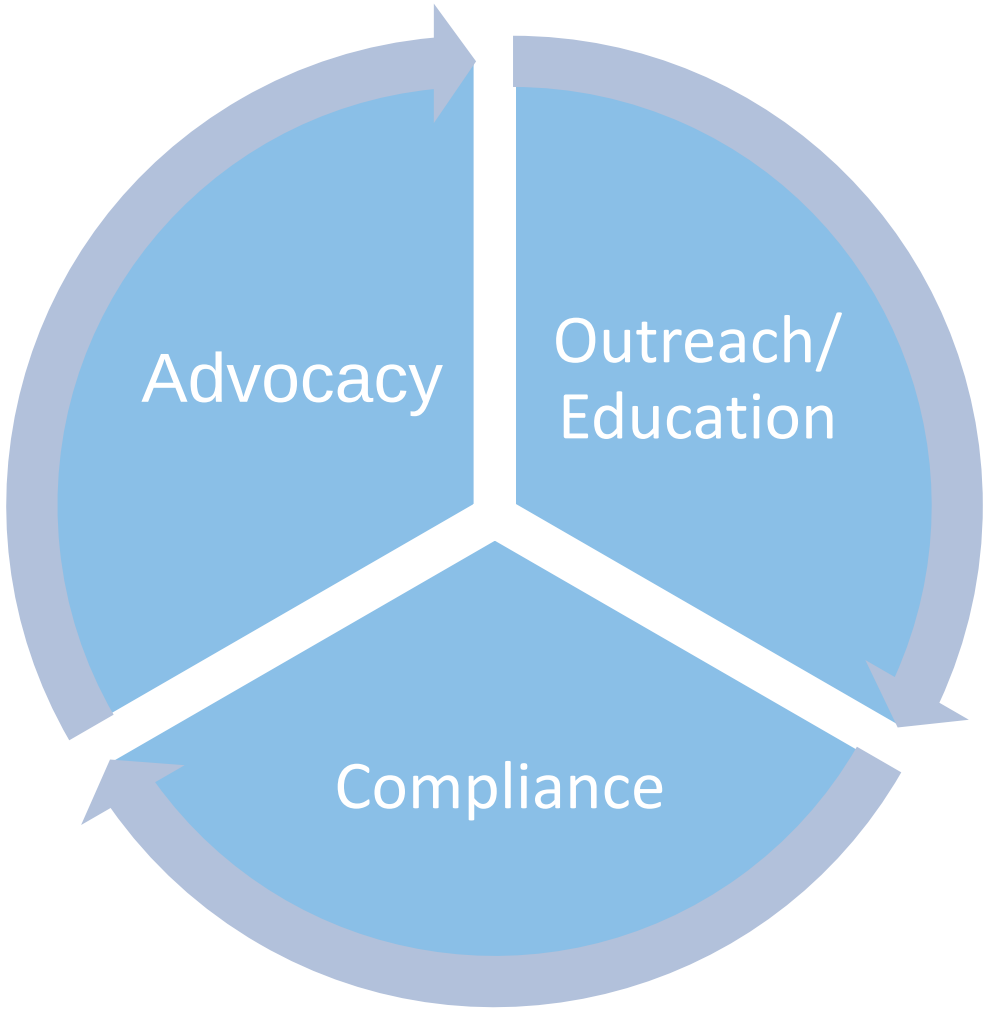
California Transit Association

Zoom to Zero: Best Practices for EV Infrastructure

(Co-Hosted by CALSTART)

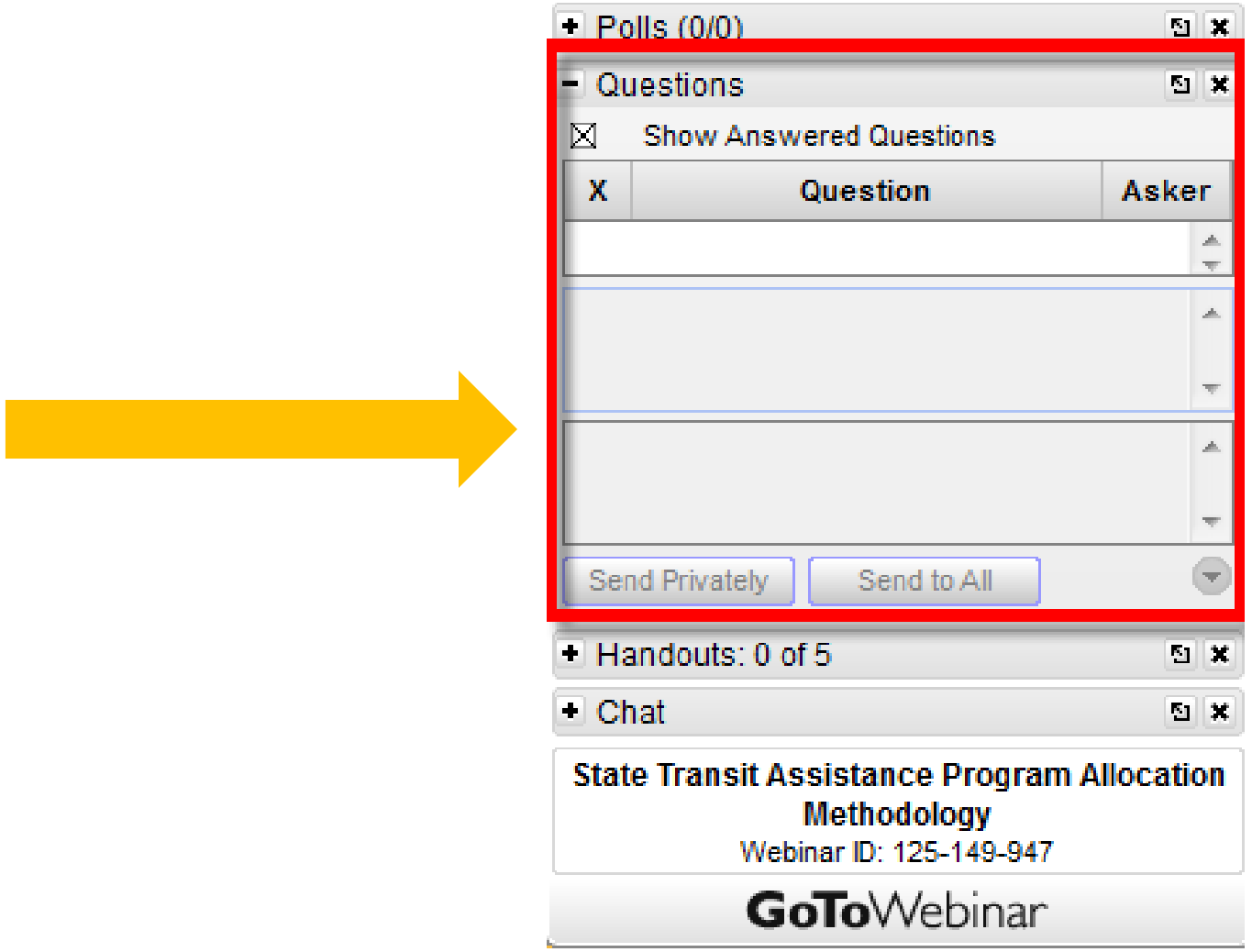
September 25, 2019

Support for ICT Regulation Implementation



How to Ask Questions

- Submit your questions anytime during the program using the Questions module in your webinar control panel at the right of your screen.
- We will collect all questions and get to as many as time permits during the Q&A portion of the program.



Your Guidance Tool for
→ ZEB Infrastructure Planning

Alycia Gilde, Director of Fuels and Infrastructure
CALSTART
agilde@calstart.org
Wednesday, September 25, 2019

OVERVIEW

- About CALSTART
- Infrastructure Barriers
- Important Considerations
- Your Check List
- 5 - Smart Planning Steps

CALSTART's 220 + Member Companies and Organizations

Changing Transportation for Good

CALSTART – A National Non-Profit Organization

9 Offices (Six Regional Offices + Four Field Offices)

California

- **3 offices**
- **2 field offices**

Challenges for Electric Bus Deployment

- ❑Deployment Lead Time
- ❑Costly Upgrades
- ❑Permitting
- ❑Space Constraints
- ❑Demand Charges
- ❑Lack of Technical Assistance

Infrastructure remains to be the Biggest Barrier to ZEB Deployment!

Infrastructure Planning Considerations

- ❑ Anticipate potential scaling needs.
- ❑ Infrastructure costs do vary.
- ❑ Begin working with your utility now.
- ❑ Evaluate EV rates and demand charges potential.

EV Infrastructure Planning Tool for Transit

INFRASTRUCTURE PLANNING TOOL
A Transit Fleet's Guide to Successful Electric Bus Charging

Going Electric

Are you a transit fleet? Have you thought about moving your fleet towards electrification? Or, have you already decided to go electric? If so, hold the brakes! Before you choose your electric bus technology and begin the procurement process, you must first assess your infrastructure needs to successfully deploy an electric bus fleet. This tool will help you get started by providing quick and simple guidance on the planning that is required to implement electric charging at your bus depot.

Infrastructure First

In California and throughout the United States, transit fleets are moving towards electrification to reduce emissions, improve efficiency and seek the operational benefits of an electric bus fleet. Though technology has advanced, and fleets are realizing the business case of an electric bus fleet, infrastructure remains to be the biggest barrier to technology adoption. Infrastructure challenges such as deployment lead time, costly upgrades, space constraints, and demand charges are impacting a fleet's ability to effectively own and operate an electric bus fleet. When going electric, infrastructure planning must come first!

Infrastructure Planning Check List

Before you get started with planning your electric charging infrastructure, make sure you are prepared to know the following and soon, you'll be ready to go!

- Fleet Deployment Goals
- Project Team (Internal & External)
- Utility Point of Contact
- Staff Electrical Engineer (or External)
- Estimated Project Timeline
- Capital Budget for Project
- Available Battery Electric Bus Technologies
- Electric Vehicle Supply Equipment Options
- Smart Charging Software & Networking
- Available Incentive Programs
- Permitting Requirements
- Understanding of Contracting Process

Important Considerations to Infrastructure Deployment

Until you have completed the infrastructure planning process, there are number of unknowns that will need to be evaluated to best determine your electric bus fleet deployment plan. For instance, though a transit fleet may initially demonstrate a few electric buses to determine fleet and operational suitability, it is critical to anticipate potential scaling needs in case a fleet transitions from 10 to 100 electric buses. Secondly, depending on fleet size, bus technology, charging equipment, access to the grid and power demand, infrastructure costs can vary with factors such as required utility upgrades, trenching and laying down conduit, and additional energy storage. Third, working with your utility from the onset of the planning process is critical to understand potential build out requirements, cost and development timelines. Lastly, working with your utility to evaluate electric vehicle rates and potential demand charges are important to avoid high charging costs while operating an electric bus fleet.

An Infrastructure Decision Tree for Transit Fleets
Five Smart Steps to Plan for Electric Bus Charging

Step 1: Consideration of Electric Bus Deployment

- Engage your utility, identify needed technical support, and obtain a new service request form.
- Confirm charging requirements, needs and costs from vehicle manufacturer and EVSE supplier.
- Determine fleet scaling potential.

Engage Utility

- Evaluate existing infrastructure programs.
- Determine EV rate structure.
- Plan charging times.
- Evaluate load sharing options.
- Understand utility application requirements.

Technical Support

- ID Electric Engineer (Internal or External)
- Evaluate options for contractor support.
- Build partnership between OEM, EVSE supplier, utility, engineer and fleet and operational staff.

Step 2: Bus Fleet Electrification

- Plan for phasing and timeline for deployment.
- Perform system modeling and understand bus duty cycles and projected energy needs (daily kWh, charging times and speed).

Step 3: Depot Yard Analysis

- Evaluate site infrastructure and utility grid infrastructure needs.
- Identify space availability.
- Evaluate charging/renewable energy options.

- Evaluate additional energy requirements, microgrids, energy storage & smart charging software.

Step 4: Development of Charging Schedule

- Identify charging hardware.
- Develop charging schedule (best window for charging).

Step 5: Development of Electric Service Plan

- Detail requested service voltage and load schedule.
- Identify service drop and transformer locations.
- Develop conceptual electric single line diagram.
- Determine costs for design, site works and installation

- Obtain permits.

Deployment Timeline

It is important that you factor in the time it will take to plan, develop and deploy your electric charging infrastructure. Full deployment can take up to 1 – 4 years based on fleet size and needed upgrades. The timeline below is based on deployment best practices.

PLANNING: Steps 1- 5
3 – 12 Months

DEVELOPMENT: Electric Upgrades and Construction
6 – 48 Months

DEPLOYMENT: Integrating Electric Buses
1 - 3 Months

Contact CALSTART for infrastructure planning assistance! www.calstart.org

Your Infrastructure Planning Check List

- ✓ Fleet Deployment Goals
- ✓ Project Team
- ✓ Utility Point of Contact
- ✓ Staff Engineer (External)
- ✓ Estimated Project Timeline
- ✓ Capital Budget for Project
- ✓ Available Zero Emission Bus Options
- ✓ Charging and Fueling Options
- ✓ Available Incentive Programs
- ✓ Permitting Requirements
- ✓ Codes and Standards

5 Smart Steps to Infrastructure Planning

1. Consideration of Electric Bus Deployment
2. Bus Fleet Electrification
3. Yard Depot Analysis
4. Development of Charging Schedule
5. Development of Electric Service Plan

Step 1: Consideration of Electric Bus Deployment

- Engage your utility, identify needed technical support, and obtain a new service request form.
- Confirm charging requirements, needs and costs from vehicle manufacturer and EVSE supplier.
- Determine fleet scaling potential.
- Communicate early plans with local utility.

Step 2: Bus Fleet Electrification

- Plan for phasing and timeline for deployment.
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- Evaluate existing infrastructure programs.
- Determine EV rate structure.
- Plan charging times.
- Evaluate load sharing options.
- Understand utility application requirements.

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Transit Agencies: How to work with your utility to deploy EV Bus fleets

Andrew Papson, Advisor, eMobility

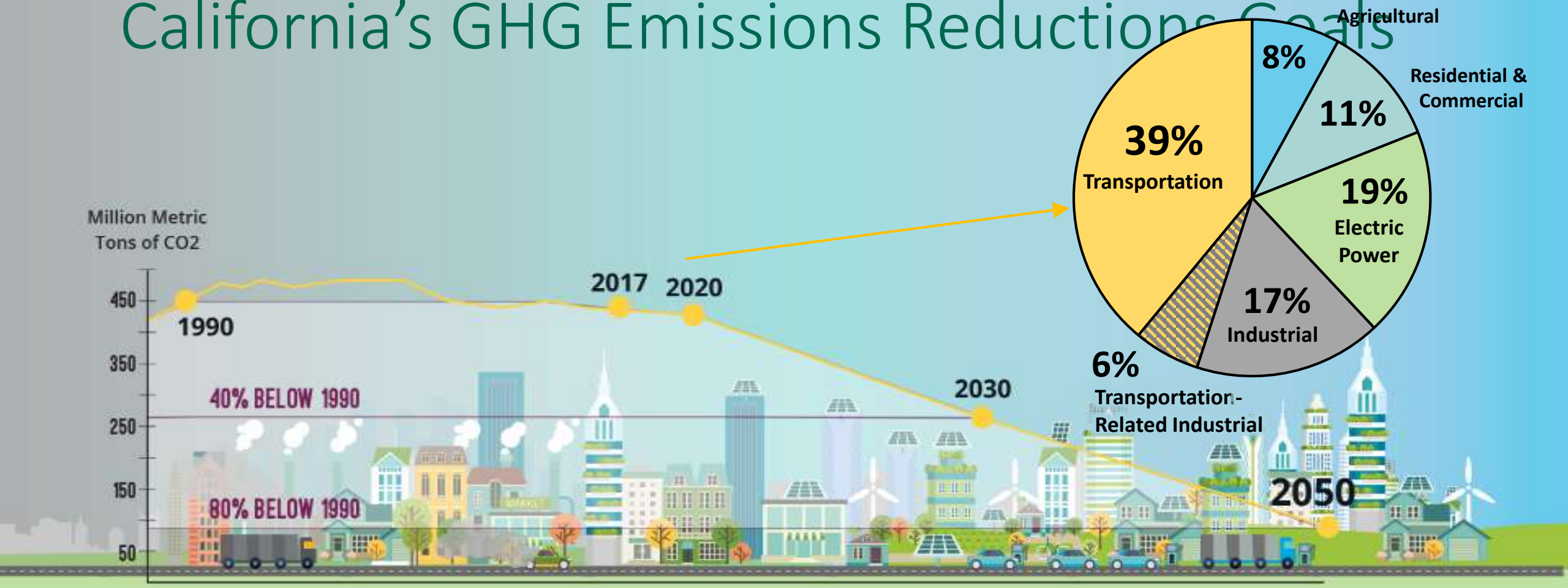
Southern California Edison

September 25, 2019

Energy for What's Ahead℠

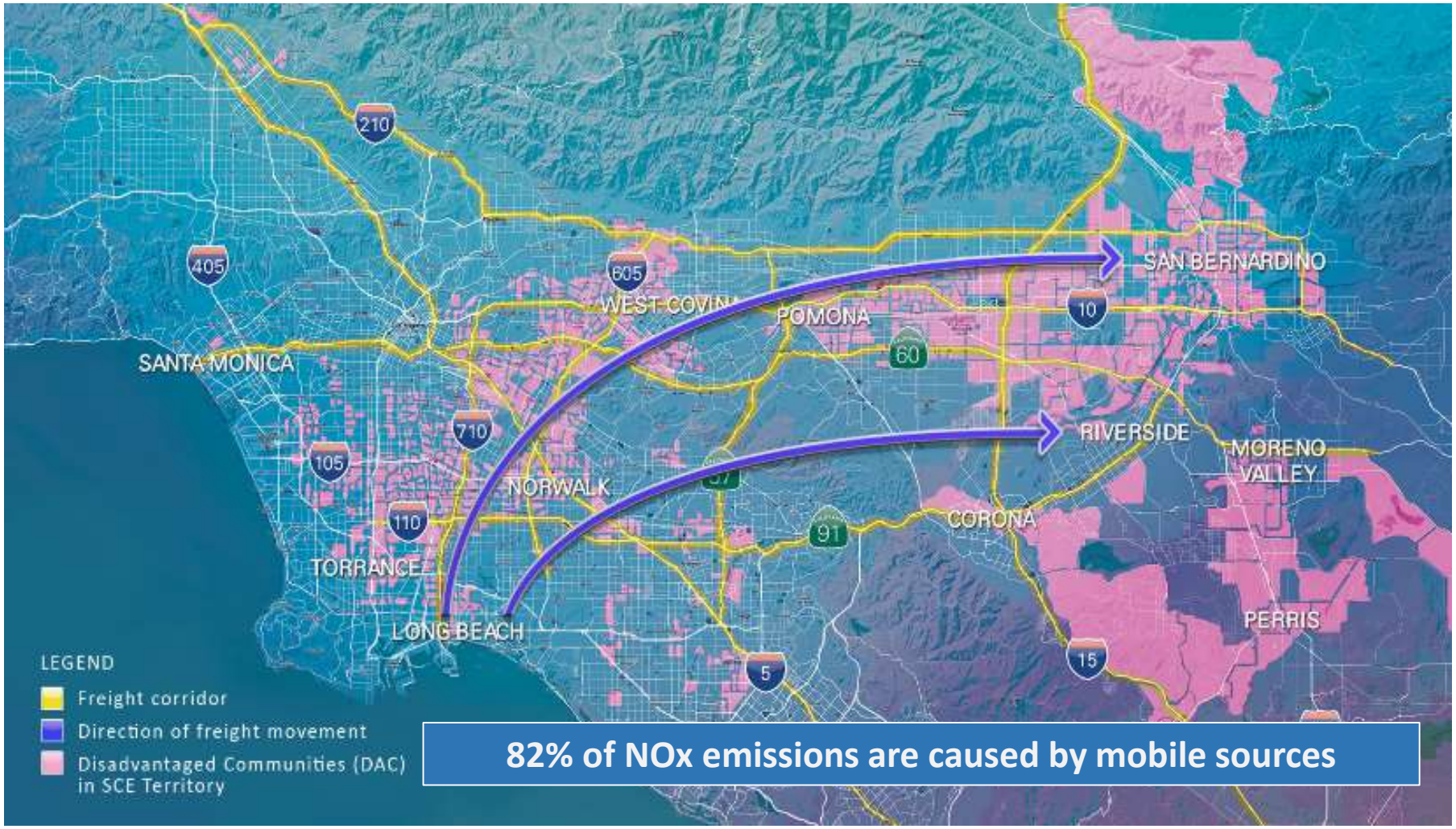
SOUTHERN CALIFORNIA EDISON®

California's GHG Emissions Reductions Goals



If we want to get to **zero emissions**, eventually we have to **replace** many of the things we rely on today that require combustion.

Vehicle pollution impacts a concentrated number of communities disproportionately



Note: Communities are considered DACs if they are in the worst quartile of environmental & economic burden, as evaluated by the California EPA using CES 3.0. Freight corridors.

SCE's Transportation Electrification Pathway to 2030

24% of cars and light trucks
7 Million total

+

15% of medium-duty trucks and vans
180,000 total

+

6% of heavy-duty trucks and buses
22,000 total

=

Removing 17,000 tons of NOx and 58 million metric tons of greenhouse gas emissions from California's Neighborhoods by 2030

Clean Power and Electrification Pathway white paper available at:

sce.com/pathwayto2030

Setting the right Frame of Mind for EV Bus infrastructure projects

EV Bus infrastructure is NOT plus-size EV car infrastructure

- Looks similar, but completely different in scale and requirements
- Especially true when you scale to 10, 20, 40 buses

EV Bus infrastructure draws as much power as large commercial buildings

- An electric bus yard draws as much power as medium and large office buildings
- Imaging installing a Las Vegas casino in your bus yard – this is the scale of electrical infrastructure that is required!
- This requires extensive and complex civil engineering work

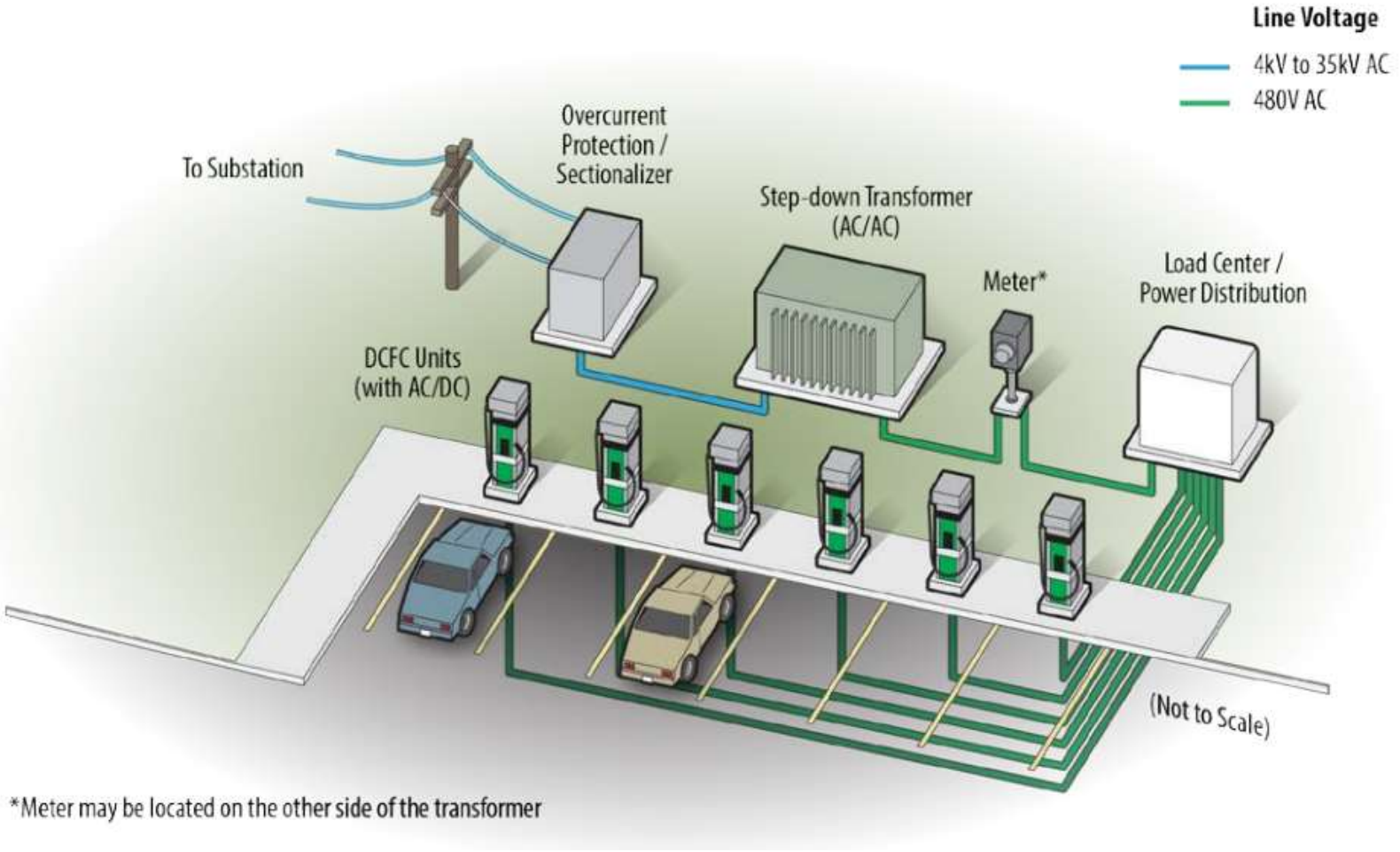
Who should be on your EV Bus infrastructure team?

- Fleet Manager
- Facilities Manager
- Energy Manager
- Bring resources from rail division (already deals with high power)

- Private contractors providing input:
  - Vehicle OEM
  - Charger hardware manufacturer
  - Third-party consultant
  - Utility

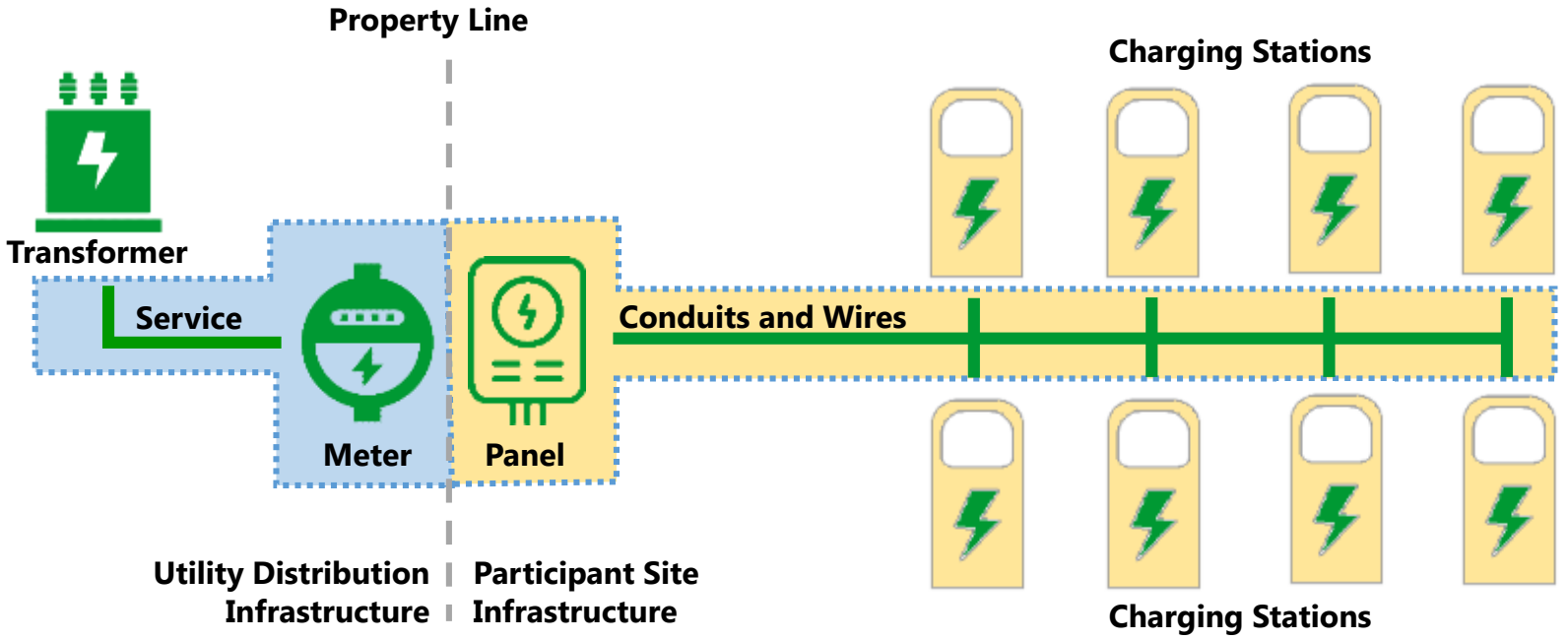
Charging Infrastructure Overview

Diagram of Charging Infrastructure Components



SOURCE: Idaho National Lab, *Considerations for Corridor and Community DC Fast Charging Complex System Design*

Typical Electrical Infrastructure Project



Utility builds off-site transformer & service drop to the meter

Customer installs on-site electrical panel, conduit, and charging stations

Introducing Charge Ready Transport: Infrastructure for Electric Truck and Bus Fleets

SOUTHERN CALIFORNIA EDISON®

Charge Ready Transport provides infrastructure for fleet electrification

Decision Summary

- Approved total program budget of **$356.4M**
- Achieve minimum **870 sites** with **8,490 electric vehicles** procured or converted
- Charging station rebates available for **transit/school buses** and **sites in DACs**
- Launching **Q2 or Q3 2019**

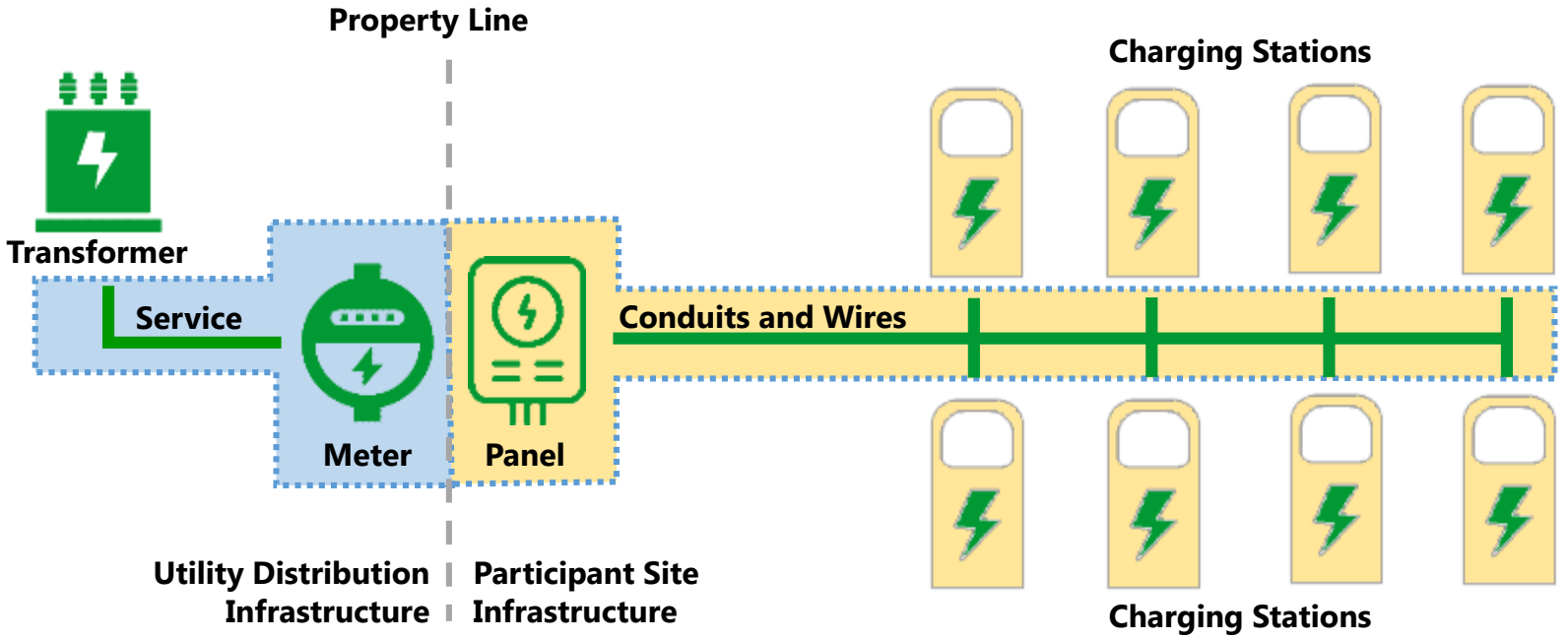
Budget Allocation

- Minimum **15%** infrastructure budget should serve **transit agencies**
- Maximum **10%** infrastructure budget should serve **forklifts**
- Minimum **25%** of infrastructure budget should serve **ports and warehouses**
- Minimum **40%** infrastructure budget should serve **sites in DACs**

How the Program Works

- Under the Charge Ready Transport Program, SCE will provide the infrastructure to support the installation of EV charging equipment at no cost to the Program Participant.
- This is a unique opportunity for fleet operators who choose to acquire EV's because the infrastructure required to support the installation of EV charging equipment typically represents a sizable investment.
- SCE will design, construct, and install the necessary infrastructure on both the utility-side and customer-side of the electric meter at no cost.
- Program Participants are responsible for the selection, purchase, and installation of the EV charging equipment.
- The Charge Ready Transport Program offers two rebate options to help Program Participants offset a portion of their costs.

Typical Electrical Infrastructure Project



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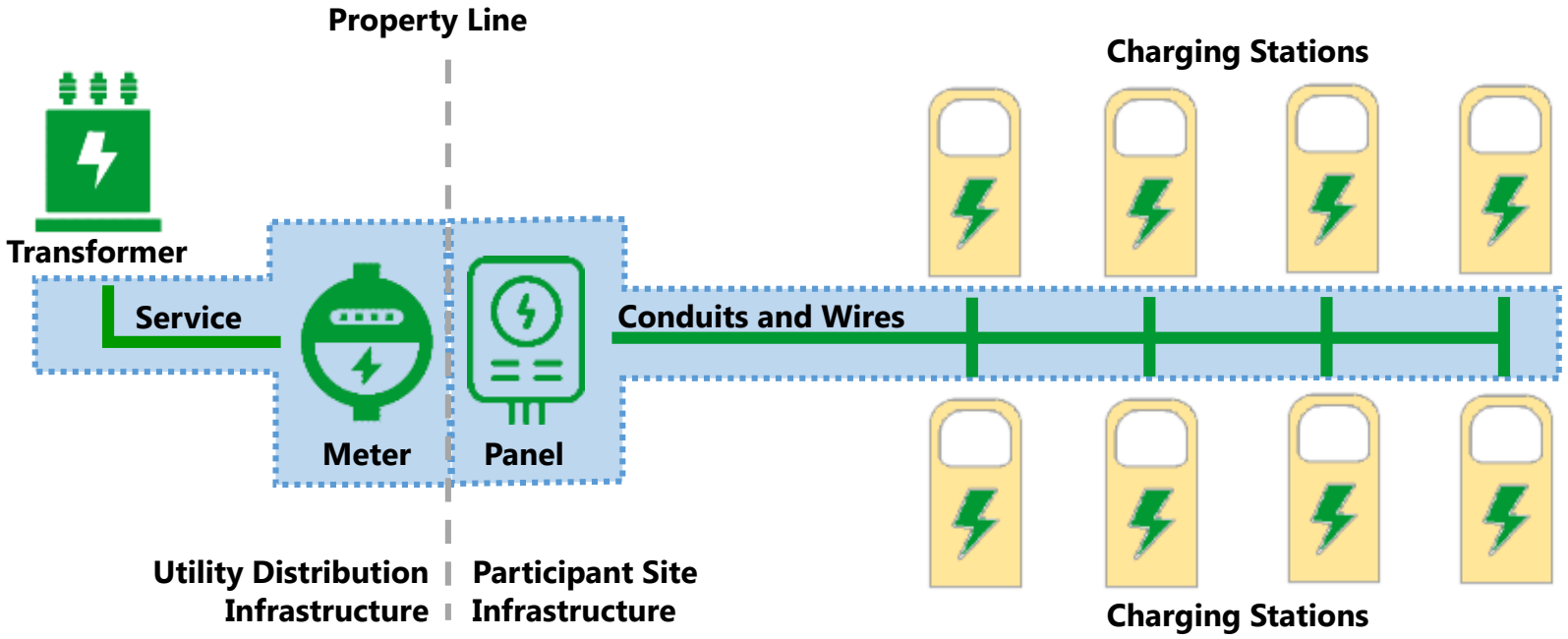


Utility builds off-site and on-site infrastructure, including transformer, meter, panels, trenching, and conduit. ("make-ready" project)

Customer installs charging stations. Transit agencies, schools, and some businesses in disadvantaged communities eligible for rebate.

Choose from a pre-approved list of chargers and charging speeds to meet your needs

AC Charging

- Up to 19 kW
- Standard J1772 Connector

DC Charging

- Up to 150 kW or more
- Standard CCS Type 1 Connector

Additional Programs and Services

Transportation Electrification Advisory Services

- Total Cost of Ownership Analysis
- Rate Intro and Rate Analyses
- LCFS Credit Estimation
- GHG Reduction Calculations

New Rates for EV Trucks & Buses

- Simplifies how the rates are charged
- Waives demand charges for five years
- Reduces uncertainty in you electricity costs

Transportation Electrification Project Management

- Single Point of Contact for multi-site projects
- Support customer-led projects outside of programs

Steps for completing a Charge Ready Transport Project

or,

Why does it take so long?

How can we speed up the process?

Getting Started with your Charge Ready Transport project

- Visit the Charge Ready Transport Website to learn more about the program
  - https://www.sce.com/crt
- Submit Expression of Interest to start discussions with an SCE Advisor
  - Contact your Account Manager
  - Submit online: https://pages.email.sce.com/chargereadytransport
  - Email me at andrew.papson@sce.com, I'll get the ball rolling
- Submit a Charge Ready Transport application
  - Submission portal at https://www.sce.com/crt
  - Typically 2-4 months to review and finalize application
  - It's an iterative process w/ Advisor to finalize details and meet program requirements.
  - There are many ways applicants can do to speed up or slow down an application

Tips to accelerate the application review process

- The best applications have a clear scope that answer four questions:
  - Is there a firm decision on the number of Electric Vehicles?
  - Is there a firm decision on number of charging stations?
  - Has the customer selected charger type and manufacturer?
  - Is the charger on our approved product list?
- A customer can submit an application before these questions are finalized, and work with an advisor to find answers to these questions.
- However, a project can’t move to design/build until these are finalized.

Steps in the design/build process (1)

- Pre-design: finalize charger placement, yard layout and other details. An iterative process with the customer to agree on a design.
- Review and sign the Program Participation Agreement (PPA)
  - Note: PPA is a contract that may require legal review and board approval
  - Once PPA is signed, vehicles must be onsite within 18 months
- Customer procures/contracts for vehicles and charging equipment
  - 45 day window from signing PPA
- Engineering design
- Easement agreement
  - Note: Easement contract may require legal review and board approval.

Steps in the design/build process (2)

- Permitting process
  - Note: Permitting depends on number authorities with jurisdiction, and their timeline for review and approval
- Civil work begins; break ground on make-ready project (up to concrete pad)
  - Timeline can have unpredictable delays, such as encountering a natural gas pipeline that wasn't on the original diagrams, or the trenching work is more difficult than expected.
- Customer installs charging equipment on concrete pad
- Interconnect and ENERGIZE!

Timelines

- From Expression of Interest to application submitted
  - As long as the customer needs, until they are ready to proceed
- From application submitted to Program Participation Agreement signed
  - Rule-of-thumb, 2-4 months
  - Customer can accelerate by developing firm project scope
  - PPA starts the clock on procurement contract and vehicle delivery, so may need to delay signing until the vehicle components are ready-to-go
- From PPA signed to Make-ready construction complete
  - 45 days to finalize procurement contract
  - Rule-of-thumb, 6-9 months for the civil engineering work
  - Depends on unexpected delays encountered in the construction process
- Customer installation of charging hardware and energize
  - Up to the customer and contractor, depends on complexity of charger installation
  - Vehicles must be on-site within 18 months of signing PPA

Get started right now!

Program web page: https://www.sce.com/crt

Expression of Interest: https://pages.email.sce.com/chargereadytransport

Contact your Account Manager

Contact me: andrew.papson@sce.com

Transit & High Power Charging

Dean Siegrist
AVP, Transformative Technologies
25 September 2019

BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

Real Life Stories: Transit & High Power Charging

- About Black & Veatch
- Electric Vehicle Infrastructure Projects

- Stakeholder Alignment & Project Goals
- Project Approaches & Risk Models
- Paperwork, Process & Permissions
- Project Scope & Schedule Management
- Equipment, Equipment, Equipment
- Rocks, Water, Trees, Traffic & Other Discoveries
- Utility Interconnection & Power Delivery Schedule

> Clients: Vehicle OEMs, Transit Agencies, Fleet Operators, Hardware OEMs, EV Network Service Providers & Utilities

About Black & Veatch

Power Infrastructure / Clean Energy

Transformative Technologies

Mission Critical Facilities

11,000+ Professionals

110+ offices

Six continents

7,000 active projects worldwide

$3.4 Billion

in revenue in 2017

Safety Performance

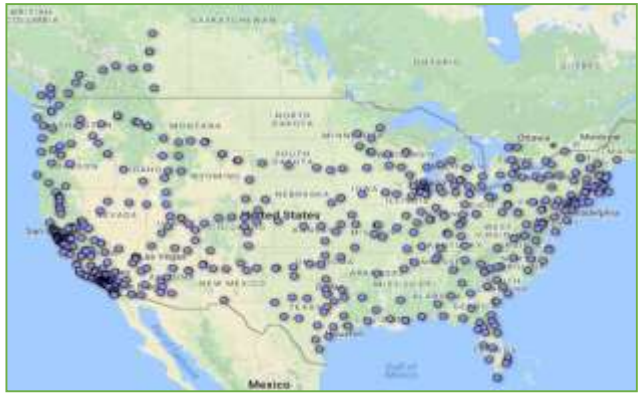
0.37

Recordable Incident Rate

0.06

Lost Time Incident Rate

Transformative Technologies



Over 1,000 250KW+ High-Power Sites

Scaling Distributed Clean Energy Infrastructure

Electric Vehicle Infrastructure

Hydrogen Infrastructure

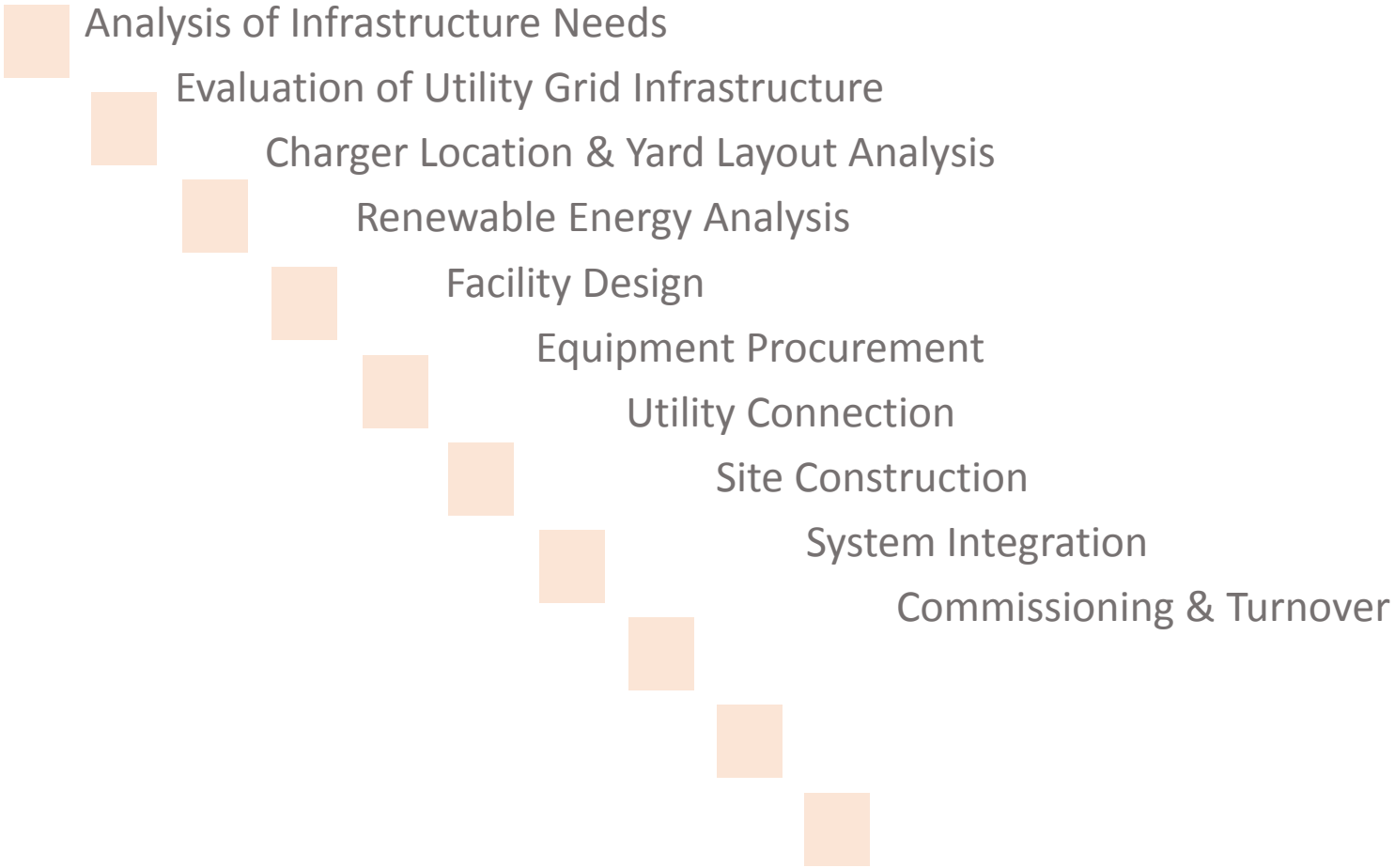
Energy Storage Networks

Emerging Distributed Technology

Autonomous, Connected Vehicle Infrastructure

We build complex networks faster

End-to-End Approach Leverages Black & Veatch Capabilities for Efficient Electrification Plans



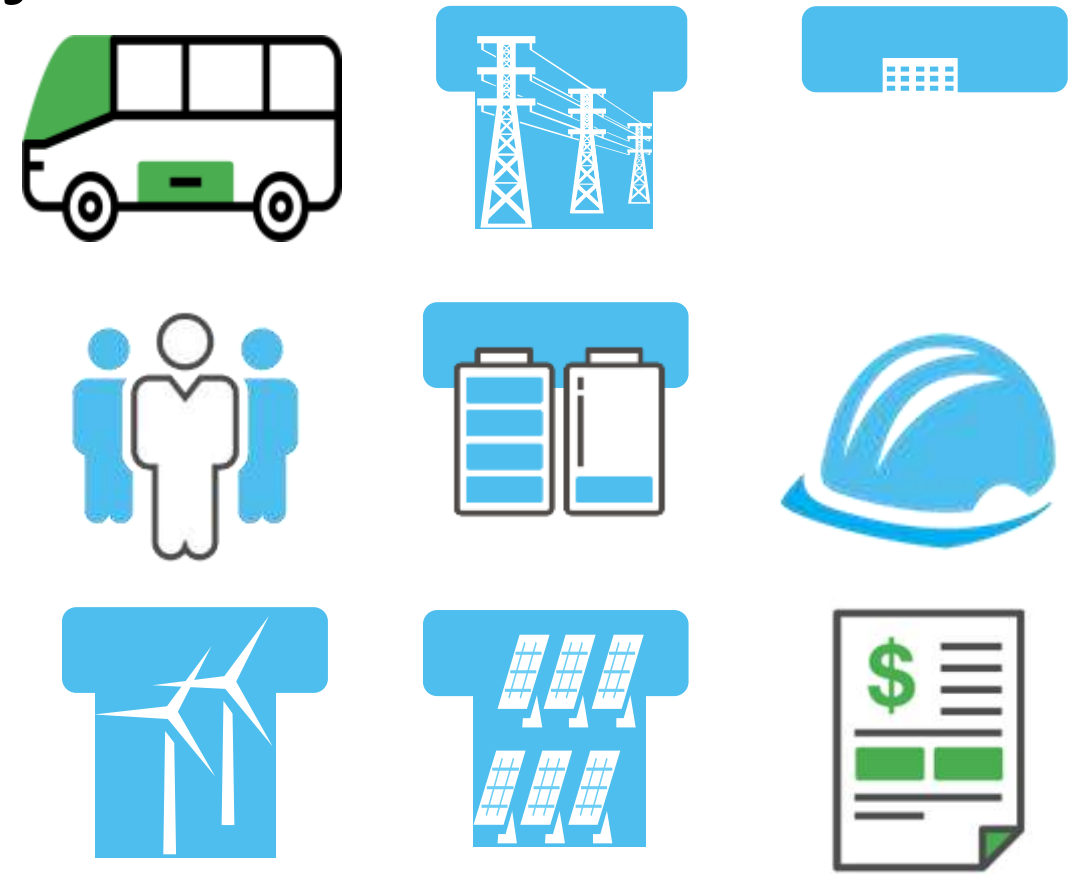
Partnering with a vertically integrated company such as Black & Veatch reduces development time and cost and allows for least regret investments as fleets Electrify.

Stakeholder Alignment & Project Goals

- Existing Project History
- Concurrent, Future Projects

- Building Load Integration
- Cost of Energy, Renewable Content
- Resilience
- Future Proofing Infrastructure

- Project Timeline
- Project Budget
- Total Cost of Operation



> Agencies & Fleets, Utilities, Cities, Vehicle OEMs, Clean Energy, Community Interests, Project Execution Team, Funding & ROI

Project Approaches & Risk Management

- Evolving Procurement Landscape
  - Bundling Infrastructure with Vehicles
  - Separate Infrastructure and Vehicle RFPs
  - Turn-Key or Separate Hardware, Software, Deployment Services, Operations & Maint.
- Alternative Contracting Methods & Tools
  - Public Contracting Rules Vary
  - Design-Build
  - Design-Bid-Build
  - Owners Engineer, Construction Administration
  - Fixed Price, Cost Plus, Open Book
  - Engineering “Bench” Services
  - Internal Engineering and Construction Services

Project Delivery/Risk Models: Different Levels of Scope Clarity & Cost Certainty

Paperwork, Process & Permissions

- Start EARLY on EVERYTHING

- Inter-Agency Agreements & Approvals
- State Environmental Impact Filings
- Sorting out Applicable Terms & Conditions, including differences between Vehicles, Infrastructure & Deployment Services

- Utility Load Letters, Right of Way & Service Agreements
- DOT & City Approvals & Special Permits
- Building & Electrical Permits (Can expire!)

> Patience & Persistence

Equipment, Equipment, Equipment

- Chargers
- UL Listings & Field Certification
- Compatibility / Interoperability

- Switch Gear
- Transformers
- Cable & Special Connectors

- Manufacturing Slots, Lead Times
- Specification Changes

- Site Delivery / Storage / Laydown Areas

> Changes Impact Schedule and Cost



> Un-documented, buried objects, required hand digging & re-routing

Rocks, Water, Trees, Traffic & Other Discoveries

- Rocks, Asphalt, Compaction Ratios
- Walls, Floors, Roofs
- Environmental Conditions
- Water
- Utilities, Hidden Obstructions
- Abandoned Conduits & Structures
- Underground Hazards & Discoveries
- Traffic Control & Security

- Re-Mobilization, Hand Digging

> Re-Engineering, Schedule and Cost Impacts

Utility Interconnection & Power Delivery Schedule

- Evolving charging loads

- Service upgrade
- Existing building Loads
- Metering location
- Switchgear sizing

- Power levels & voltage
- Lead times for increasing power
- Distribution grid upgrades

- Re-Mobilization

> Race is on for Real Estate and access to Power

Power Delivery, Grid Upgrade Schedules

Potential Grid Upgrades Required, Schedule Impacts

Potential Power Delivery Upgrades	Typical Ranges (Months)		
Supply Conductor (Service Extension)	0	-	2
Medium Voltage (Service Provisioning)	0	-	5
Feeder Re-Conductor	6	-	36
Feeder Additional Conductor	6	-	36
New Feeder	9	-	48
Substation Upgrade Required	18	-	36
New Substation Required	24	-	48

Example ranges – Power delivery scenarios are specific to a location, feeder access, existing, in queue projects and utility operating / power provisioning standards.

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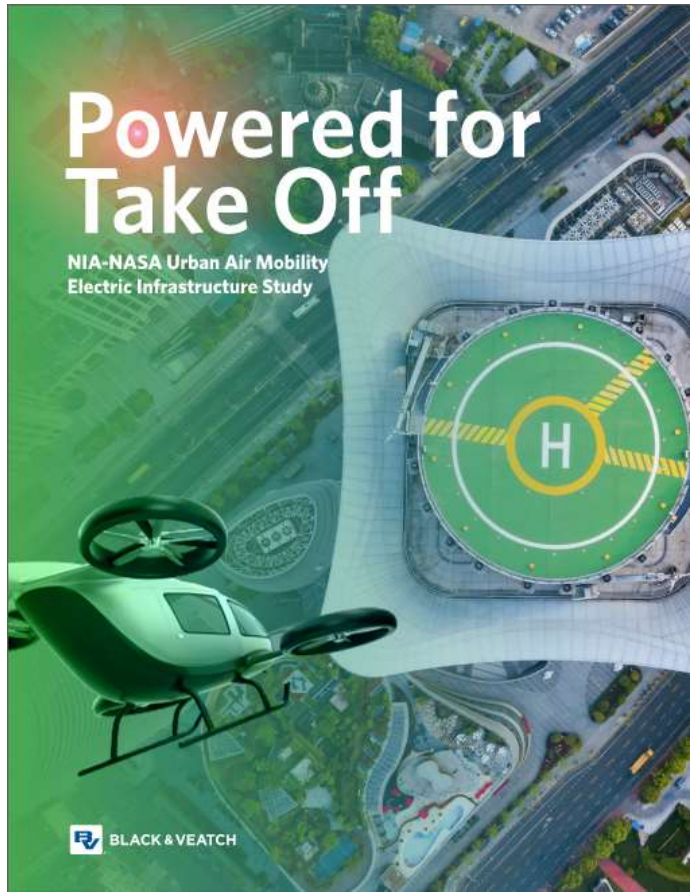
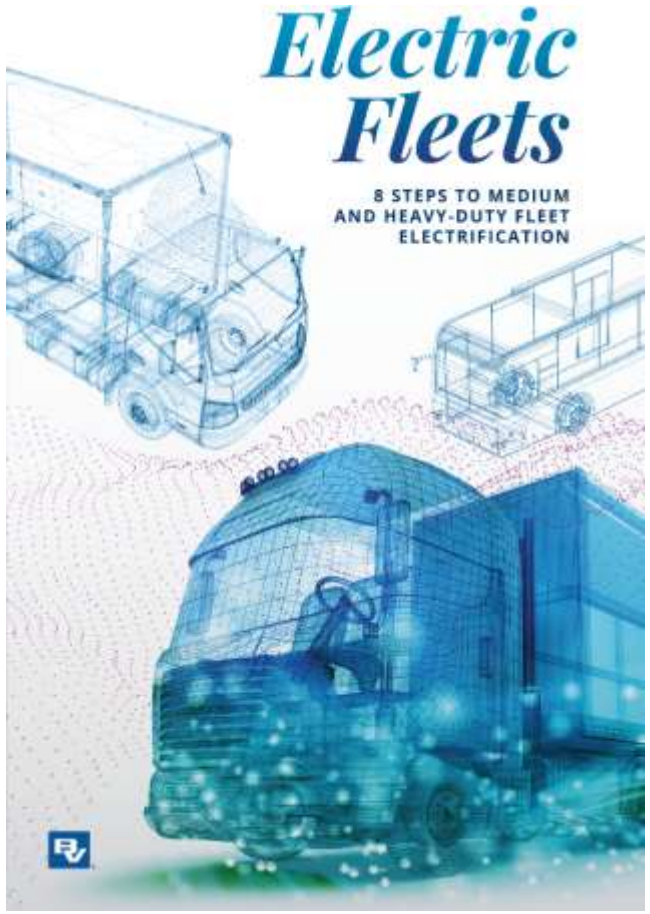


bv.com/evtols



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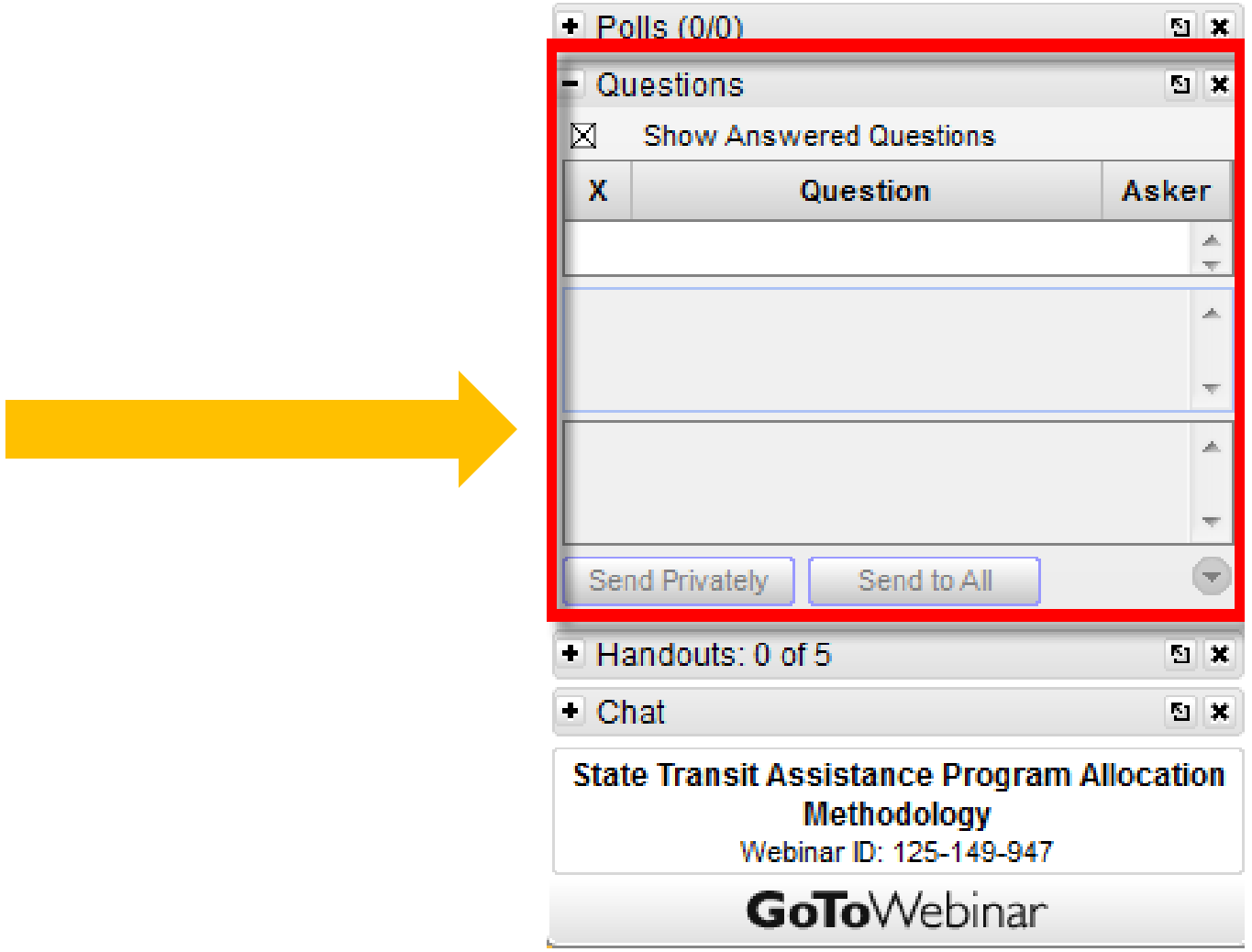
How to Ask Questions

- Submit your questions anytime during the program using the Questions module in your webinar control panel at the right of your screen.
- We will collect all questions and get to as many as time permits during the Q&A portion of the program.



Remember to Register!

- Session 4: Zoom to Zero: Fund the Electric Fleet (10/3)

Register at caltransit.org/events/webinars

Contact Us

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California Transit Association

Zoom to Zero: Best Practices for EV Infrastructure

(Co-Hosted by CALSTART)

September 25, 2019