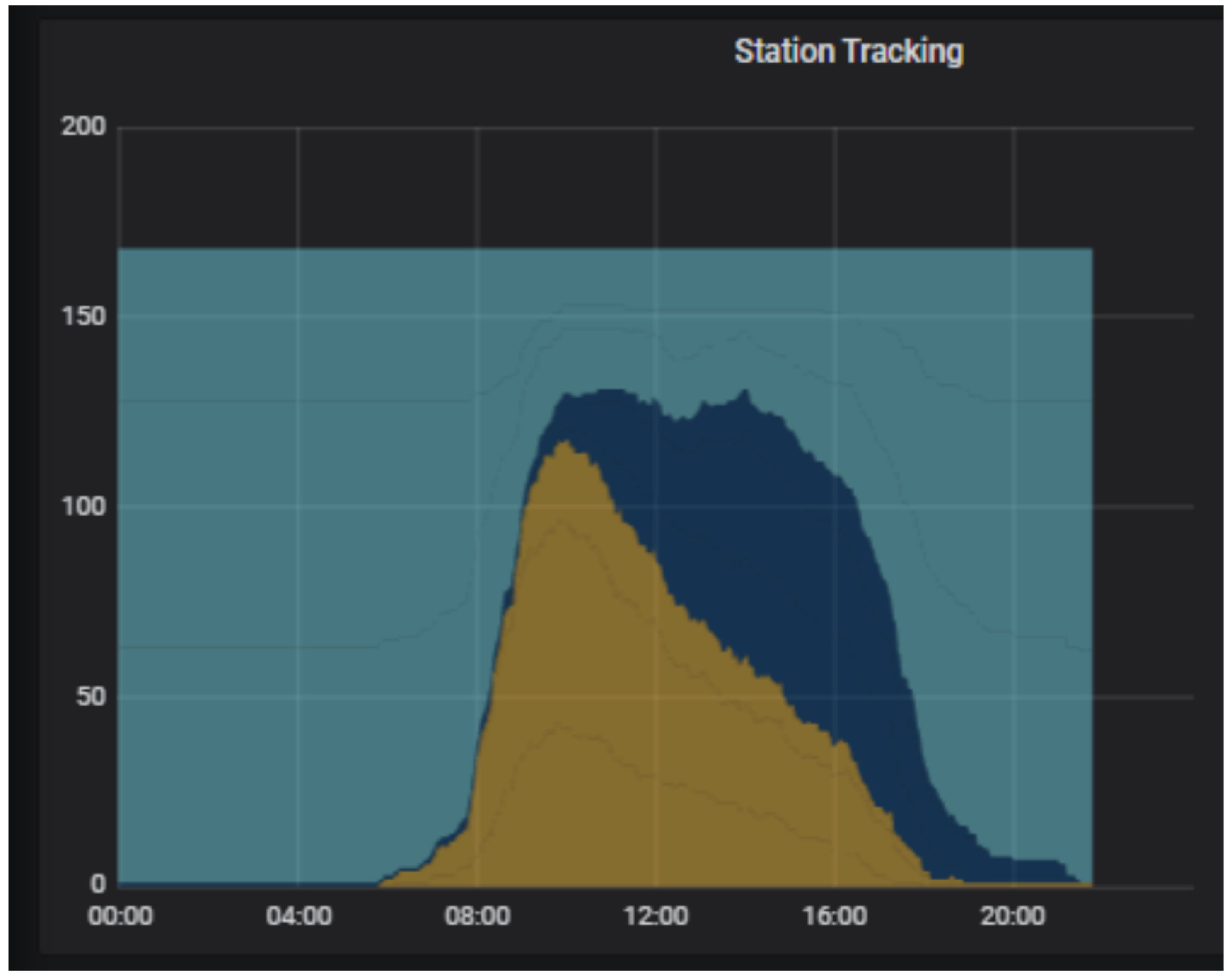
Not a single car had to stay later to receive the same amount of energy as the chart above.

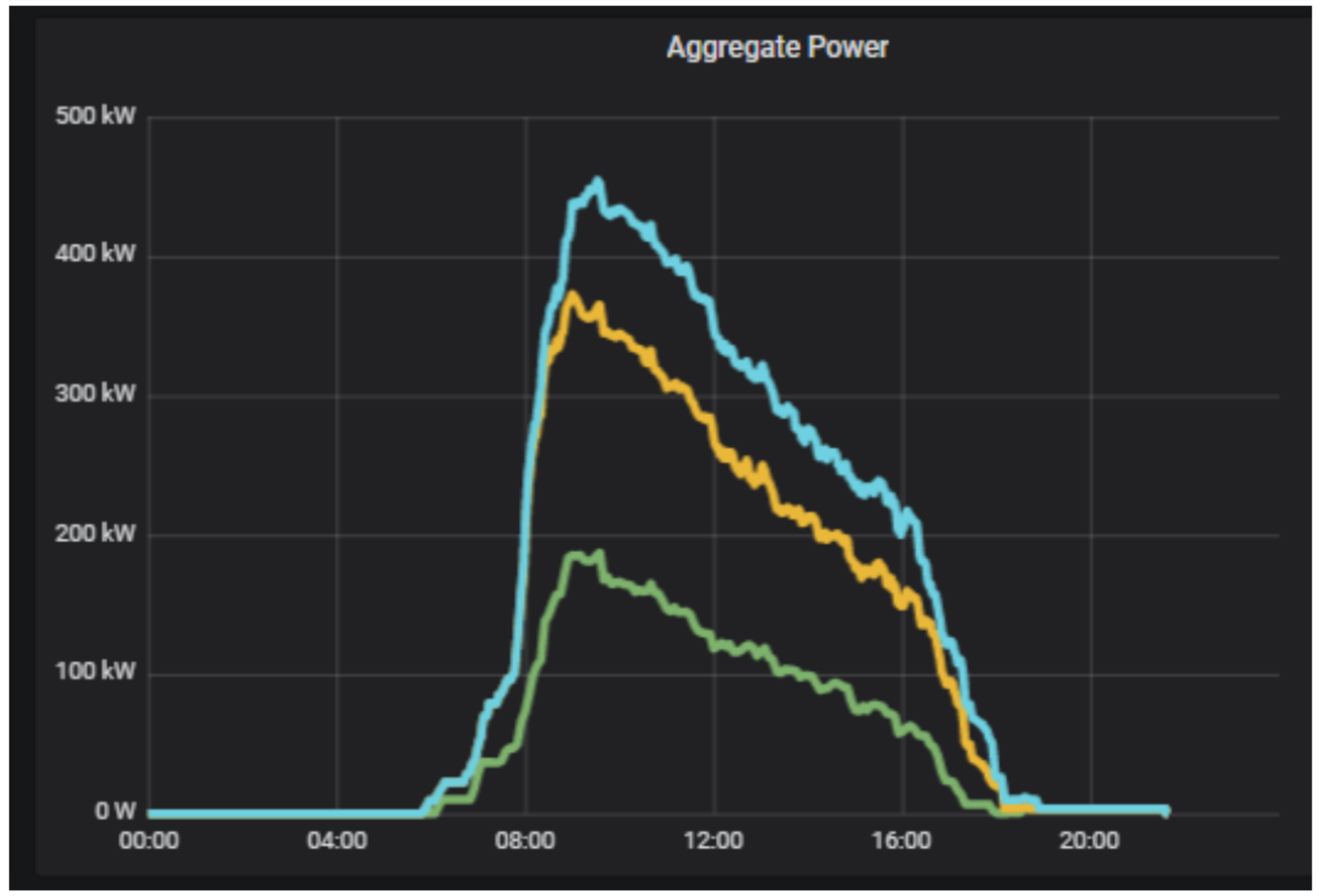




(160) 32A Charging Stations on 262 kW total capacity using UL916 Adaptive Load Management

Case Study: 168 Chargers @ 1 Site





- **168 chargers**
  - 118x Universal (J1772) x 6.6kW
  - 50x Tesla x 16kW
- 1.578MW nameplate
  - Connected to 800A/480V panel (max load @80% = 532kW)
  - 3x capacity
  - No Interconnection Upgrade
- Cost: **<$3,000/station**

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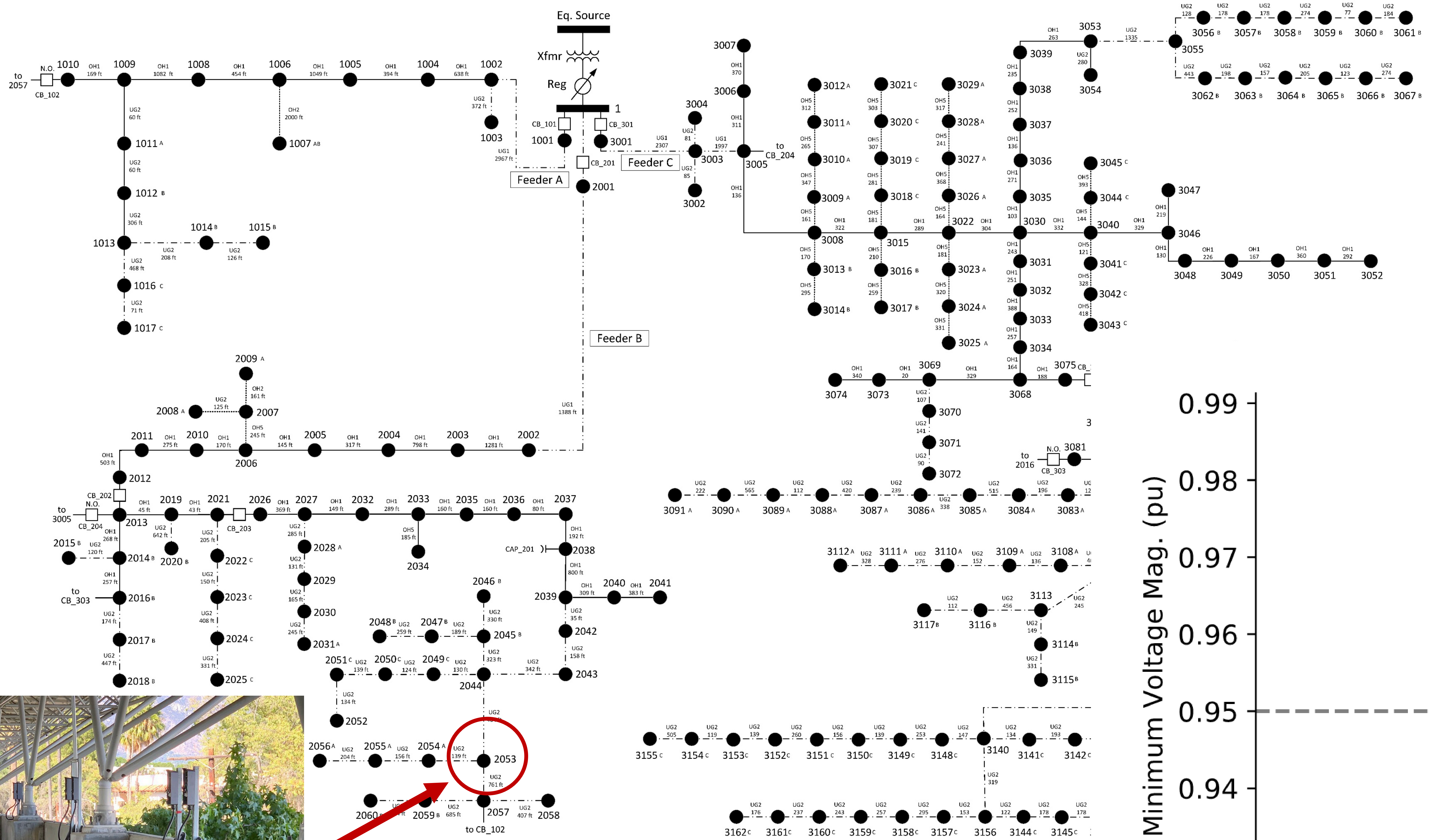
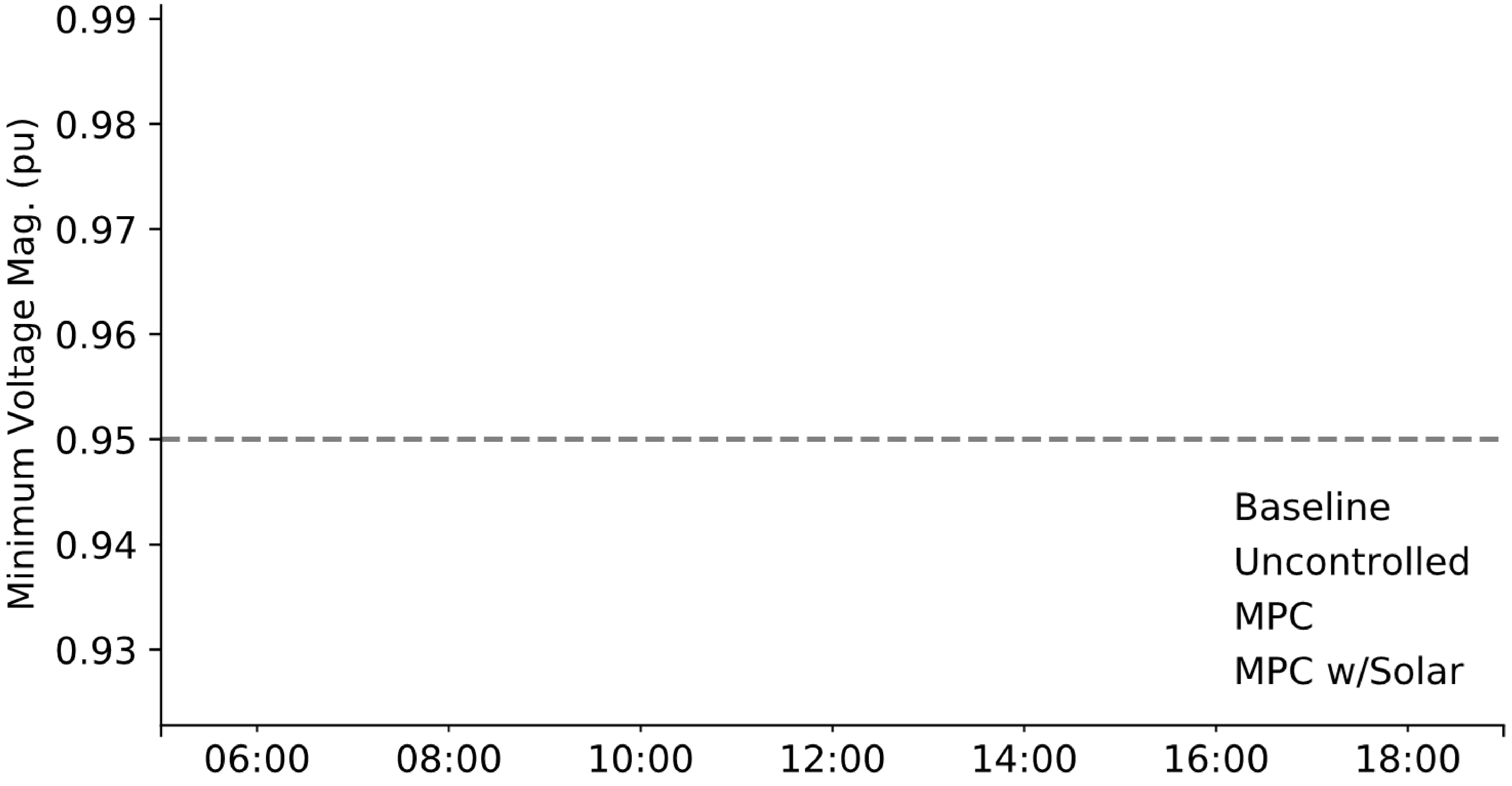
Leveraging managed charging as a solution to reduce grid upgrade costs can be accomplished by sharing more grid infrastructure data, or by establishing managed charging standards.

To implement managed charging as a way to avoid infrastructure costs at a significant scale in the market, participants said a consistent, simple, and replicable approach will be needed, rather than the ad hoc approach today.

Grid Impacts of Large-Scale EV Charging





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WHAT INFORMATION IS NEEDED TO EVALUATE EV MANAGEMENT SYSTEMS AS NON-WIRES ALTERNATIVES?

- The key is high temporal and spatial resolution
  - Ideal
    - Detailed feeder models
    - High resolution load data
    - Real-time measurements
  - Alternatively
    - Safe load envelopes to operate within
    - Fine-grained signals to follow
- Charging workload information
  - Real or statistical

Jordan Smith, Southern California Edison

CALIFORNIA PUBLIC UTILITIES COMMISSION
EPIC Policy+Innovation Coordination Group

EPIC Policy+Innovation Forum
Key Lessons Learned Transportation Electrification

Jordan Smith

Grid Edge Innovation

18 February 2021

Energy for What's Ahead®

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Key Learnings from Transportation Electrification Workstream and How to Demonstrate

- Learning #6: V2G DC-based Charging Systems - Discussion
- Learning #7: V2G AC-based Charging Systems - Discussion
- SCE EPIC V2G Demonstration Project
  1. OEM Light Duty AC System
  2. OEM Light Duty DC System
  3. School Bus DC System
  4. Transit Bus DC System

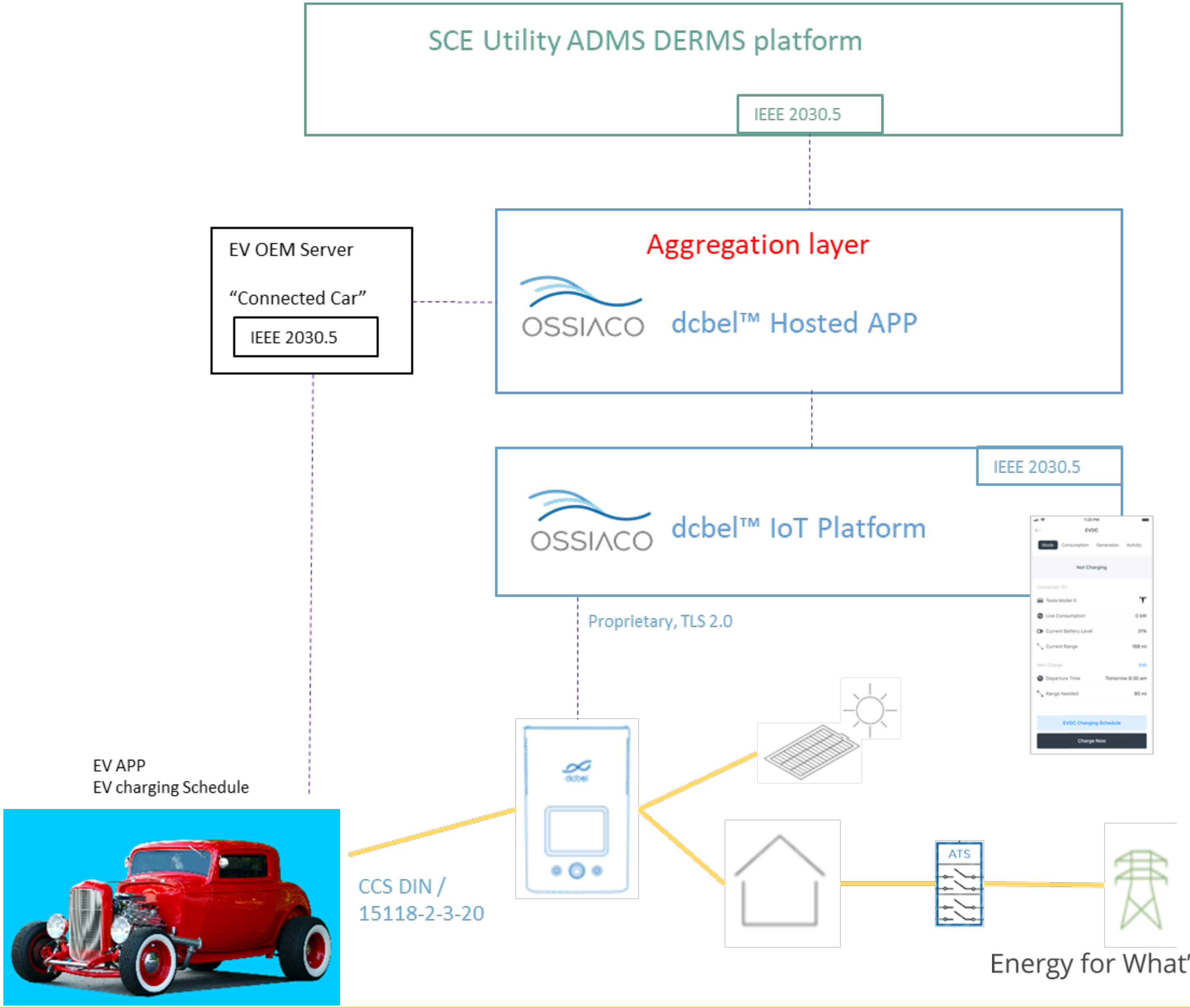
Key Learning #6

There is a clear path for V2G with DC-based charging systems with smart inverters. *Buses coming off the line with CHAdeMO (DC fast charge ports) are V2G capable. As the charging infrastructure acts as an inverter, converting AC to DC and vice-versa, it simply needs to be Rule 21-certified (interconnection standard for inverters) in order to connect to and provide services to the grid.*

While generally true that there is a clear path for interconnection of V2G DC in the rules, there are some issues to work through on the technical side to realize some V2G function, and there are some limitations on the ability to realize certain use cases

1. On the vehicle side, the manufacture must engineer and produce the interfaces, controls, and functions to enable and operate the battery side systems.
2. Though not specifically addressing V2H here (Learning #8) vehicle export power systems need to have protections and controls to help prevent unsafe operation (for example, powering a premise without isolation and protection) – part of vehicle design
3. To enable certain use cases (for example as a DSO resource) DSO controls technology and associated process need to progress. Such controls need to interface with V2G aggregator or control systems, cybersecurity, etc.

V2G DC Communications and Control Architecture – SCE and Partners in EPIC V2G Project



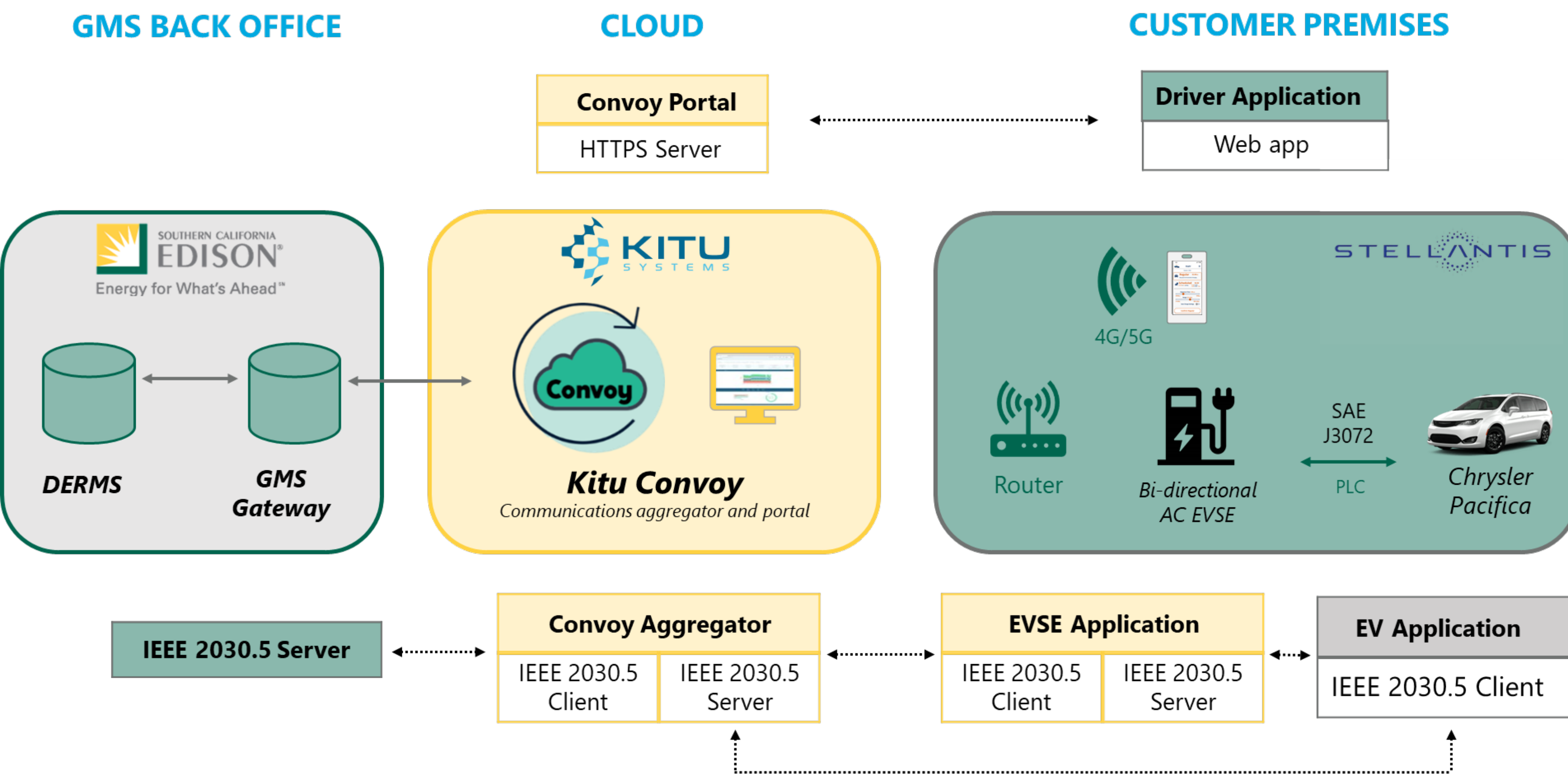
Key Learning #7

Consistent standards will support development of V2G with AC-based charging systems. *In contrast to DC fast charge systems, the future of V2G with AC-connected infrastructure (Level 1 and Level 2 AC Electric Vehicle Supply Equipment) is more uncertain because the inverter is on the vehicle itself. Consistent standards will be helpful in avoiding a patchwork of approaches to vehicle communication and control technologies, reducing the risk of stranded assets, and streamlining processes such as interconnection.*

There are certainly more technical issues with AC-based systems, as well as follow-on work needed on technical standards, commercial product development, design and production.

- V2G is not limited to a certain AC delivery format, and Level 1 is unlikely for V2G. SAE J3068 incorporates AC three-phase and higher voltage.
- The EVSE itself is a key functional component in the system
    - Functions required which are not capable of being performed with today's EVSEs and for which listing/standards are not established
- System must include
    - OEM vehicle system
    - EVSE system
    - Controls/comm: utility, home, etc.
- Same issues with utility/ISO system controls, cybersecurity

V2G AC Communication and Control Architecture – SCE and Partners in EPIC V2G OBI Project



EPIC V2G Project Objectives

- Assess and evaluate in a laboratory environment the proposed V2G-AC Rule 21 interconnection processes, anticipated SAE and UL standards, and the function of automaker OEM battery/inverter systems to support vehicle-grid integration (VGI) services
- Integrate with existing DOE V2G school bus project, and its Charge Ready Transport application, to provide an interconnection pathway by demonstrating functional requirements in the lab; evaluate deployed systems in Rialto.
- Demonstrate the secure integration of project 3rd party aggregators with SCE's Grid Management System (GMS)/DER Management Systems (DERMS) and the use of the Institute of Electrical and Electronics Engineers (IEEE) 2030.5 protocol.
- Demonstrate the use of EV battery systems to support other EV charging during grid outage conditions

Value: Customer Energy Choices

- Improve value of DERs to customers and grid by enabling load management capabilities and other services (e.g. volt/var support)
- Device-level integrated, interoperable controls that provide flexibility

Thank You

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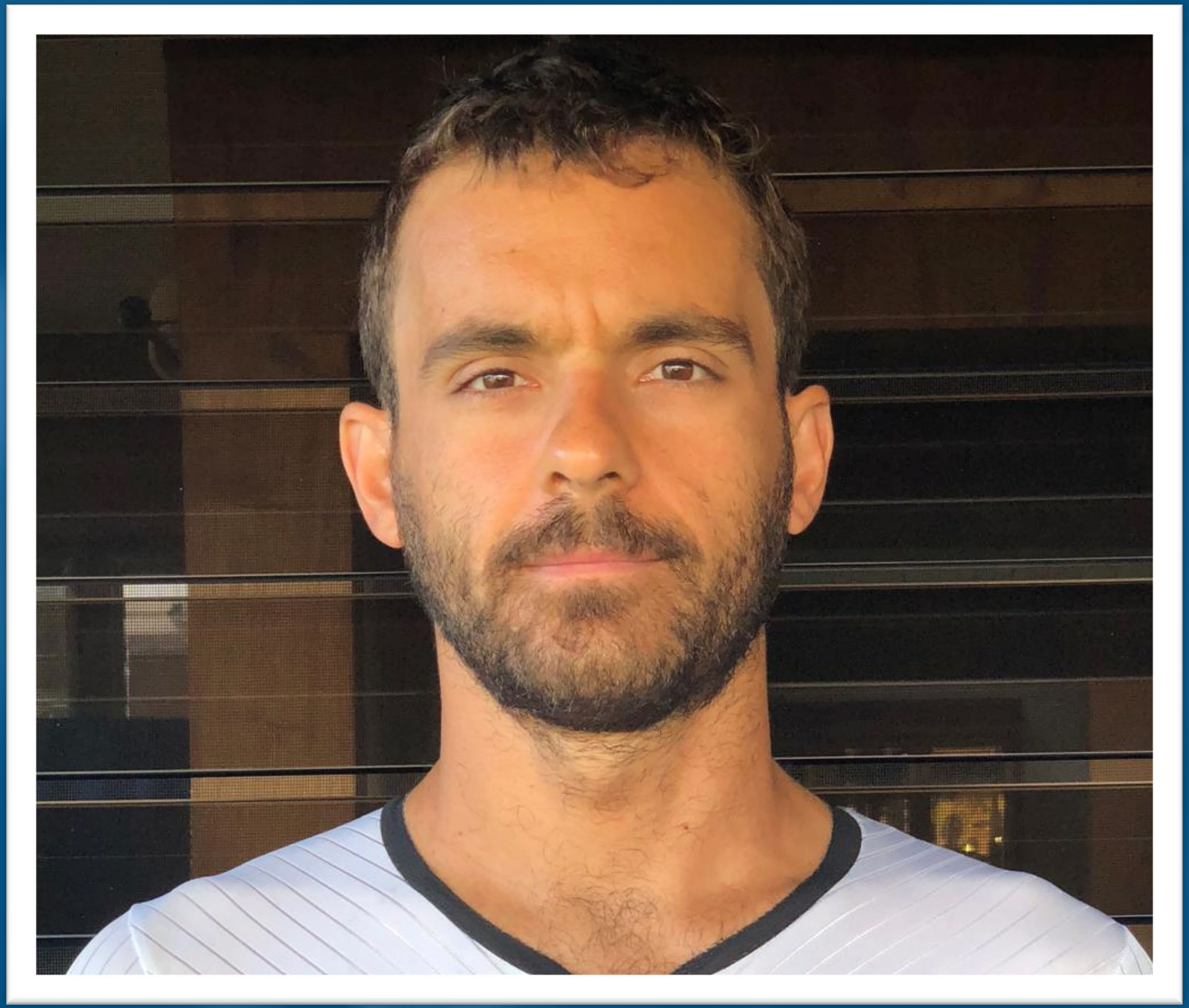

Gustavo Vianna Cezar,

SLAC National Accelerator Laboratory

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Workplace charging has potential benefits for supporting the grid, and can be the easiest to incorporate into managed charging.

Policymakers have focused extensively on ways to shift electric vehicle charging load in the middle of the workday to align solar generation, providing load when it is most beneficial for the grid.

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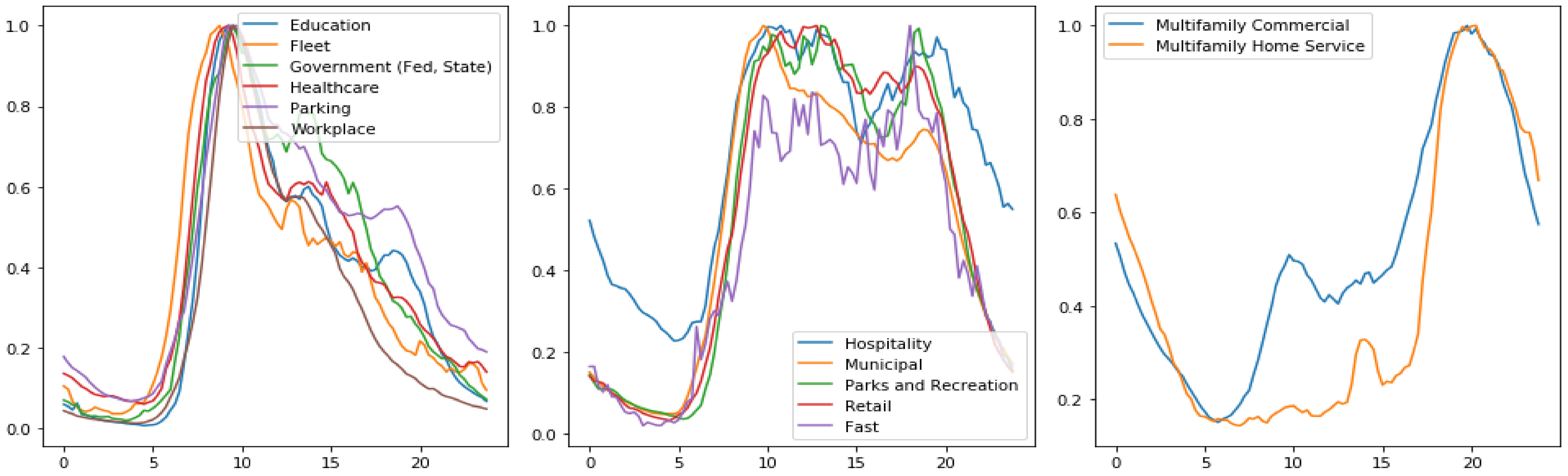
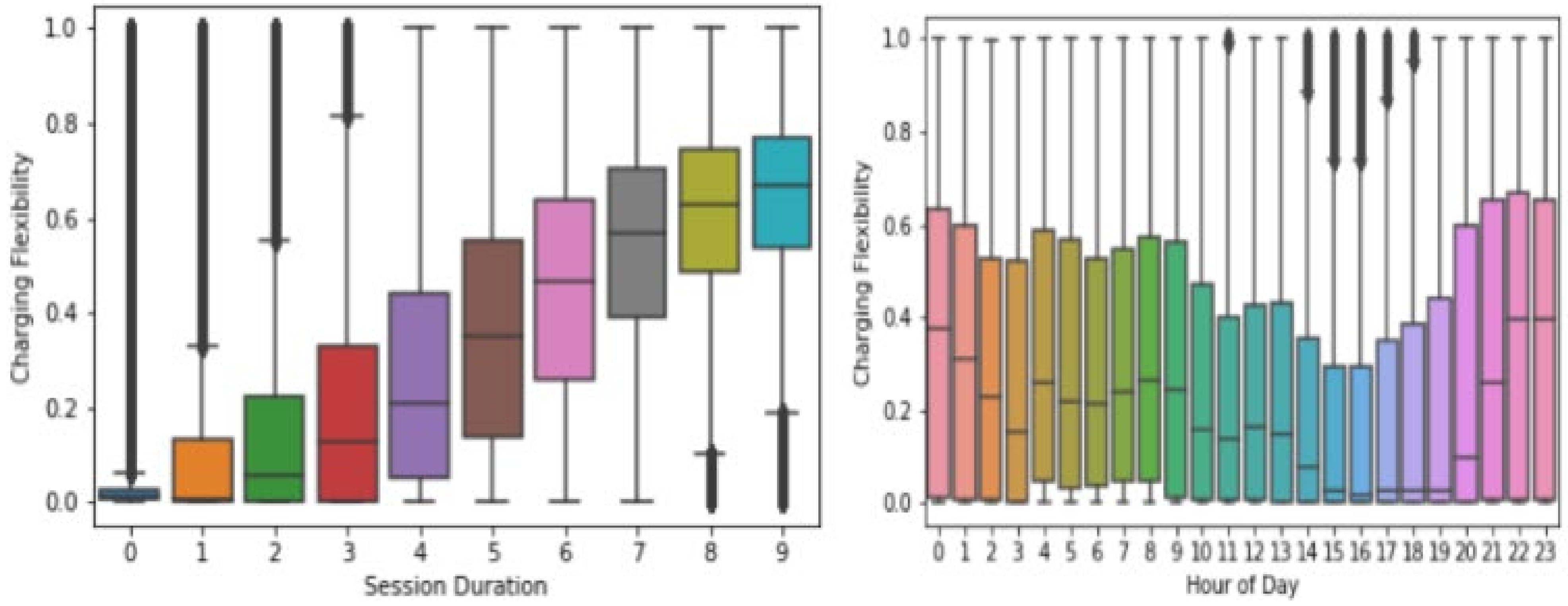
In order to manage charging, with the current state of technology, statistics are key.

Clustered segments

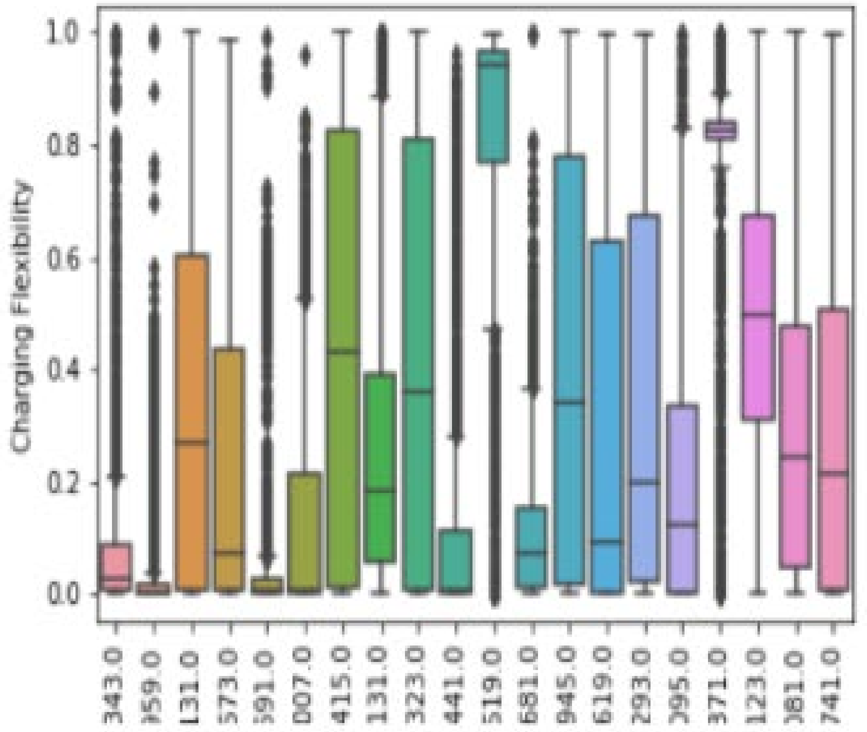


Charging Flexibility

Workplace



Individual drivers



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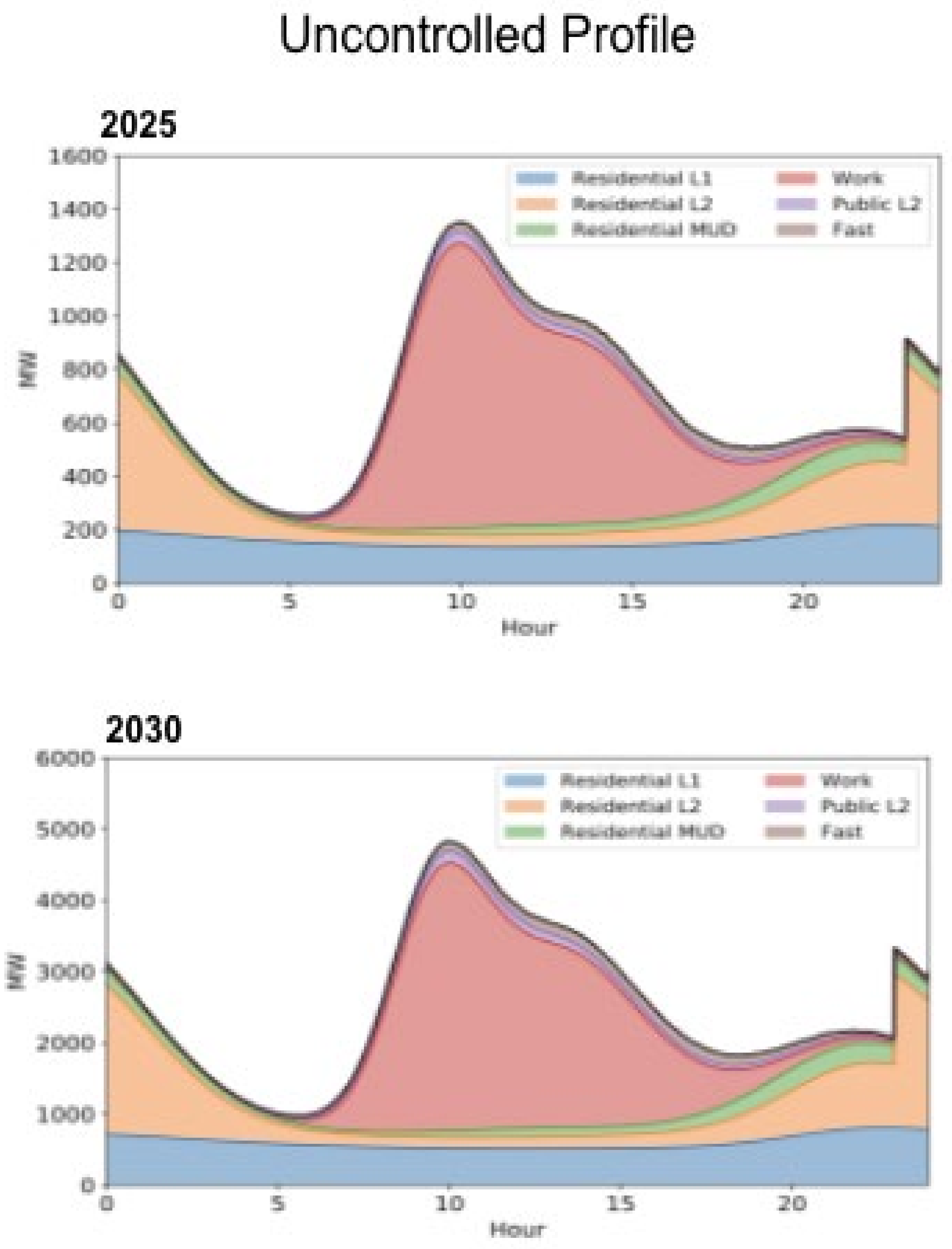

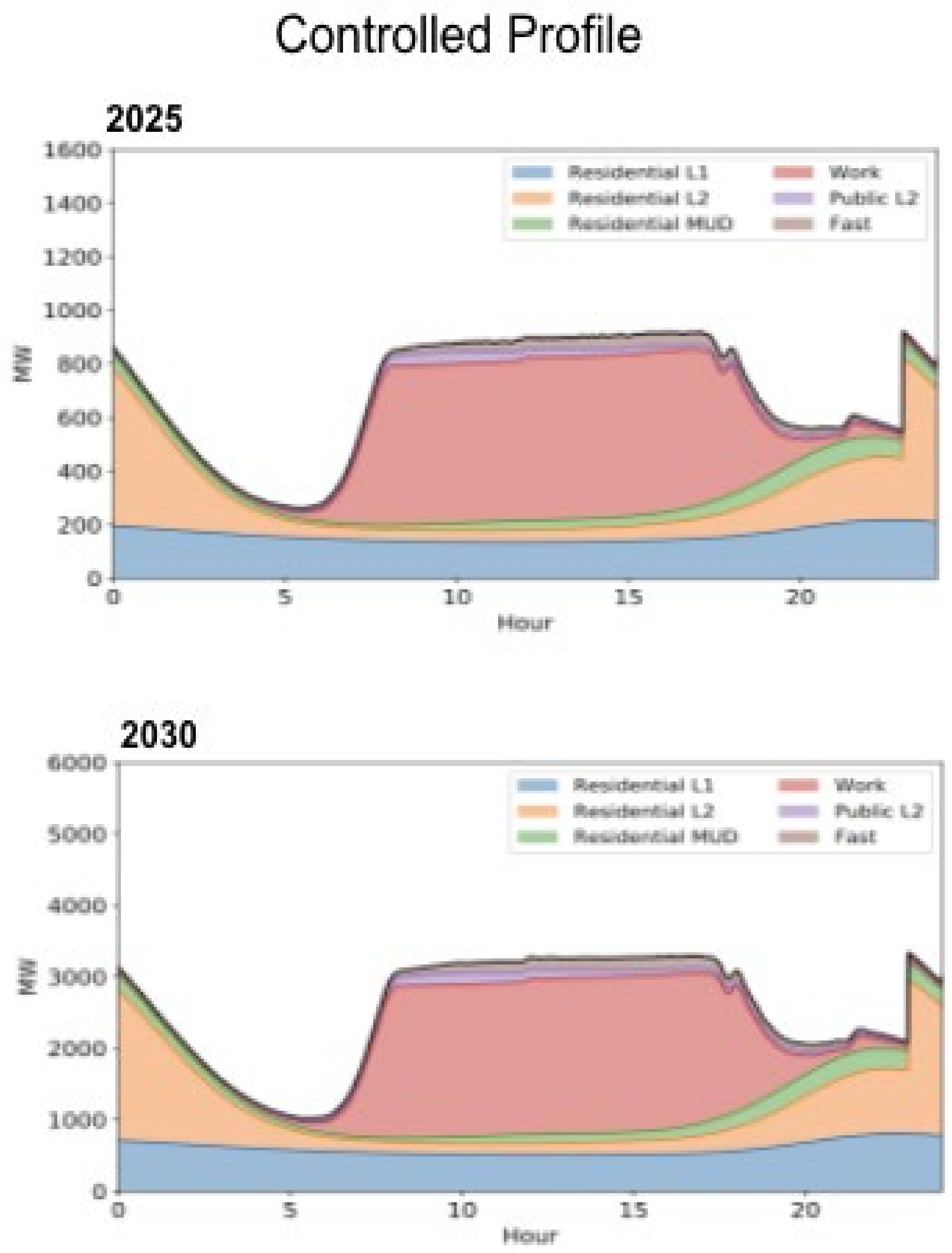

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Compiling large, anonymized EV datasets for the research community, utilities, solution providers, and policymakers can help plan for and optimize electric vehicle charging.

Understanding when, where, and how electric vehicle owners are actually charging their vehicles can drive more effective analysis, incentives, rate design, and other policies to optimize charging behavior and achieve greater consumer benefits, according to workstream panelists.

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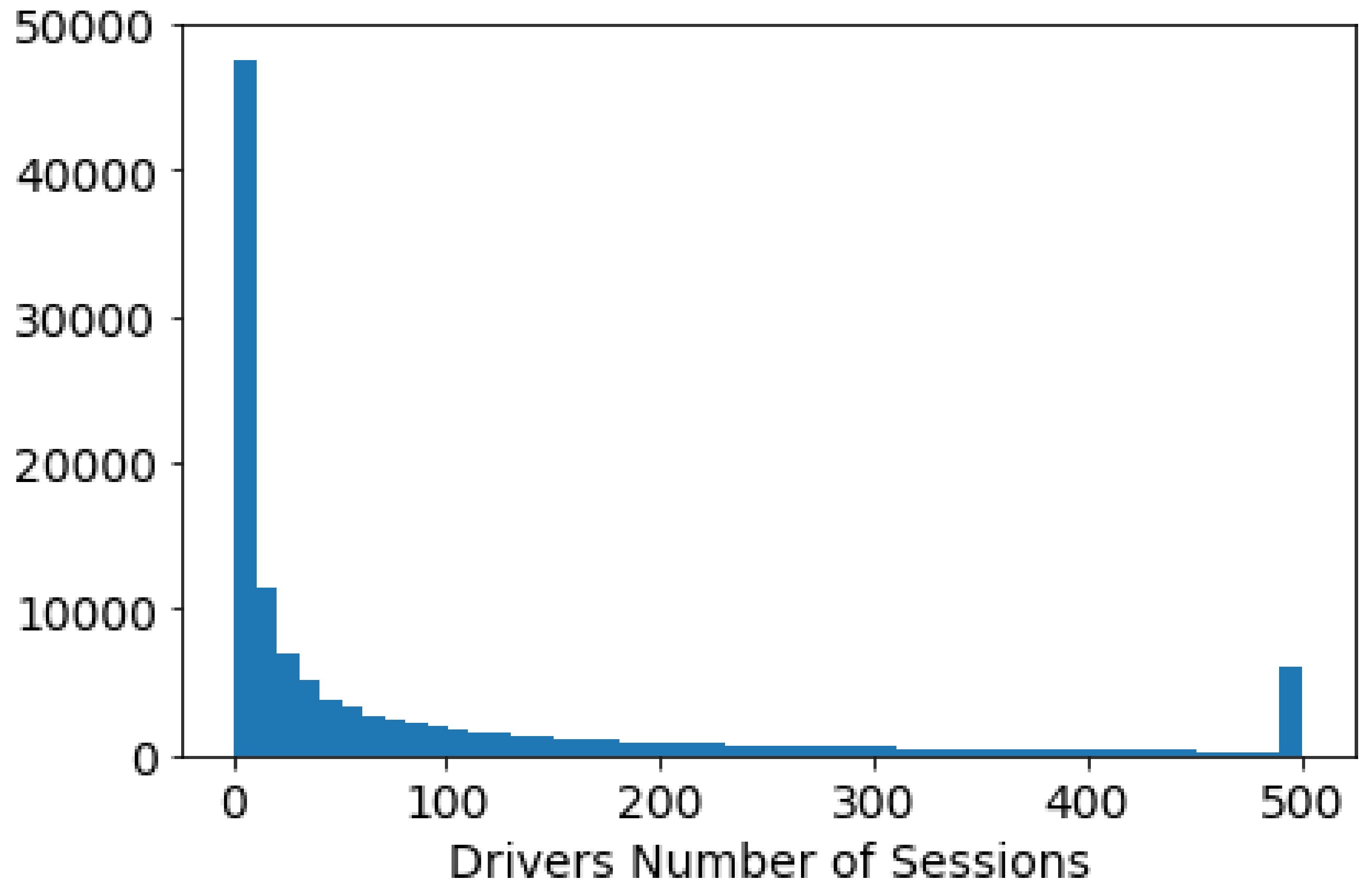
The need for compiling large EV charging datasets to better plan for the future

- Large EV charging datasets are not widely available to the research community.
- Lack of communication standards and data makes it difficult to obtain complete visibility of the system.
- It is difficult to obtain datasets that are heterogeneous and include multiple EVSE vendors and/or EV data.



Many drivers with very few number of sessions