

**Technology Off-Ramp Concepts**  
**Advanced Clean Transit Workgroup Meeting**  
**April 7, 2016**

The Air Resources Board places a high priority on ensuring that transit operators are able to deliver the level of service in the way they have planned. This paper describes potential “off-ramp” concepts for discussion. Proposed “off-ramps” or temporary extensions could address technological barriers to incorporating zero emission buses into a given fleet and could be used to avoid situations that would be impractical to implement for a given bus type or fleet situation. This rule concept would allow the Executive Officer to approve compliance extensions based on the merits of individual situations if and when they occur. This concept is being implemented in the Truck and Bus regulation<sup>1</sup> where particulate matter filter extensions are granted based on unavailability of suitable exhaust retrofits including for reasons associated with incompatibility with the engine, safety conflicts, and insufficient space for installation on the vehicle.

Extensions from zero emission bus purchase requirements could be granted in cases where the bus type (cutaway, transit bus, articulated bus...) being purchased is simply not available as a zero emission bus, but also would include situations where it would be impractical to meet existing operational needs with zero emission buses that are commercially available on January 1, of the year the purchase is planned. Commercially available means the bus model is available for purchase at retail and has completed Altoona testing.

Off-ramp concepts for discussion in this paper include situations where bus range for slow charge buses cannot meet existing needs, where there are barriers to using fast charge buses including infrastructure, where there is limited space at the bus depot for charging or fueling infrastructure, and limited access to sufficient electricity supply at a site. It is not likely that “off-ramp” extensions will be necessary when a small number of zero emission buses are initially introduced into the fleet; however, these extensions should reduce concerns about technological feasibility and impacts on transit service. Concerns about economic feasibility will be addressed as part of the staff recommendation and is continuing to be evaluated.

Technological feasibility barriers would be evaluated based on the zero emission buses that are available January 1 for the year the purchase is planned. Evaluations would be based on the bus type being purchased, and the specific situation at individual facilities or divisions within the fleet. Zero emission buses would be assessed based on their standard configuration and design. For example, if a slow charge battery electric bus was the only option for an articulated bus replacement, and it does not have sufficient range to meet the fleet’s needs with a single daily charge, the transit agency would not

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<sup>1</sup> <http://www.arb.ca.gov/msprog/onrdiesel/documents/faqPMExtension.pdf>

need to demonstrate whether additional upgrades to the bus for supplementary on route charging would be feasible. The transit agency would need to show that none of the blocks or routes for articulated buses could be served by the available bus with a single daily charge.

For an extension to be approved, the transit fleet would need to demonstrate that it has exhausted all other zero emission bus technology options to comply and there are no technologically feasible ways to incorporate additional zero emission buses into the fleet. For example, if one division is unable to incorporate additional zero emission buses into the fleet, but another division can meet the fleet requirement, the transit agency as a whole would be able to comply and would not need an extension in that year.

Transit agencies would not be expected to alter their purchase cycles to meet applicable compliance requirements of the regulation. For example, if a transit agency was planning to purchase cutaways in a given year and there were no zero emission cutaways available, the transit agency would not be expected to change their purchase plans to replace other bus types to fulfill that year's purchase requirements.

Any exempted buses would still count towards the total number of buses purchased that year, and the zero emission bus purchase requirement would still need to be fulfilled for as many buses as feasible. The following sections are potential off-ramps for discussion.

### **1. Safety Conflict Barriers**

In the event that infrastructure necessary to support zero emission buses cannot be installed safely it would not be considered an available option. The transit agency would need to demonstrate due diligence in seeking a permit for construction and identify the applicable safety requirements from federal, state, or local rules that present the conflict. The transit agency would need to provide sufficient information for the Executive Officer to assess whether other technologically feasible alternatives to complete the project are available. As part of an extension request, the transit agency would need to submit a copy of the original permit application package and the local authority's decision if applicable. The Executive Officer could grant an extension for 2 years for the applicable bus types.

### **2. Infrastructure Installation Barriers**

A transit agency could request an extension if the space required for infrastructure needed to fuel or charge zero emission buses would require the transit agency to reduce the number of buses that were being supported at the depot. The criteria would differ by fuel type as follows:

#### A. Hydrogen Fueling Station

Hydrogen fueling stations would need to be evaluated by increments of 20 buses per station. For example, if a bus depot could support 20 fuel cell electric buses, but can demonstrate that it does not have enough space to install a fueling station for 40 buses, the transit agency would not be required to deploy more than 20 fuel cell electric buses at the site. The transit agency would need to provide information about the number of buses supported at the site in the prior year, an analysis from the fuel provider or other applicable party as to the space requirements for the fueling station, including storage tank and supporting equipment, and drawings of the proposed installations at the site. The Executive Officer could grant an extension for 5 years for the applicable depot.

#### B. Slow Charge Battery Electric Bus Charging

Should slow charge battery electric bus infrastructure substantially reduce available depot space so that the existing number of buses operated at that facility would need to decrease, an extension could be granted. A single charging pedestal can support one or more slow charge buses and can be installed one at a time. For a transit fleet to request an extension, it will need to show that no additional buses can be supported because of space limitations. For example, if a site already has 40 slow charge buses and only has space to support an additional 15, the transit agency would not be required to purchase more than 15 more slow charge battery electric buses. The transit agency would need to submit a third-party assessment of potential bus parking configurations within the yard to show how many buses could be supported and the reasons that more cannot be supported with the available space. The application should include engineering diagrams of recommended installation locations within the yard from the charging system installer. The Executive Officer could grant an extension for 2 years for the applicable depot.

#### C. Fast Charge Battery Electric Bus Charging

Fast charging systems are normally installed either on-street or off-street at transit hubs. Either way, transit agencies have to secure a use/construction permit to install the chargers. An extension can be granted if permitting for the installation of the chargers is not feasible due to zoning restrictions or conflicts with local permitting requirements. The transit agency would need to submit an explanation of the reasons that available fast charging buses could not be used along with supporting information. Supporting information would include an engineering assessment of all suitable charger installations and reasons each is not feasible, including copies of permit application packages and the local authority's decision. The Executive Officer could grant an extension for 2 years for the applicable bus types.

### **3. Bus Operating Range Barriers**

Battery electric bus range is expected to continue to increase as battery technology continues to improve and bus charging strategies could change. However, if commercially available battery electric buses' ranges (slow or fast charge) are not

suitable for meeting a transit fleet's remaining service, the transit fleet would be able to request an extension. The transit agency would need to show that there are no remaining routes/block that can be served by available buses that are planned to be purchased because of incompatibilities with serving existing routes or blocks because of range limitations.

A transit agency must provide a list of mileage distances for all routes/blocks for the bus types to be purchased. This list must be compared to range estimations of the commercially available zero emission buses of the same type. For example, for a block in which the transit agency uses a motor coach, a comparison must be made to a battery electric motor coach. Range estimations of battery electric buses shall be based on the quotient of the manufacturer specified battery pack size and the average fuel economy (kWh/mile) published in the Altoona test report for that vehicle, multiplied by 80 percent to account for expected battery degradation. The range calculation equation is summarized below:

$$\text{Range} = \left[ \text{Battery Capacity (kWh)} / \text{Altoona Overall fuel economy} \left( \frac{\text{kWh}}{\text{mile}} \right) \right] * (0.8)$$

Transit agencies would not need to demonstrate whether modifying the bus from its original design to extend its range could meet the agency's needs (eg. such as upgrading the bus to supplement its charge in route). The Executive Officer could grant an extension for 2 years for the applicable bus types.

#### **4. Electricity Supply Barriers**

In the case when the utility provider is unable to provide the electrical power necessary to charge buses due to capacity limits or other reasons beyond the control of the transit agency, the transit agency may request an extension. The transit agency will need to submit an explanation as to how many buses can be supported with technologically feasible upgrades and the reasons that more buses cannot be supported. The application should include information from the utility as to what the barriers are. The Executive Officer could grant an extension for 2 years for the applicable bus types.