GHG LCA of Conventional Vehicles vs. Battery Electric Vehicles

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22.02.2022
Data Analysis
System boundary and variables

1. CV’s CTG GHG emission
2. CV lifespan
3. Fuel consumption rate
4. WTW GHG intensity of fuel
5. TTW energy consumption
6. CV’s M&R GHG emission

Conventional Vehicle (CV)

- **CTG**
  - Raw material extraction and product manufacturing of the vehicle
  - CV lifespan
- **WTW**
  - Fuel consumption
  - GHG emission analysis for Well-to-Wheel
- **M&R**
  - GHG emission for maintenance and repair in CVs
- **EoL**

Battery Electric Vehicle (BEV)

- **CTG**
  - Raw material extraction and product manufacturing for battery, charging infrastructures, and other components
  - Battery and BET lifespan
- **WTW**
  - Electricity consumption analysis based on relative powertrain energy consumption of CT/BET and energy adjustment for impacts of ambient temperature change, curb weight change, and charging infrastructure’s energy loss
  - GHG emission factor of the mixed grid electricity generation
- **M&R**
  - Comparative assumption of GHG emission for maintenance and repair in CVs
- **EoL**

1. BEV’s CTG GHG emission (except battery)
2. Charger’s CTG CTG CHG emission
3. BEV lifespan
4. Battery lifespan (CC, etc.)
5. Battery’s CTG GHG emission
6. Relative powertrain energy consumption CV/BEV
7. Ambient temperature change
8. Charger energy loss
9. Curb weight change
10. GHG intensity of the electricity (GHG emission factor of the mixed grid electricity generation)
11. BEV’s M&R GHG emission
Data Analysis
Delivery Van

GVW: 1.8 t
Payload capacity: 0.5 t
Fuel consumption rate: around 7 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 60 kWh (185 km range)

BEV ➔ 66% GHG reduction
Data Analysis
Delivery Van

GVW: 1.8 t
Payload capacity: 0.5 t
Fuel consumption rate: around 7 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 60 kWh (185 km range)

BEV ➔ 66% GHG reduction
Data Analysis

Taxi Van

GVW: 3.5 t
Payload capacity: 0.66 t
Fuel consumption rate: around 11.34 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 100 kWh (191 km range)

BEV ➔ 64% GHG reduction
GVW: 5 t
Payload capacity: 1.55 t
Fuel consumption rate: around 13.73 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 100 kWh (160 km range)
BEV ➔ 68% GHG reduction
Data Analysis

Medium-duty Truck (16 t)

GVW: 16 t
Payload capacity: 10 t
Fuel consumption rate: around 26.1 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 200 kWh (119 km range)

BEV ➔ 64% GHG reduction
Data Analysis
Heavy-duty Truck (26 t)

GVW: 26 t
Payload capacity: 16 t
Fuel consumption rate: around 36.1 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 350 kWh (145 km range)

BEV ➔ 60% GHG reduction
Data Analysis

Heavy-duty Truck (40 t)

GVW: 40 t
Payload capacity: 25.7 t
Fuel consumption rate: around 47.5 l/100km
Fuel type: diesel
Laden share: 50% of payload capacity
Battery capacity: 350 kWh (112 km range)

BEV ➔ 62% GHG reduction
Lifetime mileage for Delivery Van and Taxi Van: 300,000 km
Lifetime mileage for minibus and different trucks 500,000 km
Data Analysis
Sensitivity Analysis

Lifetime mileage for Delivery Van and Taxi Van: 300,000 km
Lifetime mileage for minibus and different trucks 500,000 km
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Lifetime mileage for minibus and different trucks 500,000 km
Data Analysis

Conclusion

- BEV in different Vehicle categories in Finland with the average annual ambient temperature of:
  - 3 °C (default) ➔ 62% to 68% GHG emission reduction
  - -5 °C ➔ 57% to 66% GHG emission reduction
  - -10 °C ➔ 53% to 64% GHG emission reduction
  - -15 °C ➔ 51% to 62% GHG emission reduction

- Carbon neutral sources for electricity generation (battery charging and battery production) ➔ 81% to 88% GHG emission reduction

- On average every 100,000 longer lifespan for BEVs in different Vehicle categories in Finland ➔ +0.3% to +0.9% GHG emission reduction

- On average +/- 10% inaccuracy in fuel consumption estimate for CVs in different Vehicle categories in Finland ➔ +/- 0.5% to +/- 1.7% GHG emission reduction
Thank you!

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