BEYOND SMART CITIES

LOCATION AND TRANSPORTATION - GREEN BUILDING TECHNOLOGY TRAINING PROGRAM

FOR GREEN BUILDING AND SUSTAINABILITY SPECIALISTS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

GREEN BUILDING SPECIALIST CURRICULUM

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ELECTRIC VEHICLES - CREDIT

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LEARNING OBJECTIVES

- Intent of Electric Vehicles - Credit
- Behind the intent
- Step by Step Guidance
- Requirements
- Required Documentation
- Connection to Ongoing Performance
- Terms and Definitions

LT- CR (1) - DESIGN

ELECTRIC VEHICLES

Intent

To reduce pollution by promoting alternatives to conventionally fueled automobiles.

Requirements

Install electrical vehicle supply equipment (EVSE) in 5% of all parking spaces used by the project or at least two spaces, whichever is greater. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles.

Potential Technologies & Strategies

Beyond climate change effects, conventional-fuel vehicles pose public health risks. Diesel exhaust from idling buses releases fine particulates, which can be especially harmful for children. 3 Idling delivery trucks at warehouse loading docks and diesel-powered yard tractors used to move cargo containers 4 emit nitrogen oxides (NO x), sulfur oxides (SO x), and particulate matter (PM).

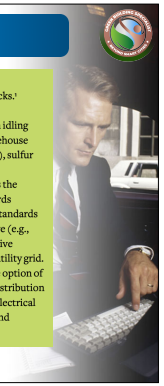
Implementation

REQUIRED DOCUMENTATION

Documentation	New Construction, Core and Shell, Retail, Data Center, Warehouse, Hotel/Healthcare		Schools	
	Option 1	Option 2	Option 1	Option 2
Signage, site plan indicating main building entrance, preferred parking spaces, and alternative fuel fueling stations	X	X	X	
Calculations based on total parking capacity	X	X	X	
For preferred parking spaces, photographs of signage or pavement marking	X	X	X	
For electric vehicle charging spaces, photographs of signage or pavement marking	X		X	
For discounted parking rate, copy of communication to building occupants or photograph of signage	X	X	X	

For electrical connection, manufacturer/ product specifications indicating charging level, compliance with relevant standard, and number of charging units	X		X	
For hood or gas fueling station, manufacturer/ product specifications indicating fuel type and refueling rate		X	X	
Phase-in plan for emissions-compliant bus fleet, including emissions reduction of current fleet, retrofit strategies, timeline, and responsible parties				X
Phase-in plan for green non-bus vehicles, including types of vehicles, timeline and responsible parties				X

BEHIND THE INTENT



In 2010, transportation accounted for 27% of the total U.S. greenhouse gas emissions from combustion of petroleum-based fuels. More than half of those emissions came from passenger vehicles and light-duty trucks.[1] Globally, greenhouse gas emissions from transportation increased 17.5% from 1990 to 2010.[2]

Beyond climate change effects, conventional-fuel vehicles pose public health risks. Diesel exhaust from idling buses releases fine particulates, which can be especially harmful for children.[3] Idling delivery trucks at warehouse loading docks and diesel-powered yard tractors used to move cargo containers[4] emit nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM).

This credit addresses vehicle emissions by rewarding local and regional infrastructure that incentivizes the purchase of green vehicles. The provision of preferred parking spaces closest to a building's entrance rewards building users who drive green vehicles. To qualify for these spaces, green vehicles must meet third-party standards that comprehensively measure both fuel efficiency and emissions. Projects must also provide infrastructure (e.g., electric charging stations) for alternative-fuel vehicles. Electric vehicle supply equipment must have effective charging speeds, align with local or regional standards, and take advantage of future improvements to the utility grid.

School projects may address employees' and visitors' vehicle use, as in other rating systems, or have the option of meeting emissions and green vehicle standards for their bus and non-bus vehicle fleets. Warehouses and distribution center projects may purchase alternative-fuel yard tractors to move trailers around the facility or provide electrical connections at loading dock doors, a strategy that allows truck drivers to operate in-cab comfort settings and appliances by plugging into grid power rather than by idling their engines unnecessarily.

STEP-BY-STEP GUIDANCE

STEP 1. DETERMINE TOTAL VEHICLE PARKING CAPACITY

Total vehicle parking spaces must include all new and existing off-street parking spaces leased or owned by the project, including any parking allocated to the project that is outside the project boundary (see *LT Overview, Total Vehicle Parking Capacity*).

STEP 2. CALCULATE NUMBER OF PREFERRED PARKING SPACES AND ALTERNATIVE-FUEL FUELING STATIONS

Use Equation 1 to determine the number of preferred spaces required for green vehicles. Use Equation 2 for the number of fueling stations required. Projects must provide both preferred parking spaces and alternative-fuel fueling stations. In lieu of preferred parking, projects may provide discounted parking rates for all green vehicles (see *Further Explanation, Discounted Parking Rates*).

EQUATION 1. Required number of preferred parking spaces

Preferred spaces = Total parking spaces × .05

EQUATION 2. Required number of fueling stations

Fueling stations = Total parking spaces × .02

STEP 3. INCORPORATE PREFERRED PARKING INTO DESIGN

On the site plan, identify the location of preferred parking spaces for green vehicles (see *LT Overview, Preferred Parking*, and *Further Explanation, Examples*).

STEP-BY-STEP GUIDANCE +

STEP 4. SELECT ALTERNATIVE-FUEL FUELING STATIONS

Consider legal, technical, and safety issues associated with each fuel type. Projects selecting electric vehicle supply equipment (EVSE) must follow Option 1. Projects selecting all other alternative fuel types must follow Option 2.

- Survey future building occupants to determine which alternative fuel is in highest demand. Regional availability of a given fuel type may be a factor.
- Compare the equipment associated with alternative fuels. The cost and complexity of designing and installing the fueling station vary with the type of fuel.
- Learn about the safety and maintenance issues associated with alternative fuels. Building personnel need to be trained to operate and maintain the fueling stations.
- Review local codes and standards for fueling facilities to determine whether other requirements must be met.

STEP 5. CONFIRM COMPLIANCE OF ANY ELECTRIC VEHICLE SUPPLY EQUIPMENT

For Option 1, select EVSE that meets the credit requirements for charge capability, standard compliance, and network features; all three must be documented for credit compliance. This information can often be found on the manufacturer's website.

- Only Level 2 and 3 chargers qualify for this credit.
- The SAE J1772 standard is common among U.S.-based EVSE manufacturers. IEC 62196 of the International Electrotechnical Commission is an equivalent standard that is common outside the U.S.
- The EVSE must have a Wi-Fi, ethernet, cellular modem, or other Internet communication mechanism that allows the device to send usage data to a server. This enables participation in demand response programs (e.g., SmartGrid) or time-of-use pricing. Specifications must demonstrate, at minimum, that the product is IP-addressable.
- A direct connection between the EVSE and on-site renewable energy is acceptable in lieu of network capability if the EVSE will draw solely from that energy source. Documentation must be provided.

STEP 6. INSTALL ALTERNATIVE-FUEL FUELING STATIONS

On the site plan, identify the location of each alternative-fuel fueling station (see *Further Explanation, Examples*).

- For Option 1, EVSE for plug-in electric vehicles or battery switching stations may be located in any area of the parking facility. Parking spaces reserved for EVSE may not contribute toward preferred parking spaces for green vehicles.
- For Option 2, liquid or gas fueling stations should be located outdoors if possible. If a liquid or gas fueling station cannot be located outdoors, provide dedicated exhaust connected directly to the outdoors.

STEP 7. ENSURE EFFECTIVE USE OF PARKING SPACES

Provide clear and permanently installed signage or pavement markings to reserve the preferred parking spaces for green vehicles only (see *Further Explanation, Signage for Green Vehicles*). In addition, clearly indicate the type of fueling station provided. For projects pursuing Option 1, provide signage that the parking space is reserved for plug-in electric vehicles only.

Projects providing discounted parking in lieu of preferred parking must communicate the discounted rate to users (see *Further Explanation, Discounted Parking Rates*).

Work with the property manager or parking management to review the policy for green vehicle parking and alternative-fuel facilities and ensure that the correct vehicles are using these spaces. Enforcement strategies will vary by project but should include consequences for violations by building users.

SCHOOLS

Determine which option the project will pursue.

Option 1 is best for schools whose vehicle fleets are not within reasonable control of the school management, and for those without vehicle fleets.

Option 2 is best for schools that are served by an outdated aged vehicle fleet and if the school management, project team, or owner has reasonable control over the vehicle fleet serving the building.

STEP-BY-STEP GUIDANCE

Option 1. Green Passenger Vehicles

Follow Steps 1 through 6 above; all references to Option 1 and Option 2 equate to Path 1 and Path 2 for Schools, respectively.

Option 2. Green Buses and School-Owned Vehicles

STEP 1. INVENTORY SCHOOL FLEET

Work with the school's fleet manager to identify the make, model, and year of each bus and each non-bus vehicle that serves the project building. All vehicles that serve the project building must be included in the inventory, including privately owned and leased vehicles.

- If the project building is part of a campus with a shared fleet, the inventory must include all buses in the campus bus fleet.
- If the project building has a dedicated bus fleet, inventory only the buses in the dedicated fleet.

STEP 2. EVALUATE BUS FLEET EMISSIONS

- Review manufacturers' data for each vehicle to find the NO_x and PM emissions values and identify each bus that exceeds the emissions in the credit requirements.
- If manufacturers' data are not available or do not include the emissions information, estimate NO_x and PM emissions based on the vehicles' engine specifications and model years, using Table 1.
- Project teams outside the U.S. should use a local equivalent table of estimated emissions by model year, if one exists, or refer to manufacturers' data. Include the data source and any supporting calculations with the submittal documentation.

TABLE 1. Estimated emissions, by vehicle model year

Model Year	NO_x (g/bhp-hr)	PM (g/bhp-hr)
1974–1978	10.7	0.60
1979–1984	10.7	0.60
1985–1987	10.7	0.60
1988–1989	10.7	0.60
1990	6.0	0.60
1991–1993	5.0	0.25
1994–1997	5.0	0.10
1998–2003	4.0	0.10
2004–2006	4.0	0.10
2007 ON	0.2	0.01

Source: EPA's historical exhaust emissions standards for heavy-duty highway compression-ignition engines and urban buses: epa.gov/otaq/standards/heavy-duty/hdci-exhaust.htm.

STEP 3. EVALUATE VEHICLES OTHER THAN BUSES

Evaluate each vehicle to determine whether it qualifies as a green vehicle, per the rating system definition.

STEP 4. IDENTIFY PHASE-OUT AND RETROFIT STRATEGIES

If the fleet includes buses or other vehicles that do not meet credit requirements, determine whether to retrofit or phase out these vehicles to meet the emissions standards.

- Buses should be retrofitted using emissions control strategies approved by a relevant third party, such as the California Air Resources Board or a local equivalent. Confirm that each bus will meet credit emissions criteria by applying the emissions control strategies to the manufacturer's data or Table 1 estimates.

STEP-BY-STEP GUIDANCE

- Non-bus vehicles that do not meet green vehicle criteria must be phased out.

STEP 5. DOCUMENT PLANS TO ADDRESS ALL NONCOMPLIANT VEHICLES

Develop a plan to retrofit or phase out all noncompliant vehicles within seven years of the school's certificate of occupancy date. Include the following in the plan:

- Emissions evaluation of each vehicle in the current bus fleet serving the school
- Phase-out strategy or retrofit products for each bus that does not meet the emissions criteria
- Make, model and year of each non-bus vehicle, and whether it meets the green vehicle criteria
- Phase-out strategy for each non-bus vehicle that is not a green vehicle, including types of replacement vehicles
- Timeline and responsible parties for each stage of the plan
- For projects in which bus service is contracted, the policy governing scheduled contact bidding or unscheduled changes to the bus company contract
- Signed commitment from the school (or other entity with control over the fleet) to implement the plan.

If bus or non-bus vehicle fleets used by the school already meet the credit requirements, supply the emissions evaluations for buses as well as make, model, and year information for non-bus vehicles.

WAREHOUSES AND DISTRIBUTION CENTERS

Option 1. Alternative-Fuel Vehicles

STEP 1. SELECT ALTERNATIVE-FUEL YARD TRACTOR

Purchase at least one yard tractor to be used at the project site facilities that is powered by electricity, propane, or natural gas.

- Before selecting a model, compare the environmental and economic costs and benefits of each fuel type. Regional availability of a given fuel type may also be a factor.
- Consider the required standards for the type of fueling station that would be required.
- Compare the equipment associated with alternative fuels. The cost and complexity of designing and installing the fueling station vary with the type of fuel.
- Learn about the safety and maintenance issues associated with alternative fuels. Building personnel need to be trained to operate and maintain the fueling stations.
- If the project owner already owns an alternative-fuel yard tractor that will be dedicated to the facility, it is not necessary to purchase a new yard tractor to comply with the credit requirements.

STEP 2. PROVIDE ALTERNATIVE-FUEL FUELING STATION TO SUPPORT YARD TRACTOR(S)

- Work with the owner, civil engineer, mechanical engineer, and other team members to select an appropriate location for the alternative-fuel fueling station(s).
- Liquid or gas fueling stations should be located outdoors if possible. If a liquid or gas fueling station cannot be located outdoors, provide dedicated exhaust connected directly to the outdoors.

Option 2. Reduced Truck Idling

Install electrical connectors for at least 50% of loading dock doors. Indicate the locations on an electrical plan.

- When identifying the placement of electrical connectors, consider such factors as the frequency with which the door is used, the type of product carried at the door, the length of time trucks are idling, and project design elements that may require a reduction in engine idling (e.g., proximity to places of worship, residences, or schools).
- Electrical connectors must allow drivers to shut down truck engines while maintaining use of in-cab heating, air-conditioning, communications, and entertainment systems.
- Although demonstrating this compatibility is not required, vehicles supplying the project will need adapters to take advantage of the electrical connectors. Contact rebate programs such as the Shorepower Truck Electrification Project in the U.S. (the-step-project.org) for potential assistance in subsidizing or supplying adapter kits.

REQUIREMENTS

Provide charging infrastructure for electric vehicles for on-site parking.

Option 1. Electric Vehicle Supply Equipment (1 point)
Install *electrical vehicle supply equipment (EVSE)* in 5% of all parking spaces used by the project or at least two spaces, whichever is greater. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles.

The EVSE must:

- Provide a Level 2 charging capacity (208 – 240 volts) or greater for each required space
- Comply with the relevant regional or local standard for electrical connectors, such as SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler or IEC 62196 of the International Electrotechnical Commission for projects outside the U.S.
- Meet the *connected functionality* criteria for ENERGY STAR certified EVSE and be capable of responding to time-of-use market signals (e.g. price). Projects pursuing EA credit Grid Harmonization should incorporate EVSE into any demand response program or load flexibility and management strategies.

OR

Option 2. Electric Vehicle Ready Infrastructure (1 point)
Make 10% of parking spaces or at least 6 spaces, whichever is greater, *EV Ready*.

To be *EV Ready*, include a dedicated electrical circuit with sufficient capacity for each required space. Each circuit shall have conduit and wire sufficient to provide Level 2 charging or greater, and shall end at an electrical box or enclosure located near each required space.

SCHOOLS

Meet Option 1 or Option 2 above.

OR

Option 3: Electric buses or school-owned vehicles (1 point)
Develop and implement a plan for acquiring at least 1 electric bus and/or for every other bus serving the school to meet the following emissions standards within seven years of the building certificate of occupancy:

- nitrogen oxide (NOx) emissions of 0.50 grams or less per brake horsepower-hour; and
- particulate matter emissions of 0.01 grams or less per brake horsepower-hour.

Emission standards must be met for each bus and not by an average of the entire fleet serving the school.

Develop and implement a plan for 50% of all other (non-bus) vehicles owned or leased to serve the school to be electric vehicles.

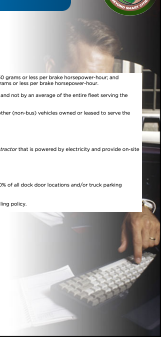
WAREHOUSES & DISTRIBUTION CENTERS

Option 1. Electric Vehicle Charging (1 point)
Provide an on-site fleet with at least one *yard tractor* that is powered by electricity and provide on-site charging for the vehicles.

OR

Option 2. Reduced Truck Idling (1 point)
Provide an electrical connection for at least 50% of all dock door locations and/or truck parking locations to limit truck idling on the site.

Provide signage to communicate a reduced idling policy.

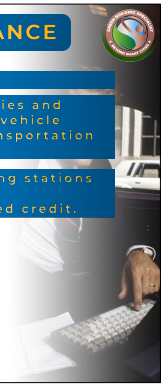


CONNECTION TO ONGOING PERFORMANCE

LEED O+M LT Prerequisite Transportation Performance :

Providing and improving electric vehicle charging facilities and infrastructure implementing any corresponding electric vehicle incentivising programs may help improve a project's transportation performance score.

LEED O+M EA credit Grid Harmonization : Electric charging stations aligning with the existing demand response program or infrastructure comply with the related performance-based credit.



REQUIRED DOCUMENTATION

Documentation	New Construction, Core and Shell, Data Centers, Hospitality, Retail, Healthcare		Schools	
	Option 1	Option 2	Option 1	Option 2
Parking or site plan indicating main building entrance, preferred parking spaces, and alternative-fuel fueling stations	X	X	X	
Calculations based on total parking capacity	X	X	X	
For preferred parking spaces, photographs of signage or pavement marking	X	X	X	
For electric vehicle charging spaces, photographs of signage or pavement marking	X		X	
For discounted parking rate, copy of communication to building occupants or photograph of signage	X	X	X	
For electrical connectors, manufacturers' product specifications indicating charge level, compliance with relevant standard, and internet addressability	X		X	
For liquid or gas fueling stations, manufacturers' product specifications indicating fuel type and refueling rate		X	X	
Phase-in plan for emissions-compliant bus fleet, including emissions evaluation of current fleet, retrofit strategies, timeline, responsible parties				X
Phase-in plan for green non-bus vehicles, including types of vehicles, timeline and responsible parties				X

Warehouses and Distribution Centers		
Documentation	Option 1	Option 2
Manufacturer's documentation of yard tractor model and fuel type	X	
Site plan showing electrical connector locations at loading dock doors		X
Calculations for number of dock doors with electrical connection		X

REFERENCED STANDARDS

- American Council for an Energy Efficient Economy (ACEEE) Green Book: greenercars.org
- Society of Automotive Engineers, SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler: standards.sae.org/j1772_201001
- International Electrotechnical Commission 62196: iec.ch

TERMS AND DEFINITIONS

Alternative fuel low-polluting, non gasoline fuels such as electricity, hydrogen, propane, compressed natural gas, liquid natural gas, methanol, and ethanol

Demand response (DR) a change in electricity use by demand-side resources from their normal consumption patterns in response to changes in the price of electricity or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized

Electric vehicle supply equipment the conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other ittings, devices, power outlets or apparatuses installed speciically for the purpose of delivering energy from the premises wiring to the electric vehicle. (National Electric Codes and California Article 625)

THE WORLD'S 1ST GREEN TECHNOLOGY MARKETPLACE