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**CALIFORNIA AIR RESOURCES BOARD ZEV HD CERTIFICATION**

# COMMENTS OF SAN DIEGO AIRPORT PARKING COMPANY (SDAP) ON CARB PROPOSED REGULATION OF ZERO-EMISSION POWERTRAIN CERTIFICATION REGULATION

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## I. INTRODUCTION

San Diego Airport Parking Company ("SDAP") submits the following comments on the Proposed Regulation to consider a Zero-Emission Powertrain Certification Regulation (ZEPC) SDAP represents small commercial business fleets and shuttle and airport ground transportation operators, that provide service to urban and densely populated areas that are mainly supporting the residential communities in the territory and provide transportation services in the surrounding roadways that are to and from the San Diego Airport. The areas that in are proximity to the airport are exposed to the highest levels of pollution and thereby when airport and port fleet operators adopt zero emission vehicles, this will directly benefit the low-income communities throughout this territory. SDAP is specifically a small business fleet that has been in business since 1991 and serving the San Diego Airport customer, providing parking and shuttle service to and from the airport 24/7 and 365 days per year. SDAP operates 20,000 miles per month with a Class 2b or Class 3 shuttle bus in short duty cycle with many stops and idle times throughout the day. SDAP has been an SDG&E small business commercial class customer since beginning business in 1991 and thereby has never incurred 20 kilowatts or any demand fees in its SDGE rates and billing.

SDAP has Transportation Electrification (TE) fleet experience in both EV commercial vehicles and EVSE charging equipment including installing equipment and running an EV Fleet. In Q2 of 2015 SDAP became the very first Airport EV bus in California when it purchased its first electric shuttle bus and within 1 year had purchased 3 electric buses by Q2 2016 which comprised of 50% of SDAP's fleet. In 2015, SDAP installed three Level-2 AC 14 kW chargers to support its EV fleet. SDAP has operated over 100,000 electric miles with plans to be 100% electric by 2020. SDAP was a party in the SB350 Priority Review (PR) and Standard Review (SR) proceeding with the CPUC and thereby contributed to the decisions in the PR pilot projects for SDG&E. SDAP is a site host for the Green Shuttle PR (GSP) pilot project in the SDGE territory *(see CPUC filing on 1-31-19 by SDGE , The interim report, proceeding # 17-01-020)* and expects to have all construction completed by Q1 2019 which is expected to include two DCFC chargers at 50 kW of 3-phase power, a new 400-amp meter and a new 480-volt transformer. SDAP has procured it's 2nd generation of EV shuttles which will be delivered to SDAP Q2 of 2019 which will provide 3-phase power technology and will be delivered by Green Power Bus. Additionally, SDAP is also a site host to SDGE Power Your Drive Pilot and installation was completed in Dec 2018 and the site will be energized in March 2019, this included installing 10 Level-2 AC chargers with 6 kW single phase, trenching, a new 400-amp meter and a design to meet the ADA Commercial Building Code requirements.

Early adopters in this space are taking on the risks as there are no standards in the MHD space and the equipment and technology is all proprietary. There are no MHD EVSE standards to support international standards, there are no MHD receptacle connector standards, there are no minimum power level requirements, there are no EV vehicle durability standards and testing requirements for the reliability of the vehicles that supports its expected useful life for its vocation, there are no requirements for the OEM to provide local garage support to the customer with this proprietary equipment ---- this is still very much a "wild west" stage in the MHD EV space – which is very different than the LD passenger EV cars. For these reasons, SDAP is highly supportive of this Proposed Regulation with Modifications.

## II. SMALL BUSINESS

Small businesses are not only vital to California's economic health and welfare but also constitute an important class of ratepayers for utility companies. The ratepayer interests of the small business class often diverge from residential ratepayers and larger-size commercial customers on a variety of utility matters. The needs of small businesses are critical to consider not only because they have a substantial impact on California's economy but also because engagement from small businesses and their employees is critical to the future of California's grid and the ZEV technology. There are approximately 3,941,201 small businesses in the state that comprise of 99.8% of all employer firms, provide 48.8% of private sector employment, account for over 280,000 net new jobs, and comprise approximately 43.2% of California's $152.1 billion in exports. *California Small Business Profile, U.S. Small Business Administration Office of Advocacy. See https://www.sba.gov/sites/default/files/advocacy/2018-Small-Business-Profiles-CA.pdf.*

Due to the important role small businesses play in the state's economy and to the legislative mandates, SDAP believes that the ZEPC ultimately needs to require a mandatory certification and not create an optional pathway. The risk is all on the fleets if CARB is going to continue to promote the technology with no certification mandate as this does provide confidence to fleets unless you require the technology when sold in California to be certified --- these are the lessons already learned and the reason, the market itself still lacks consistency, stability and other issues from the TE technology. TE technology, as proposed, does not match other fossil fuel technologies that are proven as robust, durable and reliable for long useful life periods and have long warranty periods with lots of garage support services and enforcement to support that all parties are creating robust product. In order to accelerate adoption by fleets CARB needs to identify more benchmarks, incorporate a mandatory certification, and consider and meet the needs of fleets that rely on the capital equipment for meeting the needs of their transportation business. Additionally, providing a 3 year 50,000 mile warranty on proto-type technology that still is not proven in the MDHD sector outside of Transit buses creates concerns and more risk on small businesses which can be greatly impacted without a regulation to support and enforce that the technology, when sold, is reliable and will be supported if it does not work beyond 50,000 miles. There is still not enough support for this expensive upfront investment when choosing this technology and there are many complications that have already been reported in the interim reports by the CPUC SB350 pilot projects that were not foreseen that have increased the issues to install infrastructure; thereby requiring the incentive programs and funding to better support small business fleets is necessary in order to ensure the future of accelerated adoption of TE is feasible and fairly includes the small business and or private fleets

Implementing specific business standards and processes via a mandatory certification will ensure success and taking the necessary steps to comply with standard applicable government regulations should be no different for the ZEV technology. OEM's, Upfitters and Powertrains Manufacturers, should be identifiable to fleets as achieving a high commitment to excellence by their effective use of safety and quality standards the same as emission vehicles must comply.

## III. TRL

Hazard Analysis/ Safety: Design and performance requirements for TE should be 100% addressed and hazards relating to safety should be "designed in" early instead of "added on" later with increased cost and decreased effectiveness. Safety with passenger movement while on our road ways which are shared by many other mobility vehicles should not be compromised. We cannot sacrifice technology hazards for air quality and specifically when this proposal acknowledges the lack of readiness level in the technology by some OEMs. SDAP can speak from firsthand experience after experiencing the technology which consistently could not support our vocation and was not supported by the OEM. To date these vehicles have not run for over 3 years as they are 100% proprietary which depends on the OEM to diagnose and repair the technology. Analysis of hazards results in the identification of potential accident scenarios and the determination of how to prevent and mitigate defects and accidents. Safety Structures, Systems and Components are identified and incorporated into the design to prevent or mitigate the consequences of hazards to the driver, the garage service center, the collocated worker and the public. A mandatory certification for both the vehicles and garage support for this technology is required with education regarding safety, testing and validation of safety functions in the relevant environment for the applicable and appropriate vocation.

## IV. GVWR

As a company or fleet, you're placing your employees, customers, or the public in these vehicles. It is very important to company wellbeing and employee safety to make sure the buses / trucks you purchase are designed for their intended purposes, and GVWR and GCWR are specified properly for safe, efficient operation.

The TE technology and ZEPC should require a mandate for all vehicles that includes the GVWR since many vehicles that are being converted to a ZEV are adding EV kits onto a base Gasoline vehicle which is increasing the weight substantially once the EV battery packs are installed. This creates a safety concern and wear and tear that is not the same as what the vehicle was designed to achieve when loaded. Testing for Vertical Center of Gravity should be required as with the additional increased weight this can compromise the center of gravity

The combined center of gravity calculation takes into account the weights, centers of gravity and positions of all equipment that is added to the base vehicle which may affect the vertical center of gravity of the complete vehicle.

The result is then compared to the allowable center of gravity for the completed vehicle, as defined by the vehicle manufacturer. *https://truckscience.com/vertical-center-of-gravity/*

> **Goss axle weight rating:** This is the maximum weight that can be carried by a single axle; it should be identified as either front or rear. This rating can be found on tow vehicles and on trailers. It can measured by placing all wheels of a single axle on a scale.
>
> **Gross combined weight rating:** The maximum combined weight of the tow vehicle and all towed units or trailers. This includes all cargo, fluids, passengers and vehicles in the train. This can be checked by placing the tow vehicle and trailer(s) onto a scale, or if a scale isn't big enough, then weighing each vehicle or axle individually on the scale and adding up the individual weights.

**Gross vehicle weight rating:** The maximum amount of weight that can be loaded on a vehicle; it should include the weight of the vehicle, all of its topped-off fluids, cargo, passengers and trailer tongue weight, if applicable. This is easily measured by placing all four (or six if you have a dually) wheels of the vehicle on a professional scale.

**Tongue weight:** Tongue weight is the amount of weight that a trailer places onto a tow vehicle through the hitch ball when connected. This can be measured in a few ways, but using a tongue weight scale or a ball mount with a built-in scale are the most common methods.

**Trailer weight:** This is how much a trailer weighs. This includes the weight of all axles and the weight on the tongue jack. The best way to measure this is to place the trailer on a full-length scale and disconnect it fully from the tow vehicle. Of course, you can also weigh the tow vehicle, then the tow vehicle and attached trailer, and subtract the weight of the tow vehicle to get the trailer weight.

Often, gross vehicle weight rating (GVWR) and gross vehicle weight (GVW) are thought to be the same, but they are not. A truck's GVWR is the maximum weight rating established by the chassis manufacturer. GVW is the total weight of the truck and payload at a point in time.

There's a common misconception that a truck's GVWR is determined by adding gross axle weight ratings (GAWRs) together for all axles. Although this was a common way of calculating GVWR many years ago, it's no longer an accurate method. The chassis manufacturer task of establishing a vehicle GVWR is much more difficult today due to advancement of safety system standards and how vehicles meet these requirements. Therefore, many trucks have a GVWR much lower than the combined axle ratings. It is not uncommon for a truck with a GVWR of 19,500 pounds to have a front axle rated at 7,500 pounds and a rear axle rated at 14,700 pounds. Safety standards that apply to braking, vehicle stability, and chassis manufacturer internal standards for durability, dynamic stability and handling can restrict GVWR even though the sum of the axle ratings exceeds 22,000 pounds. In this instance, the OEM set the GVWR at 19,500 pounds based on test results and vehicle dynamic performance to ensure a safe, reliable truck.

A specific vehicle's GCWR is based on parameters established by chassis manufacturers. The manufacturer makes an assessment in accordance with SAE International test protocols, determining maximum GCWR. Additionally, the OEM runs stringent tests based on internal requirements which may include testing total GCWR braking capability using only the towing vehicle chassis braking system. GCWR is the total weight of the truck pulling the trailer and the trailer itself. The truck chassis dictates proper GCWR for safe operation of the combination truck and trailer.

When end users and fleets are looking to either purchase or specify the proper chassis for their needs, different driver qualifications and regulations are part of the process. A key driver qualification is the commercial driver's license rule, better known as CDL. Many fleets prefer to specify their chassis in a way that allows drivers without a CDL to operate their vehicles. Federal CDL requirements help clarify what's considered a non-CDL truck and how GVWR comes into play. Each individual state may have more stringent CDL licensing requirements.

However, every state must follow federal requirements as a baseline. One element in federal CDL operator requirements is a vehicle's GVWR. The federal requirement specifies that, when a vehicle has a GVWR of 26,000 pounds or less, the operator does not need a CDL. However, this does not mean the truck GVW can be loaded above the GVWR of 26,000 pounds and operated by a non-CDL driver. Federal requirements state the GVW must, in addition, be 26,000 pounds or less. CDL requirements become more confusing when the vehicle is towing a trailer.

There are three key aspects to consider when assessing CDL operator requirements for commercial work trucks involved in towing a trailer: truck GVWR, trailer GVWR and GCWR of the truck-trailer combination. Trailer GVWR is most critical to determining when a CDL is required. When a trailer has a GVWR of 10,001 pounds or more and the combined GCWR of the truck and trailer is 26,001 pounds or more, a CDL is required of the operator. For example, if a trailer has a GVWR of 11,500 pounds and is towed by a truck with a GVWR of 15,000 pounds, resulting in a GCWR of 26,500 pounds, then the operator must have a CDL.

In contrast, when the trailer in the truck-trailer combination has a GVWR of 10,000 pounds or less, the CDL requirements allow for a greater GCWR for both the truck and trailer without requiring a CDL. For example, a truck with a GVWR of 26,000 pounds or less can tow a trailer with a GVWR of 10,000 pounds or less and not require the operator to have a CDL under federal requirements. However, CDL requirements mandate that the truck and trailer GVW not exceed 26,000 pounds and 10,000 pounds, respectively. In short, the truck and trailer cannot be overloaded. However, in California anything 10 seats or more requires a CDL. So, number of seats will also trigger the CDL.

When determining the truck and trailer combination(s) that end customers or fleets want, it's important to understand which combination(s) will require a CDL or know how to specify and load trucks and trailers properly to remain within CDL weight limitations. There's a common perception that a truck's original GVWR can be changed to avoid CDL requirements. Even though there are provisions in the vehicle certification rules that allow the company finishing the new incomplete vehicle (final-stage manufacturer) to determine the vehicle's final GVWR, the final-stage manufacturer should not be making changes to the original GVWR without guidance from the incomplete vehicle manufacturer. And for these reasons, CARB ZEPC should monitor and test that the vehicle GVWR was not compromised once the Battery packs were installed.

Many incomplete medium-duty vehicle manufacturers include GVWR information as part of the Vehicle Identification Number (VIN) coding in the vehicle description section (4–8) and, therefore, will not change an incomplete vehicle's GVWR after it is manufactured as the VIN would need to be updated. Many incomplete vehicle OEMs will provide guidance about changing GVWR for a VIN-specific new incomplete chassis through their dealer network; however, they make the final-stage manufacturer the responsible party. Many times, altering GVWR requires changing key components (such as tires, suspensions or even axles). If a company claims it can change GVWR, CARB should consider mandating what approach was used in testing, engineering analysis and certification documentation to ensure ongoing compliance.

Despite what the GAWRs may add up to, the GVWR is the maximum total weight for which a vehicle is rated. That includes passengers, liquids (fuel, oil and coolant, etc.), cargo and the tongue weight of the trailer if you are towing. To find out if you are exceeding your GVWR, place all the wheels of the loaded tow vehicle onto a scale — and if you are towing, you need to do this with the trailer attached but without placing the trailer on the scale.

For example, if we add the two GAWRs from the 2015 Ram, we come up with 12,500 pounds. If we look at the GVWR, it is only 10,000 pounds. That's 2,500 pounds less than the sum of the two axle ratings. Manufacturers rate their vehicles for what the vehicle can consistently and safely handle, so although each axle can handle more than the truck is rated for, other components and systems may not be able to handle the sum of the gross axle weight ratings. These systems may include the powertrain, drivetrain, brakes, cooling system, suspension or other components. Probably more than in any other vehicle segment, a pickup is only as strong as its weakest link.

The same cautions that apply to motor vehicles apply to trailers. The brakes, suspension, axles, bearings, tires, frame and other components are all designed to safely handle loads up to the maximum GVWR. It is unsafe to overload a trailer above its ratings.

One number that is not listed on a pickup's door tag— is the GCWR. This is the total weight of the vehicles connected while towing: truck, passengers and its load, and the trailer and its load.

To measure GCWR, place the tow vehicle and any associated trailers on a scale, and get the readout for the total weight of all axles. Many scales are only large enough to pick up one axle, or two closely spaced, at a time. In that instance, take add the weight of all the axles of the tow vehicle and trailer after measuring them one at a time. To find out a vehicle's GCWR, you often must look in the owner's manual. Much like GAWRs and GVWRs, the GCWR is not the sum of the GVWR and the maximum towing capacity of the tow vehicle. It also is not the sum of the GVWRs of the tow vehicle and attached trailer, even if the federal Department of Transportation requires commercial vehicles to be registered that way. This is done to protect the components of the tow vehicle.

Below is the scenario of the Class 3 Transit bus converted and note that when all seats are used the battery pack must be reduced and the remaining payload in both conversions has significantly compromised the remaining payload.

**Gas Base Vehicle**:
Ford Transit Wagon 350 HD ---- General Weight
**OEM GVWR** = 10,360 lbs.
**OEM Curb weight** = 7,132 lbs.
**OEM Payload** = 3,480 lbs.
**FTA per passenger weight** = 150 lbs.
**11 Passenger Seats** = 1,650 lbs.
**Remaining payload after loaded** = 1,830 lbs.

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**11 Seat Bus Converted:**
11 Seat EV Conversion, Weight Calculation
**GVWR** = 10,360 lbs.
**Battery Packs** (86 kWh and 115-mile range) = 1,250 lbs.
**Curb weight** = 8,382 lbs.
**Payload** = 1,978
**Passenger weight** = 150 lbs. x 11 = 1,650 lbs.
**Total Gross weight** = 10,032 lbs.
**Remaining payload after loaded** = 328 lbs.

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**15 Seat Bus Converted:**
15 Seat EV Conversion, Weight Calculation
**GVWR** = 10,360 lbs.
**Battery Packs** (43kwh and 55-mile range) = 625 lbs.
**Curb weight** = 7,757 lbs.
**Payload** = 2,603
**Passenger weight** = 150 lbs. x 15 = 2,250 lbs.
**Total Gross weight** = 10,007 lbs.
**Remaining payload after loaded** = 353 lbs.

## III. INCOMPLETE VEHICLE AND COMPLETE VEHICLES.

IF YOU BUILD or modify trucks by installing truck bodies, or related equipment, you must certify them. Failure to certify can result in penalties of $1,100 for each violation up to a maximum of $880,000 for a related series of violations.

There is no reason to not create a mandate for Completed ZEV vehicles in the MD Class 2B and Class 3 as the intention is to ensure reliability and all MDHD ZEV's should be compliant to achieve the same standard. The conversion substantially changes the vehicle and increase the curb weight and impacts the center of gravity.

To certify a vehicle is to document in writing that the vehicle that you helped to produce still conforms to all applicable motor vehicle safety standards. Companies must make such a statement when they install truck bodies or equipment on incomplete vehicles (such as a truck chassis) or if they alter a completed truck that previously had been certified (such as a complete vehicle like the Class 2B or Class 3 Gas Van that is converted but is being identified as a complete vehicle as long as it has not been registered before converted and has zero or close to no miles on it once purchased and registered).

This process involves: Determining vehicle type (chassis cab, bare chassis, cutaway van, or chassis cowl) and the standards that apply to the model being certified. Determining the type of conformity statement to be used (there are three, reviewed later within), Performing a Federal Motor Vehicle Safety Standards (FMVSS) compliance analysis. This is a checklist of the various vehicle components and how they conform to all FMVSS. Performing a payload analysis. Payload capacity is determined by subtracting the completed weight of the vehicle, including driver and passengers, from the gross vehicle weight rating (GVWR). Performing a weight distribution analysis. This determines the distribution of the total gross vehicle weight imposed on the ground at each axle (measured in units of weight or as a percent of total truck weight). Anyone who manufactures or assembles motor vehicles or motor vehicle equipment for resale is required to certify.

**Who is a Manufacturer?**

A manufacturer can be any person who performs a manufacturing operation on a new, incomplete vehicle. This definition includes the manufacturer of the completed vehicle or a vehicle in its incomplete, intermediate and/or final-stages. Any person who alters a completed vehicle, which has already been certified in the final stage before it is sold, is also considered a manufacturer of motor vehicles under the National Traffic and Motor Vehicle Safety Act and National Highway Traffic Safety Administration (NHTSA) regulations.

All vehicles must be certified in the final stage. Certification is also a requirement for manufacturing operations performed on motor vehicles prior to the first purchase. For example, installing a service body, or removing a pickup box before the vehicle is sold requires certification. After the vehicle is certified in the final stage, and purchased, licensed, and titled, the certification obligation ends.

The four types of motor vehicle certification are incomplete vehicle (chassis cab, stripped chassis, cutaway, cowl); intermediate stage certification; final stage certification (the last maintenance operation before it is put into use); and altered certification (altering a previously certified vehicle). For example, adding a snowplow to a pickup truck requires altered certification and thereby so should the altered and converted gas vehicle to ZEV.

The incomplete vehicle document is a vital guide to the certification process. The manufacturer must include this document with every new incomplete vehicle. This document helps subsequent manufacturers determine what can or cannot be done to the incomplete vehicle in order to stay within the original manufacturers' guidelines. The same is necessary for the Completed ZEV vehicles as they are being tampered after certified as a gas vehicle.

The incomplete vehicle document contains the name and address of the incomplete vehicle manufacturer, the month and date of the last manufacturing operation, vehicle identification number, GVWR, gross axle weight rating, and vehicle type, such as truck or multipurpose passenger vehicle. The document also lists the standards (in effect at the time the incomplete vehicle was manufactured) that apply to each type, followed by a conformity statement. The three types of conformity statements are:

Type I: "A statement that the vehicle when completed will conform to the standard if no alterations are made in the identified components of the incomplete vehicle." Type II: "A statement of specific conditions of final manufacture under which the manufacturer specified that the completed vehicle will conform to the standards." Type III: "A statement that the conformity with the standard is not substantially affected by the design of the incomplete vehicle, and that the incomplete vehicle manufacturer makes no representation as to conformity with the standard."

**Analyzing Payload**

A payload analysis is vital because the distribution of chassis, body, and payload weight on a truck is critical to the proper operation and long life of the vehicle. It is possible for a vehicle to be overloaded even though it may not be loaded beyond the recommended GVWR. When a chassis/body combination is incorrectly matched or when the payload is not positioned properly, the front or rear gross axle weight rating (GAWR) may be overloaded.

Once the chassis configuration and payload capacity have been determined, a weight distribution calculation should be performed. This will verify that the weight of the body and/or payload is distributed to both the front and rear axles in proper proportions. It also assures that the front and rear GAWRs are not exceeded.

The weight of the driver and passenger(s) can sometimes make the difference between exceeding and not exceeding a vehicle's GAWR. Therefore, the weight of the driver and passenger(s) is included in the calculations when performing a weight distribution or payload analysis.

**Ultimate Responsibility**

The final stage manufacturer is the last line of defense for motor vehicle safety and bears full responsibility for any vehicle defects. If there is a defect or non-conformity in the original equipment produced by another manufacturer who refuses to recall the vehicle, the final stage manufacturer is still responsible for recalling the vehicle and correcting the problem. This is common in all technologies and there is no justification for this technology to not have enforcement with penalties when an OEM poisons the ZEV market. These are lessons learned that have been experienced and we need to move beyond after 10 years of an HVIP incentive program tied to this technology.

Once certification is complete, the certification label can be attached to the hinge pillar, the door-latch post, or the door edge that meets the door-latch post. It can also be placed next to the driver's seating position, to the left side of the instrument panel, or the inward facing surface of the door next to the driver's seating position.

## IV. WARRANTY

The 50,000-mile warranty does not meet the needs of the fleet nor does it keep the fleets and roadways safe with prototype technology and does not compare to other choices such as conventional fueled vehicles that continue to have increased warranty support. There is an overall contention by State regulators, and other industry professionals, that the current HD manufacturer warranty requirements for on-road heavy-duty vehicles are not sufficient to guarantee that emission control performance will be maintained throughout the exceptionally long service life of modern heavy-duty vehicles, (e.g., up to 1,200,000 miles). This lack of emission control maintenance may contribute to a negative economic impact, and poorer air quality in California. This impression is supported in large part by the results of the owner/operator survey summarized herein. Longer warranties could potentially assist with reduced emissions and provide better longevity

and durability for such vehicles. Specifically, longer warranties may contribute to timelier repair of malfunctioning components in heavy-duty vehicles and will likely lead to better vehicle maintenance (source CARB).
*https://www.arb.ca.gov/regact/2018/hdwarranty18/apph.pdf?_ga=2.205632208.2111585522.1549629595-405255107.1516164047*

## V. REPAIRS

Carb should create a mandatory repairability provision for this technology and an incentive program is necessary in order to support the technology as improvement has not been achieved toward garage services support for this technology and fleets cannot achieve confidence without such a provision. The same concerns should be realized with the lessons learned and the amount of downtime that will increase and effect emissions. This technology faces increased emissions when not supported to stay on the roads. Without an enforcement for garage service stations by ZEV OEM's when this technology is 100% proprietary, you cannot increase confidence without the ability to be ensured of support 24/7 in all local territories, additionally these are short range vehicles with high voltage.

See the below examples from CARB HD survey on associate cost when repairs and downtime occur.

Survey and Analysis of Heavy-Duty Vehicle Warranties in California Nov 2017.
*https://www.arb.ca.gov/regact/2018/hdwarranty18/apph.pdf?_ga=2.205632208.2111585522.1549629595-405255107.1516164047*

There were a significant number of days of lost revenue due to downtime for repairs. Following is a breakdown of the average number of days of downtime due to vehicles being out of commission:

| **Length of Downtime** | **% Owners** | **Estimated Total Days** |
|---|---|---|
| 1-2 days | 14% | 57 |
| 3-6 days | 32% | 396 |
| 1-2 weeks | 19% | 742 |
| 3-4 weeks | 16% | 1,078 |
| More than 1 month | 17% | > 1,400 |
| Total | 98% | > 3,673 |

Owner/Operator | Length of Repair Downtime • Owner/operators indicated that there was a significant loss of revenue attached to the downtime.

See below Table for the estimated costs associated with downtime as reported by on-road heavy-duty vehicle owners/operators:

Repair Shop owners/managers indicated that the most frequent year(s) of heavy-duty vehicles that come in for repairs are either models earlier than 2007 (25%), or 2010 and 2011 models (24%).•The majority of repair shops (56%) provide extended warranties (a warranty package that covers beyond the life of the manufacturer's mandatory warranty period) to their heavy-duty vehicle customers. The average cost of the most frequently purchased extended warranty package falls between $1,000 and $2,500 (41%), according to repair shop owners/managers. The majority (59%) of extended warranty packages cover one to two years beyond the life of the mandatory warranty period according to the repair shop owner/managers.

| **Loss of Revenue** | **% Owners** | **Estimated Total Revenue** |
|---|---|---|
| Zero | 5% | - |
| $1-$999 | 10% | $13,500 |
| $1,000 -$4,999 | 32% | $261,000 |
| $5,000 -$7,499 | 18% | $312,500 |
| $7,500-$9,999 | 11% | $253,750 |
| > $10,000 | 19% | $520,000 |
| Unsure | 5% | - |
| Total | 100% | $1,360,750 |

## VI. HVIP AND INCREMENTAL COST

The current HVIP MHD Sales to date only total 607 sales since 2009 with 365 sales by extinct OEM's that no longer exist and determines that the highest number of OEM sales by the existing OEM's is 58 by one OEM. This continues to address facts and concerns that all listed OEM's are still in the proto-type phase except for a couple of the OEMs' that have larger sales outside of California. The tables below depict the list of OEMs' with sales as of 1-23-19. A total of 17 OEM's have had a history of sales (the red text is OEM's that no longer exist) and a total of 12 OEM's are by remaining existing OEM's. The last table demonstrates the history and number of sales years over year since the HVIP began in 2009. *https://www.californiahvip.org/eligible-technologies/*

| | Vehicle OEM Sales | | |
|---|---|---|---|
| 1 | BYD Motors | 45 | 7.41% |
| 2 | Chanje | 20 | 3.29% |
| 3 | *EVI* | 112 | 18.45% |
| 4 | *Ford* | 51 | 8.40% |
| 5 | Lion Bus | 6 | 0.99% |
| 6 | Motiv Powers | 10 | 1.65% |
| 7 | *Navistar* | 34 | 5.60% |
| 8 | New Flyer | 0 | 0.00% |
| 9 | Orange EV | 26 | 4.28% |
| 10 | Phoenix MotorCars | 43 | 7.08% |
| 11 | Proterra | 23 | 3.79% |
| 12 | *Smith Electric* | 168 | 27.68% |
| 13 | Zenith Motors | 58 | 9.56% |
| 14 | Workhorse AMP / Thor | 1 | 0.16% |
| 15 | Lightning Systems | 3 | 0.49% |
| 16 | Eldorado National | 5 | 0.82% |
| 17 | Blue Bird | 2 | 0.33% |
| | **Total EV ZEV Sales** | **607** | **100.00%** |

| | New OEM's with Sales | | |
|---|---|---|---|
| 1 | BYD | 45 | 7.41% |
| 2 | Chanje | 20 | 3.29% |
| 3 | Lion Bus | 6 | 0.99% |
| 4 | Motive Powers | 10 | 1.65% |
| 5 | Orange EV | 26 | 4.28% |
| 6 | Phoenix MotorCars | 43 | 7.08% |
| 7 | Proterra | 23 | 3.79% |
| 8 | Zenith Motors | 58 | 9.56% |
| 9 | Workhorse AMP | 1 | 0.16% |
| 10 | Lightning Systems | 3 | 0.49% |
| 11 | Eldorado National | 5 | 0.82% |
| 12 | BlueBird | 2 | 0.33% |
| | | 242 | 39.87% |

| Fiscal Year Sales | | | |
|---|---|---|---|
| Fiscal Year 2009-10 | 1 | 0.16% | |
| Fiscal Year 2010-11 | 305 | 50.25% | |
| Fiscal Year 2011-12 | 55 | 9.06% | |
| Fiscal Year 2012-13 | 0 | 0.00% | 0.00% |
| Fiscal Year 2013-14 | 39 | 6.43% | 6.43% |
| Fiscal Year 2014-15 | 35 | 5.77% | 5.77% |
| Fiscal Year 2015-16 | 57 | 9.39% | 9.39% |
| Fiscal Year 2016-17 | 115 | 18.95% | 18.95% |
| | 607 | 100.00% | 40.53% |

SDAP has been procuring shuttles since 1991 and the baseline cost for a class 2b or 3 shuttle van is $50k not $80k which can be supported by the most recent quote attached dated 11-2018. Fleets needs incremental cost. The facts are that SDAP procured an Electric Van Class 3 at $105k in 2015 and today this same van is $120k and the rebate is less, the cost is NOT going down. Additionally, when procuring a ZEV, the voucher rebates will not support a reduced cost on sales tax, insurance and registration fees as all these cost and fees are derived from the listed purchase cost of the vehicle which creates more cost for a ZEV when compared to conventional fueled vehicles. Allow repowers with more incremental cost, the same as allowed for school buses, this will help accelerate adoption when the risk is so high. *See Appendix, Table 1*

Should be encouraged

## VII. OEM CREDITS AND EXEMPTIONS

Based on Volume of Sales, it appears that all existing OEM's on the HVIP list with sales will remain exempt for some time to come ---- further creating additionally concern to fleets. It is time to move this technology into the stage of compliance, there should be a penalty if the vehicle is not serviced and kept on the road. All sales should be USA based not just California based. Motor carrier operations are at stake and cannot risk product that is not supported or proven. The entire intention is to influence fleets to adopt and ensure confidence – exemptions will not achieve this. Additionally, you have acknowledged that few have expressed interest in the ZEVC.

## VIII. POWER LEVEL

**Power Level illustrated: AC verses DC charging**

The Single-Phase AC verses DC Fast Charging is illustrated below, *See Appendix, Table 3 & 4*

This can determine the site capacity and range and capacity and range can be increased with fast charging when available on the vehicle, even with one EVSE installed this can support these increases; but the vehicles power level needs to comport and accept DCFC:

(Assumption: Vehicle efficiency is 1 kWh per mile)

**19kW Charger:**

**100 miles divided by 19 miles per hour = 5.25 hours per day of charging.**

**50kW Charger:**

**100 miles divided by 50 miles per hour = 2.0 hours per day of charging.**

**100kW Charger:**

**100 miles divided by 100 miles per hour = 1.0 hours per day of charging.**

Commercial EV Fleets are already challenged by the Zero Emission vehicle technology whereby with a short range of 100 EV miles or less and with trying to keep its customer demand on its schedule with a short range EV bus or truck of 100 miles VS 300-miles of range, as in the conventional diesel bus or truck is extremely challenging. Moreover, the 19kW AC EVSE charger at 1 kWh per mile will take 5.25 hours to charge one vehicle and for a fleet of 3 vehicles it will take 16 hours of charging on the grid. However, a 50 kW DCFC EVSE will take 2 hours to charge the one vehicle and a 100 kW DCFC will take 1 hour to charge one vehicle.

Essentially the higher power levels create increased capacity on site just with 1 fast DCFC charger, increases the range potential when fast charging allows for the driver to schedule the time of the charging when the power level is high enough and thereby the miles replenished per minute achieve enough range to avoid peak time loading and charging while increasing the range. This illustrates that DCFC is another opportunity to manage charging which supports CPUC 740.12(a)1 part G.

Because several factors benefit fleets when fast power level is accepted and because this is the current advanced technology, and for all the reasons below, fast DCFC should be achieved for all MHD vehicles and it can also be determined that this will avoid the equipment ending up as a stranded asset.

(a) Increases range

(b) Creates higher site capacity

(c) Enables load management

(d) Supports Smart TOU Charging at the lowest CI hourly window

(e) Creates higher grid reliability

(f) Reduces Peak time loading

(g) Reduces losses when transmitting at a higher power level

(h) Reduces Demand fees as you can reduce simultaneous charging

(i) Reduces time on the grid

(j) Supports higher consumption per EVSE

(k) Reduces installation cost for fleets with multiple vehicles.

(l) Has higher efficiency

**The ZEPC should include a policy toward Advanced and fast DCFC minimum power level development and include higher incentives and funding, as minimum power levels for commercial technology is the future.** "Power Level", should support the future technology and should support the newest standards that are now being deployed in order to avoid any stranded assets and which enables the option to charge in a manner consistent with the electric grid conditions. When enough power is supported, this develops a reliable charging infrastructure which is critical to the commercial MHD sector.

## IX. CLASS 2B AND CLASS COMMERICAL VAN MARKET SHARE

**Not all commercial van chassis have van bodies mounted on them by OEMs. Some are sold as cab chassis and cutaways, which means they need to be upfitted. Many body styles — and an even larger number of equipment types — could be mounted. These commercial van chassis compete in the market with all other vocational truck chassis in their weight class and are ultimately sold as Class 1–3 trucks other than commercial vans. Among hundreds of possible applications, they could be used by local governments as ambulances or by landscape companies to plow snow.**

**ntea.com/marketdata** **Commercial van overview and market data insights**

### Commercial van market size

Commercial van sales data from the following sources differs from NTEA levels for various reasons. For year-end 2016, GoodCarBadCar said U.S. commercial van sales totaled 463,487 units. The WardsAuto total confirmed this report, citing more than 400,000 units. This would have been true for all sources based on sales by model data. In addition, many vans listed in Figure 1 (see page 2) are purchased by individuals for personal use, and those sales are included in the totals published by some sources. The total published by NTEA is roughly one-third lower than the estimates referenced above as its calculations only encompass commercial vans.

NTEA is a commercial van data source that explicitly excludes cab chassis and cutaway sales from the total. We include these items in the totals calculated for those cab types instead, so our overall sales sum will be less than those published by other sources.

In addition, NTEA's data collection process is intended to only include commercial vans used by businesses as work trucks or buses (see Figure 1 on page 2). In other words, most (if not all) cargo van sales captured by the Association go through an upfit process to have shelves/partitions/racks/bins installed. Almost all passenger van sales will likely be used for commercial transport (such as airport shuttles).

For 2016, NTEA's U.S./Mexico commercial van sales total was 264,164 units. The Canadian total was 27,932 units, so overall North American commercial van sales were 292,096 units. This total will likely increase to about 305,000 units in 2017. The market is segmented by weight class and roof-height in Figure 2. High roof-height vans allow for a worker to stand up inside the van. The term standard roof-height includes anything lower.

The Commercial Van Market, the Class 2b and Class 3 are widely used in commercial applications and for these reasons SDAP shares the following facts in support of the class of vehicles which is a growing market and will continue to be a growing market with the rise of the gig economy market. This information is difficult to obtain due to the various applications and van verses chassis configurations.

**In Europe and the U.S., chassis-cab sales are roughly one-half of commercial van sales in the Class 1–3 commercial truck market. On both sides of the Atlantic, this ratio could significantly influence how commercial truck industry companies interact with the van market, in terms of encouraging continued product innovation.**

## U.S. new business registrations of commercial vans

**2016 – Units**

| Vehicle type | Ford | GM | Mercedes-Benz | Nissan | Ram | Total |
|---|---|---|---|---|---|---|
| Van cargo | 33,030 | 7,426 | 0 | 17,934 | 2 | 58,392 |
| Van passenger | 10,674 | 0 | 0 | 12,316 | 16,976 | 39,966 |
| **Class 1 total** | **43,704** | **7,426** | **0** | **30,250** | **16,978** | **98,358** |
| Cutaway | 2,564 | 10,225 | 0 | 0 | 803 | 13,592 |
| Van cargo | 90,735 | 44,162 | 12,199 | 19,617 | 20,941 | 187,654 |
| Van passenger | 36,021 | 14,167 | 7,560 | 4,182 | 0 | 61,930 |
| **Class 2 total** | **129,320** | **68,554** | **19,759** | **17,799** | **27,744** | **263,176** |
| Cutaway | 19,553 | 11,859 | 0 | 0 | 0 | 31,412 |
| Van cargo | 1,120 | 0 | 2,094 | 0 | 0 | 3,214 |
| Van passenger | 2,112 | 0 | 0 | 0 | 0 | 2,112 |
| **Class 3 total** | **22,785** | **11,859** | **2,094** | **0** | **0** | **36,738** |
| **Total Classes 1–3** | **195,809** | **87,839** | **21,853** | **48,049** | **44,722** | **398,272** |
| Total minus cutaways | 173,692 | 65,755 | 21,853 | 48,049 | 43,919 | 353,268 |
| Fleet of one count | 49,848 | 14,551 | 10,860 | 18,954 | 13,482 | 107,695 |
| **Total minus cutaways and fleets of one** | **123,844** | **51,204** | **10,993** | **29,095** | **30,437** | **245,573** |

Source: IHS Markit

With cutaways and fleets of one removed from IHS Markit data, the bottom line is 245,573 new commercial vans registered in 2016 in the U.S. — within 20,000 units of NTEA's total, providing verification of the commercial van market size. It should be noted that the methodology applied to compare NTEA and IHS Markit numbers is not ideal. Some vans in fleets of one were upfitted and should be counted, and some personal-use vehicles are reported as commercial and vice-versa. In addition, some vans shipped as cutaways are not identified as such by IHS Markit. Lastly, new registrations will never be exactly equal to sales for any vehicle type in any year. Even still, the close match between IHS Markit's new registration total and NTEA's sales total validates the accuracy of both data sets. In short, the U.S. commercial van market was not greater than 400,000 units in 2016 — it was closer to 260,000 units for business registrations.

Figure 2 (see page 4) clarifies that Class 2 accounts for a majority of the commercial van market. Class 1 makes up most of the remainder, while Class 3 remains a small percentage of the total market in the standard and high roof-height segments. In 2016, the standard roof-height market segment was about twice as large as the high roof-height segment.

However, in the last two years, the market has changed significantly. As shown in Figure 3, the high roof-height market has been growing much faster than the standard roof-height segment. In fact, this data indicates the high roof-height segment represents all market growth since 2013. While standard roof-height sales trended down between 2013 and 2016, high roof-height sales more than doubled.

## X. REGULATE THE kWh EFFICIENCY THE SAME AS CORPORATE AVEARAGE FUEL ECONOMY STANDARDS

Without standards and improvement towards better economy the cost per mile with these heavy battery packs and no bench mark for achieving best fit for Class and vocation can create more cost per mile and more upstream emissions than is required and thereby there is no reason for not applying a standard as this impacts the cost per mile.

Potential cost comparing --- kWh to the price of fuel impacts the results.

Difference if EV kWh rate is more and or requires more kWh per mile.

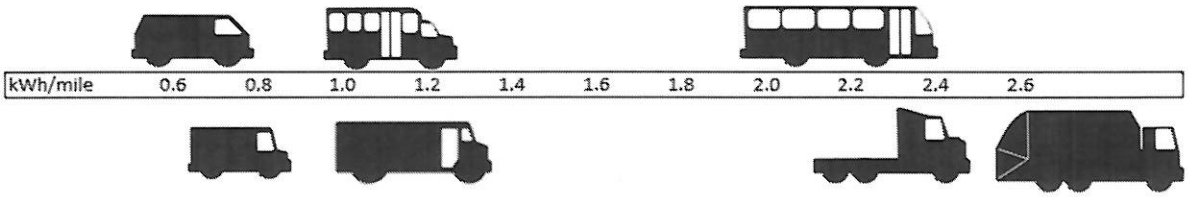
Example of 8 ¢ per mile more.

Fleet of 10 = 25,000 VMT/ year x 10 = $20,000 more / year with KWh

Fleet of 25 = 25,000 VMT/ year x 25 = $50,000 more / year with KWh

Fleet of 50 = 25,000 VMT/ year x 50 = $100,000 more / year with KWh

**EV Commercial Vehicle Fleet Efficiency**




The kWh per mile of the EV vehicle closely impacts the maximum range, the cost per mile of fuel, the charging time required, the number of EVSE's necessary to support the TE fleet. EV Fleet energy consumption needs to support the use case and the property where EV dispensing will take place when displacing from Fossil fuel or comparing results to other options that reduce tail pipe emissions such as Propane, CNG, Renewable diesel, Ethanol, B-20 fuel etc. Considering cost impacts to savings results for a typical fleet business depends on these factors to declare if a business case is feasible.

## XI. CONNECTION STANDARDS

**Connection Standards, SAE:** *See Appendix Table 5 for Industry Statements Testimony*

SAE High Power Charging connections - Current

SAE J-1772 CCS, to 1000 V, 350 A and 350 kW

SAE J-3068, 3- Phase AC, 480 V, 160 A and 133 kW

SAE J-2954-2, Wireless Inductive Charging, currently 11 kW with heavy duty specification being drafted at 22 kW up to 500 kW

SAE J-3105, inverted and roof-mounted overhead charging systems up to 500 kW

**Increasing Power levels:** *See Table 6*

**(1) J1772 new standard 400A and 1,000V**
*https://www.sae.org/standards/content/j1772_201710/preview/*

The SAE standards group has officially updated the J1772 standard to change DC Level 2 fast charging from its previous limit of 50-500 volts at 200 amps to 0-1,000 volts at 400 amps. The update specification was published October 2017.

**(2) J3068 new standard 1,000V**

**https://www.sae.org/standards/content/j3068_201804/**

The J3068 Standard was issued 4-2018. This Electric Vehicle Power Transfer System uses a Three-Phase Capable Coupler and was developed from existing international standards, which were extended to cover higher North American grid voltages and ultra-higher power levels. J3068 allows vehicles to fully utilize three-phase AC power where it is available and preferred, such as commercial and industrial locations. J3068 was developed in a consensus process by SAE International's Medium and Heavy-Duty Vehicle Conductive Charging Task Force Committee, which today is comprised of over 100 global experts from the automotive industry, utilities, charging equipment manufacturers, national laboratories, and academia.

The actual international specifications are all aligning to support 400 amps at 1,000 volts which is a peak theoretical 400 kW. Actual vehicles currently and typically charge at lower rates determined by their battery configuration and design. But, the typical charging voltages for the MHD currently starts at 50kW and most commercial trucks and buses of the future will range from 300-600 volts or more.

The CHAdeMO standards group in Japan updated their DC charge coupler specification to support 500 volts at 400 amps (200 kW) from its previous limit of 500 volts at 125 amps (62.5 kW). Efforts are under way to increase that again to 1,000 volts at 400 amps which will match the new SAE J1772 limits. China has their own AC and DC charging standards commonly called GB/T. The GB/T DC coupler already supports 1,000 volts at 400 amps.

Some new charger products from ABB and ChargePoint document support for DC charging at 500A under some configurations and currently EVgo has a 150-kW charger in Baker, California. These charger products are being introduced that directly support the MHD Trucks and Buses for the commercial sector and can support Ultra high-power levels which are just beginning to be delivered and installed and are mainly being introduced through the Electrify America deployment. The supplier companies are ABB, BTC Power, Efacec and Signet. These depots include 'certified cooled-cable 150/350-kilowatt (kW) DC Fast Charger technology. They are equipped with the same features, like a CHAdeMO (50kW) connector, plus additional dual-handle chargers with SAE CCS1 (50 to 150kW or 350 kW) connectors. Currently, there are not many vehicle passenger models that would accept anything beyond 100 kW, but, for the commercial sector, this is just the beginning and soon it will also be common for the high-end luxury passenger car market (150 kW) as manufacturers such as Audi, Jaguar, Porsche, Tesla and more are designing for this ultra-high power.

Specifically, in the Commercial MHD sector the battery sizes are larger which creates a demand for faster charging. And even now, in the newest passenger EV's batteries, they are three or four times the size of those original electric vehicles, making the fast, convenient and flexible charging essential to EV ownership and specifically to ensure fleets stay on the road and enable the option to manage the load and the time of charging. This new high-power level is just one way to ensure fleets can stay on the road and can have the flexibility that they will need in order to schedule charging while it also increases the scalability of EV adoption for a site. EVSE companies are working closely with many vehicle OEMs and suppliers to push the technology to where it needs to go in order to meet the needs for a robust, higher and faster charging network. This will not only meet the needs of fleets, it will support accelerated adoption as the technology barrier for range is removed and now with fast charging capability --- it keeps pace with the longer distances traveled by fleets.

## XII. RECOMMENDATIONS

SDAP recommends that the Board develop the following modifications and mandate a certification:

1. **Small Business**: The feasibility is not the same for small business; thereby more incentives and funding should be ear-marked to help accelerate adoption by small fleets. This could be achieved the same as the DAC.

2. **TRL**: Designs are still in the proto-type stage except for transit buses. Testing and mandates for certification are required to ensure safety and hazards from lessons learned are improved and forces the technology towards more commercialized products.

3. **GVWR**: Must test and no changes required to original OEM GVWR.

4. **Incomplete and Complete Vehicles:** All vehicles should be in compliance to ensure the technology is consistent and reliable. All manufacturers of vehicles should be required to be certified.

5. **Warranty**: Make a consistent, reliable, effective product and produce a quality product that matches the expected useful life the same as all other emission technologies. The expensive components should be treated with the same level of warranty support as emission vehicles and Hybrids. Specifically, this equipment and technology is 100% proprietary.

6. **Repairs**: Adopting a mandate for local garage services support is critical and is the only way to ensure fleets that the vehicles can stay on the road. Additionally, this impacts emissions when these vehicles cannot stay on the road.

7. **HVIP**: Establish incremental cost and provide metrics year over year in order for more transparency that is driven to be incremental, but this is not the case. Allow all vehicles to be re-powered and to have higher incremental cost, the same as school buses are allowed.

8. **OEM Credits**: Require volume to be by OEM and not just California based. Otherwise, every manufacturer will remain as exempt. Also, there should be a penalty if the OEM does not keep the vehicle on the road; yet, they received credits for the sale.

9. **Power Level**: kWh impacts range and time to charge which is optimally tied to the power level. Commercial fleets will require fast DCFC and requiring and encouraging OEM's to invest with advanced technology by higher rebates are appropriate as power level creates many benefits and avoids a stranded asset.

10. **Class 2b-3**: Adoption of Class 2b and 3 is increasing and will continue thereby procedures to support completed vehicles and Class 2b and 3 should fall under the same measure.

11. **Efficiency on kWh per mile**: Establish efficiency bench mark on cost per mile and improve the technology as it is already a barrier due to the heavy weight.

12. **Connector Standards**: Require a defined standard or two. Exiting standards are needed in order to drive the technology forward with feasibleness.

## XIII. CONCLUSION

SDAP agrees with a ZEPC; however, without the modifications addressed, the optional certification will achieve no greater success in the short term and the remaining outstanding issues raised and the lessons learned will continue to be repeated. SDAP has shared facts in the foregoing comments and has provided evidence from the EV fleet end user experience that supports the need for a mandated ZEPC. Currently the lack of policy, regulations and standards to support the EV commercial MHD technology to move beyond the prototype phase needs to be considered as fleets adopting need a cost-effective solution that improves the technology and ensures fleets that it is reliable for the same useful life as that of fossil fuel vehicles. Addressing the emerging technology changes and lessons learned can only be comprehended by actual on the ground experience. The expected achievements of this technology cannot be identified the same as a real-world experience for the specific application. Supporting accelerated adoption of this technology can best be accomplished when a certification matches the useful life and the warranty supports the expensive components.

Respectfully submitted,

/s/ Lisa McGhee
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Tel: 714-881-4856, E-mail: sdapparking@gmail.com

Dated: February 21, 2019

# Appendix:

## Table 1: 1-23-19 , HVIP MHD Mapping Tool Results

- **607 Total MHD Sales since 2009**
- **365 Sales are from Extinct OEM's that no longer exist (see red font)**
- **The most sales by any one OEM per the list of current active OEM's in the HVIP list is "58" sales**

Uploaded on 1-23-19 | HVIP Data updated last on 12-1-2018 | https://www.californiahvip.org/eligible-technologies/

### Fiscal Year Sales

| | | | | |
|---|---|---|---|---|
| 1 | Fiscal Year 2009-10 | 1 | 0.16% | |
| 2 | Fiscal Year 2010-11 | 305 | 50.25% | |
| 3 | Fiscal Year 2011-12 | 55 | 9.06% | |
| 4 | Fiscal Year 2012-13 | 0 | 0.00% | 0.00% |
| 5 | Fiscal Year 2013-14 | 39 | 6.43% | 6.43% |
| 6 | Fiscal Year 2014-15 | 35 | 5.77% | 5.77% |
| 7 | Fiscal Year 2015-16 | 57 | 9.39% | 9.39% |
| 8 | Fiscal Year 2016-17 | 115 | 18.95% | 18.95% |
| 8 | Total over 8 Years | 607 | 100.00% | 40.53% |
| | | 246 | | Last 5 Years |

### Vehicle Class Sales

| | | | |
|---|---|---|---|
| 1 | LDA | 51 | 8.40% |
| 2 | Class 2 | 0 | 0.00% |
| 3 | Class 3 | 98 | 16.14% |
| 4 | Class 4 | 8 | 1.32% |
| 5 | Class 5 | 110 | 18.12% |
| 6 | Class 6 | 234 | 38.55% |
| 7 | Class 7 | 16 | 2.64% |
| 8 | Class 8 | 90 | 14.83% |
| 8 | Total Z | 607 | 100.00% |

### Vehicle Vocation Sales

| | | | |
|---|---|---|---|
| 1 | Beverage Delivery | 29 | 4.78% |
| 2 | Parcel Delivery | 200 | 32.95% |
| 3 | Other Truck | 207 | 34.10% |
| 4 | Other Bus | 22 | 3.62% |
| 5 | School Bus | 10 | 1.65% |
| 6 | Shuttle Bus | 87 | 14.33% |
| 7 | Urban Bus | 52 | 8.57% |
| 7 | Total Vehicle Vocation Sales | 607 | 100.00% |
| | Bus Sales | 171 | 28.17% |

### Vehicle OEM Sales

| | | | |
|---|---|---|---|
| 1 | BYD Motors | 45 | 7.41% |
| 2 | Chanje | 20 | 3.29% |
| 3 | EVI (First Priority) | 112 | 18.45% |
| 4 | Ford | 51 | 8.40% |
| 5 | Lion Bus | 6 | 0.99% |
| 6 | Motiv Powers | 10 | 1.65% |
| 7 | Navistar (Workhors | 34 | 5.60% |
| 8 | New Flyer | 0 | 0.00% |
| 9 | Orange EV | 26 | 4.28% |
| 10 | Phoenix MotorCars | 43 | 7.08% |
| 11 | Proterra | 23 | 3.79% |
| 12 | Smith Electric (Ch | 168 | 27.68% |
| 13 | Zenith Motors | 58 | 9.56% |
| 14 | Workhorse AMP / T | 1 | 0.16% |
| 15 | Lightning Systems | 3 | 0.49% |
| 16 | Eldoardo National | 5 | 0.82% |
| 17 | Blue Bird | 2 | 0.33% |
| | Total EV ZEV Sa | 607 | 100.00% |

### OEM Sales 12-1-2017, Increase since 12-1-17

| | | | | |
|---|---|---|---|---|
| 1 | BYD Motors | 40 | 5 | (Bus/Truck) |
| 2 | Chanje | 0 | 20 | (Truck) |
| 3 | Lion Bus | 0 | 6 | (Bus) |
| 4 | Motiv Powers | 10 | 0 | (Truck/Bus) |
| 5 | New Flyer | 0 | 0 | (Bus) |
| 6 | Orange EV | 0 | 26 | (Truck) |
| 7 | Phoenix MotorCar | 42 | 1 | (Bus/Truck) |
| 8 | Proterra | 10 | 13 | (Bus) |
| 9 | Zenith Motors | 43 | 15 | (Bus/Truck) |
| 10 | Workhorse AMP / | 0 | 1 | (Truck) |
| 11 | Lightning Systems | 0 | 3 | (Bus/Turck) |
| 12 | Eldoardo National | 0 | 5 | (Bus) |
| 13 | Blue Bird | 0 | 2 | (Bus) |
| | Total EV ZEV Sales | 97 | | |

### New OEM's with Sales

| | | | |
|---|---|---|---|
| 1 | BYD | 45 | 7.41% |
| 2 | Chanje | 20 | 3.29% |
| 3 | Lion Bus | 6 | 0.99% |
| 4 | Motive Powers | 10 | 1.65% |
| 5 | Orange EV | 26 | 4.28% |
| 6 | Phoenix MotorCars | 43 | 7.08% |
| 7 | Proterra | 23 | 3.79% |
| 8 | Zenith Motors | 58 | 9.56% |
| 9 | Workhorse AMP | 1 | 0.16% |
| 10 | Lightning Systems | 3 | 0.49% |
| 11 | Eldoardo National | 5 | 0.82% |
| 12 | BlueBird | 2 | 0.33% |
| | | 242 | 39.87% |

### Shuttle / Bus ZEV OEM Sales

| | | | | |
|---|---|---|---|---|
| 1 | BYD Motors | 45 | 26.16% | All Class 7 (10) and rest Class 8 |
| 2 | Lion Bus | 6 | 3.49% | All Class 8 |
| 3 | Motiv Powers | 5 | 2.91% | |
| 4 | New Flyer | 0 | 0.00% | |
| 5 | Phoenix MotorCars | 41 | 23.84% | |
| 6 | Proterra | 23 | 13.37% | All Class 8 |
| 7 | Zenith Motors | 43 | 25.00% | |
| 8 | Lightning Systems | 2 | 1.16% | |
| 9 | Eldoardo Nation | 5 | 2.91% | All Class 8 |
| 10 | Blue Bird | 2 | 1.16% | |
| | Total Bus Sales | 172 | 28.34% | |

SHUTTLES: HD verses MD

| | | |
|---|---|---|
| 81 | Heavy Duty = | 47.09% |
| 91 | Medium Duty = | 52.91% |

### Extinct OEM's

| | | | | |
|---|---|---|---|---|
| 1 | EVI | 18.45% | 112 | Fiscal Year 2010-11 |
| 2 | Ford (LDA) | 8.40% | 51 | Fiscal Year 2010-11 |
| 3 | Navistar | 5.60% | 34 | Fiscal Year 2010-11 |
| 4 | Smith Electric | 27.68% | 168 | Fiscal Year 2010-11 and 2011-12 |
| | | 60.13% | 365 | |

Overall Total ZEV Sales 607 100.00%

HVIP Funding = $37.7 Million to date for ZEV's

*California needs 150,000 Trucks to Meet Emission Reduction Goal*

**Table 2: Ford Transit Van Class 3 Shuttle Quote 11-2017**

- **Purchase price $50,280**
- **See GVWR – page 2 of quote.**

Fritts Ford
9000 Auto Drive, Riverside, California, 925044103
Office: 951-687-2121

**2019 Transit-350, High Roof HD Ext. Passenger Van**
High Roof HD Ext. Passenger Van 147.6" WB DRW XLT(U4X)
Price Level: 928

## Selected Equipment & Specs

### Dimensions

- Exterior length: 268.1"
- Exterior height: 107.7"
- Front track: 68.6"
- Turning radius: 23.9'
- Rear legroom: 33.7"
- Front headroom: 58.6"
- 3rd row headroom: 65.2"
- Rear hiproom: 69.6"
- Front shoulder room: 67.9"
- 3rd row shoulder room: 67.0"
- Maximum cargo volume: 515.0cu.ft.
- Exterior width: 81.3"
- Wheelbase: 147.6"
- Rear track: 65.7"
- Front legroom: 39.7"
- 3rd row legroom: 35.6"
- Rear headroom: 55.2"
- Front hiproom: 67.5"
- 3rd row hiproom: 67.3"
- Rear shoulder room: 71.4"
- Cargo volume: 112.0cu.ft.

### Powertrain

- 275hp 3.7L DOHC 24 valve V-6 engine with Ti-VCT variable valve control, SMPI
- ULEV II
- Rear-wheel drive
- Fuel Economy Highway: N/A
- Recommended fuel : regular unleaded
- 6 speed automatic transmission with overdrive
- Fuel Economy City: N/A
- Capless fuel filler

### Suspension/Handling

- Front independent strut suspension with anti-roll bar, HD shocks
- Hydraulic power-assist rack-pinion Steering
- LT195/75SR16 CBSW AS front and rear tires
- Rear rigid axle leaf spring suspension with HD shocks
- Front and rear 16 x 7 silver forged aluminum wheels
- Dual rear wheels

### Body Exterior

- 3 doors
- Driver and passenger power remote heated, power folding door mirrors with turn signal indicator
- Black door mirrors
- Running boards
- Front and rear 16 x 7 wheels
- Sliding right rear passenger
- Turn signal indicator in mirrors
- Black bumpers
- Clearcoat paint
- 1 rear tow hook(s)

### Convenience

- Manual air conditioning
- Auxiliary rear heater
- Power front windows
- Remote power door locks with 2 stage unlock and illuminated entry
- Manual telescopic steering wheel
- 1 1st row LCD monitor
- Dual illuminated visor mirrors
- Driver and passenger door bins
- Rear HVAC
- Cruise control with steering wheel controls
- Driver 1-touch down
- Manual tilt steering wheel
- Day-night rearview mirror
- Front and rear cupholders
- Full overhead console
- Rear door bins

### Seats and Trim

- Seating capacity of 14
- 4-way driver seat adjustment
- 4-way passenger seat adjustment
- Driver and passenger armrests
- Front bucket seats
- Manual driver lumbar support
- Manual passenger lumbar support
- Fixed rear bench seat

Prices and content availability as shown are subject to change and should be treated as estimates only. Actual base vehicle, package and option pricing may vary from this estimate because of special local pricing, availability or pricing adjustments not reflected in the dealer's computer system. See salesperson for the most current information.

Prepared by: John Wittsey Date: 11/07/2018

# Selected Equipment & Specs (cont'd)

- Fixed 3rd row split-bench seat
- Removable 5th row split-bench seat
- Metal-look instrument panel insert
- Fixed 4th row split-bench seat
- Cloth seat upholstery

## Entertainment Features

- AM/FM stereo radio
- CD-MP3 decoder
- 8 speakers
- Single CD player
- Auxiliary audio input
- Fixed antenna

## Lighting, Visibility and Instrumentation

- Halogen aero-composite headlights
- Variable intermittent front windshield wipers
- Rear window defroster
- Deep tinted windows
- Tachometer
- Trip computer
- Trip odometer
- Fully automatic headlights
- Rain sensing wipers
- Fixed rearmost windows
- Front and rear reading lights
- Camera(s) - rear
- Parking sensors
- Lane departure

## Safety and Security

- 4-wheel ABS brakes
- 4-wheel disc brakes
- ABS and driveline traction control
- Dual seat mounted side impact airbag supplemental restraint system
- Airbag supplemental restraint system occupancy sensor
- Manually adjustable front head restraints
- Brake assist with hill hold control
- AdvanceTrac w/Roll Stability Control Electronic stability control
- Dual front impact airbag supplemental restraint system
- Safety Canopy System curtain 1st, 2nd and 3rd row overhead airbag supplemental restraint system
- Power remote door locks with 2 stage unlock and panic alarm
- Manually adjustable rear head restraints

## Dimensions

### *General Weights*

| | | | |
|---|---|---|---|
| Curb | 7219 lbs. | GVWR | 10360 lbs. |
| Payload | 3480 lbs. | | |

### *Front Weights*

| | | | |
|---|---|---|---|
| Front GAWR | 4130 lbs. | Front curb weight | 3350 lbs. |
| Front axle capacity | 4130 lbs. | Front spring rating | 4130 lbs. |
| Front tire/wheel capacity | 4298 lbs. | | |

### *Rear Weights*

| | | | |
|---|---|---|---|
| Rear GAWR | 6720 lbs. | Rear curb weight | 3869 lbs. |
| Rear axle capacity | 7275 lbs. | Rear spring rating | 6720 lbs. |
| Rear tire/wheel capacity | 8156 lbs. | | |

### *General Trailering*

| | | | |
|---|---|---|---|
| Towing capacity | 3800 lbs. | GCWR | 11200 lbs. |

### *Fuel Tank type*

| | | | |
|---|---|---|---|
| Capacity | 24.99 gal. | Capless fuel filler | Yes |

### *Off Road*

| | |
|---|---|
| Load floor height | 28 " |

Fritts Ford
8000 Auto Drive, Riverside, California, 925044193
Office: 951-687-2121

**2019 Transit-350, High Roof HD Ext. Passenger Van**
High Roof HD Ext. Passenger Van 147.6" WB
DRW XLT(U4X)
**Price Level: 920**

# Selected Options (cont'd)

| Code | Description | MSRP |
|---|---|---|
| **Emissions** | | |
| 425 | 50-State Emissions System | N/C |
| | *Standard equipment on all non-FFV vehicles including the 3.5L EcoBoost V6 and 3.2 I-5 diesel engines. Required for 3.7L Ti-VCT engines shipped to California emission state dealers (CA, CT, DE, MA, MD, ME, NJ, NY, OR, PA, RI, VT, WA). Optional for 3.7 Ti-VCT engines shipped to cross border state dealers (AZ, DC, ID, NH, NV, OH, VA, WV) and fleet orders.* | |
| **Interior Colors** | | |
| CB_02 | Charcoal Black | N/C |
| **Primary Colors** | | |
| YZ_01 | Oxford White | N/C |
| SUBTOTAL | | $48,885.00 |
| Destination Charge | | $1,395.00 |
| TOTAL | | $50,280.00 |

## Table 3:

## SDGE ADVICE LETTER on GSP Modification requesting more DCFC

- **DCFC utilization is required to effectively support Airport EV Shuttles in the GSP SDGE PR Pilots, thereby a modification was requested for more DCFC and no Level-2 Charging for the Airport Shuttle use case.**

January 14, 2019

**ADVICE LETTER 3332-E**
(U 902-E)

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

**SUBJECT: Modification to the Green Shuttle Project in Compliance with Decision 18-01-024**

**PURPOSE**

Decision (D.) 18-01-024 approved San Diego Gas & Electric Company's (SDG&E's) Green Shuttle Priority Review Project ("Green Shuttle" or "the Project"). SDG&E has faced implementation challenges with this project, and as such it is requesting a modification to effectively implement the Project and transition customers to electric shuttles.

With respect to implementation, D.18-01-024 ordered the following:

> "[t]he utilities should finalize implementation details for the approved projects based on feedback from its PAC. If a utility identifies any modifications necessary to effectively implement the programs approved in this decision, it should propose those modifications via a Tier 2 Advice Letter after reviewing the changes with their PAC."[1]

In accordance with D.18-01-024, SDG&E discussed the modification to the Project at a PAC meeting on September 25, 2018. There were no protests or objections from the PAC members to the proposed modification. SDG&E hereby submits the same modification proposal presented at that PAC meeting in this Advice Letter. SDG&E believes that the proposed modification to the Project, described below, will support an effective implementation of the Project, further California's greenhouse gas reduction goals, demonstrate the viability of Electric Vehicles (EVs), and accelerate EV adoption.

**PROPOSED MODIFICATION TO SDG&E's GREEN SHUTTLE PROJECT**

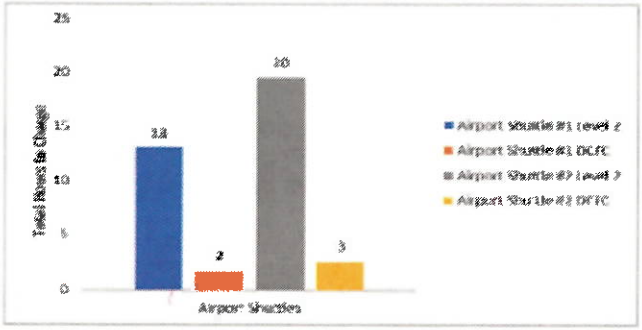
SDG&E proposes to modify an aspect of the Green Shuttle Project as approved in D.18-01-04. The modification will help SDG&E better serve site host needs, which will enable the EV market. SDG&E proposes to modify the program to increase the number of Electric Vehicle Supply Equipment (EVSE) it can provide for site hosts in order to better meet the site host's business needs. The table below outlines the authorized EVSE for each site and SDG&E's modification request, which is based on customer input.

[1] D.18-01-040 page 94.

| Modification | Decision | Detailed Modification Request |
|---|---|---|
| Site Design | SDG&E is authorized to install two Level 2 EVSEs and up to one DCFC at up to five (5) sites. | Airport Shuttle Sites: two (2) DCFCs for each site for a total of six (6) DCFCs |
| | | Workplace: total of six (6) Level 2 EVSEs at one site |

The original site design proposed by SDG&E in A.17-01-020 was designed to support a variety of EV types, including Class 1, 2, and 3 vehicles, by installing two Level 2 (L2) chargers and up to one DC Fast Charging (DCFC) at each site[2]. The decision modified the types of vehicles to focus on, but not the charging infrastructure or site design to support these vehicles. SDG&E is asking to modify the number and type of EVSEs per site to meet the needs of the site hosts operating electric shuttles, which have different charging requirements and duty cycles than Class 1 light-duty vehicles. To demonstrate the need for this modification, SDG&E will provide descriptions of two use cases represented by SDG&E's current site hosts: airport shuttles and workplace shuttles.

Airport shuttles, which include both offsite airport parking shuttles and a shuttle at the San Diego International Airport (SDIA), have predictable duty cycles with very little down time for charging. Even though these shuttles can accommodate both L2 and DCFC EVSE, the size of the battery and their duty cycles mean that a shuttle charged with a L2 EVSE will not receive a sufficient charge in its limited down time. To illustrate, one shuttle has an onboard AC charger that charges at a rate of 6.6kW. The DC fast charge accepts a connection up to 50kW. Using a L2 EVSE at a power level of 6.6kW for a shuttle that has a 129kWh battery would take up to 13 hours of charging time to get a full charge. The chart below illustrates the dramatic differences between a L2 and DCFC when it comes to charging speeds.[3]




Airport shuttle operations are nearly 24 hours a day, with the longest downtime being from 1:00 – 4:00am. Due to this limited time frame, the only way these shuttle operators can keep their

[2] US Department of Energy, Vehicle Weight Classes and Categories, https://www.afdc.energy.gov/data/10380

[3] Airport Shuttle #1 is based on a shuttle with a battery size of 86kWh and Airport Shuttle #2 is based on a shuttle with a battery size of 129kWh.

shuttles on the road and provide flexibility to avoid charging during peak times would be to charge with DCFCs. One of SDG&E's goals for this project is to demonstrate the viability of managed charging. Without DCFCs for their airport shuttles, shuttle operators will not be able to fully charge their vehicles during off-peak hours and the shuttles' limited down time, resulting in a poor user experience which could discourage them from adopting electric shuttles. Additionally, it might not make business sense for these customers to convert to EVs if the ability to charge in a certain, limited, timeframe is not possible.

The second use case is a workplace shuttle for a San Diego based company ("Workplace Shuttle"). The Workplace Shuttle customer has 6 shuttles operating daily on fixed routes. These shuttles are different from the airport shuttles mentioned above because they have a longer downtime period and the shuttles do not accommodate DCFCs. The Workplace Shuttles are used primarily during business hours (6:30am-5:00pm), which allow for longer charging times in the off-peak periods. However, the site host seeks six L2 chargers, or a 1x1 ratio of charger to shuttle so that the workplace can charge their vehicles during super off-peak hours. Without a dedicated charger for each shuttle the Workplace Site customer would need to charge during on-peak hours and through the night (starting at 5:00 PM – 7:00 AM) to get a full charge—this would cut into their driving time. Therefore, the workplace site requires a 1x1 charger to shuttle ratio to meet its business needs and managed charging goals.

As ordered in the Decision, SDG&E is working with project participants to design sites that best meet the shuttle companies' needs.[4] The modification, requested herein, is to offer customers up to two DCFCs at the airport shuttle sites and six high powered L2s at the Workplace Shuttle site. The previously approved budget can accommodate the proposed modification, which is designed to meet the needs of the program participants and will facilitate an increase adoption and utilization of EVs in their fleet thereby reducing GHG emissions. Additionally, approving the modification will allow the program participants to operate in a way that provides a better customer experience, thereby demonstrating the viability of EVs in this sector.

## EFFECTIVE DATE

This submittal is subject to Energy Division disposition and is classified as Tier 2 (effective after staff approval) pursuant to GO 96-B and D.18-01-024. SDG&E respectfully requests that this advice letter become effective on February 13, 2019, 30 days from the date of this filing.

## PROTEST

Anyone may protest this Advice Letter to the California Public Utilities Commission. The protest must state the grounds upon which it is based, including such items as financial and service impact, and should be submitted expeditiously. The protest must be made in writing and must be received no later than February 4, 2019, which is more than 20 days from the date this Advice Letter was filed with the Commission. There is no restriction on who may submit a protest. The address for mailing or delivering a protest to the Commission is:

CPUC Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102

[4] D.18-01-040, Ordering Paragraph 8

**Table 4:**

**DCFC CHARGING RESULTS**

**(increased capacity of kWh range, see columns D & H)**

- **Efficiency of EV vehicle impacts the results on Cost per Mile and Range Maximum of EV vehicle, see column F & G.**
- **DCFC enables Managed Charging.**
- **Charging Connector, see column E. Note of these 5 illustrated, there are "5" different Connectors.**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | OEM | kWh Battery Capacity, for Range potential | DCFC kW Charging Level, Speed Acceptance | Charging Connection / Receptacle Plug | Average KWh per Mile, for efficiency which impacts cost per mile & results in Range Maximum. | Range | Average Miles per one hour of Charging | SDGE AL TOU kWh Average Rate (out the door kWh rates illustrated). | Cost Per Mile Illustration. |
| 4 | 1 | Lightning Systems Passenger Shuttle | 80 | 50 | SAE CCS, 50 kW, DCFC | 0.66 | 121.21 | 33 | 0.46 | 0.30 |
| 5 | 2 | Phoenix MotorCars E450 Shuttle | 105 | 50 | Chadmo, 50 KW, DCFC | 1.1 | 95.45 | 55 | 0.36 | 0.40 |
| 6 | 3 | Green Power EV Star Shuttle | 100 | 50 | SAE CCS, 50 KW, DCFC | 0.77 | 129.87 | 38.5 | 0.46 | 0.35 |
| 7 | 4 | BYD Motors -C6 Shuttle | 135 | 0 | BYD EVSE, Level-3 AC, 80 kW (7-pin inlet plug Connector BYD proprietary for EV). | 1.1 | 122.73 | 0 | 0.36 | 0.40 |
| 8 | 5 | Motiv Power Systems E-450 Shuttle | 106 | 0 | Meltric Plug, Level-2 AC, 19 kW (208V, 80amp 3-phase Proprietary for EV). | 1.2 | 88.33 | 0 | 0.36 | 0.43 |
| 9 | | DCFC CHARGING ILLUSTRATION - RATES AND SHUTTLE COST PER MILE ILLUSTRATED | | | | | | | | |

## AC CHARGING RESULTS
## (reduced capacity of kWh range, see columns D & H)

- **Efficiency of EV vehicle impacts the results on Cost per Mile and Range Maximum of EV vehicle, see column F & G.**
- **Charging Connector, see column E. Note of these 5 illustrated, there are "5" different Connectors.**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | | OEM | kWh Battery Capacity, for Range potential | AC kW Charging Level, Speed Acceptance | Charging Connection / Receptacle Plug | Average KWh per Mile, for efficiency which impacts cost per mile & results in Range Maximum. | Range | Average Miles per one hour of Charging | SDGE AL TOU kWh Average Rate (out the door kWh rates illustrated). | Cost Per Mile Illustration. |
| 12 | 1 | Lightning Systems Passenger Shuttle | 80 | 6.6 | J1772 AC at 6.6 kW | 0.66 | 121.21 | 4.36 | 0.46 | 0.30 |
| 13 | 2 | Phoenix MotorCars E450 Shuttle | 105 | 13 | J1772 AC at 13kW | 1.1 | 95.45 | 14.3 | 0.36 | 0.40 |
| 14 | 3 | Green Power EV Star Shuttle | 100 | 10 | J1772 AC at 10 kW | 0.77 | 129.87 | 7.7 | 0.46 | 0.35 |
| 15 | 4 | BYD Motors -C6 Shuttle | 135 | 80 | BYD EVSE, Level-3 AC, 80 kW (7-pin inlet plug Connector BYD proprietary for EV). | 1.1 | 122.73 | 88 | 0.36 | 0.40 |
| 16 | 5 | Motiv Power Systems E-450 Shuttle | 106 | 19 | Meltric Plug, Level-2 AC, 19 kW (208V, 80amp 3-phase Proprietary for EV). | 1.2 | 88.33 | 22.8 | 0.36 | 0.43 |
| 17 | | AC CHARGING ILLUSTRATION -- RATES AND SHUTTLE COST PER MILE ILLUSTRATED | | | | | | | | |

**Table 5:**

**INTERNATIONAL CONNECTOR TYPE STANDARDS ARE NEEDED FOR COMMERCIAL TE BUS AND TRUCKS**


- ***State leaders could set infrastructure standards and efficiency metrics for key areas as soon as possible.***

Industry participants stressed the need for government standard-setting—in consultation with industry—in a handful of areas critical to the promotion of efficient technologies: electric vehicle and equipment plug sizes; electric vehicle and equipment charging speeds; and smart and autonomous vehicle communication protocols.

Vehicle and equipment electrification and autonomous vehicle technologies topped nearly every participant's list of necessary technological developments, as well as industry participants' lists of developments already underway. Each of these technologies will necessarily interact with centralized infrastructure or otherwise require cross-industry compatibility in order to be fully functional.

For example, electrified trucks will be produced by dozens of manufacturers, but will need to be able to charge at shared stations along public highways. But charging station technology is also being developed by multiple companies that may use different physical plug formats (think of the different household wall outlet shapes in the U.S. and Europe), and different charging speeds (such as the Level 1, Level 2 and DC fast charging formats currently available for passenger electric vehicles) that may not be compatible with every vehicle. While market forces could eventually determine one dominant technology to which all manufacturers adapt, such as the now-ubiquitous USB port present in all personal computers,[29] it would save both time and money if state leaders, together with industry representatives, could select formats around which all manufacturers could focus their development efforts.

*"We need to set standards for charging infrastructure such as connectors and voltage. Standards will speed innovation as well as ensure interoperability for freight trucks that visit a variety of facilities."*

**- Elizabeth Fretheim, Walmart**

**Case Study in Standardization:**
**Electric Vehicle Charging**

Currently, three main options exist for passenger electric vehicle charging. Level 1 charging uses 120-volt outlets found in most homes and can add about five miles of range per hour. Level 2 charging involves 240-volt current that can add about 25 miles of range per hour but usually requires new wiring within a home. DC fast-charging can charge a vehicle up to 90 miles of range in 30 minutes and requires installation of dedicated charging infrastructure. Since each technology has its own charging protocols and outlet designs, some vehicle models can only charge where the right charging stations are located. While electric trucks will likely rely on their own, separate charging infrastructure, a similar situation would severely limit their range and economic viability.

**Table 6:**
**STANDARD CONNECTORS**

## SAE High Power Charging Documents

**Manual DC connection at high power-** SAE J-1772 CCS

An existing document that will make provisions for the higher power (1000V, 350A, 350 kW) needs of the buses

**Manual 3 phase AC at high power-** SAE J-3068

Recently published document that is getting good acceptance

**Wireless connection at high power-** SAE J-2954-2

A developing document that will make provisions for the higher power needs of the buses

**Automatic Charging at high power-** SAE J-3105

Document planned to be published in early 2019

## Example – Power Table

| Continuous (A) | 277VAC 1Φ (kW) | 208VAC 3Φ (kW) | 480VAC 3Φ (kW) | Breaker (A)* [NEC] |
|---|---|---|---|---|
| 16 | 4.4 | 5.8 | 13.3 | 20 |
| 20 | 5.5 | 7.2 | 16.6 | 25 |
| 32 | 8.9 | 11.5 | 26.6 | 40 |
| 63 | 17.5 | 22.7 | 52.4 | 80 |
| 80 | 22.2 | 28.8 | 66.5 | 100 |
| 100 | 27.7 | 36.0 | 83.1 | 125 |
| 120 | 33.2 | 43.2 | 99.8 | 150 |
| 140 | 38.7 | 50.4 | 116.4 | 175 |
| 160 | 44.3 | 57.6 | 133.0 | 200 |

*NEC 240.6 Fuses and Fixed-Trip Circuit Breakers. The standard ampere ratings for fuses and inverse time circuit breakers shall be considered: 15, 20, 25, 30, 35, 40, 45, 50, 70, 80, 90, 100, 110, 125, 150, 175, 200, ...
*NEC 625, EV loads are considered continuous loads and the breakers rated at 125%. Breakers in other counties are differently rated.

**SAE J3068**