

Public Workshop on the Proposed

**Innovative Clean Transit Regulation
Discussion Document**

December 15, 2017

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Executive Summary

The California Air Resources Board (CARB or Board) is developing strategies to transition the heavy-duty mobile source sector to zero and near-zero emission technologies to meet air quality, climate, and public health protection goals. The long-term vision of the Innovative Clean Transit (ICT) effort is to achieve a zero emission transit system by 2040 as a key step in that transition. The following are key goals we seek to achieve:

- Support the near-term deployment of zero emission buses (ZEB) where the economics are viable and where transit service can be maintained or expanded.
- Improve transit service while working towards meeting a long-term vision for transitioning to zero emission technologies across all transit modes.
- Partner with transit agencies to pilot innovative approaches to improve access to transit systems with zero emission first- and last-mile solutions.

Transit agencies have often been leaders in facilitating the introductions of new technologies and have been partners in addressing air quality by continuing to be instrumental in leading adoption of low nitrogen oxide (NOx) engines, zero emission technology deployment in heavy duty vehicle applications, and in addressing barriers. This document describes a proposal for a complete transition of public transit fleets to zero emission technologies and includes safeguards to allow for adjustments if needed. This regulatory strategy is intended to complement other existing State policies while encouraging transit agencies to act early to take advantage of existing and potentially new incentive programs that improve transit services and reduce emissions, and provides transit agencies the flexibility to continue to evolve to meet expanding needs for effective, efficient, and affordable regional transit services across California.

The proposal is generally consistent with normal purchase schedules and would not require any accelerated purchases. It is structured to allow transit agencies to take advantage of incentive programs by acting early, proposing that purchases made before they are required can be used to meet future obligations. All fleets would need to report bus information annually to demonstrate compliance, and agencies that use other proposed compliance options would need to report additional information. We are also proposing to conduct periodic informational updates to the Board. The first informational update to the Board would be around 2022 to assess zero emission technology, fleet experiences, costs, and to evaluate the regulatory structure for achieving mobility improvements and a complete transition to a zero emission future. The informational updates to the Board would provide an opportunity to discuss any needed adjustments.

Please send any comments about this discussion draft to Shirin Barfjani at Shirin.Barfjani@arb.ca.gov by January 12, 2018. Comments received on or after the December 15, 2018 public meeting will be considered in preparing draft regulatory language to be discussed at another workshop in spring of 2018 before taking a proposed recommendation to Board in June 2018.

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I. Overview

California faces very challenging mandates to reduce air pollution in order to meet the health-based federal ambient air quality standards and State climate protection goals. To date, California has made significant progress and is on track to meet the Assembly Bill 32 goals of reducing greenhouse gas (GHG) emissions to the 1990 level by 2020. However, we need to continue making progress beyond 2020 to meet the following goals:

- Federal health-based ambient air quality standards (key milestones in 2023 and 2031).
- 40 percent reduction in GHG emissions from 1990 levels by 2030.
- 80 percent reduction in GHG emissions from 1990 levels by 2050.
- 50 percent petroleum reduction target by 2030.
- Continued reductions in criteria pollutants and toxic air contaminants to protect public health.

Meeting all of these goals requires evolution wherever possible to zero emissions technologies in all sectors including industrial, residential, electricity, and transportation.

Substantial progress has been made in reducing emissions from all mobile sources, mainly by replacing older vehicles/engines with newer vehicles/engines that are subject to more stringent emission standards. Transit agencies have been partners in leading efforts to introduce new technologies to reduce emissions in California. Despite this progress, the transportation sector remains a major contributor to statewide emissions of NO_x, GHG, and particulate matter (PM). The transportation sector accounts for 39 percent of the total GHG emissions statewide.¹ New technologies, integrating renewable energy, and innovative ways to improve transportation efficiencies are needed to achieve established goals. Zero emission trucks and buses have a fuel efficiency two to five times as great as conventional internal combustion engines, and are one of the most promising technologies to lead the transportation sector in reducing petroleum use, reducing total energy consumption and eliminating tailpipe emissions from heavy duty vehicles.

ZEBs are the beachhead of heavy duty zero emission vehicle (ZEV) technologies and are resulting in technology transfer to other heavy duty truck applications. In addition, the deployment of ZEBs is part of the 2016 ZEV Action Plan that supports the governor's Executive Order B-16-12, which calls for 1.5 million ZEVs (including heavy duty vehicles) in California by 2025 and establishes several milestones on the pathway toward this target.

The Transit Fleet Rule was originally adopted in 2000 and includes a 15 percent ZEB purchase requirement for fleets with 200 or more buses. Transit fleets were one of the first to achieve significant reductions in NO_x and PM by retrofitting existing engines or by switching to alternative fuels from 2002 to 2010. Several agencies also worked together on an early demonstration of zero emission buses to gain experience with the technology. However, in

¹ California Greenhouse Gas Emission Inventory, <https://www.arb.ca.gov/cc/inventory/data/data.htm>, accessed 11/25/2017

2009, staff presented a ZEB technology evaluation to the Board and concluded that the technology was not commercially ready at that time. The Board, through Resolution 09-49,² directed staff to withhold the ZEB purchase requirement through a rule amendment and report back to the Board regarding technology readiness.

Staff conducted another technology evaluation in 2015 and concluded the ZEB technologies are in their early commercialization stage and published an initial discussion paper on the plan to develop amendments to the regulation. Staff updated the Board in early 2016 at a public hearing about the status of ZEB technology, price, and deployment. Since that update a lot has changed, for example:

- Dozens of transit fleets have purchased ZEBs as well as committed to significantly converting their fleet to ZEBs over the next several years
- Multiple ZEB models and configurations have become available from several manufacturers
- A fuel cell bus power plant exceeded 25,000 hours of operation, which is U.S. Department of Energy's ultimate performance target
- Several manufacturers now offer battery electric buses (BEB) with a nominal range exceeding 200 miles and at least one with 300 miles per charge
- Proterra set a world record by operating its commercially available battery electric bus for 1,100 miles on a test track
- Cummins announced it would produce electric drivetrains for transit buses by 2019 and for trucks by 2020
- GILLIG partnered with Cummins to power their zero-emissions transit buses
- New funding opportunities are becoming available

Despite their higher capital costs, today, when BEBs (with a nominal range of 150 miles) are replaced on a one-for-one basis in California, the operational savings can make the total cost of ownership comparable to conventional buses even without incentives. Incentives can offset some of the initial capital costs and reduce the early financial risks for transit agencies. With more experience, and a successful market expansion, cost should continue to decline to a point where incentives won't be needed.

The ICT measure is part of CARB's holistic approach to transform the transportation sector. ICT focuses on a long-term goal of transforming the public transit sector to zero emission modes. The overall strategy includes a combination of incentives and regulatory measures to provide a strong market signal for zero emission technology deployment, utilization of low NOx engines where zero emission technologies are unavailable, the use of renewable fuels, and encouraging innovative transit solutions. The concept considers flexibility to allow transit fleets to implement zero emission technologies in a way that is synergistic with their operation, recognizes early actions to reduce emissions, and encourages innovative mobility options.

² <https://arb.ca.gov/board/res/2009/res09-49.pdf>, last accessed 11/25/2017

This proposal starts in 2020 with requirements for large transit agencies (with 100 or more buses) to begin phasing-in ZEBs when bus purchases are made and would encourage fleets to act early to maximize funding opportunities. Smaller fleets would have more time before the ZEB purchase requirements would begin. The proposal would also recognize innovative zero emission mobility options that would count towards meeting the ZEB purchase requirement. All fleets in more polluted regions of the State would be required to purchase low-NOx engines, and larger transit agencies would also be required to use renewable fuels when diesel or natural gas contracts are renewed. The proposal recognizes that all transit fleets may deploy different infrastructure solutions to meet their own operational needs and builds in a procedural method to avoid unintended consequences or potential barriers that are beyond an individual transit agency's control. Staff is also discussing how to add a fleet wide performance-based option that could be used in lieu of meeting future bus purchase requirements beginning in 2023 to provide transit agencies more flexibility in providing new and innovative transportation services while continuing progress towards meeting a mutual goal of providing the cleanest and most effective transportation services. Details of the proposal and rationale are in Section V.

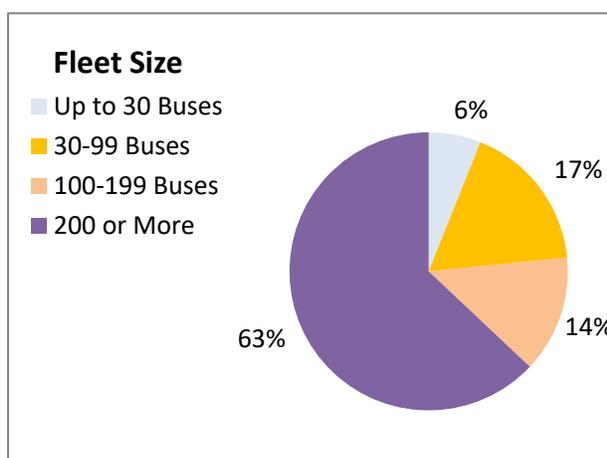
II. Role of California Transit Systems

Transit fleets operate in local communities and have a key role, not only in helping transit-dependent riders, but also in helping to shape transportation systems. Public transit agencies are our clean air partners and have played, and will continue to play, an important role in helping California meet air quality standards and GHG emissions reduction goals; namely, by employing the cleanest technologies, providing safe and reliable public transit services to reduce light-duty passenger vehicle miles traveled and single occupancy trips, and reducing congestion on roadways.

Transit agencies are diverse. There are currently over 200 public transit agencies in California operating more than 14,000 transit buses, including cutaways and trolley buses. They provide different modes of transportation, including buses, passenger rail, shuttles, vanpools, demand response paratransit services, and bus rapid transit systems with differing fleet sizes, composition, terrain, weather, route length, and other factors. Some agencies are small, operate in rural areas, and provide service with only one or two modes of transportation, such as vans and buses with few staff.

Other agencies are big, serving dense urban areas with various modes of transportations and have complex service schedules and hundreds of staff. Figure 1 shows the percent of buses in California based on bus fleet size.

Figure 1 Bus Fleet Size Distribution



Transit agencies are not only coping with continued change of environment and demands, but they are also adapting to new and transformative transportation innovations that are changing rapidly. Examples include new shared mobility services, autonomous vehicles, and electric vehicles that are significantly changing customer’s behaviors, reshaping the communities, and redefining transportation services. Shared mobility services, such as Uber, Lyft and micro-transit systems are available on demand, can be more convenient than traditional transit services, and in some cases could have lower fares.

III. Zero Emission Bus Market

California has the most ZEBs deployed in the United States. To date, multiple fleets already operating ZEBs in regular revenue service. As of September 2017, there are 107 ZEBs in operation in California and an additional 340 are on order from transit agencies and universities³. To put this in context, nearly 1000 transit buses are purchased in California annually. Figure 2 identifies the transit agencies that are implementing zero emission technologies.

Figure 2 Battery and Fuel Cell Electric Buses in California

(107 in operation and 340 on order/awarded as of September 2017)



³ Battery and Fuel Cell Electric Buses in California, last accessed 11/25/2017, <https://arb.ca.gov/msprog/ict/zbusmap.pdf>

Seven transit agencies with over 3,400 buses, representing about 25 percent of all buses in California, have committed to fully electrify their fleets (Table 1). Six of these agencies have set a goal of making the transition long before 2040.

Table 1 Transit Agencies Committed to 100% ZEB Target

Agency	Total Buses	All ZEB Target
Antelope Valley Transit Authority	77	2018
Porterville Transit	15	2018*
San Joaquin Regional Transit District	111	2025
Los Angeles County Metropolitan Transportation Authority	2,457	2030
Foothill Transit	327	2030
Los Angeles Department of Transportation	326	2030
Santa Cruz Metro Transit District	98	2040
Total	3,411	

* No Board resolution, but stated goal of transforming the active fleet to ZEB by 2018.

These early deployment strategies have included fuel cell electric buses (FCEB) and BEBs charged in the depot, on-route and combinations of depot charging with on-route charging for extending daily range. FCEB fueling and range is similar to existing compressed natural gas (CNG) buses, but still has a high upfront cost for buses and infrastructure. Depot charging for BEBs is similar to current operations, but bus range needs to be considered in providing daily service. Longer range buses provide more operational flexibility, but have additional upfront costs for a larger battery. According to recent CARB survey⁴ a majority of California transit standard buses drive less than 150 miles per day. Most of transit agencies have parking, maintenance, and fueling facilities at their depot yards with different capacities, and available space. Though transit agencies provide similar services, their operations could be quite different. A technology that works for one transit may not work for the other.

⁴ Transit Agency Survey Preliminary Results, August 29, 2016, https://www.arb.ca.gov/msprog/bus/transit_survey_summary.pdf

California is now home to ZEB manufacturing that is creating high quality jobs for standard bus manufacturing and small bus manufacturing. Six standard bus original equipment manufacturers (OEM), including BYD, Complete Coach Works, El Dorado National-California, GILLIG, GreenPower, and Proterra, are all manufacturing BEBs or FCEBs in California. BYD and Proterra exclusively manufacture battery electric buses and have battery production plants in California. Greenpower is locating a battery electric bus manufacturing plant in Porterville and plans to begin production in 2018. The other manufacturers also produce buses with internal combustion (IC) engines. Table 2 shows the locations of these OEMs, their production capacity. These manufacturers are offering ZEBs in different sizes and configurations, including standard buses, motor coaches, articulated buses, double deckers and other configurations. There are multiple bus models and manufacturers available in the market.



Table 2 Zero Emission Bus Manufacturers in California

Manufacturer	CA Facilities	Propulsion Technology	Total Bus Production Capacity/Year*
BYD	Lancaster	BEB, BE trucks, and Battery mfr	1500
Complete Coach Works	Riverside, Alameda	BEB and IC	500
El Dorado National	Riverside	FCEB and IC	
GILLIG	Livermore	BEB and IC	
GreenPower**	Porterville	BEB	150
Proterra	Burlingame	(Battery mfr.)	
Proterra	City of Industry	BEB	500

*Annual production capacity for all types of buses, including IC buses. Areas without public information are left blank.

**Porterville manufacturing plant to begin production in 2018

There are other OEMs that primarily manufacture small ZEBs that are typically shorter than 26-feet, such Ebus, Phoenix Motorcars, and Zenith. Ford recently expanded its alternative fuel options to include electric drivetrains for some of its chassis that can be used as trucks, shuttle buses or school buses. Motiv Power Systems, based out of Foster City now offers an all-electric powertrain for the Ford E-450 and F-59 chassis in partnership with Ford. These OEMs currently offer buses with a 70-130 kWh battery capacity and 100-145 miles of ranges and some of these same platforms are also used as cargo vans or trucks. Several airports and private companies are operating these vans and buses, and a few are being used by transit fleets. However, at this time, these smaller ZEBs have not been Altoona-tested and are not yet eligible for purchase with federal funds.

IV. Potential Funding and Incentive Opportunities

The Funding Plan⁵ serves as the blueprint for expending Low Carbon Transportation funds appropriated to CARB in the State budget. The plan establishes CARB's priorities for the funding cycle, describes the projects CARB intends to fund, and sets funding targets for each project.

The amount allocated for the Clean Truck and Bus Vouchers (HVIP + Low NOx Engine Incentives) is \$188 million for FY 17-18. The staff proposal includes the base proposed voucher amounts shown in Table 3 with higher amounts for disadvantaged communities (DAC) or low income census tracts. The voucher amounts are intended to fully cover the incremental cost for a low NOx engine, the majority of the incremental cost of a BEB, and about half of the incremental cost of a FCEB. The Funding Plan will be considered at the December 14, 2017 Board Meeting.

Table 3 Proposed Voucher Amounts

Category	Base Amount*
Low NOx Engine (8.9 Liter)	\$10,000
Zero Emission Bus (20 ft – 24 ft)	80,000
Zero Emission Bus (25 ft – 29 ft)	\$90,000
Zero Emission Bus (30 ft – 39 ft)	\$95,000
Battery Electric Bus (40 ft – 59 ft)	\$150,000
Battery Electric Bus (60 ft)	\$175,000
Fuel Cell Electric Bus (≥ 40 ft).	\$300,000

* Up to \$15,000 more for use in a DAC.

The Clean Mobility Options for Disadvantaged Communities program offers alternate modes of transportation and encourages use of zero emission and plug-in hybrid vehicles, vanpools, electric and regular bicycle sharing, and other mobility options. Use of advanced technology vehicles instead of conventional vehicles in a car sharing component provides the primary GHG and criteria pollutant emission reductions and increases mobility options. The funding allocation for this program is \$17 million for FY 2017-18 and could be used by transit agencies to implement such a program. More information about the program is at https://www.arb.ca.gov/msprog/aqip/ldv_pilots.htm.

The Transit and Intercity Rail Capital Program⁶ (TIRCP) provides grants from the Greenhouse Gas Reduction Fund (GGRF) to fund transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems, and bus and ferry transit systems, to

⁵ https://www.arb.ca.gov/msprog/aqip/fundplan/1718_draft_funding_plan_workshop_100417.pdf

⁶ <http://www.dot.ca.gov/drmt/sptirpc.html>

significantly reduce GHG emissions, vehicle miles traveled, and congestion. The California Department of Transportation, in collaboration with California State Transportation Agency (CalSTA), is responsible for administering this program.

The Low Carbon Transit Operations Program⁷ (LCTOP) was created to provide operating and capital assistance for transit agencies to reduce GHG emission and improve mobility, with a priority on serving disadvantaged communities. Approved projects in LCTOP will support new or expanded bus or rail services, expand intermodal transit facilities, and may include equipment acquisition, fueling, maintenance and other costs to operate those services or facilities, with each project reducing GHG emissions. Five percent of the annual auction proceeds in the GGRF are continuously appropriated for LCTOP. This program is administered by the California Department of Transportation (Caltrans) in coordination with CARB and the State Controller's Office (SCO).

The Congested Corridors Program under SB 1, with an annual budget of \$250 million, also allows projects like ZEB deployment, transit hubs to increase linked trips or multimodal transportation modes, and transit hubs or stations and nearby roadways providing accessibility for first mile and last mile connectivity to public transit systems.

The Volkswagen Environmental Mitigation Trust provides California approximately \$423 million to fund specified eligible actions to mitigate the lifecycle excess NOx emissions caused by Volkswagen's emissions test defeat device. CARB is the lead agency to administer these funds. CARB staff held the first public workshop on allocation of the Volkswagen Environmental Mitigation Trust (First Partial Consent Decree, Appendix D) on October 26, 2017.⁸ Transit agencies are potentially eligible to use these funds.

On July 17, 2017, both the California Assembly and Senate passed AB 617. This bill directs CARB to establish community air monitoring plans for toxic air contaminants (TACs) and criteria pollutants, determine communities most affected by high cumulative exposure burden, and develop a strategy to reduce emissions in those communities. \$250 million in Low Carbon Transportation fund is intended to help meet the goals of AB 617 through early action. These funds are to be spent on projects pursuant to the Moyer Program with focus on mobile sources and infrastructure. These funds are distributed through air districts as \$107.5M to South Coast AQMD, \$80M to San Joaquin Valley Unified APCD, \$50M to Bay Area AQMD, and \$12.5M to the remaining districts. Eligible projects should provide targeted reductions of criteria pollutants or air toxics (such as diesel particulate matter) within communities affected by a high cumulative air pollutant exposure burden. What this means in practice in the short-term is that a majority of the funds must be used to aid disadvantaged and low-income communities. Moyer 617 funds are to be distributed as expeditiously as possible to provide immediate emission reductions in impacted communities.

⁷ <http://www.dot.ca.gov/drrmt/splctop.html>

⁸ More information on Volkswagen settlement is available at https://www.arb.ca.gov/msprog/vw_info/vw-mititrust/vw-mititrust.htm. Last accessed 12/1/17.

The Low Carbon Fuel Standard (LCFS) program lowers the carbon intensity of transportation fuels in California and the program results in an incentive for fuel producers or vehicle operators to use a variety of low carbon fuels. The program⁹ is currently being updated and changes that have been proposed are scheduled to be considered by the Board in early 2018.

LCFS program staff is proposing to increase the energy efficiency ratio (EER) for heavy-duty battery-electric vehicles to about 5.0 based on new data for battery electric trucks and buses. The EER is currently 4.2 for buses. If the proposed change to the LCFS regulation is approved, a fleet that earns credits worth about \$8,000 for using electricity in a battery electric bus (at a credit value of \$100 per credit, for example) would earn about 20 percent more credits which would increase the value to about \$9,600 per year. Another change the LCFS program staff is proposing is to clarify how hydrogen station operators will receive credits. The change would make it clear that a transit agency that operates a hydrogen fueling station can receive the credits directly from the LCFS program rather than indirectly through the fuel provider.

SB 350 provides a potential opportunity of transportation electrification to transit agencies. Three major investor owned utilities (IOU) together have proposed over \$750 million worth of investment in infrastructure to support transportation electrification that could offset most of the costs of making electrical service upgrades and installing charging infrastructure over a 5 year period. The California Public Utilities Commission (CPUC) issued its first proposed decision approving 15 of the IOUs' transportation electrification "priority review" pilot projects¹⁰ that could be implemented quickly. CPUC is expected to vote on whether to approve the proposed decision at a January 18, 2018 meeting. CPUC also plans on making a decision on the longer term standard projects in the March/April 2018 timeframe.

There are a number of other state funding programs, local air district funds and federal funds that may also be available that are not addressed here.

Table 4 Incremental Cost Example for a BEB Compared to a CNG Bus Without Infrastructure Service Upgrades (\$2016)

Category	Upfront Capital Cost	Avg. Annual Operating Costs
40' Bus Price (with charger)	\$235,000	--
Voucher	-\$150,000	--
Maintenance	--	-\$10,000/yr
Fuel	--	-\$5,000/yr
LCFS Credit (@\$100)	--	-\$7,500/yr
Total Bus Costs	\$85,000	-\$22,500/yr

⁹ Preliminary draft of potential regulatory amendments to the low carbon fuel standard, https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/092217_draftregtext.pdf. Last accessed 12/1/2017.

¹⁰ The full document can be accessed at <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M198/K874/198874393.PDF>. Last accessed 11/30/2017

Shown in Table 4 is a simple example of how available funding could be used to offset higher capital cost of a BEB purchased today where the average annual savings over the life of the bus would result in about a 4 year payback for the bus purchase (without electrical service upgrades). The actual costs for an individual fleet will vary and could be higher or lower than the values shown in the example and would need to account for needed infrastructure.

For a BEB, associated infrastructure service upgrades will depend on site conditions, charging strategy, number of chargers installed and other factors, but are expected to range from about \$20,000 to 75,000 per bus. Some of or all of the costs of the charger and electrical service upgrades could potentially be offset if the utility proposals are approved by CPUC in April 2018. Similarly, hydrogen station costs likely range from about \$3,000,000 for a 10 bus station to \$5,000,000 for a 50 bus station. Some of these hydrogen station costs could be partially offset by about \$100,000 per bus if the proposed funding plan is approved.

V. ICT Proposed Regulation

With any strategy, we need to ensure compliance targets are technologically and financially feasible, emission reductions are real and quantifiable, and compliance is straightforward and enforceable. With these overarching criteria in mind, we are proposing to implement an advanced technology purchase requirement when bus purchases are made starting in 2020, and would include a method to recognize the benefits of innovative mobility programs implemented by transit agencies that use other types of ZEVs like micro transit, vans or cars.

The following is a summary of the overall rule proposal with more details and rationale in the subsequent sections:

January 1, 2020

- Large transit fleets with (≥ 100 buses) would need to:
 - Purchase 25 percent ZEB when bus purchases are made or implement an equivalent innovative zero emissions mobility program.
 - Purchase renewable fuels when diesel or natural gas contracts are renewed.
 - Report fleet wide information for all modes and fuel purchases needed to evaluate their progress in meeting a fleet wide performance-based goal.
- All transit agencies in more polluted areas of California would be required to purchase low NOx engines if available at the time of conventional bus purchases.

January 1, 2023

- The proposed concept would be expanded to include medium size transit fleets with more than 30 buses.
- Affected transit fleets would need to meet a 50 percent ZEB purchase requirement.

January 1, 2026

- All transit fleets, including smaller transits would need to meet a 75 percent ZEB purchase requirement.

January 1, 2029

- All bus purchases would need to be ZEBs.

VI. Applicability

The regulation would apply to all public transit agencies that own, lease, or operate buses with a gross vehicle weight rating greater than 14,000 lbs. Buses subject to the regulation include cutaway buses, transit buses (including bus rapid transit), articulated buses, double deckers, commuter coaches, trolley buses and vintage trolley buses,. Fleet size would be based on the number of buses in the active fleet in 2019 as follows:

- A large transit agency is a transit agency with 100 or more transit buses.
- A medium transit agency has 30 to 99 transit buses.
- A small transit agency has fewer than 30 transit buses.

With a goal of achieving a zero emission public transit fleet, we are interested in comments as to whether the scope should be expanded to include non-bus modes of passenger transportation including vans, or cars.

VII. Renewable Fuel Requirements

We are proposing to require large transit agencies with 100 and more transit buses to purchase renewable fuels when diesel or natural gas contracts are renewed. Smaller fleets would be exempt from the renewable fuel requirement. This proposed requirement should result in little or no cost, but would send a market signal that supports California's existing fuel policies to further reduce the carbon intensity of transportation fuels through the LCFS program. However, the GHG emissions benefits of using renewable natural gas or renewable diesel is due to the LCFS program and cannot be counted as new reductions in the ICT because they are already required by the LCFS program.

To date, about 60 percent of California transit buses are operating CNG buses and are the primary users of renewable CNG in California. Renewable CNG producers need to sell the fuel to California fleets to earn LCFS credits. Most renewable CNG is currently produced outside California, but this proposal supports the program and contributes to State efforts to increase in-state production. Renewable fuels are currently commercially available due to the federal Renewable Fuel Standard Program¹¹ and CARB's LCFS Program.¹² Today, transit agencies can procure renewable natural gas at a price equal to or lower than that of fossil natural gas due to these programs.

Renewable diesel is a drop-in fuel, and is also available at costs to the users that are similar to conventional diesel fuel. However, renewable diesel providers are primarily contracting with larger transit fleets and do not necessarily need to contract with smaller transit agencies to sell the renewable fuel in California and earn credits. Some smaller transit agencies have not received bids for renewable diesel and requiring the use of renewable diesel for these smaller agencies could result in higher costs for them.

¹¹ <https://www.epa.gov/renewable-fuel-standard-program>, accessed on 11/22/2017.

¹² <https://www.arb.ca.gov/fuels/lcfs/lcfs.htm>, accessed on 11/22/2017.

VIII. ZEB Purchase Requirements

Staff is proposing to initially require ZEB purchases for larger transit fleets with deferred compliance for smaller and medium transit agencies. The ZEB purchase requirement would start with larger transit agencies beginning January 1, 2020. Medium size transit agencies (30 to 99 buses) would be exempt from the ZEB purchase requirements until 2023 and the smallest would be exempt until 2026. The purchase requirement applies at time of normal purchase and does not require any accelerated purchases. The proposed ZEB purchase requirement is shown in Table 5.

Table 5 Zero Emission Bus Purchase Requirement¹³

Starting January 1	Percent of Bus Purchases	Fleet Size as of 2019
2020	25%	>100 buses
2023	50%	>30 buses
2026	75%	All fleets
2029	100%	All fleets

All purchases made before they are required by the regulation or that exceed the minimum purchase requirement would generate a ZEB credit that could be banked and used for a future purchase date. This approach counts early ZEB purchases towards future obligations, and is intended to be consistent with incentive programs that require early action to be eligible for funding. The ZEB credits also provide transit agencies with more flexibility in how they procure ZEB and utilize infrastructure. For the following example, we will use a fictitious large fleet that has 200 buses and normally contracts to purchase about 40 new buses every 3 years. The fleet is planning its normal bus purchases in 2019 and 2022.

- Since the regulation does not take effect until 2020, the fleet does not need to purchase any ZEB in 2019, but when the fleet makes a 40 bus purchase in 2022, 10 buses would need to be ZEB to meet the 25 percent ZEB purchase requirement. However, these purchases would not qualify for HVIP or other incentive programs because they do not result in early emission benefits.
- If the fleet chose to purchase 10 ZEB in 2019, before any ZEB purchases are required, the 10 ZEB purchase would remain eligible for funding and the fleet would bank 10 ZEB credits. In 2022, when the fleet makes its next 40 bus purchase, the fleet could use the 10 banked ZEB credits to meet the ZEB purchase requirement (25% of the 40 buses or 10 ZEBs) without purchasing any more ZEB that year. Again, the fleet could continue to purchase ZEBs to go beyond the minimum requirement. If they bought 10 more ZEBs in 2020, they would be eligible for funding and would earn credits that could be used for the next planned purchase after 2022.

¹³ Trolley buses operated on a fixed guideway are ZEBs but would not be counted towards the ZEB purchase requirements except when expanding the existing fleet from a 2015 baseline.

The credit mechanism also provides some flexibility in making two separate bids in the same year. For example, if a transit agency is planning one contract for standard buses and a different contract for commuter coaches in the same year, the agency could purchase enough ZEB in the first contract for standard buses so that the credits from the first purchase would meet the minimum ZEB requirement of the second contract for commuter buses. The earned ZEB purchase credit would be void if the contract is cancelled or the bus is not placed in service.

We are also proposing to provide bonus ZEB credits for early actors that are already operating ZEBs or take more risks in deploying early technologies. They have been pioneers in addressing fuel cell maintenance, electricity rates, charging standards, education, training, developing new technologies, and other issues. These pioneers and their experiences in addressing barriers have benefited the broader market for zero emission heavy duty vehicles and for other transit fleets. We believe their actions should be recognized with additional credits; therefore, we are proposing to provide bonus ZEB credits as shown in Table 6.

Table 6 Bonus ZEB Purchase Credits

Technology	Placed in Service	Bonus ZEB Credit
FCEB	January 1, 2018 to January 1, 2023	+1
BEB	Before December 31, 2017*	+1
FCEB	Before December 31, 2017*	+2

* Must still be in service as of January 1, 2018

The bonus credits provide more time for these early actors and give them more flexibility in expanding their ZEB fleets and taking advantage of technology improvements. For example, a BEB that was purchased and placed in service in 2017 would receive a standard purchase credit plus a bonus credit for a total of 2 credits. A fuel cell bus placed in service before 2018 would receive a credit for the purchase and 2 bonus credits for a total of 3 credits.

A. ZEB Purchase Provisions

Because we recognize that transit fleets are different, we have structured this proposal with significant flexibility to utilize funding. We also are proposing to include some provisions to address individual fleet situations if they occur. The provisions are intended to address uncommon situations that present unintentional adverse impacts for an agency due to factors beyond their control, and to safeguard infrastructure investments that have been made. Compliance is determined when a bus purchase order is placed, so the transit agency would not be out of compliance due to manufacturer delays, but there may be other circumstances that a contract cannot reasonably be executed. The following are proposed conditions that would be approved for temporary delays:

- If the planned bus purchase and deployment at a given depot is delayed because the utility is unable to supply sufficient power to the property in time to place the BEB purchases in service when they are delivered.

- If the planned bus purchase and deployment at a given depot is delayed for reasons outside the transit agency's control and would not be completed on time to place the FCEB purchases in service when delivered. The off-ramp would apply to delays for hydrogen fueling station construction or when expanding an existing hydrogen station's capacity.
- An agency would not be out of compliance for purchasing conventional buses when equivalent ZEB type has not successfully completed Altoona testing. However, this off-ramp would only apply if the transit agency has no other options available to meet the purchase requirement (i.e. if the fleet could meet the ZEB purchase requirement with other bus types included in the purchase contract, there would be no need for an extension. A transit fleet that still chooses to purchase a bus that has not been Altoona-tested could count the bus towards compliance or would receive a ZEB purchase credit to be used at a later date.)
- If the planned ZEB fleet expansion cannot be completed in compliance with local permitting requirements or other safety requirements, could not have reasonably been foreseen, and cannot reasonably be addressed before the planned ZEB purchases would be delivered and placed in service;

The Executive Officer would be able to provide a 1-year extension based on the specific situation. At this time we do not believe off-ramp provisions are needed for small deployments to address battery electric bus range because there are already multiple standard buses available with a 200 mile range and some with more than a 300 mile range that can meet all daily needs. Similarly, concerns about space constraints for charging infrastructure in the depot may not be an issue for smaller or larger deployments because of overhead charging solutions that have minimal impact on congested yards. These issues could be revisited as part of an informational update to the Board before the proposed requirements ramp up.

B. Joint ZEB Compliance Option

On a case-by-case basis, multiple transit agencies may petition the Executive Officer to implement a joint zero emission bus deployment within a region. If approved, two or more transit agencies would comply as if they were one joint transit agency. The Executive Officer would approve the joint agreement provided the following criteria have been met and would issue a joint agreement number to track annual reporting:

1. Jointly comply with the number of ZEB purchases the partners would be required to purchase individually.
2. Jointly fund bus purchases and infrastructure through a common a metropolitan planning organization or other transportation policy-making organization.
3. Operate the ZEBs at a transit agency affected by the zero emission bus purchase requirement.
4. Show how the deployment prioritizes benefits in DAC.
5. Place the buses in revenue service with the intent of operating them in California for the FTA minimum useful life criteria.
6. Provide appropriate maintenance and storage facilities for the applicable technology.

7. Train bus operators and maintenance personnel from each participating transit agency.
8. If the joint ZEB deployment fails to comply as a group, each participating agency must immediately comply individually.
9. Participating agencies must report annually and identify the joint agreement number.

IX. Low NOx Engine Purchase Requirement

Staff is proposing to require all transit agencies to include low NOx engines when purchases are made if they are available for the bus type being purchased. This would not apply to fleets that operate in areas defined as NOx exempt areas¹⁴. The requirement would begin with purchases made on or after January 1, 2020 or two years after a low NOx engine becomes commercially available for the bus fuel type being purchased. Purchases that are made before they are required would earn a low NOx engine credit that would count towards the low NOx purchase requirement for future bus purchases. The credits could be used to meet a future obligation or could be used to ensure the fleet remains eligible for funding if continuing to purchase low NOx engines. Low NOx engine purchases would not be required if they are not available for the bus and fuel type the transit agency purchases, and would not be required at time of rebuild.

Low NOx engines are currently available for CNG buses, propane shuttle buses, but are not yet available for diesel buses nor gasoline buses. Low NOx engine for most CNG buses became commercially available in 2016. To date, low NOx engines have been installed on CNG buses for either repower or new purchase. CARB is also planning on a low NOx engine regulation in the near future that would apply to all heavy duty engines.¹⁵ CARB Board action on a lower NOx standard for on-road heavy-duty engines is expected in 2019 and potentially could apply to the 2023 engine year for all heavy duty engines.

X. Innovative Zero Emission Mobility

We are proposing to include a credit mechanism that would count towards the ZEB purchase requirement to encourage the introduction of innovative zero emission transit services that may lead to a broader zero emission future. For purposes of this regulation, innovative zero emission mobility options are non-bus (nor fixed guide way) transportation services provided by the transit agency with lighter ZEVs like micro transit, on-demand van or car transportation, or autonomous shuttle services. Other modes, such as buses that are within the scope of the regulation and light rail, heavy rail and trolley bus services, are considered to be conventional transit modes. Zero emission mobility options that are directly operated by the transit agency or under contract that are used to provide on demand services or for shared transportation, like van pools, would be eligible for credit.

¹⁴ The following counties make up the NOx Exempt Areas: Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Eastern El Dorado, Glenn, Humboldt, Inyo, Eastern Kern, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Monterey, Nevada, Eastern Placer, Plumas, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz, Shasta, Sierra, Siskiyou, Northern Sonoma, Northern Sutter, Tehama, Trinity, Tuolumne, and Yuba.

¹⁵ <https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm>, accessed 11/24/2017

Because there are a wide range of innovative mobility services, we are proposing that the transit fleet apply to the Executive Officer to determine the appropriate credit amount for new and innovative services based on the details of the program. The transit agency would need to clearly identify how miles and passenger counts would be measured and how records would be kept and made available to CARB. The credit for an innovative zero emission mobility program would be provided in the form of a ZEB purchase credit where 350,000 zero emission passenger miles per year from the program would be deemed to be equivalent to purchasing a ZEB. If for any reason the zero emission mobility program is ended, the transit agency would receive a ZEB purchase deficit equal to the credit it initially received. The fleet would not be deemed to be out of compliance, but the deficit would need to be made up during the next bus purchase.

We would use the informational update to the Board to assess the zero emission mobility option at that point. CARB could modify the option, make it mandatory for lighter vehicles, or replace it with a performance based option beginning in 2023.

XI. Performance Based Option

A fleet-wide performance-based option that includes all transit modes has the potential to account for a wide range of actions that reduce NOx and GHG emissions. It could provide for the greatest opportunity to let market forces drive the form of the emission benefits. The approach needs to be equitable for a bus-only fleet and a multimodal fleet, and needs a straightforward metric to account for the emissions benefits of switching to ZEBs, cleaner engines, eco driving, improvements in mobility, right sizing vehicles, improving vehicle efficiency, increasing ridership density among other things. We need additional detailed information from transit agencies to clear up data gaps we see in the National Transit Database (NTD) for several fleets, how data are tracked, and to understand how methodology changes may affect the results of a performance based approach. Starting in 2020, large transit agencies (with 100 or more buses) would be required to report annual information for all modes they operate dating back to 2015 as the proposed baseline year. The information would be used for an informational update to the Board and would answer questions about whether the scope of the regulation should be expanded to include non-bus modes, whether zero emission miles or another metric should be used for fleet wide compliance, or whether the zero emission mobility option should be expanded.

We evaluated strategies based on emissions per passenger mile or emission per seat mile, but we encountered a number of challenges with applying a fleet-wide performance-based option. First and foremost, most funding programs would not allow funding to be used to purchase ZEB or low NOx engines until the transit agency could show compliance with the next compliance requirement. This means that a bus fleet would not be able to take advantage of existing funding programs and ultimately would incur higher costs to achieve the same emissions reductions as the proposed purchase requirements. Second, it is challenging to identify a mechanism that is equitable for all fleets. For example, a uniform NOx reduction goal may be easy to meet for a CNG bus fleet because low NOx engines are already available but may be impractical for a diesel bus fleet that could be forced to retire buses and aggressively ramp up

ZEB purchases to achieve the same reductions. Similarly, some transit fleets are “dirtier” than others for a variety of reasons, and the “dirty” fleets would need to do more than clean fleets to meet a common goal. Third, there are challenges with properly separating new actions from those that are already occurring due to CARB regulations for engine emissions standards, vehicle efficiency requirements, and policies to reduce transportation fuel carbon intensity. Finally, fuel use, mileage and passenger counts reported in the NTD fluctuate from year to year and may not be suitable for adequately measuring small changes.

A zero-emission-miles-based fleet-wide approach may be a promising method to set a performance goal that could be used in lieu of meeting the bus purchase requirement. A performance-based requirement that is based on zero emission miles squarely fits with the end goal of achieving a zero emissions transit system and could include all ZEV modes ranging from bicycles to light rail. ZEVs of all types eliminate local emissions and reduce both NOx and GHG emissions at the same. Zero emission miles as a metric could allow for a single metric to evaluate progress towards the final goal and we will continue to discuss options to integrate this into the proposed regulation.

XII. Reporting Requirements

Reporting is needed to ensure that credits are appropriately tracked and that compliance can be monitored appropriately. All transit agencies must report their bus fleet information annually starting January 1, 2020. Each transit agency would be subject to reporting and record keeping requirements each January and would need to provide information about bus and engine purchases made each year. The basic reporting includes the following items:

1. Transit agency name
2. Contract number
3. Purchase order number
4. Joint agreement number (if applicable)
5. Vehicle identification number (VIN) if in service
6. Fleet vehicle ID number
7. Bus type
8. Fuel type
9. Model year
10. Make
11. Model
12. Propulsion technology type
13. Horsepower
14. Engine family name
15. Engine displacement (liters)
16. Odometer reading
17. Odometer reading date
18. Traction battery capacity (if applicable)
19. Purchase contract number
20. Date of purchase contract

21. Date placed in service

We would also need data from large transit agencies with 100 or more buses to evaluate and develop a performance based option. The data would need to come directly from transit agencies for all modes they operate. The data would allow us to evaluate trends and identify and clear up anomalies that we currently see in the NTD data and are not available in the public data sets. Starting in 2020, large transit agencies would be required to report annual information for all modes they operated dating back to 2015 as the proposed baseline year. Modes would include all modes reported to NTD and would include all vehicles types used for passenger transportation (directly operated or purchased).

The following is a list of the individual vehicle information that transit agencies would need to report for each transportation mode:

1. Vehicle information:
 - a. Vehicle identification number (if applicable) and fleet identification number.
 - b. Transportation mode.
 - c. Type of service.
 - d. Fuel type.
 - e. Vehicle type and length category.
 - f. Vehicle model year.
 - g. Engine family.
 - h. Engine year.
 - i. Fuel consumption per vehicle type.
 - j. Vehicle odometer reading.
2. Annual totals by transportation mode:
 - a. Passenger counts per revenue mile.
 - b. Sampling and data collection method.
 - c. Total revenue miles.
 - d. Deadhead miles.
 - e. Average trip length.
 - f. Passenger miles traveled.
 - g. Average trip length.
 - h. For linked trips.
 - i. Number of linked trips (a trip contains at least one transfer from one vehicle or mode to the next).
 - ii. Number of transfers per trip.
 - iii. Average length of linked trip.