

Preliminary Cost Document for the Transport Refrigeration Unit Regulation



This document was prepared by California Air Resources Board (CARB or Board) staff to document the preliminary cost inputs and assumptions to be used for the economic analysis of the Transport Refrigeration Unit (TRU) Regulation under development. This document is being released in advance of the Standardized Regulatory Impact Analysis (SRIA) and Initial Statement of Reasons (ISOR) for the TRU Regulation to support stakeholder input and the opportunity for staff to make revisions prior to publication of the SRIA and ISOR.

Please send comments or cost information to [Lea Yamashita](#) by September 10, 2020 to be considered prior to completion of the SRIA. Stakeholders can also continue to comment through the formal regulatory process.

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Background

CARB staff held a teleconference in March 2020 to discuss the updated concept for the TRU Regulation under development. This document outlines the preliminary cost inputs and assumptions to be used to develop the cost estimates for the version of the concept presented during the teleconference. The SRIA will assess the economic impact of the formal regulatory proposal for consideration by the Board and will be released prior to the Board hearing. This document is not intended to detail the regulatory requirements or implementation dates, which can be found in the draft regulatory language on the TRU Regulation [webpage](#).

Assumptions

CARB staff are utilizing the following assumptions for SRIA development. Please provide comments and supporting data if they should be revised.

1. Trailer TRUs and Domestic Shipping Container (DSC) TRUs will primarily use electric-standby or hybrid-electric (plug-in) technology to meet the stationary operating time limit (SOTL) requirement.
2. For the in-use units that will need to take compliance action to meet the particulate matter (PM) requirement by December 31, 2023, 80 percent will utilize the Level 3 Verified Diesel Emissions Control Strategy and 20 percent will purchase a new unit.
3. Out-of-state based fleets doing business in California will retrofit or replace approximately 60 percent of their fleet to comply with the regulation for purposes of business in California; only that part of their fleet with compliant equipment will continue to operate in California. This overall percentage is based on the assumption that all fleets based in neighboring states but doing business in California will retrofit or replace all of their equipment, fleets with less than 10 TRUs based in non neighboring states will retrofit or replace all of their equipment, and fleets with 10 or more TRUs based in non neighboring states will retrofit or replace 50 percent of their equipment. Retrofitting or replacing a percentage of their fleet for operation in California will minimize the cost for out-of-state based fleets to continue to operate in the State.
4. To comply with the facility TRU reporting requirement, 15 percent of applicable facilities will collect and report all TRU activity to CARB, 15 percent will check for compliance onsite, and 70 percent will only do business with companies that are on CARB's compliant list.
5. Port operations already utilize plug-in infrastructure. Additional infrastructure installation is not expected.
6. Truck TRUs typically return to base and will utilize Level 2 dual port chargers at off-peak times.
7. The average power draw for trailer TRUs is 7.3 kilowatts.
8. All grocery store and refrigerated WHDC facilities will utilize operational and efficiency measures, such as a scheduling system, to minimize the amount of fueling or electrical infrastructure needed to meet the SOTL requirement. Refrigerated WHDCs will install additional plugs to accommodate for daily peak activity.
9. For the alternatives analysis, staff is utilizing the average industry cost estimate for a full zero-emission trailer TRU of \$137,000, depending on the battery size.

Table 1. Summary of Updated Concept

Year	Requirement	Applicable Facility	Truck TRU	Trailer TRU	DSC TRU	Railcar TRU	TRU Gen Set	Utility
12/31/2021	Register with CARB	All	All	All	All	All	All	n/a
	Use refrigerant with GWP $\leq 2,200$	n/a	New	New	New	n/a	n/a	n/a
12/31/2022	Facility stationary operating time limit (SOTL) compliance plan submittal	All	n/a	n/a	n/a	n/a	n/a	n/a
	Electric Utility reporting	n/a	n/a	n/a	n/a	n/a	n/a	All
12/31/2023	Facility SOTL compliance plan completion	All	n/a	n/a	n/a	n/a	n/a	n/a
	Full zero-emission (15% per year)	n/a	All	n/a	n/a	n/a	n/a	n/a
	Meet diesel emission standard (PM)	n/a	n/a	In-use	In-use	In-use	In-use	n/a
	Use zero-emission operation when stationary > 15 minutes at an applicable facility, equipped with an electronic telematics system (ETS) and meet diesel emission standards (NOx, PM, CO)	All	n/a	New	New	New (std. only)	New	n/a

Table 1. Summary of Updated Concept (Continued)

Year	Requirement	Applicable Facility	Truck TRU	Trailer TRU	DSC TRU	Railcar TRU	TRU Gen Set	Utility
12/31/2027	Use zero-emission operation when stationary > 15 minutes at an applicable facility, equipped with ETS	All	n/a	All	All	n/a	All	n/a
12/31/2030	Meet diesel emission standards (NOx, PM, CO)	n/a	n/a	All	All	All	All	n/a

Table 2. Scope and Timing of Analysis

Years of Cost Analysis	2021-2034
Applicable Facility Thresholds (used to determine number of applicable facilities and plugs statewide)	<ul style="list-style-type: none"> Refrigerated Warehouse or Distribution Center - Size \geq 20,000 sq. ft. and has Trailer TRU or TRU Gen Set activity Grocery Store - Size \geq 15,000 sq. ft. and has Trailer TRU or TRU Gen Set activity Intermodal Port or Railyard - Ports or Railyards with Trailer TRU or TRU Gen Set activity
Staff assumptions regarding technology	<ul style="list-style-type: none"> Truck TRU – Battery-Electric Trailer and DSC TRU – Electric-Standby or Hybrid-Electric Railcar TRU – not applicable TRU Gen Set – not applicable
Currency	All costs assumed to be in 2019 U.S. Dollars. Staff used the U.S. Bureau of Labor Statistics Consumer Price Index (CPI) Inflation Calculator to convert costs to 2019\$ where cost inputs were derived from information provided to CARB in previous year dollars
Growth rates	<p>1.6 percent annual growth applied to TRU and facility populations.</p> <p>(CARB, 2019) Draft 2019 Update to Emissions Inventory for Transport Refrigeration Units. California Air Resources Board, October 2019. https://ww2.arb.ca.gov/sites/default/files/classic/cc/cold-storage/documents/hra_emissioninventory2019.pdf</p>

Table 3. Applicable Facility – Cost Inputs

Data Input	Value	Units	Basis
Wall or Pedestal Plug Cost	13,600	\$/plug	Average of CARB funded and stakeholder project data. Includes equipment, design, construction, and installation costs for 30A 480V 3-phase plug. Does not include additional site transformer or substation costs.
Plug Maintenance	92.5	\$/unit/year	(Avista, 2019) Avista Corp Electric Vehicle Supply Equipment Pilot Final Report. Avista Corp, October 18, 2019. https://smartenergycc.org/wp-content/uploads/2019/10/Avista-EVSE-Pilot-Project-Review.pdf Plugs consist of a power cord, management system, connector, and safety components. These devices do not contain software like in an EVSE. Since no published maintenance values exist for these plugs, staff is assuming that the maintenance costs will be half of estimated EVSE maintenance costs, or \$92.50.
2019 Electricity Cost	0.16	\$/kWh	California Energy Commission (CEC) staff email to CARB staff dated 2/26/20. Staff calculated a weighted statewide electricity rate based on the number and location of estimated facilities.

Table 3. Applicable Facility – Cost Inputs (Continued)

Data Input	Value	Units	Basis
SOTL Compliance Plan Cost	165.4 to 6,615	\$/plan	One per facility. Staff estimate assumes 2.5 hours per grocery store, 5 hours per super center, 10 hours per standard refrigerated WHDC, 50 hours per high-cube refrigerated WHDC and railyard, and 100 hours per port at \$66.16/hour. This is based on the BLS median wage plus benefits for Transportation, Storage, and Distribution Managers in CA.

Note: Infrastructure and electricity costs apply only if facilities choose that compliance path. Infrastructure is site specific, resulting in cost differences. Current estimates are based on installing infrastructure at refrigerated WHDCs. Staff is currently reviewing railyard estimates.

Table 3b. Estimated Number of Applicable Facilities and Plugs Needed Statewide

Applicable Facility Type	Statewide Estimate of Applicable Facilities	Statewide Number of Plugs Needed
Refrigerated Warehouse or Distribution Center	2,200	20,210
Grocery Store	3,900	4,620
Ports ²	10	0
Railyards	15	1,100

Note: Values have been rounded.

² Existing total TRU plug count at ports is 17,840.

Table 4. Truck TRU Home Base Facility – Cost Inputs

Data Input	Value	Units	Basis
Level 2 Dual Port Charger and Pedestal Cost	1,900	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Level 2 Charger Installation	7,000	\$/dual port charger	(CARB, 2018b) Technical and Cost Analysis: 2019 Code Cycle-Electric Vehicle (EV) Charging Infrastructure: Multifamily Building Standards, Table F15. California Air Resources Board, April 13, 2018. https://ww3.arb.ca.gov/cc/greenbuildings/pdf/tcac2018.pdf
Level 2 Charger Maintenance	185	\$/unit/year	(Avista, 2019) Avista Corp Electric Vehicle Supply Equipment Pilot Final Report. Avista Corp, October 18, 2019. https://smartenergycc.org/wp-content/uploads/2019/10/Avista-EVSE-Pilot-Project-Review.pdf
2019 Electricity Cost	0.16	\$/kWh	CEC staff email to CARB staff dated 2/26/20. Staff calculated a weighted statewide electricity rate based on the number and location of estimated facilities.

Table 5. Truck TRU – Cost Inputs

Data Input	Value	Units	Basis
Baseline Truck TRU Equipment Cost	12,500 to 20,800	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution. Cost range for diesel truck TRU with and without electric standby.
Proposed Zero-Emission Truck TRU Equipment Cost	35,000 to 50,000	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Baseline Truck TRU Maintenance	1.50	\$/hour	eNow email to CARB staff dated 10/22/19.
Proposed Zero-Emission Truck TRU Maintenance	0.5	\$/hour	eNow email to CARB staff dated 10/22/19.
Baseline Refrigerant	36	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Baseline Refrigerant Maintenance	13	\$/unit/year	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Refrigerant	144	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Refrigerant Maintenance	34	\$/unit/year	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed CARB TRU Registration Fee	25	\$/unit/year	Staff analysis of program costs. Annual registration fee.
Zero-Emission Truck TRU Battery Capacity	32.5	kWh	eNow email to CARB staff dated 10/22/19. Staff calculated average battery capacity for units on truck boxes ranging in size from 12 to 28 feet (10 to 60 kWh).
2019 Diesel Fuel Cost	3.81	\$/gallon	(CEC, 2020) Final 2019 Integrated Energy Policy Report. California Energy Commission, January 2020.

Table 5. Truck TRU – Cost Inputs (Continued)

Data Input	Value	Units	Basis
Low Carbon Fuel Standard (LCFS) Credit Value	0.17	\$/kWh	LCFS Staff Analysis Completed on 03/09/20. Staff assumed CA grid average carbon intensity of 81.49, and credit price of \$200.
Percent of LCFS Credits Claimed	100	%	Staff assume that entities eligible to claim LCFS credits (TRU owners) would maximize their opportunity for revenue from these credits.

Table 6. Trailer TRU, Domestic Shipping Container TRU, Railcar TRU, and TRU Gen Set – Cost Inputs

Data Input	Values	Units	Basis
Baseline Trailer and DSC TRU Equipment Cost - Less than 25 Horsepower	24,400 to 28,500	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution. Cost range for Trailer and DSC TRUs less than 25 horsepower.
Baseline Trailer and DSC TRU Equipment Cost - Greater than 25 Horsepower	28,400 to 31,800	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Baseline Trailer and DSC TRU Equipment Cost - Less than 25 Horsepower with Electric-Standby or Hybrid-Electric	25,300 to 32,500	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Trailer and DSC TRU Equipment Cost for Electric-Standby or Hybrid-Electric and to Meet Diesel Emission Standards for NOx, PM, CO)	33,500 to 36,000	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.

Table 6. Trailer TRU, Domestic Shipping Container TRU, Railcar TRU, and TRU Gen Set – Cost Inputs (Continued)

Data Input	Values	Units	Basis
Incremental Trailer and DSC TRU Equipment Cost for Electric-Standby	4,000	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution. Incremental cost for units pre-wired for electric- standby.
Level 3 Verified Diesel Emission Control Strategy and Installation to meet Diesel Emission Standard for PM	4,625	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Baseline Railcar TRU Equipment Cost - Less than 25 Horsepower	24,400 to 28,500	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Railcar TRU Equipment Cost to Meet Diesel Emission Standards for NOx, PM, CO	28,400 to 31,800	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Baseline TRU Gen Set Equipment Cost - Less than 25 Horsepower	17,000 to 17,900	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Proposed TRU Gen Set Equipment Cost to Meet Diesel Emission Standards for NOx, PM, CO	21,500	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Baseline Diesel TRU Maintenance	1.5	\$/hour	eNow email to CARB staff dated 10/22/19.
Proposed Electric-Standby or Hybrid-Electric TRU Maintenance	0.5	\$/hour	eNow email to CARB staff dated 10/22/19. Staff assume reduced maintenance cost (\$0.50/hour) for amount of time TRU is plugged in and diesel engine is not in use.
Baseline Refrigerant	112	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.

Table 6. Trailer TRU, Domestic Shipping Container TRU, Railcar TRU, and TRU Gen Set – Cost Inputs (Continued)

Data Input	Values	Units	Basis
Baseline Refrigerant Maintenance	17	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Refrigerant	304	\$/unit	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed Refrigerant Maintenance	46	\$/year	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Proposed CARB TRU Registration Fee	25	\$/unit/ year	Staff analysis of program costs. Annual registration fee.
Electronic Telematics System Equipment Cost	500 to 1,000	\$/unit	Claimed confidential data obtained from industry sources that requested non-attribution.
Electronic Telematics System Data Plan	240	\$/year	Average of claimed confidential data obtained from industry sources that requested non-attribution.
Low Carbon Fuel Standard (LCFS) Credit Value	0.17	\$/kWh	LCFS Staff Analysis Completed on 03/09/20. Staff assumed CA grid average carbon intensity of 81.49, and credit price of \$200.
Percent of LCFS Credits Claimed	100	%	Staff assume that entities eligible to claim LCFS credits (TRU owners) would maximize their opportunity for revenue from these credits.