Lifecycle climate impact and primary energy use of electric and biofuel cargo trucks

SND-ID: 2023-3-1. **Version**: 1. **DOI**: https://doi.org/10.5878/0h1w-e950

Download data

Sathre_Gustavsson_2023_truck_climate_impact.xlsx *(609.86 KB)*

Associated documentation

Documentation_Sathre_Gustavsson_2023_truck_climate_impact.pdf *(208.87 KB)*

References_Sathre_Gustavsson_2023_truck_climate_impact.pdf *(84.67 KB)*

Download all files

2023-3-1-1.zip *(~903.4 KB)*

Citation

Sathre, R., & Gustavsson, L. (2023) Lifecycle climate impact and primary energy use of electric and biofuel cargo trucks (Version 1) [Data set]. Linnaeus University. Available at: https://doi.org/10.5878/0h1w-e950

Creator/Principal investigator(s)

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Description

Heavy trucks contribute significantly to climate change, and in 2020 were responsible for 7% of total Swedish GHG emissions and 5% of total global CO2 emissions. Here we study the full lifecycle of cargo trucks powered by different energy pathways, comparing their biomass feedstock use, primary energy use, net biogenic and fossil CO2 emission, and cumulative radiative forcing. We analyse battery electric trucks with bioelectricity from standalone or combined heat and power (CHP) plants, and pathways where bioelectricity is integrated with wind and solar electricity. We analyse trucks operated on fossil diesel fuel and on dimethyl ether (DME). All energy pathways are analysed with and without carbon capture and storage (CCS). Bioelectricity and DME are produced from forest harvest residues. Forest biomass is a limited resource, so in a scenario analysis we allocate a fixed amount of biomass to power Swedish truck transport. Battery lifespan and chemistry, the technology level of energy supply, and the biomass source and transport distance are all varied to understand how sensitive the results are to these parameters. The scenario spans 100 years into the future. We find that pathways using electricity to power battery electric trucks have much lower climate impacts and primary energy use, compared to diesel and DME based pathways. The pathways using bioelectricity with CCS result in negative emissions leading to global cooling of the earth. The pathways using diesel and DME have significant and very similar climate impact, even with CCS. The robust results show that truck electrification and increased renewable electricity production is a much better strategy to reduce the climate impact of cargo transport and much more primary energy efficient than the adoption of DME trucks. This climate impact analysis includes all fossil and net biogenic CO2

emissions as well as the timing of these emissions. Considering only fossil emissions is incomplete and could be misleading.

This dataset contains data on 4 metrics (primary energy use, biomass feedstock use, cumulative CO2 emissions, and cumulative radiative forcing) resulting from scenario modeling of cargo truck use in Sweden powered by different energy pathways. The energy pathways include battery electric trucks powered by bioelectricity, solar photovoltaic electricity and wind electricity, and internal combustion trucks powered by fossil diesel and dimethyl ether. The scenario spans 100 years into the future.

The Excel sheet "tables" contains input data for the scenario modeling, with sources listed where applicable. The remaining sheets contains the modeled results and generated figures that are also a published in the associated article Sathre & Gustavsson (2023). Refer to the method description and reference list in the included documentation files for details.

Data contains personal data

No

Language

English

Variables

4

Data format / data structure

Numeric

Data collection 1

- Mode of collection: Simulation
- Description of the mode of collection: Scenario modeling
- Time period(s) for data collection: 2022-01-01 – 2022-08-31

Geographic spread

Geographic location: Sweden

Responsible department/unit

Department of Built Environment and Energy Technology

Research area

Climate research (Standard för svensk indelning av forskningsämnen 2011)

Environmental sciences (Standard för svensk indelning av forskningsämnen 2011)

Transport systems and logistics (Standard för svensk indelning av forskningsämnen 2011)

Forest science (Standard för svensk indelning av forskningsämnen 2011)

Renewable bioenergy research (Standard för svensk indelning av forskningsämnen 2011)

Keywords

Radiative forcing, Biofuel, Electric vehicle, Lorry, Biomass energy, Biomass, Bioelectricity, Cumulative radiative forcing, Dimethyl ether, Woody biomass, Climate impact

Publications

Sathre, R., Gustavsson, L. (2023). Lifecycle climate impact and primary energy use of electric and biofuel cargo trucks. Global Change Biology Bioenergy.

Accessibility level

Access to data through SND
Data are freely accessible

Use of data

Things to consider when using data shared through SND

Versions

Version 1. 2023-01-25

Download metadata

DataCite

DDI 2.5

DDI 3.3

DCAT-AP-SE 2.0

JSON-LD

PDF

Citation (CSL)

File overview (CSV)

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