



Proposal for a Forklift Estimation Methodology

Discussion draft for the May 30, 2023 webinar

Contact: OregonCleanFuels@deq.oregon.gov

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This draft proposal is being produced for discussion purposes only. It is not an official estimation methodology that has been approved by Oregon DEQ for use in the Clean Fuels Program. It cannot be used for reporting in the Clean Fuels Program.

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.

Acknowledging that metering at the point of dispensation can be complicated and unique to individual scenarios, the regulation allows for DEQ to approve an estimation methodology to avoid these obstacles. Prior to the rulemaking, there was no specific allowance for an estimation methodology, but DEQ staff had informally allowed for the use of the California Air Resources Board draft regulatory guidance for estimating forklift consumption, available at: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/regguidance_17-02.pdf. At this time, DEQ is proposing an estimation methodology for use in the short-term, as fleets and operators transition to metering.

California Air Resources Board estimation methodology

The following table presents the variables and parameters used in the CARB 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.
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.

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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.
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:

$\begin{aligned} & \text{kWh per forklift per charge cycle} \\ & = \text{Depth of discharge} \times \text{Battery capacity rating} \times \text{Charger efficiency rating} \times \text{charge return factor} \end{aligned}$
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$\begin{aligned} & \text{kWh per forklift per quarter} \\ & = \text{kWh per forklift per charge cycle} \times \text{Shifts per day} \times \text{number of work days per quarter} \end{aligned}$
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The total amount of electricity reported per quarter would be the sum of all forklifts for that facility/FSE.

New information

After the adoption of the rulemaking in September 2022, DEQ began planning for implementation of the changes to the electricity reporting requirement. Information related to these changes were communicated via a webinar held on January 19, 2023 and through the guidance document titled “Changes to Fuel Supply Equipment Registration.” DEQ has repeatedly said that this is a living document that is being continuously updated as lessons are learned and frequently asked questions are responded to. This document was first posted on January 12, 2023 and subsequently updated on March 8, April 25, and May 16.

Additionally, the states that implement an LCFS have had recent discussions about the CARB estimation methodology and that the assumptions likely overestimate the amount of charging by forklifts. Specifically, the assumptions used for the depth of discharge and the shifts per day are significantly greater than reality, thereby leading to the overgeneration of credits.

DEQ proposal

DEQ is focusing on these two variables and is proposing this modified version of the CARB estimation methodology for use in the CFP. The two changes being proposed are:

Variable/Parameter	Unit	Description
Depth of discharge	%	This 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. <u>This amount cannot exceed 20% of the battery’s capacity.</u>
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. <u>The number of shifts cannot exceed two shifts per day and thus only two charge cycles per day may be claimed.</u>

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

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 20% 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 kWhs to calculate the total quarterly electricity use, using the formulas given above. This value should be reported in the Oregon Fuels Reporting System and is segregated into the two categories of forklifts - those manufactured pre- or post-2016. The spreadsheet furnished by DEQ allows the reporting party to inventory the number of pre- or post-2016 forklifts by FSE and forklift class, and calculates the kWh accordingly.

The reporting party using this methodology must also furnish the spreadsheet created by DEQ for each quarter when reporting to the Clean Fuels Program.

Timeline

DEQ will consider the feedback received during the May 30, 2023 webinar and allow for written comments to be submitted by June 6, 2023. Submit comments via email to: OregonCleanFuels@deq.oregon.gov.

If approved, DEQ proposes to allow for the use of this estimation methodology for the Q1 and Q2 2023 reports. Starting with the Q3 2023 report, only metered data will be accepted. This applies to both the new FSE Registrations as well as the active FSEs in the OFRS.

Contact

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