

Transportation Electrification: New Technology Implications

U.S. Department of Energy Workshop Series
An EV Future: Navigating the Transition
August 13, 2020
Erika H. Myers

Clean + Modern Grid

Utility Business Models | Regulatory Innovation | Grid Integration | Transportation Electrification



Who Are We?



Smart Electric
Power Alliance

A membership
organization



Staff of ~50
Budget of ~\$10M



Based in
Washington, D.C.



No Advocacy –
501c3



Founded in 1992



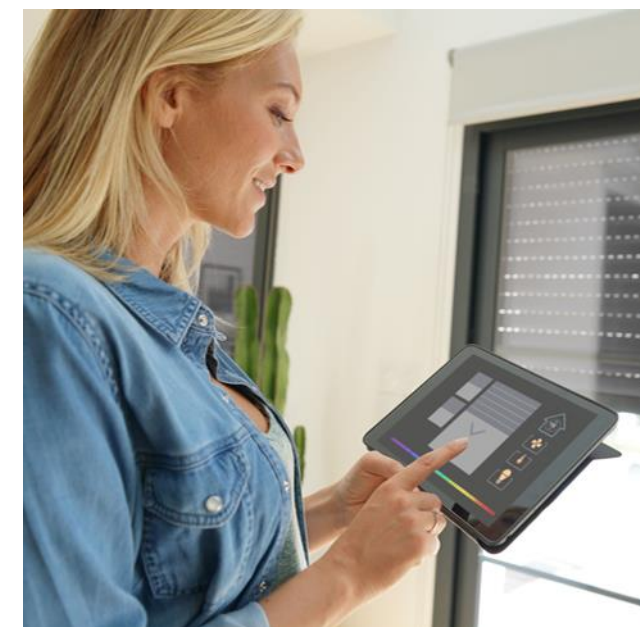
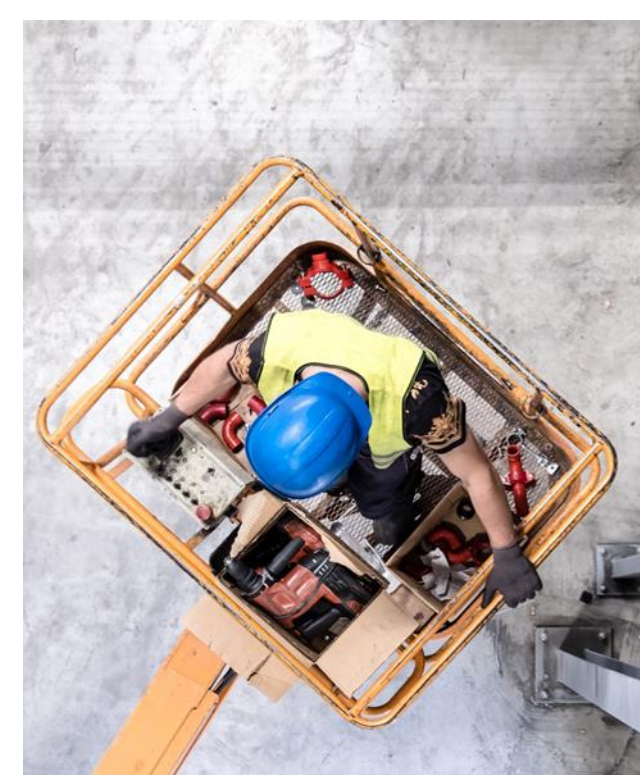
Research,
Education,
Collaboration &
Standards



Unbiased



Technology
Agnostic



Pathways



Utility Business Models

Utilities actively engaging in new technologies and partnerships for sustainable value creation, as both Integrators and Accelerants for a clean energy future.



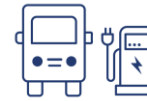
Regulatory Innovation

State regulatory processes to enable the timely and effective deployment of new technologies, partnerships and business models.



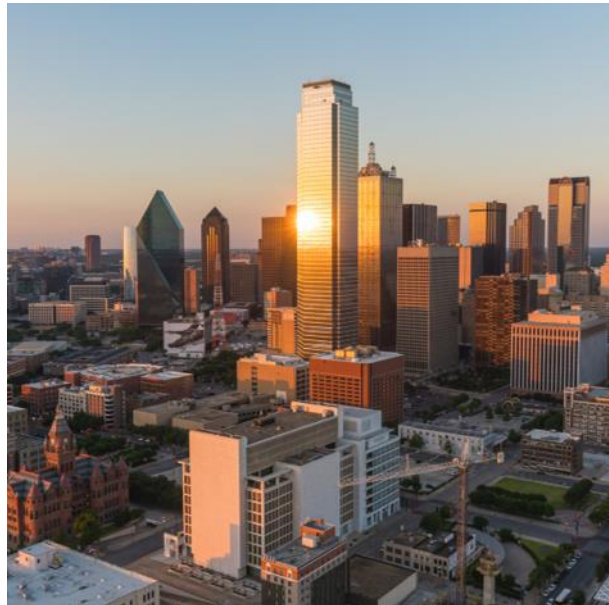
Grid Integration

Seamless integration of clean energy yielding maintained or improved levels of affordability, safety, security, reliability, resiliency and customer satisfaction.



Transportation Electrification

The nation's fleet of light, medium and heavy-duty vehicles powered by carbon-free electricity.



Leveraging advanced technology to support EV Infrastructure



1. Co-location of EVSE with DERs
2. DERMS for EVSE aggregation
3. AMI for Residential EV Rates
4. Active Managed Charging Technologies
5. Microgrids for Fleet Electrification



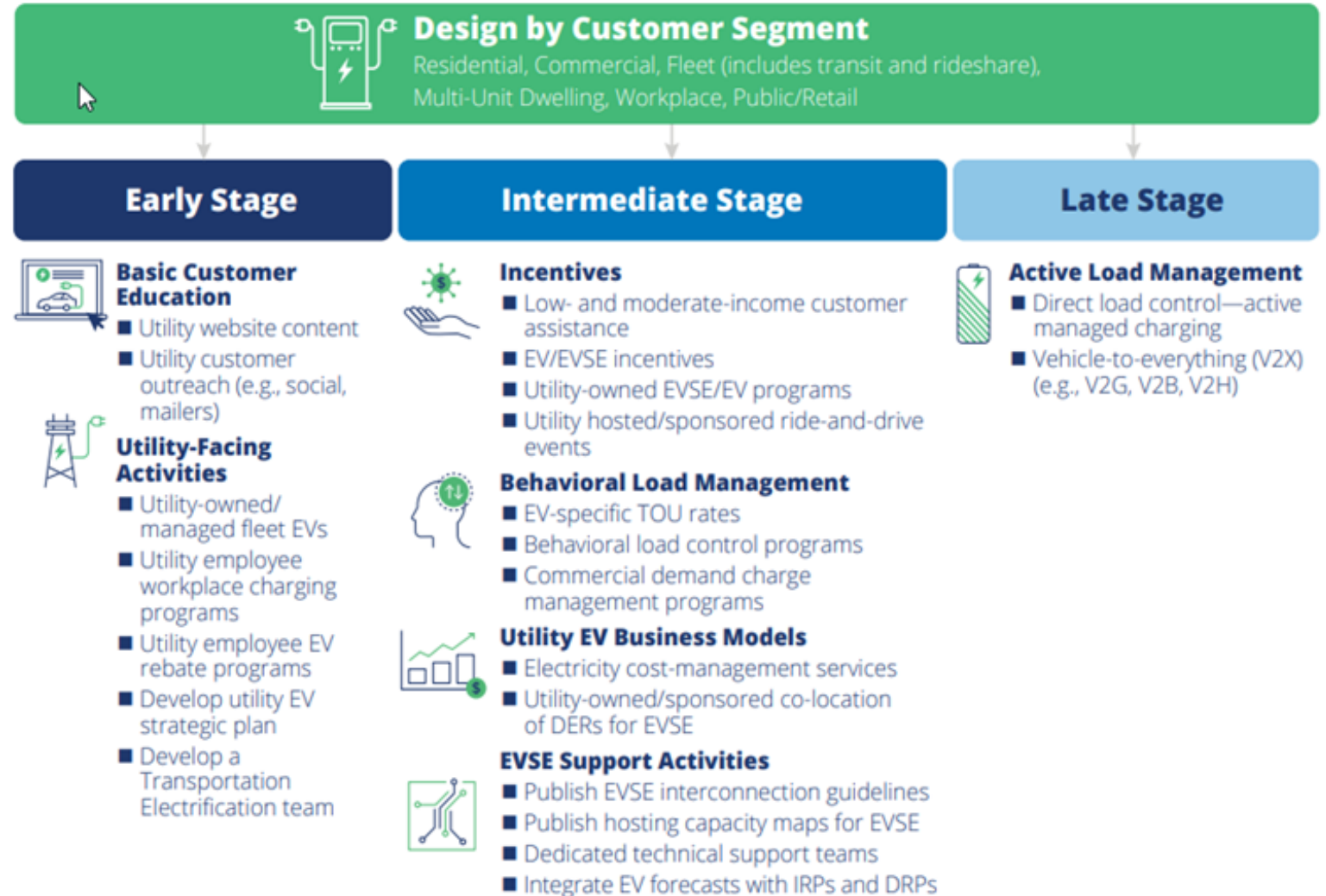


Co-location of EVSE with DERs

Utility EV Program Development: Walk, Jog, Run



- Transportation electrification will require a reimagining of how utilities provide power
- Utility programs will depend on EV penetration, local/regional constraints, program goals, and prioritization
- Load management and co-location of DERs are essential as EVs scale



Source: Smart Electric Power Alliance, 2020.

EVSE Challenge: Long lead times & high energy service upgrade costs

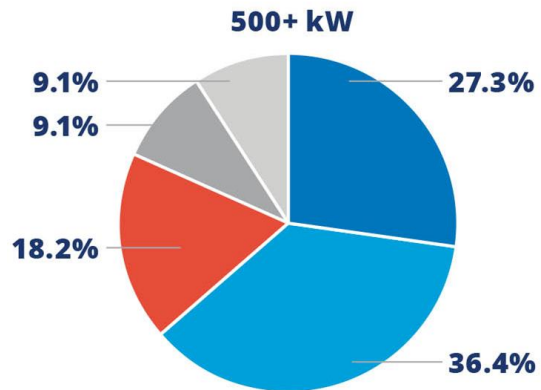
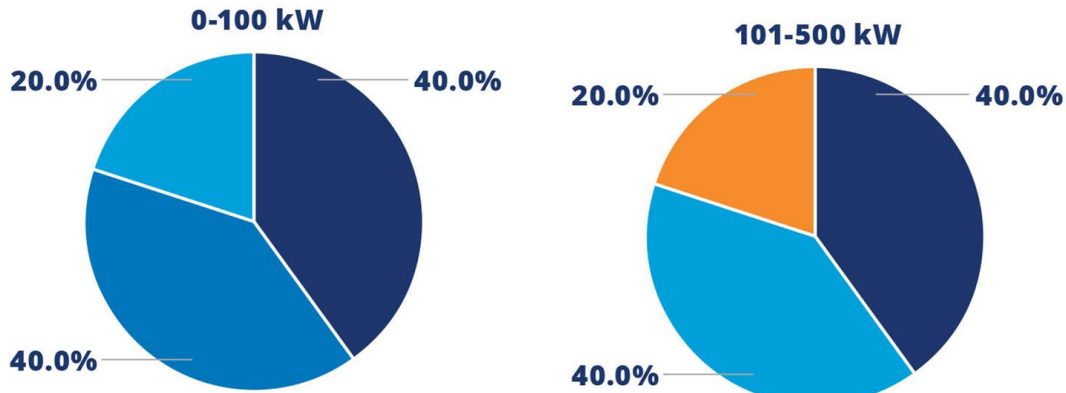


Table 3: Power Delivery Schedules

Potential Power Delivery Upgrades	What is Involved	Typical Ranges (Months)
No Distribution Circuit Upgrades (up to 1 MW)	Often, site loads below 1 MW can be supported with a new service transformer connected to the local distribution grid.	0-2
Supply Conductor Upgrade, No Grid Upgrades (up to 1 MW)	The supply conductor upgrade may require replacement to serve the increased load. The service transformer may also be replaced with a larger size.	0-2
Medium Voltage Service, No Grid Upgrade (up to 2 MW)	The manager may have to take primary service at medium voltage to allow for multiple service transformers (customer-owned) behind the meter if the site load exceeds standard service transformer and low voltage switchboard ratings (typically around 3,000 A).	0-5
Grid Upgrade Deployment: Re-conductor or New Line Equipment (over 1 MW)	The overhead or underground wire may require upsizing to increase the load capacity and improve voltage regulation on the feeder if the charging load overloads the distribution circuit.	6-36
Substation Upgrade: New Transformer Bank (over 10 MW)	An overloaded transformer bank is either replaced by a larger bank in the substation or an additional bank is added.	18-36
New Substation (over 20 MW)	A new utility or dedicated high voltage substation may be required for very large installations.	24-48

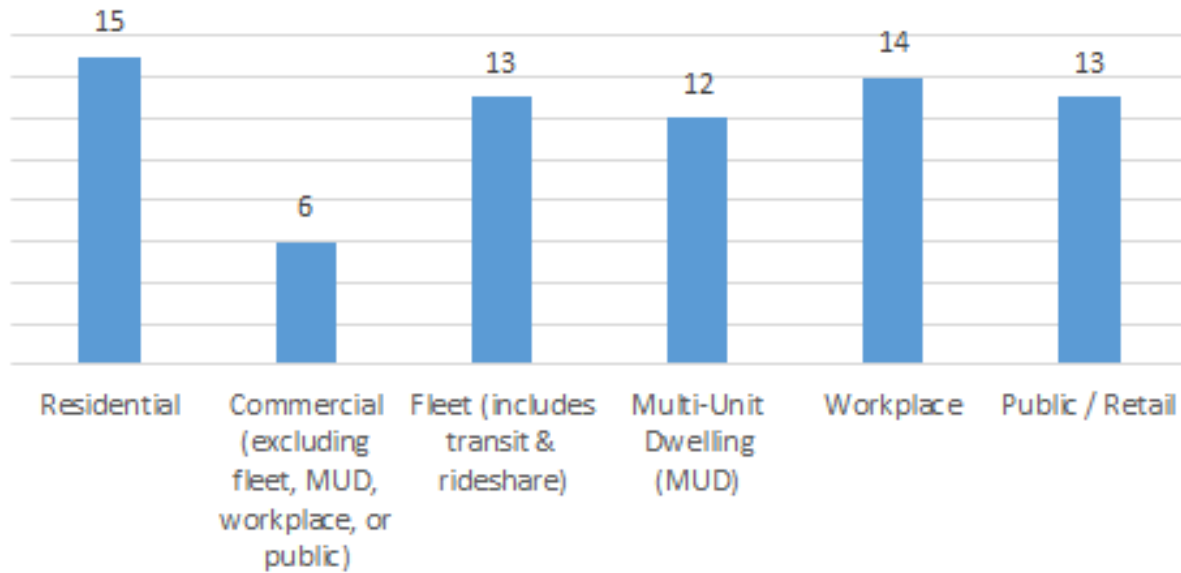
Source: Black & Veatch. 2019. Electric Fleets: 8 Steps to Medium and Heavy-Duty Fleet Electrification.²⁸

Note: Example ranges—all power delivery scenarios are specific to a location, feeder access, existing, in queue projects and utility operating/ power provisioning standards, and available land/ right of ways.

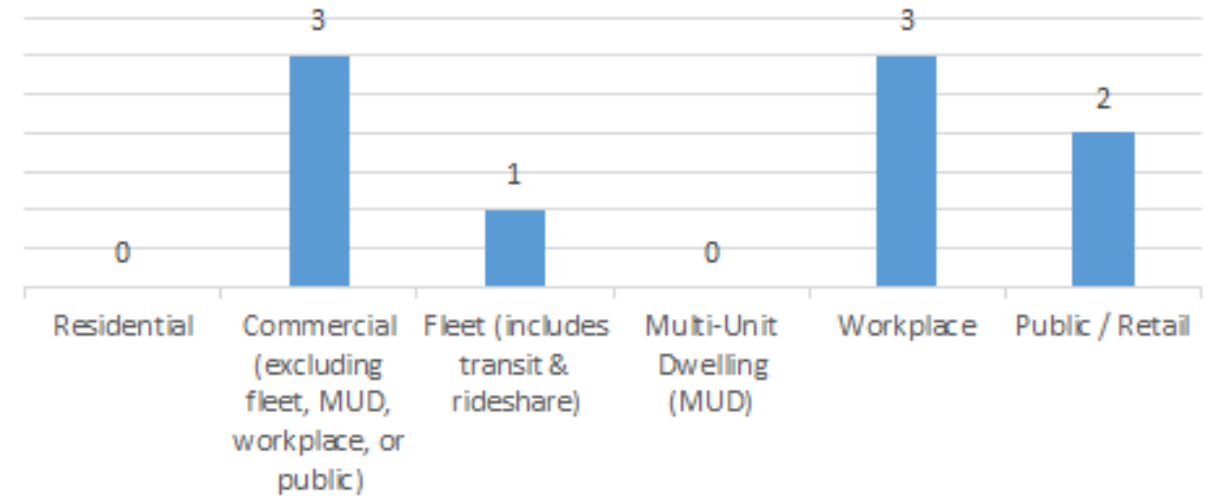


Consider new utility business models

Utilities with EV Electricity Cost-Management Strategies by Sector



Utilities with Owned/Sponsored EVSE Packages offering co-location of storage or other DERs by Sector



Source: Smart Electric Power Alliance, 2020. N=128
*Includes charging-as-a-service, DR/DSM, consulting services

Source: Smart Electric Power Alliance, 2020. N=128



DERMS for EVSE aggregation

Guidelines for Selecting a Communications Protocol for Vehicle-Grid Integration

Use Case 2: V1G Workplace Managed Charging

Other than the residence, the location with the longest EV dwell time is the workplace, where most charging occurs during the day. A potential benefit of workplace charging is to address the concentration of chargers in specific areas of the grid. Many V1G managed charging programs have focused on workplace or commercial deployments with similar networking and communications requirements.

In California, the investor-owned utilities proposed generous incentives for commercial customer use of shifting EV charging from the home to the workplace, eliminating the additional 50-hour evening ramp, and absorbing the excess energy produced during the day.

In both residential V1G use cases and workplace charging, a key requirement is data collection to measure and verify the overall impact and EV load generated. Most utilities and/or state regulators who provide incentives require data at the EVSE level as well as aggregated data at the site level (which is used to ultimately bill the site host for operational controls). Examples of operational controls include limiting the access to the chargers to certain diversions or limiting the duration of charging sessions/energy delivered per session.

The main applications of V1G managed charging at the workplace are load shaping and load shifting.

Workplace charging is controlled as defined by the Charge Ready pilot. In the Charge Ready pilot, the demand

ing and status of the EVSE. In a worst case, a tandem of electrical facilities, but the CCS use case for V1G and V2G.

ility can call on the user to follow the user manual protocol. This involves identifying the required and the protocols.

program or set of use communications architecture and

February 23, 2018, in CA California Energy Storage Alliance.

12 Southern California Edison "Transportation Electrification Program Advisory Council March 28, 2018"

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Smart Electric Power Alliance

Guidelines for Selecting a Communications Protocol for Vehicle-Grid Integration

August 2020

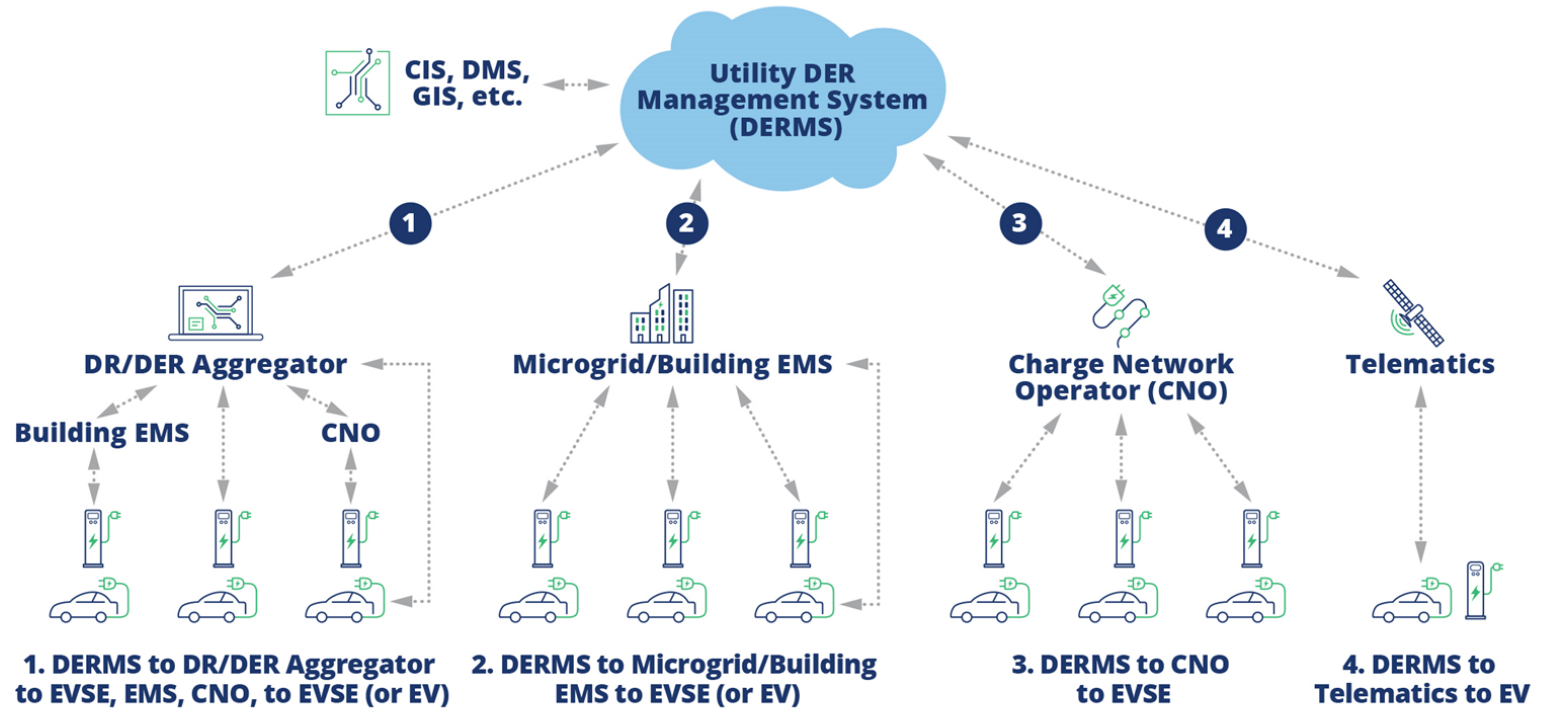
In Partnership with

KITU **QualityLogic**

EV aggregation via DERMS

- DERMS: A hardware and software platform to monitor and control DERs in a manner that maintains or improves the reliability, efficiency, and overall performance of the electric distribution system.

Figure 3: Grid to EV Communications Architectures

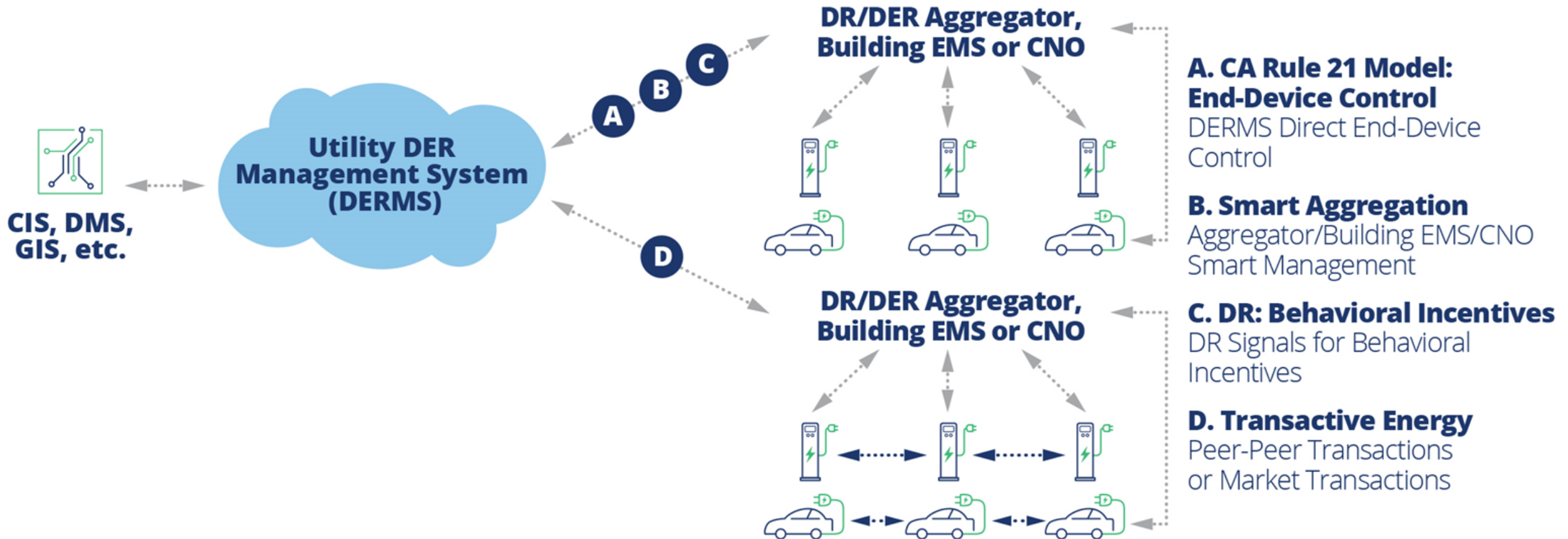


- **Distribution Utility:** determines grid requirements; specific device or Group DER settings; communicates to DER
- **DER/DER Aggregator:** receives grid requirements; specific device or Group DER settings; communicates to DER; monitors and reports to DERMS
- **Building EMS:** receives grid requirements; determines how to implement; reports results to DERMS
- **Charge Network Operator:** receives grid requirements; determines how to implement; reports results to DERMS

- **EV:** with off-board, on-board or split inverter, uni- or bi-directions, AC or DC
- **EVSE:** with off-board, on-board or split inverter, uni- or bi-directional, AC or DC
- **Telematics:** Vehicle Telematics System—receives grid requirements; determines how to use EVs to meet grid needs

EV Aggregation via DERMS (Cont'd)

Figure 4: Grid-EV Communications Architectures: Where Decisions Are Made



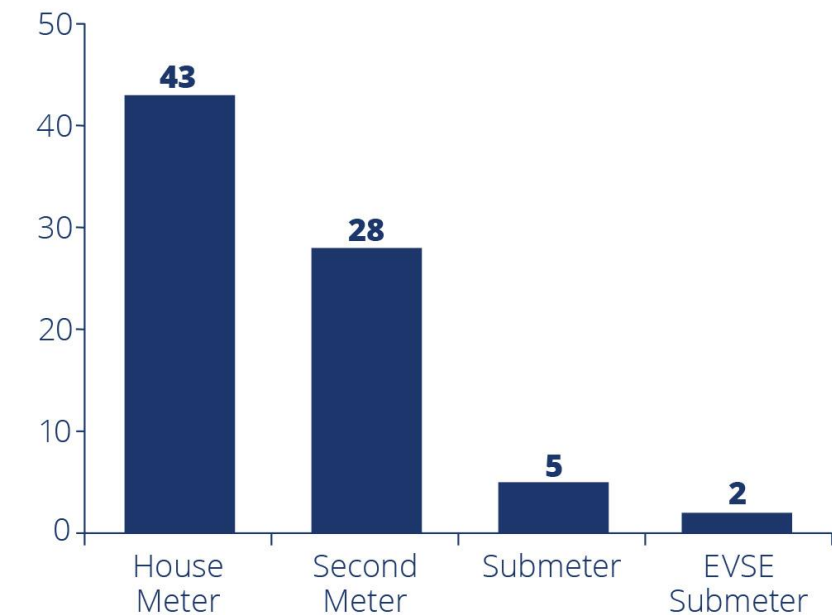


AMI for Residential EV Rates

Residential EV Rates: Metering Strategies



Figure 24: Metering Configuration for EV Rate Population



Source: Smart Electric Power Alliance, 2019. N=64
 Note: The authors did not identify AMI vs. non-AMI meters.

Table 7: Pros and Cons of Different Metering Approaches					
	Existing Meter	Secondary Meter	Submeter	EVSE Telemetry	AMI Load Disaggregation
Ability to Meter EV Charging Separately	No—Does not separate the EVSE from rest of load	Yes	Yes	Yes—Accuracy for billing purposes depends on EVSE manufacturer	Yes—Accuracy depends on ability to identify unique kW signature of EVSE
Utility Bill Integration	Easiest to integrate	Easiest to integrate	Easier to integrate	Difficult to standardize among multiple vendors and retroactively integrate into billing system; data via AMI backhaul more accurate	Depending on the format of the disaggregated data, may not integrate
Consumer Participation Cost	No additional cost	Depending on tariff, no up-front cost to consumer, or consumer pays for the full cost	Depending on tariff, no up-front cost to consumer, or consumer pays for the full cost	No additional cost if consumer already purchased the equipment; potential additional cost for compatible EVSE	Depending on tariff, some cost for administration, third-party costs, or equipment
Volume of Eligible Customers with AMI	Highest— independent of EVSE type	Highest— independent of EVSE type	Highest— independent of EVSE type	Limited to eligible EVSE vendors	Highest— independent of EVSE type

A COMPREHENSIVE GUIDE TO ELECTRIC VEHICLE MANAGED CHARGING

spikes during off-peak hours. At the same time, managed charging can smooth unimodal TOU timer peaks. Avoiding grid upgrades is potentially an even more significant value for utilities. Even during the early days of EV deployment, researchers with The EV Project identified the "clustering" trend, in which multiple EVs connected to a single distribution transformer caused strain on the equipment.⁸¹ In some areas, this impact is even more pronounced today, leading to a risk of triggering costly upgrades to distribution equipment. More EV owners

UTILITY INTEREST IN MANAGED CHARGING

Given this projected growth in EVs and charging infrastructure, it is not surprising that utilities are evaluating managed charging. In fact, 38 utility-run managed charging pilot and demonstration projects were identified at the date of publication (see Appendix A). Of these projects, the majority (25) were actively available to customers, while one-third were implemented as pilot or demonstration projects that are now complete and in various stages of evaluation or review. The projects were segmented between load control via the charging device, load control via the vehicle, and behavioral load control as shown in Figure 2. The most popular type of managed charging project at the date of publication is load control via the charging device, representing 71% of

are installing L2 chargers at home that have demands of 7.2 kW and higher. Seeking to mitigate these costs, a Sacramento Municipal Utility District (SMUD) report found that managed charging reduced almost cost impacts of higher residential charging loads up to 19.2 kW, potentially saving significant transformer upgrades.⁸² The impact to try is expected to be highly dependent on the design, capacity, age, other customer loads, degree of clustering and overlap of EV char-

the total projects. This trend appears like a higher percentage of surveyed utilities load control via the charging device (see Figure 2). Load control via automaker telematics is a stage of implementation and has very few projects—the majority of those identify behavioral load control largely include the on-board diagnostic port (OBD-II) to vehicle behavior and provide incentive charge during off-peak hours.

To gain additional clarity about utility charging programs, SEPA administered a Response Survey between January and February 2019. 53% were interested in

demand response programs and only 26% expressed no interest (aggregated results from managed charging via charging infrastructure and automaker telematics). The survey revealed more utility interest in direct load control via the charging infrastructure than through

Utilities were also asked how they were using, or planned to use, managed charging as shown in Figure 3. The most common planned use was to avoid higher cost periods of energy (22%), followed by helping their customers manage their energy use (17%) and increasing customer engagement (20%). These options do not represent an "either-or" choice if managed charging is to be a feasible "win-win" scenario. Managing charging to avoid high

FIGURE 2: UTILITY-RUN MANAGED CHARGING PROJECTS BY TYPE AND STAGE, UNITED STATES, 2015-2019

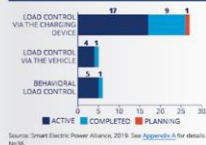
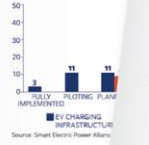


FIGURE 3: UTILITY INTEREST IN CHARGING PROGRAMS BY TIC



81. The EV Project, 2018, What Clustering Effects Have Been Seen by The EV Project? <https://evpilot.org/sites/default/files/2018/08/01/Clustering-Effects-Report-2018.pdf>
 82. SEPA, April 2017, Utilities and Electric Vehicles: The Case for Managed Charging and SEPA, Black & Veatch, and District, May 2017, Beyond the Meter: Planning the Distributed Energy Future, Volume II: A Case Study of Smart Metering Utility Districts.

A Comprehensive Guide to Electric Vehicle Managed Charging

MAY 2019

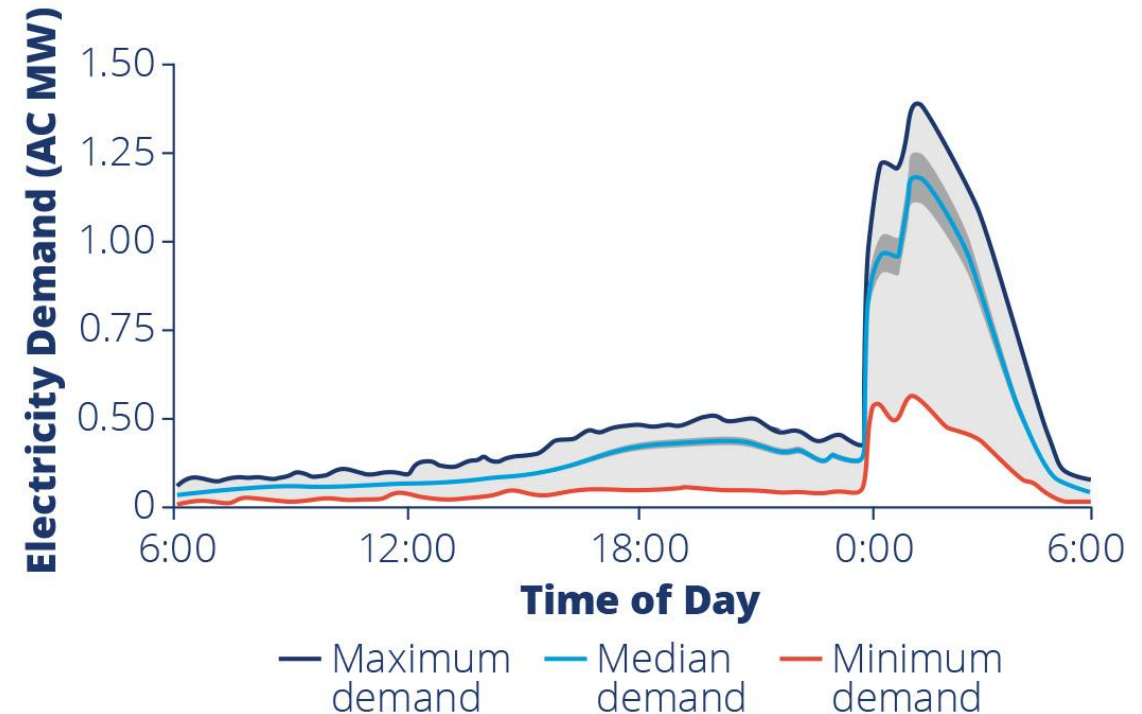


Active Managed Charging Technologies

Active Load Management Strategies

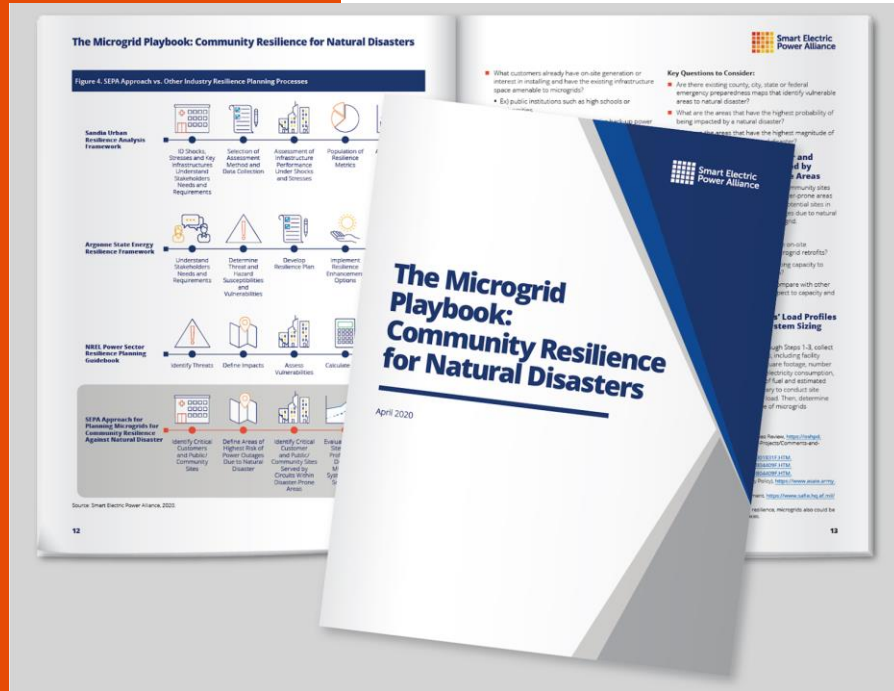
- Vehicle Telematics
- EVSE
- Building Energy Management System (Adaptive Load Management)/ Microgrids
- On-board diagnostic interface (OBD-II port)
- Smart circuit breakers/ smart panels
- Smart plugs
- Meter collars
- Distributed ledgers/ transactive energy

Figure 3: Illustration of San Diego Gas and Electric Weekday “Timer Peak”



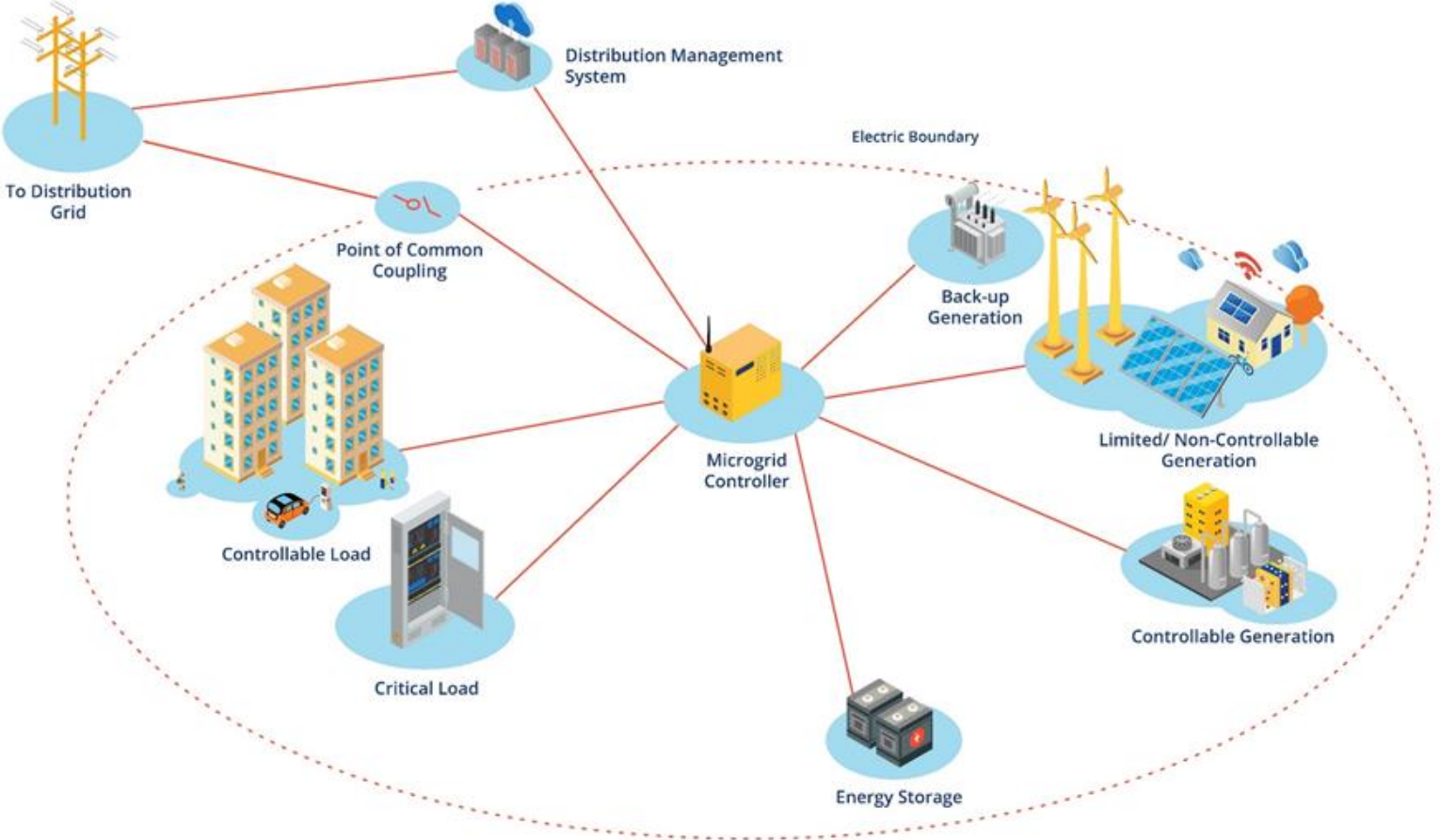
Source: MJ Bradley & Associates, 2017²⁴

Note: This is a rendition of the original graphic.

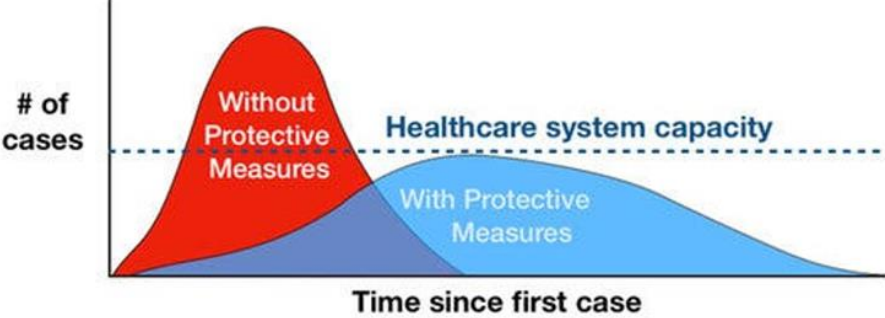


Microgrids for Fleet Electrification

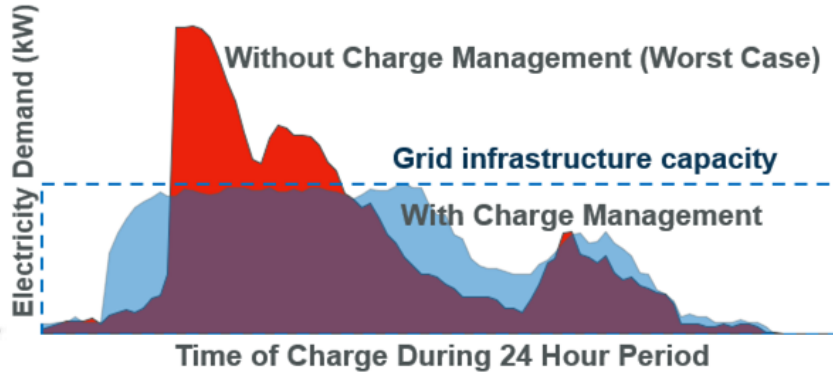
Resilience, Reliability, and Demand Charge Management



COVID-19 INFECTION RATE CURVES



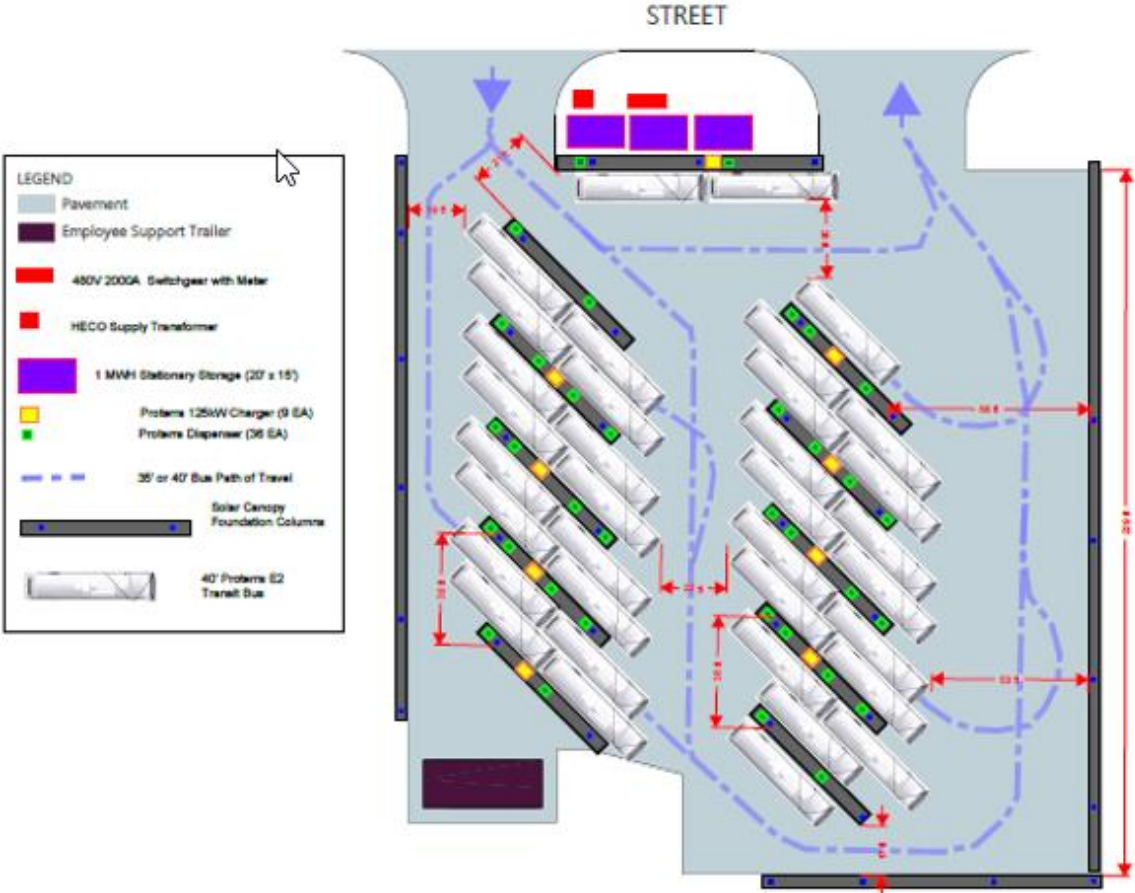
FLEET CHARGING ENERGY CURVES



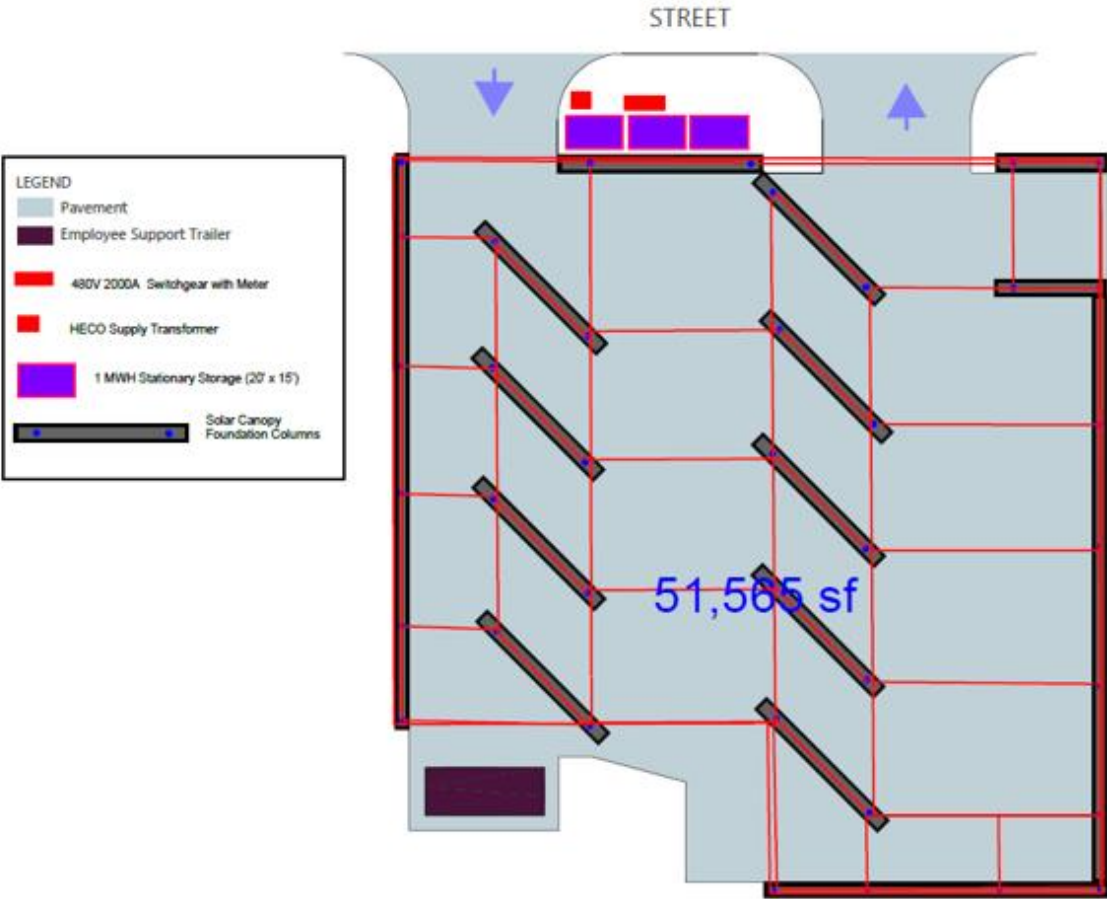
Source: Smart Electric Power Alliance, 2020.

Proterra: Bus Depot Modeling

Bus Depot Space and Charging Layout



Microgrid Solar and Storage Layout



Source: Proterra, 2020.

Working Groups



Collaborative teams
of member SMEs
addressing important
industry issues



 Smart Electric
Power Alliance



Community Solar



Customer Grid
Edge



Cybersecurity



Electric Vehicles



Energy Storage



Grid Architecture



Microgrids



Testing and
Certification



Transactive Energy
Coordination



Erika Myers
Principal, Transportation
Electrification
emyers@sepapower.org
202.379.1615

HEADQUARTERS

Smart Electric Power Alliance
1220 19th Street, NW, Suite 800
Washington, DC 20036-2405
202.857.0898

