State of Oregon
DEQ Department of Environmental Quality

Memorandum

To: Colin McConnaha, Manager, Office of Greenhouse Gas Programs

From: Cory-Ann Wind, Team Lead, Oregon Clean Fuels Program

Date: June 9, 2023

Subject: Approval of an Electric Forklift Estimation Methodology

Attachment: Estimation Methodology for Electric Forklifts

OAR 340-253-1000(2) provides authority for DEQ to approve "an alternative methodology" for calculating fuel quantities reported to the Clean Fuels Program (CFP). The CFP team has been working with stakeholders on a proposal for an Estimation Methodology for Electric Forklift reporting. DEQ held a webinar on May 31st to discuss a draft proposal and get feedback on that and additional input from stakeholders. Additionally, we received 6 written comments.

After consideration of the feedback received, the CFP team recommends modifying 2 items in the draft proposal: 1) to change the depth of discharge from 20% to 30% and 2) to extend the estimation methodology to Q3 2023 reporting. Additionally, CFP confirms that the number of shifts per day remain capped at 2.

See the Attachment for the final Estimation Methodology and sign below to indicate your approval.

Colin McConnaha 6/9/2023

Colin McConnaha, Manager, Office of GHG Programs Date

Oregon Department of Environmental Quality

Electric Forklift Estimation Methodology

For Q1-Q3 2023

Contact: OregonCleanFuels@deq.oregon.gov

Version: June 9, 2023

This methodology is authorized for use only for reporting the first, second, and third quarters of 2023 (Q1, Q2, and Q3 2023) in the Clean Fuels Program. It cannot be used for fourth quarter 2023 reporting or any subsequent quarter.

Background

In the Clean Fuels Program Expansion 2022 Rulemaking, a requirement was added that all electricity reporting must be made using accurate metering at the point of dispensation. This addition was made to ensure that credit generation better aligns with the program's statutory requirement that each credit represent an actual ton of GHG reductions. The rules allow DEQ to adopt an estimation methodology. This methodology is being adopted to ease the transition to actual metering, and thus it expires when the Q3 2023 report is due on September 30, 2023o. Starting with Q4 2023 reporting, all reporting for electric forklifts must reflect actual metering at the point of dispensation.

Applicability

This methodology applies to all registered parties that report on behalf of electric forklifts where direct metering of the forklift charging is not currently available at that location. Any reporter who has the actual charging data must use that for reporting.

Methodology

The following table presents the variables and parameters used in this estimation methodology:

Variable/Parameter	Unit	Description
Depth of discharge	%	This is the measure of the amount of energy that is discharged during the operation of a forklift, given as a percentage of the battery's capacity. This amount cannot exceed **30%** of the battery's capacity.
Battery capacity rating	kWh	This is the measure of the capacity of the forklift's battery, given in kWh.
Charger efficiency rating	%	This is the measure of how efficient the charger is, given in percentage. This varies by the type of charger technology and the age of the charger.

Charge return factor	%	This is the measure of how well the charger tailors its charging profile to the battery's actual depth of discharge, given in percentage. This varies by the type of charger technology.
kWh per forklift per charge cycle	kWh	This is a measure of how many kWh of electricity are dispensed per charge cycle.
Shifts per day	#	This is the measure of how many charge cycles of a forklift per day, assuming there is one charge cycle per shift. The number of shifts cannot exceed two shifts per day and thus only two charge cycles per day may be claimed.
Work days per quarter	#	This is the measure of how many work days per quarter the forklift is operated.
kWh per forklift per quarter	kWh	This is the measure of how many kWh of electricity are dispensed per forklift per quarter.

The variables in the first four rows - Depth of discharge, the Battery capacity rating, the Charger efficiency rating, and the Charge return factor - combine to yield the kWh per forklift per charge cycle. This is then multiplied by the number of shifts per day and the number of work days per quarter to determine kWh per forklift per quarter.

The formulas to calculate kWh consumption of electric forklifts are as follows:

$$kWh\ per\ forklift\ per\ charge\ cycle = Depth\ of\ discharge\ x\ Battery\ capacity\ rating\ x\ Charger\ efficiency\ rating\ x\ charge\ return\ factor$$

$$kWh\ per\ forklift\ per\ quarter = kWh\ per\ forklift\ per\ charge\ cycle\ x\ Shifts\ per\ day\ x\ number\ of\ work\ days\ per\ quarter$$

The total amount of electricity reported per quarter would be the sum of all forklifts for that facility/FSE.

In order to use this methodology, the reporting entity will:

1. **Identify the Battery capacity rating**. The forklift owner and operator should use a tool such as this one: http://mptools.enersys.com/oem/ to identify the capacity of the battery or batteries used by their forklifts.

2. **Adjust for Depth of discharge.** The fleet owner or operator should adjust the depth of discharge variable to reflect the amount of power that needs to be returned to recharge the battery. Battery is discharged during forklift operation, **up to a maximum of 30% of the battery's capacity** under this methodology.

3. **Adjust for Charger efficiency rating.** The fleet owner or operator should adjust the charger efficiency rating based on the charger technology and the age of each charger used by the fleet. Ferro-resonant chargers typically run in the 82% to 86% efficiency range. Silicon Controlled Rectified (SCR) chargers run in the 78% to 82% range. High Frequency chargers typically run in the 90% to 96% range. With all of these technologies, the older chargers tend to run toward the lower end of the range, and the newer chargers tend to run on the higher end of the range.

4. **Adjust for Charge return factor.** The fleet owner or operator should adjust the charge return factor for each charger based on the charger technology. Ferro-resonant chargers and High Frequency chargers are typically designed to provide a 15% over-charge or 115% total. SCR chargers are typically closer to an 18% over-charge or 118% total.

5. **Determine the number of shifts per day.** The fleet owner or operator should determine how many shifts/charging cycles that occur per day, based on their typical daily operations. The number **shall not exceed two shifts/charging cycles per day**.

6. **Determine the number of work days per quarter.** The fleet owner or operator should determine how many days the forklifts were in operation during the quarter in question.

7. **Calculate the total electricity use per quarter.** The fleet owner or operator should calculate the electricity use per charger per quarter and sum up the kWh to calculate the total quarterly electricity use, using the formulas given above. This value should be reported in the Oregon Fuels Reporting System (OFRS) and should be segregated into the two categories of e-forklifts - those manufactured pre- or post-2016 – based on the e-forklift model year. The spreadsheet furnished by DEQ allows the reporting party to inventory each of the pre- or post-2016 e-forklifts by FSE ID, e-forklift unique identifier and e-forklift model year, and calculates the kWh accordingly.

The reporting party using this methodology must also upload a filled out copy of the DEQ-provided spreadsheet when submitting the quarterly report in OFRS.

Contact

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Non-discrimination statement