Heavy Duty Electric Transportation Workgroup Meeting
April 8, 2016, 10:00 a.m. to 4:00 p.m.
Cal/EPA Headquarters Building, Sacramento, California

Attendees List

First Name	Last Name	Organization
Amy	Mesrobian	California Public Utilities Commission
Andrew	Papson	Foothill Transit
Bill	Boyce	Sacramento Municipal Utility District
Bill	Spraul	San Diego Metropolitan Transit System
Chris	Peeples	Alameda-Contra Costa Transit
David	Sawaya	Pacific Gas & Electric Company
Dianna	Vasquez	Sierra Club California
Donna	DeMartino	San Joaquin RTD
Edward	Lovelace	XL h Hybrids
Frank	DeRosa	Sun Edison
Fred	Silver	CALSTART
Greg	Fritz	ACTIA
Greg	Mann	Allison Transmission
Hannah	Goldsmith	California Electric Transportation Coalition
Jaimie	Levin	Center for Transportation and the Environment
Jana	Corey	PG&E
Jim	Wilson	Humboldt Transit Authority
Jimmy	O Dea	Union of Concerned Scientist
Joanna	Gusman	CPUC
John	Boece	CALSTART
John	Somers	Clean Energy
Jonathan	Nelson	Weideman Group
Keerthi	Ravikkumar	Sun Edison
Kent	Leacock	Proterra
Kiel	Pratt	California Energy Commission
Laura	Renger	Southern California Edison
Laura	Taylor	Braun Blaising Mc Laughlin & Smith
Len	Engel	Antelope Valley Transit Authority
Lisa	Mcghee	San Diego International Airport
Mark	Triplett	Greencharge Networks
Michael	Liu	BYD America
Michael	Masquelier	Wave
Michael	Pimentel	California Transit Association
Naveen	Berry	South Coast Air Quality Management District
Noel	Crisostomo	CPUC

First Name	Last Name	Organization
Paul	Hernandez	Center for Sustainable Energy
Rachel	Liesching	Sun Edison
Ray	Pingle	Sierra Club California
Ron	Zigres	Victor Valley Transit Authority
Ryne	Shetterly	Complete Coach Work
Sarah	Johnson	California Airports
Shrayas	Jatkar	Coalition for Clean Air
Steve	Jones	ITM Power
Steve	Miller	Golden Gate Transit
Tim	Carmichael	Southern California Gas Company
Tommy	Edwards	Sunline Transit Agency
Wendell	Krell	San Joaquin Regional Transit District
Zach	Kahn	BYD Coach & Bus

This was the first meeting of the Heavy Duty Electric Transportation Workgroup Meeting. In attendance there was a wide range of stakeholders representing investor-owned electric utilities, publicly-owned electric utilities, vehicle manufacturers, storage system providers, fleet owners, transit agencies and others. This meeting was also webcast was recorded by video. The detailed agenda, meeting materials, presentations, and video recording for this meeting are available at http://www.arb.ca.gov/msprog/bus/actmeetings.htm. The following are the primary agenda items for the meeting:

- Introduction
- Background on Senate Bill (SB) 350 and transportation electrification
- Utility rate design, electrification, and demand side management presentations
- Transit agency needs and concerns
- Panel discussions and questions and answers session

Introduction

This was the first meeting of the utility workgroup with the goal of finding opportunities for utilities and transit agencies to work more closely to discuss transportation electrification issues, identify potential synergies, and improve communication between electric utilities and transit agencies that choose to electrify their fleets. The topics of discussion relate to heavy duty trucks and buses but the focus of this initial meeting was on transit buses and transit agency needs. ARB is currently working closely with transit agencies in evaluating strategies for advanced clean transit. Total cost of ownership (including capital costs for the vehicle, infrastructure and operating costs) for zero emission buses is key to determining the best path forward.

ARB established the Utility Workgroup in response to comments from utilities and transit agencies that participated in the ARB's technology symposium held on

February 8, 2016. The meeting materials, and video recording for the Technology Symposium meeting are available at http://www.arb.ca.gov/msprog/bus/actmeetings.htm. The goal of the utility workgroup meeting is to discuss the demand charges and electricity rates a transit agency should expect when electrifying its fleet, how CPUC and utilities can work together through rate design proceedings to remove barriers of heavy duty electric transportation per SB 350, and how transit agencies can work with their utilities to strategize their individual electrification approach. ARB believes there are potential synergies with transportation electrification in meeting air quality goals, reducing dependence on fossil fuels, improving grid stabilization, and opportunities to lower electricity costs for rate payers and vehicle operators.

CPUC, Los Angeles Department of Water and Power (LADWP), Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), Sacramento Municipal Utility District (SMUD), and energy management system providers BYD and Greencharge Networks each delivered a presentation on programs they have to support electric vehicles and actions they are taking to support transportation electrification.

Background on SB 350 and transportation electrification presentation

CPUC explained its role in regulating investor-owned utilities and their role to coordinate with other agencies to achieve the State's transportation electrification goals, including coordinating the utility build-out of infrastructure to charge electric vehicles, establishing fair and economic rates, and utilizing vehicle-grid integration technologies. Transportation electrification is a major component of SB 350. SB 350 requires CPUC to direct the electric utilities to file applications for programs and investments to accelerate widespread transportation electrification. CPUC has developed a straw proposal for guidance to give the utilities for filing their applications. CPUC is seeking stakeholder feedback on this draft guidance during an April 29 workshop at the CPUC headquarters in San Francisco. CPUC encouraged participants to attend this workshop and provide feedback. Parties can also file formal comments following the workshop. Additional details can be found in a CPUC ruling document at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M159/K712/159712276.PDF..

Utility demand side management presentations

Each utility provided a summary of rate design components, including demand charges, existing incentive programs, demand side management programs or other activities related to using electricity as a transportation fuel. Copies of the presentations are available online with the other meeting materials. The following are highlights of the presentations:

- Pacific Gas and Electric Company (PG&E) explained how demand charges work and why they're applied. In 2013, CPUC allowed governmental entities with zero emission buses (ZEBs), including San Joaquin Regional Transit District (RTD), to be eligible on a three-year temporary basis for an electric tariff that has no demand

charges.. RTD operated two fast charge Proterra buses under the PG&E A1 rate as a pilot demonstration. Overall, both RTD and PG&E feel the rate pilot was a positive experience and a success. The cost of electricity for the buses was comparable to the cost of using diesel. RTD is purchasing 13 more fast charge ZEBs and has some concerns about operation on standard rates with peak demand charges. How and when the buses are charged can greatly affect the cost of electricity. PG&E highlighted that electricity costs are very stable, considerably more so than natural gas or gasoline over the last 15 years.

- Southern California Edison (SCE) outlined activities and programs that can reduce the cost of deploying and operating zero-emission buses (ZEBs), including participation in the low carbon fuel standard (LCFS) program and utilization of SCE Rules 15 and 16, which calculates standard allowances to cover costs of distribution line extensions and service line extensions for additional customer load. Additionally, the CPUC granted an allowance to SCE which was a precursor to the one permitted for PG&E government ZEB operators, which enabled Foothill Transit to temporarily access an electric rate with no demand charge for three years. This provision expired in December 2015. SCE recently implemented a new EV4 rate suitable for fast charging an electric bus during the day. Foothill's total electricity bill under the new SCE EV4 rate plan is only 10 percent higher compared to last year under the waiver.
- San Diego Gas and Electric (SDG&E) discussed their ongoing Vehicle-Grid Integration Pilot (approved in D.16-01-045 and now known as Power Your Drive) as well as the proposed GRC Phase II Rate, which will add a "super-off-peak" period where there will be no demand charge for electricity use during that period.
- Los Angeles Department of Water and Power (LADWP) introduced options to reduce infrastructure costs, including government grants and an available 30 percent federal tax credit. LADWP is developing an incentive program for heavy duty vehicle charging.
- Sacramento Municipal Utility District (SMUD) explained that for large users, that rates with demand charges can be more economical than rates with energy charges alone, particularly at higher levels of utilization, by comparing costs as a function of energy use under tariffs with demand charges and energy-only charges. SMUD also offers services like LCFS credit calculation support, which can be returned to the customer. SMUD has committed financial support of electric bus proposal by utilizing the cap-and-trade consignment auction proceeds.
- BYD presented the benefit of energy storage, which can increase reliability and decrease electricity demand for transits or stabilizing the grid and potentially drawing electricity when there is excess renewable electricity. Stationary energy storage could be second life application for batteries from retired electric vehicles.
- Green Charge Networks demonstrated how on-site energy storage, when combined with a facility energy management plan, can reduce demand and electricity costs for individual fleets. Storage systems are expected to be most advantageous for fast charging or for vehicles that need to charge during peak demand periods.

- All the utilities in the panel encourage transit agencies to work with their utilities early to discuss their battery electric vehicle charging needs, and a rate that works for transit agencies.

Transit agency needs and concerns

- Utilities need to assign staff who understand the transit perspective if they are going to assist fleets. Foothill felt that their customer representative at SCE didn't understand transit operations well and gave them advice that was not suitable to meet their transit needs. It is important to improve the communication between utilities and transit agencies. Having a transit specialist at the utility would be useful.
- Transit agencies with large fleets need to manage lots of buses and thousands of schedules and routes. Including ZEBs in their fleets adds another layer of complexity to transit operations.
- Despite solutions to ZEB fueling costs being offered by private companies, investments in infrastructure, software, storage, or solar generation may add even more operational complexity. Transit agencies will need staffing and expertise to this effect. Transit agencies have already optimized operation and schedules for transporting passengers, but managing storage systems for charging, especially on-route, will add complexity and cost to their existing operations.
- Transit agencies are looking for clear statewide policies that allow some certainty and predictability for electricity cost.
- One stakeholder noted rates are very different depending on the geographic locations of East Bay. This can be a challenge for agencies whose buses cross boundaries between utility service areas.

Panel discussions and questions and answers session

- Battery electric buses are charged with two primary strategies. They are slow charged at night at the end of the day or they are charged on-route during the day. Transit fleets need to be able to understand the electricity cost differences of using one strategy or another to make a fleet purchase decision for the next 20 years.
- There are many different components of rates including transmission costs and demand charges. Inherently, rates are designed to cover utility costs or the cost of service. Electricity prices have historically been more stable than petroleum prices.
- ARB has a simple spreadsheet model to show how electricity costs differ for fast charging and slow charging strategies for different utilities and rates. ARB can make the model more widely available to assist fleet owners with estimating costs for their own strategies.
- Policies that reduce or eliminate demand charges, while otherwise designed to recover utility costs and encourage efficient use of infrastructure could be relevant for new and small ZEB fleets that use fast charging strategies. Short-term modifications to eligibility for TOU-based rates allow transit agencies to focus on mastering ZEB operation before needing to focus on managing rates. Utilities should do more to help customers understand demand charges and improve engagement and communication in the transition to a rate that includes demand charges.

- There is some uncertainty about the interval with which demand is metered. While the standard is to average demand over a 15-minute period, some utilities have language in their tariffs that allows for five-minute metering, which could greatly change costs by calculating the applicable demand over a shorter period.
    - In the creation of modification of electricity rates, CPUC requires public proceedings to examine utility proposals for a specific rate design. Any change in metering interval, which could require substantive grid and billing infrastructure modifications that would be subject to the Commission's reasonableness review would — but 15-minute intervals also can't be guaranteed forever.
    - LADWP uses a 15-minute interval and has no interest in changing the metering interval, reminding attendees that any rate change needs to go through an intensive public process.
    - SCE tariffs currently allow metering on a 5-minute interval, but it would be logistically difficult for SCE to switch from 15-minute intervals. SCE is exploring whether shorter intervals would make more sense in the future.
    - PG&E's current commercial meter measures a 15-minute increment. For a change in metering interval, the meter would need to be replaced. A specific rate design would also be needed to support five-minute metering.
    - SMUD commented that rates just cover a utility's costs and SMUD has no need to change their rates.
- SMUD noted that rate design is a lengthy public process typically lasting 18 months. Unless there is a change in the cost driver, there won't be a chance to change the rate.
- Rate changes for investor owned utilities must be approved by CPUC, and are set through General Rate Case proceedings on about a three-year basis, with some annual adjustments.
- PG&E expects changes in future TOU rates with peak hours shifting later in the evening. They don't expect demand charges to change.
- CPUC noted that the utilities have very different cost structures and that there is no reason to expect standardized statewide rates.
- The findings from this utility workgroup meeting will be provided at the CPUC workshop for the Alternative Fueled Vehicles Rulemaking (R.13-11-007) on 29, 2016. The CPUC SB 350 and Transportation Electrification Workshop on April 29 will cover all mobile sources, including light-duty and heavy-duty sectors. From the workshop and comments following the workshop, CPUC will develop the guidance ruling to provide direction to the utilities to file applications to accelerate transportation electrification.
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- SDG&E has a proposed rate (GRC Phase II) awaiting approval that will not have demand charges during a new "super-off-peak" time period during the night. SDG&E will release a request for proposal aimed at developing tools for managing electricity costs.
- Multiple parties commented about concerns with demand charges and suggested schedules with no demand during parts of the day (like the proposed GRC Phase II schedule from SDG&E, which has a demand-free super-off-peak period). It was

suggested that utilities work with CPUC to identify the time of day when there is the least demand on the grid or excess renewables and eliminate demand charges during that time.

- SCE thinks that off-peak demand waiver programs may not be necessary because existing rates already incentivize off peak charging and the difference in cost to operators without demand charges may not be considerably less than it is now.
- SCE cautioned that introducing demand waivers to some customers might not be favorable for others, as the other customers would have to absorb the price.
- A participant asked whether the cap-and-trade consignment auction proceeds utilities receive on behalf of their ratepayers as part of the state's Greenhouse Gas Cap-and-Trade Program could be used to fund transportation electrification initiatives and whether the CPUC review process can be streamlined and simplified. Further comments were made that ZEB operation itself provides air quality and climate benefits, which benefits ratepayers.
    - CPUC explained that pursuant to state law, the proceeds investor-owned utilities receive must be credited directly to the utilities' residential, small business, and emissions-intensive and trade-exposed customers. However, up to 15 percent of those proceeds can be used for clean energy or energy efficiency projects that are not otherwise funded by another funding source. CPUC established a process by which utilities can propose clean energy or energy efficiency projects provided they have GHG emissions reductions as a measurable and stated goal and are not existing programs already funded by ratepayers. Any streamlined process for the transit agencies would help advance transportation electrification. It was also suggested that more of the proceeds be put toward infrastructure improvements benefiting transportation electrification.
- A transit agency voiced concerns about electricity supply and BEB operation reliability, citing forecasted blackouts in Southern California this summer as a result of the massive natural gas leak from Aliso Canyon. With an electric vehicle fleet, blackouts could greatly impact bus operators.
    - LADWP noted that utilities have good record on reliability, and have the obligation to provide reliable electricity. LADWP used the port as an example to illustrate the importance of reliability. Ships need to be plugged in when they come to the ports to comply with regulation. That technology didn't exist at that time and shipping companies were concerned about the cost of the power. LADWP worked out rate plan for this requirement. LADWP concluded that utilities would step up to make the transportation electrification work.
    - SCE echoed the points made by LADWP, but noted that we should be mindful for all the pressures that are on the utilities. Utilities have other interveners in rate proceedings that speak out on behalf of the ratepayers who might oppose a waiver. There are other groups that would have very different opinions that we need to factor those consideration into.
    - The problem with a lack of natural gas supply also affects fleets that use CNG and requires back-up systems for electric compressors to compress natural

gas. Systems that store electricity can also provide back-up power to charge electric buses.

- Questions were raised regarding the electricity used for hydrogen production (e.g. electrolysis) and whether that falls into the discussion of SB 350 transportation electrification. Both CPUC and utilities confirmed that using an electrolyzer to generate hydrogen for use in fuel cell electric buses and trucks could be considered in SB 350 applications and it has the potential to use excess renewable electricity. PG&E is interested in this space and is monitoring it closely.
- LADWP wants to do a case study of a battery electric or fuel cell deployment that closely involves operators, utilities, and bus OEMs. ARB would be willing to coordinate such an effort and put information together.
- Questions were raised about standardizing charging interfaces (for BEBs). New Flyer updated participants about an existing coordination effort among OEMs, Electric Power Research Institute (EPRI), and the American Public Transportation Association via SAE. The charging standards include SAE J3105 (overhead rapid charging), J3068 (plug-in charging), and J2954 (Inductive/wireless charging). The group meets bi-monthly with the last meeting held by EPRI at the end of March. It is projected that the rapid charging standard will be in place this year.
- Transit agencies and utilities should work closely at all stages of planning and procurement of a zero emission bus fleet. After Steve Miller of Golden Gate Transit asked some questions about their PG&E rate schedule, PG&E offered to sit down with Golden Gate directly to discuss their current rates and the potential costs with electrification of the Golden Gate Transit fleet.
- Battery storage systems might be a viable way for transit agencies to mitigate demand costs, to increase reliability and have back-up power. However, ARB believes if utilities or third parties were to provide and manage the energy storage system as a service for the transit fleet, the fleet charging demand on the grid would be better managed.
- There is a growing interest in optimization software, which can optimize charging and discharging to reduce costs. Paired with a vehicle-to-grid program, there might even be a potential for transits to reduce overall costs from their sale of electricity back to the utility. CPUC spoke in favor of software solutions and provided some example deployments.
- LADWP reminded attendees that there are both simple and complex ways of mitigating costs and that the simple ones should be attempted first.
- BYD mentioned that there are also off-grid charging opportunities by incorporating solar and especially by using both solar and energy storage.
- ARB held a meeting the day before about the LCFS program and how fleets can take advantage of credits. This led many transits to wonder if their utility could take and sell the credits on behalf of the transit, returning the value to the customer through rates like they do for light duty cars. The utilities can already serve that role on behalf of a transit fleet, but indicated they would not engage in speculation and their sales would likely be conservative.
- PG&E believes private brokers can already serve the market and would allow a transit fleet to sell the credits when they see fit. A transit agency currently has the

option to work with their utility to track and sell credits or to work with any other party to conduct the transaction.

- With vehicles using a large number of batteries and also using energy storage systems, the fate of batteries after their useful life was questioned. Green Charge Networks mentioned that they are working with Nissan on a second life for batteries after being used in vehicles. PG&E currently has a pilot project with BMW using former car batteries for energy storage.
- BYD has a clear strategy on battery for its second life. After 12 years of use in a bus BYD will repurpose the used batteries into stationary energy storage systems. After their life in a storage system, the batteries can be recycled. BYD has not recycled many batteries yet because these batteries entered the EV market in 2008 and haven't yet completed their first life cycle. By the end of 2018, the first batch of transit buses will retire. BYD works on recycling of every element of their non-toxic batteries, but needs to consider the costs. It is possible to do some low-cost treatments and safely landfill the batteries. For lead acid batteries (a mature technology), 98% of a battery can be recycled. Lithium ion battery recyclers charge owners $5/lb. to take the batteries. BYD expects to have a clearer idea by 2018.

Open Issues

There were several open issues that are still to be addressed and information that needs to be exchanged between utilities and fleet operators. The following are several issues or questions that could help the CPUC or utilities develop pilots or programs that can reduce barriers to electrify transportation.

- What are the major considerations in a transit agency's decision between a vehicle technology that uses a high-energy storage capacity (infrequent, lower charge rate) versus a one with a lower energy storage capacity (more frequent faster charge rate)?
- Do transit agencies have sufficient space at bus depots or easements at stops on-route to accommodate charging and/or storage systems needed to accommodate electric buses?
- Transit buses are typically in operation for about 12 years. On what duration do the transit agencies plan for fuel and operational costs? What is the usual timeframe for diesel or natural gas fuel purchase agreements?
- Are transit agencies' funding and procurement processes set up to simultaneously consider bus procurement (i.e. capital expense) and a utility or third party energy management program (i.e. operations & maintenance expense)? For example, is it feasible to procure both vehicles and participate in an energy efficiency program as complements?
- Are transit agencies open to using fleet management software that would synthesize bus routing requirements with electricity tariff and charging equipment availability in order to minimize electricity costs? See for example: CPUC Resolution E-4595 at p. 20.
- Several of the utilities' presentations showed that the per-mile operational cost has an inverse relationship with the number of buses charging on the applicable rate (including a demand charge). The main driver of this inverse cost

relationship, as posited in CPUC Resolutions E-4514 and E-4628, is the spreading of fixed costs associated with demand charges over more energy use (kWh) from the additional vehicles operating in the fleet. To what extent is this cost relationship contingent upon the fleet's ability to stagger charging so demand does not coincide? Is such staggering feasible in transit operations?

- The utilities presented design variations on the major electric rate components: demand charges and energy rates. For example, demand charges may be not applied during off-peak hours, fixed per kW based on average demand, or location/circuit-specific. Energy rates may be flat per kWh, time-of-use differentiated, or hourly and dynamic. Given that parties seemed to agree that meeting State policy goals would require comprehensible electricity costs that are competitive with conventional fuels, how can utilities and third parties communicate rates and energy management solutions to their customers most effectively?
- Would the transit agencies be open to an agreement with a third-party solutions provider that offers a "Transit-Grid Integration Agreement" that offers a certain electricity price (or effective per-mile cost) over an extended period that uses fleet- and-electricity management software and equipment to manage charging demand?
- For utilities, what was the magnitude (if any) of un-recovered costs associated with the temporary eligibility for Time-Of-Use rates for Government–Owned or –Operated Zero Emission electric buses that were offered pursuant to CPUC Resolutions E-4514 and E-4628?
- How do utilities manage easements for the siting of utility-owned infrastructure such as transformers or possibly for charging equipment?
- Grid planning is an important part of transit electrification. For example, a utility will need to identify the nearby substation or step-down transformer to serve a bus yard or fast charging station. How can utilities be involved with transits as they look to electrify? By working together, are there opportunities for savings in time, costs, or resources?
- What are the best modeling resources to help transit agencies understand what it will cost to run their buses on electricity as they consider fleet electrification?
- How can the utilities, CPUC, and ARB better help transit agencies to take advantage of the LCFS Program and generate credits to benefit their fleets?
- How can the CPUC and/or utilities help transits to explore low- or no-capital financing of the installation of solar? Could utilities provide a list of all the options (e.g. PACE financing, leasing), how they work, and any examples of transit agencies that have installed solar?

Action Items

- ARB will make its electricity rates model available on its website.
- ARB will schedule a follow-up workgroup meeting to continue the discussion
- PG&E rates department will meet with Steve Miller from Golden Gate Transit.