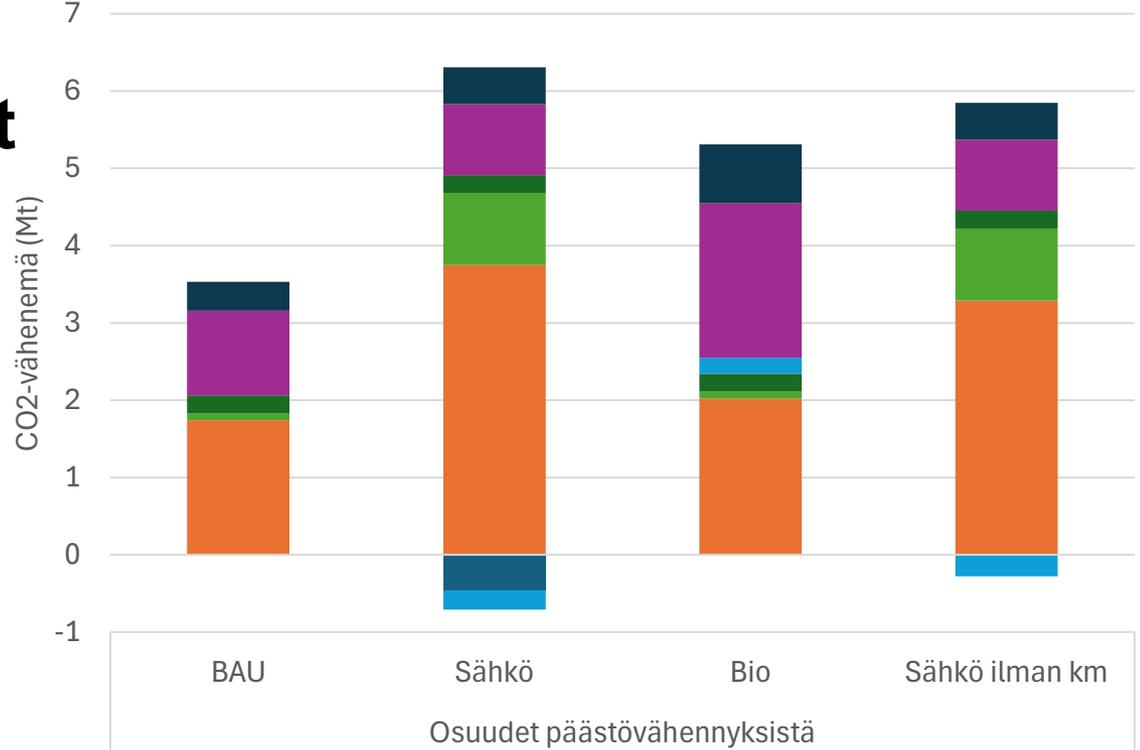
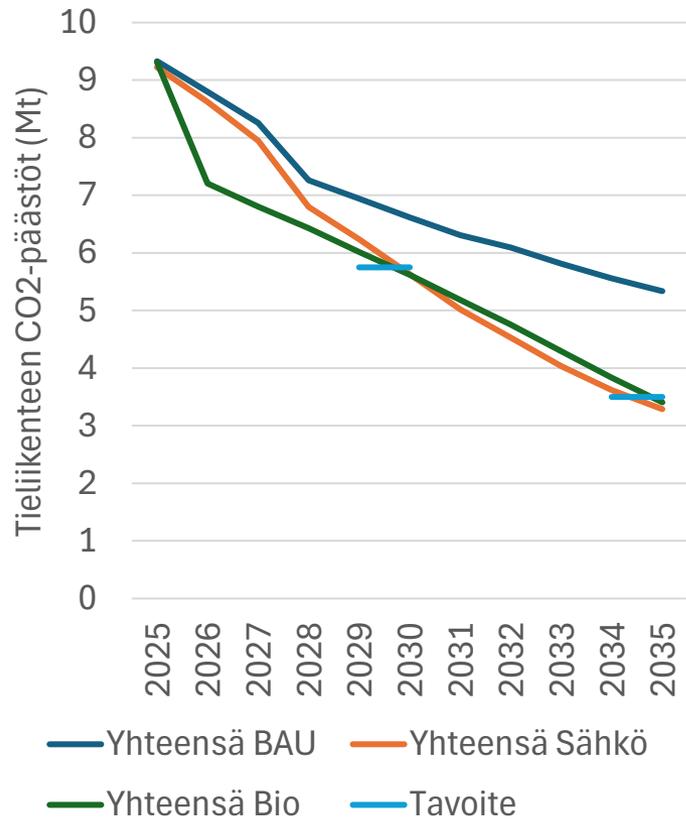




Mehdi Jahangir Samet, Heikki Liimatainen, and Mikko Pihlatie

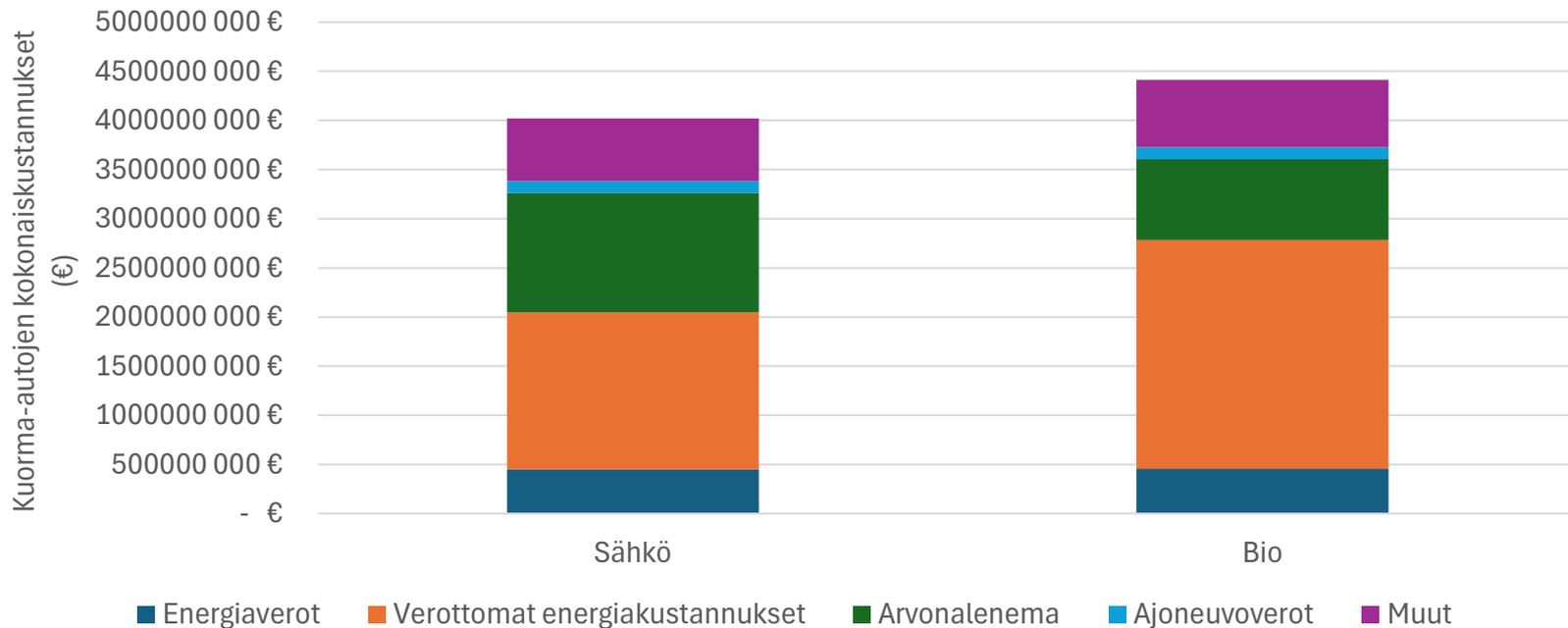
# **KULJETUKSET TIEVERKOLLA JA LATAUSINFRAAN TARVE**

# CO2- päästövähennykset 2035



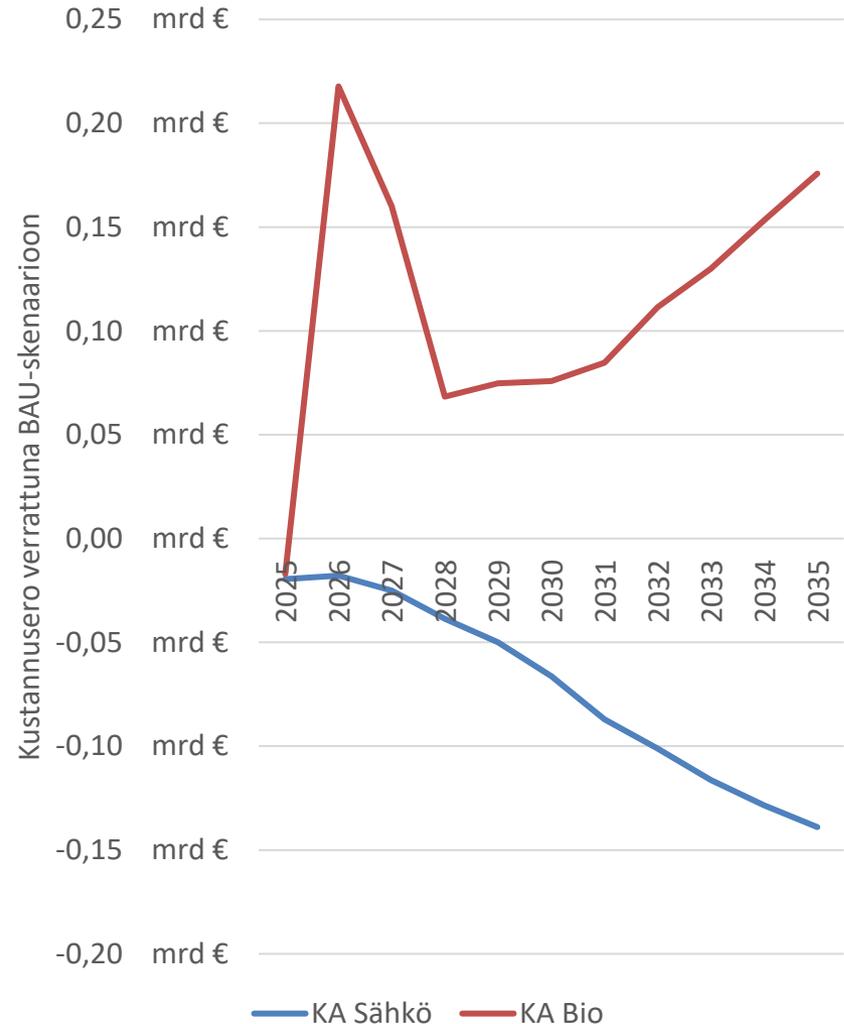
- Uusiutuvat polttoaineet linja- ja pakettiautoissa
- Uusiutuvat polttoaineet kuorma-autoissa
- Uusiutuvat polttoaineet henkilöautoissa
- Sähkölinja- ja pakettiautot
- Sähkökuorma-autot
- Sähköhenkilöautot
- Suorituksen kasvu

# Kuorma-autojen kustannukset 2035 kustannuskomponenteittain

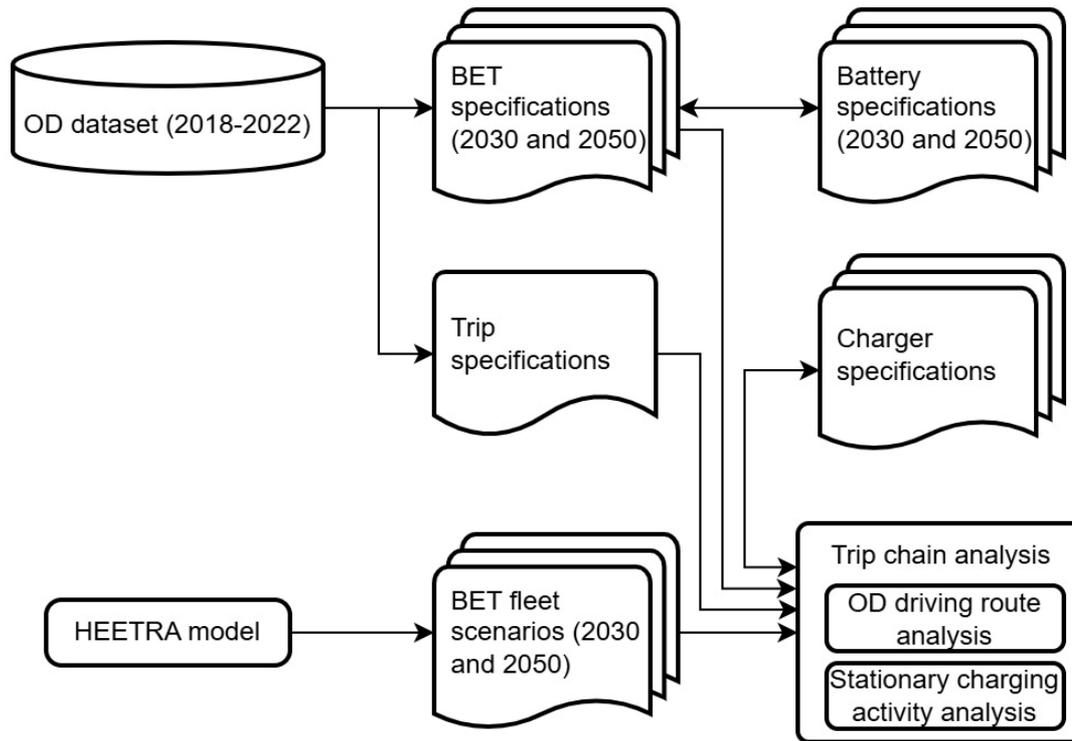


# Kuorma-autoliikenteen kustannukset kasvavat ilman sähköistymistä

- Kustannusten nousu on vältettävissä siirtymällä sähkö- ja kaasukuorma-autoihin.
  - Ammattidiesel tekehengittäisi yhä kallistuvaa teknologiaa.
- Alkuvaiheessa siirtymää voi tukea hankintatuilla, latausinfran tukia voi jatkaa pidempään.
  - Sähkökuorma-autojen hankintatuen kustannusvaikuttavuus on  $-113 \text{ €/t}$  ([Liikenteen päästövähennystoimenpiteiden kokonaisvaltainen taloudellinen arviointi](#)).
- Tuet kannattaa kohdistaa raskaiden ajoneuvoyhdistelmien sähköistykseen.
  - Perävaunuttomien kuorma-autojen osalta kokonaiskustannukset ovat jo hyvin lähellä tai jopa alle dieselkuorma-autojen kustannusten ([Jahangir Samet ym. 2024](#)).



# Methodology (1/2)



**Figure 1.** The model flow for analyzing the plug-in charging requirements of BETs in Finland.

# Methodology (2/2)

Charger groups	Maximum charging power (ChP <sub>max</sub> ) in kW	Available charging time (t <sub>ch</sub> )	Positioning in the work schedule	“Off-shift” or “mid-shift”	The possible charger ownership and application	The location in the OD driving route analysis*
private1	400	9 h for 2d-SLH	Before starting the trip	Off-shift	Private (depots)	Centroid of the origin zone
private2	700	3 h 45 for 2d-U	Before starting the trip	Off-shift	Private (depots)	Centroid of the origin zone
private3	400	3 h 45 for 2d-U	During mandatory long breaks	Off-shift	Private (depots) or Public (depots and on-road stations)	Centroid of the origin or destination zone
private4	400	30 min and more for all shifts	During the loading or unloading	mid-shift	Private (at the delivery points of origins or destinations)	Centroid of the origin or destination zone
public1	200	9 h for 2d-SLH and 14 h 15 for 1d	During mandatory long breaks	Off-shift	Public (depots and on-road stations)	An estimated location on the road network
public2	1200	45 min and more for all shifts	During mandatory short breaks	mid-shift	Public (on-road stations)	An estimated location on the road network

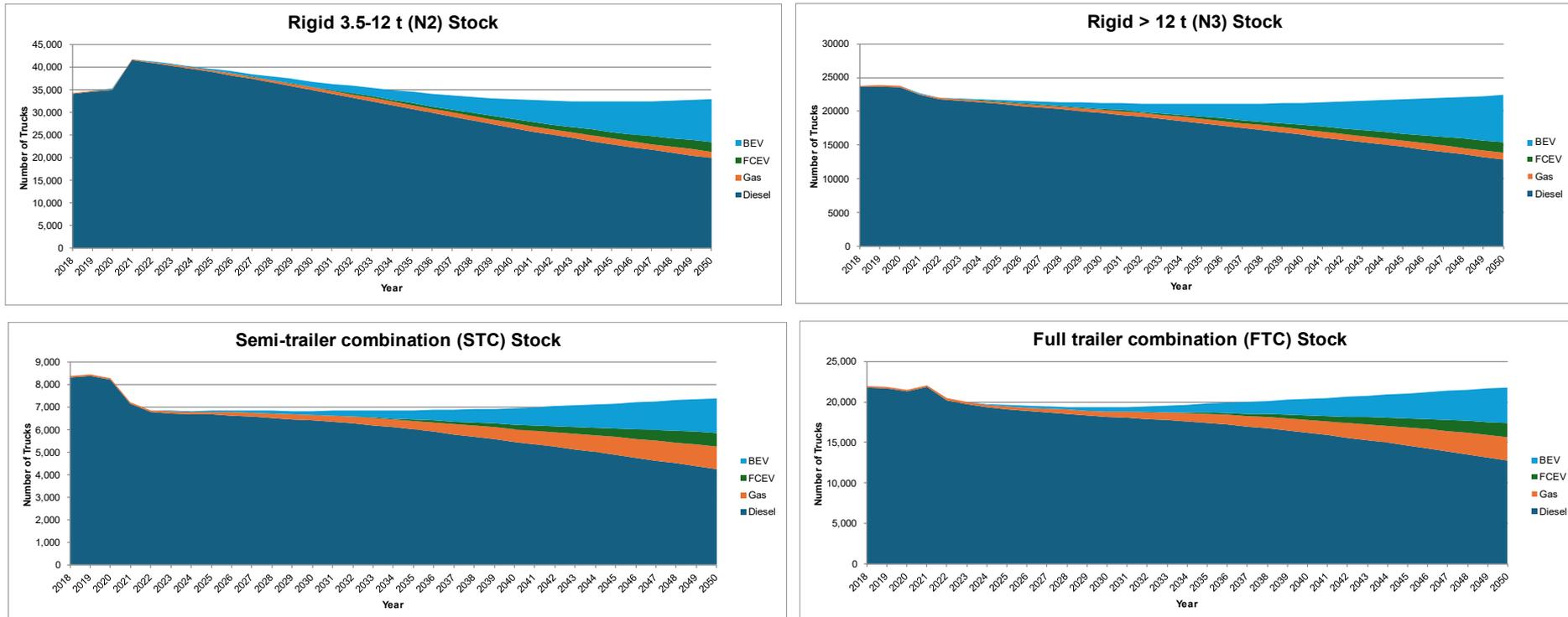
## Working schedules

## Identification criteria



**Figure 3.** The criteria and working schedules.

# Results: BET stock scenarios (1/2)



**Figure 4.** Pessimistic scenario for BET fleet number of different truck types in Finland.

# Results: BET stock scenarios (2/2)

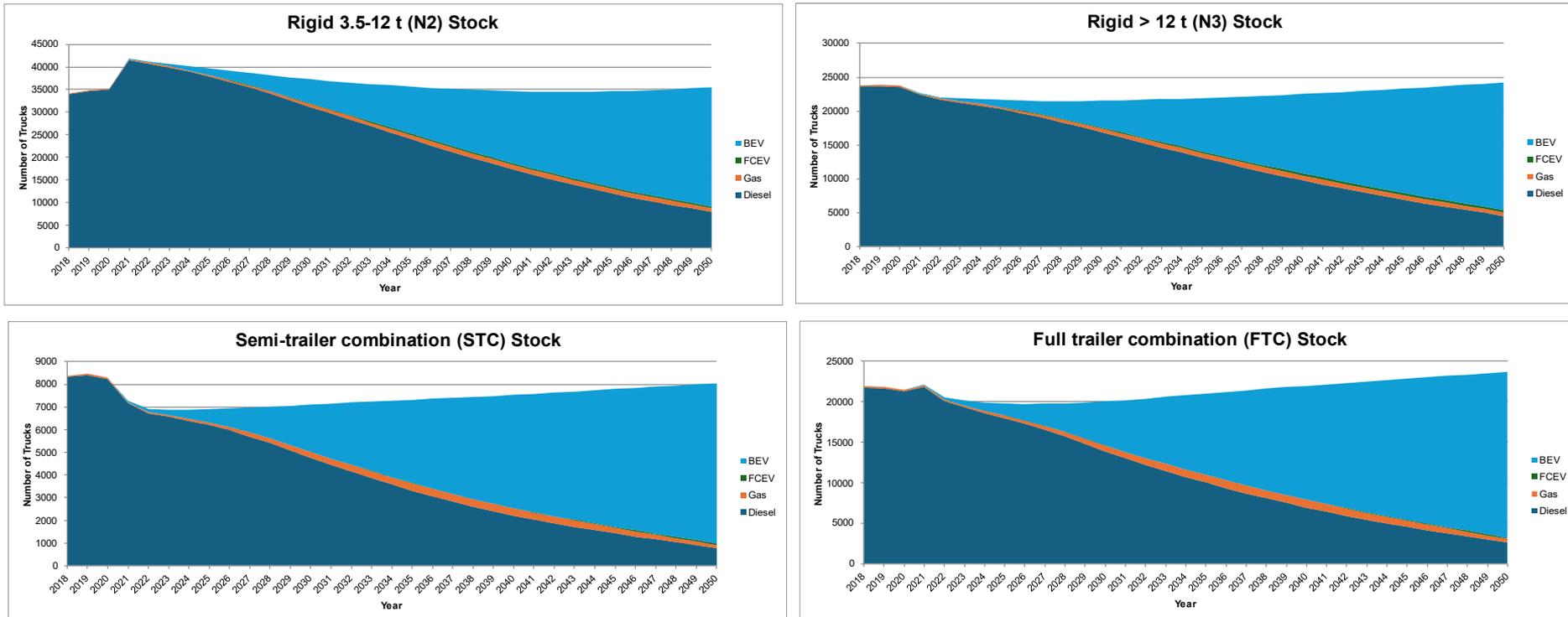
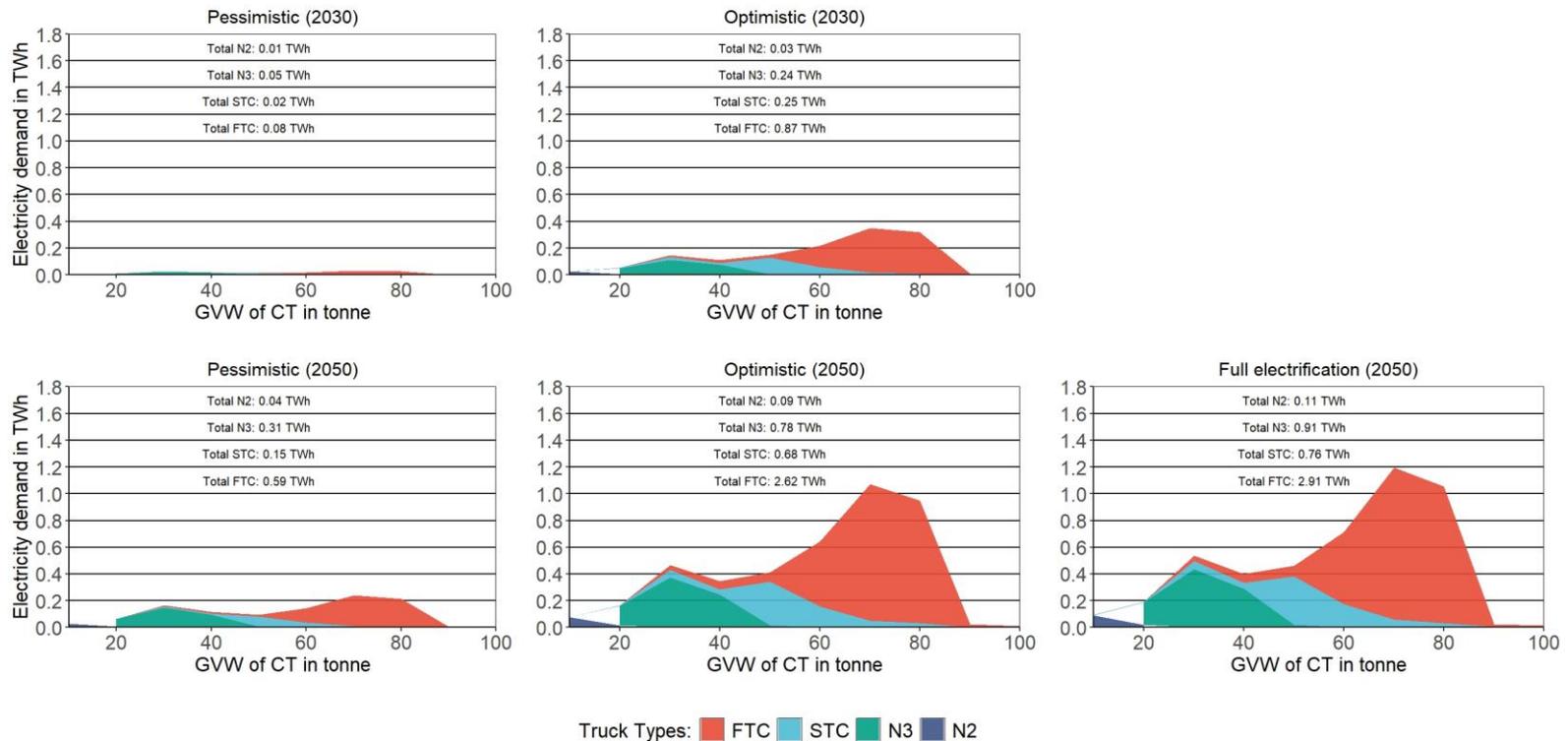


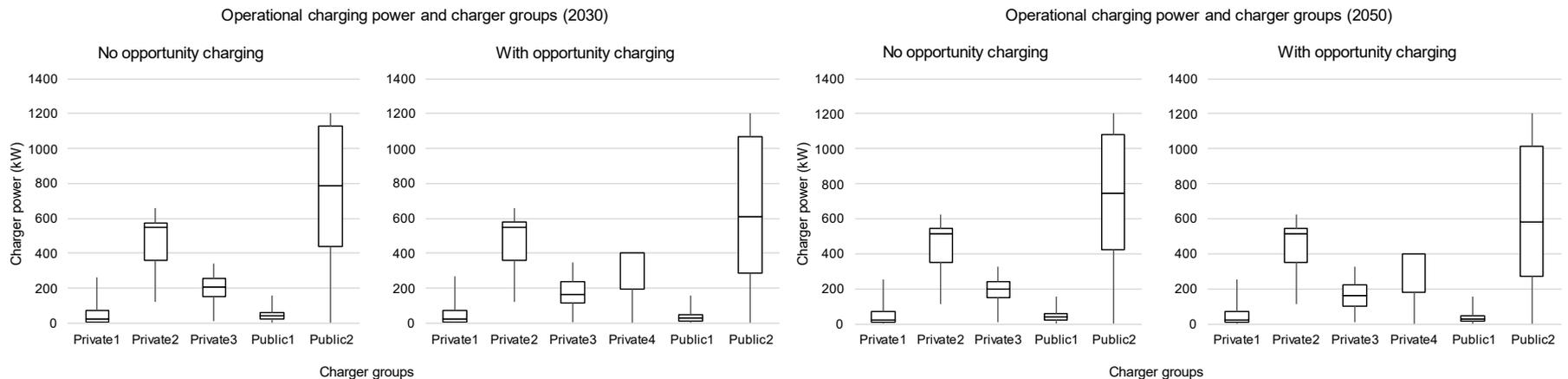
Figure 5. Optimistic scenario for BET fleet number of different truck types in Finland.

# Results: National electricity demand



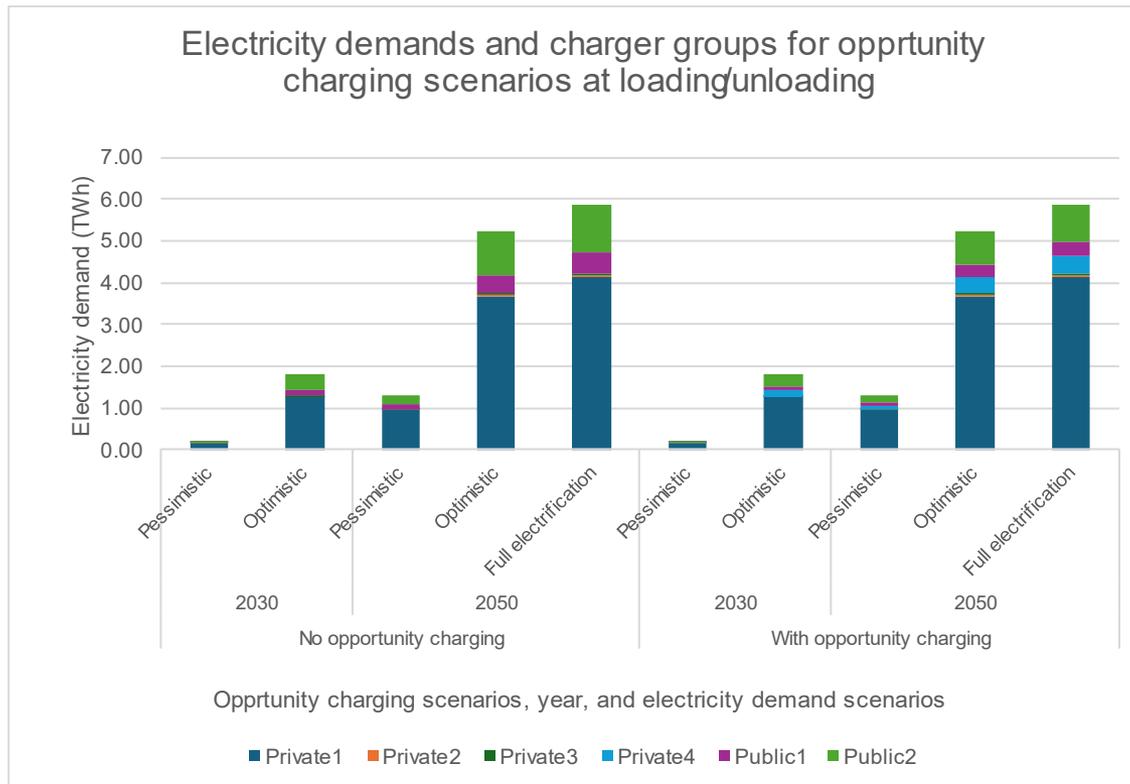
**Figure 7.** The national electricity demand estimates for different electrification scenarios and truck types in different GVWs in Finland. The GVWs in the graphs are represented as 10 t interval groups (i.e., 5 t GVW are represented as 10 t in the chart).

# Results: Operational charging power



**Figure 12.** The distribution of the operational charging power demands (kW) for different charger groups, and years with (no) opportunity charging during loading/unloading in Finland. The box plots represent the minimum, the first quartile, the median, the third quartile, and the maximum.

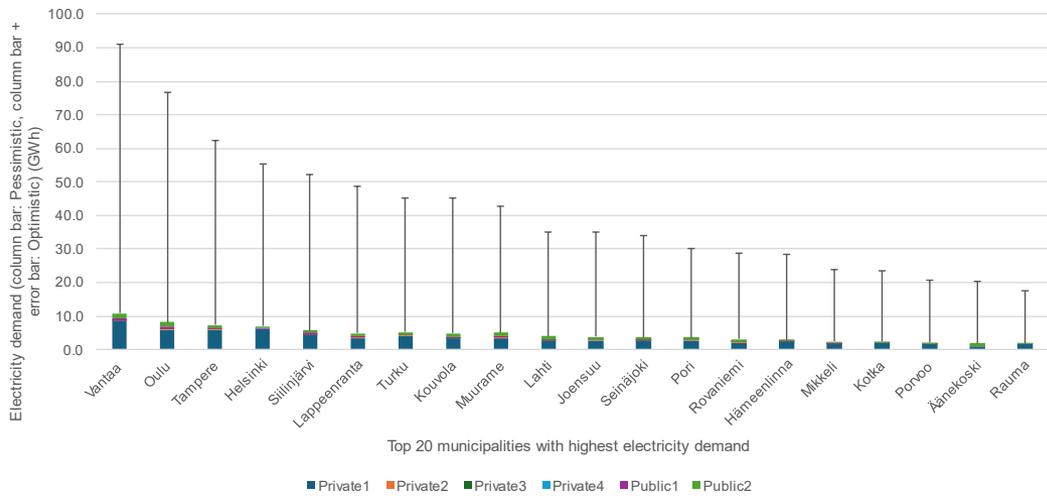
# Results: Electricity demand vs. charging groups



**Figure 13.** The distribution of the electricity demand for different electrification scenarios, and years with (no) opportunity charging during loading/unloading based on different charging groups in Finland.

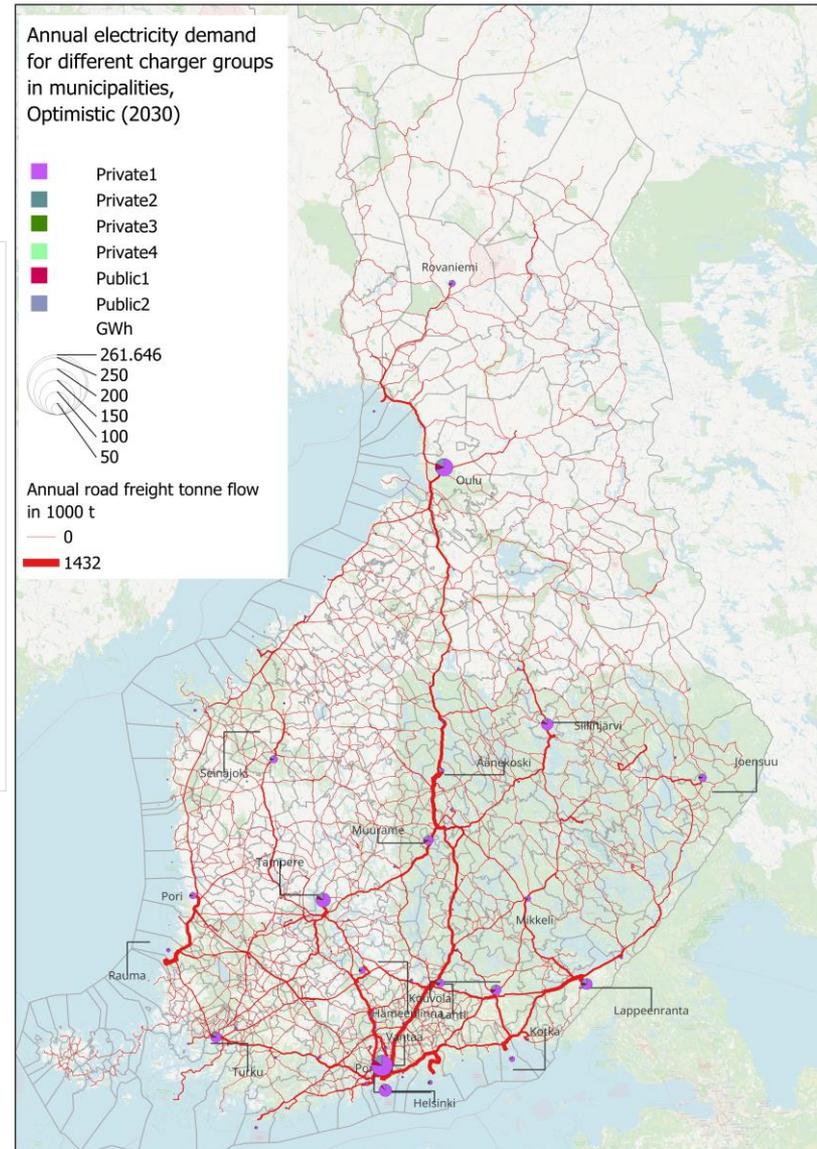
# Results: Charging demands maps (1/4)

Electricity demand for BET charging activities in top 20 municipalities (2030)

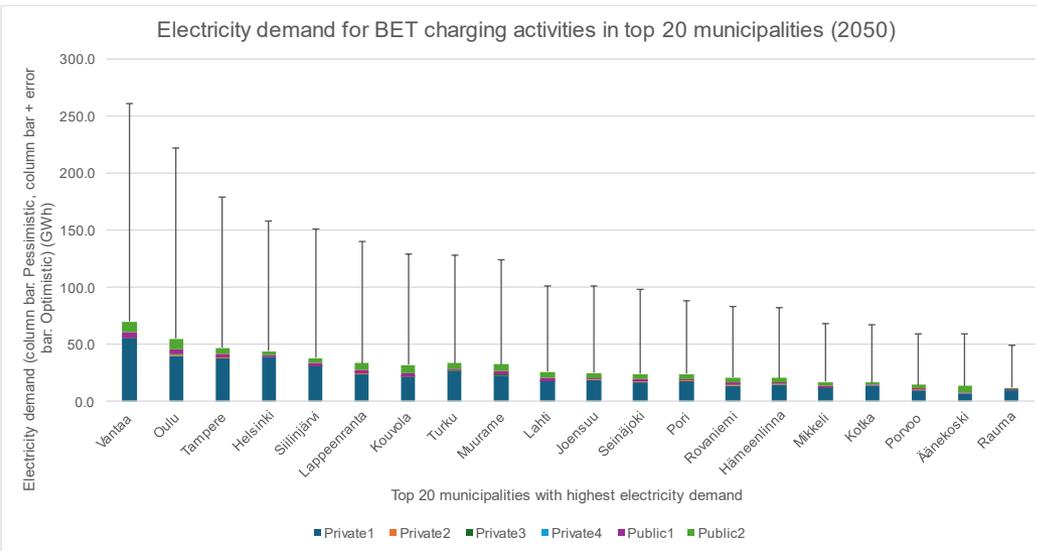


**Figure 15.** The electricity demand (GWh) of different charging groups for the top 20 municipality areas with the highest demand in 2030 in Finland.

**Figure 16.** The geospatial distribution of the electricity demand for MT (2030) horizon of Optimistic electrification scenario based on different charging groups in municipality areas in Finland.

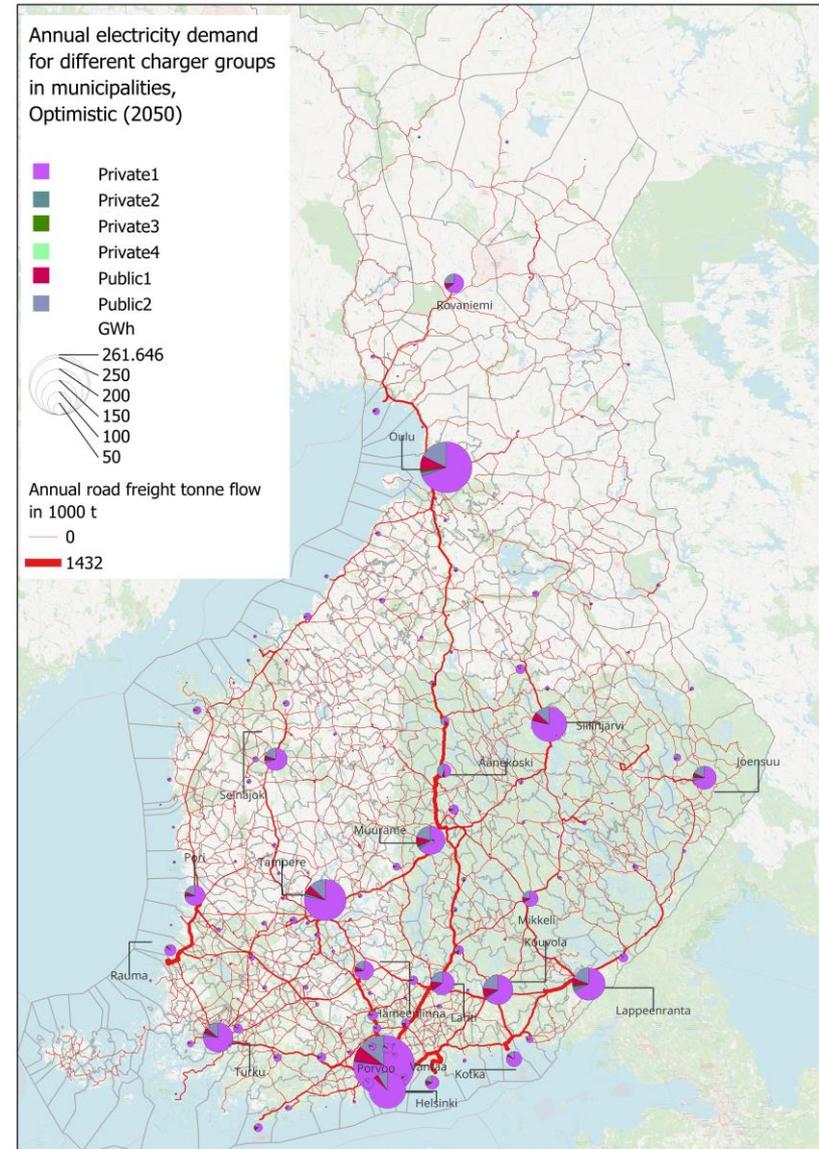


# Results: Charging demands maps (2/4)

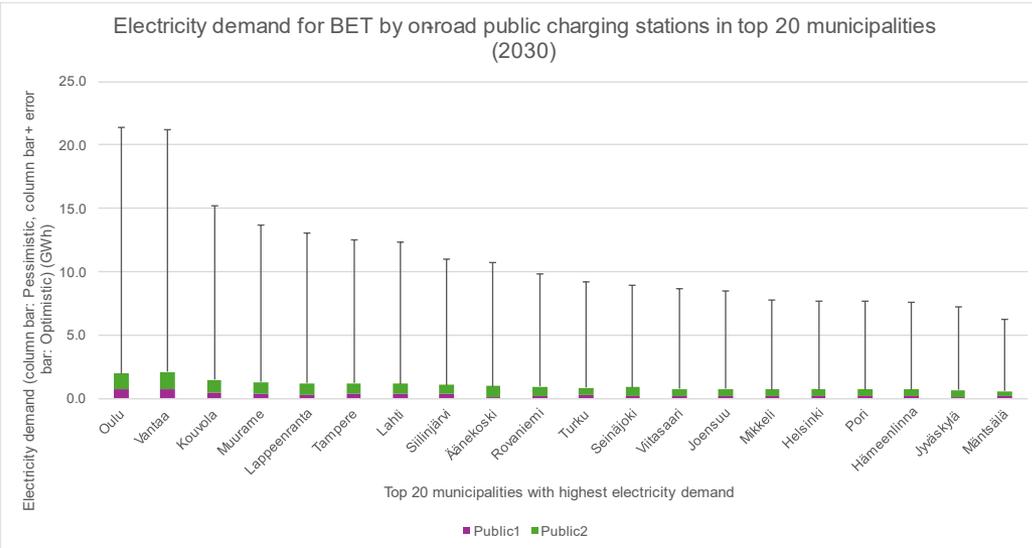


**Figure 17.** The electricity demand (GWh) of different charging groups for the top 20 municipality areas with the highest demand in 2050 in Finland.

**Figure 18.** The geospatial distribution of the electricity demand for LT (2050) horizon of Optimistic electrification scenario based on different charging groups in municipality areas in Finland.

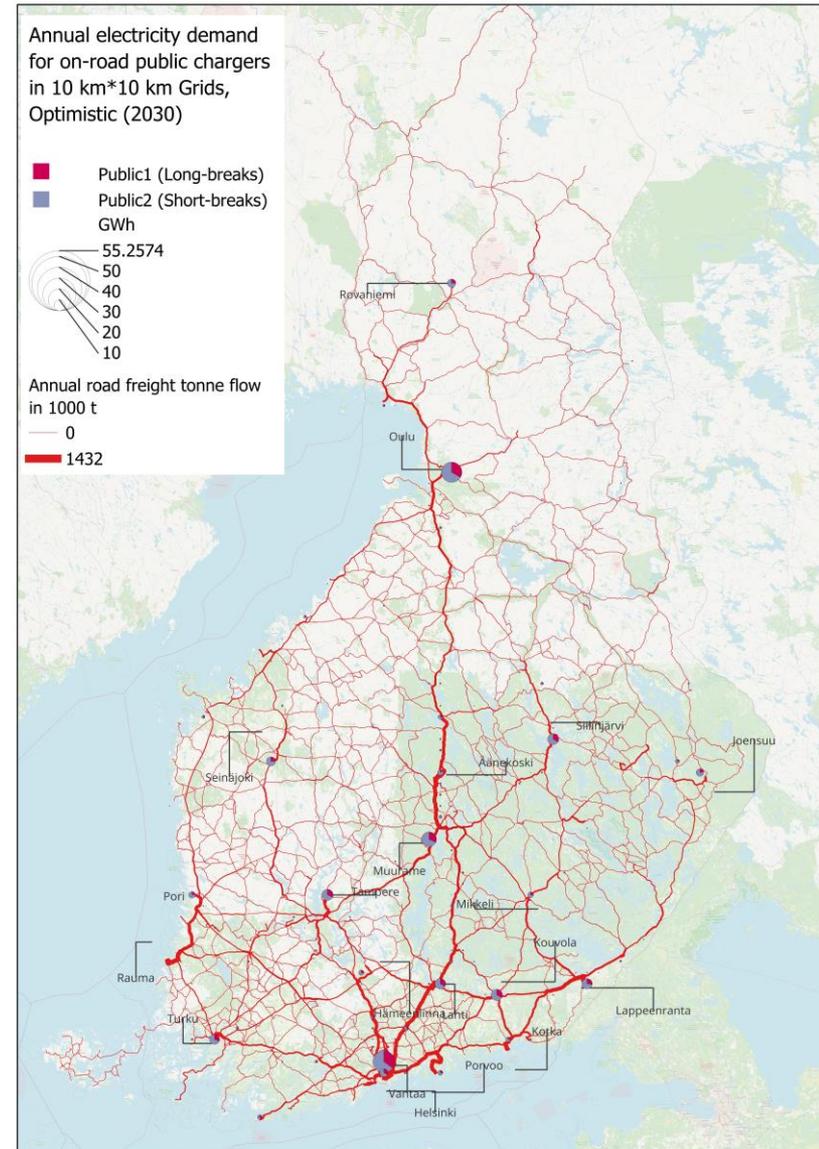


# Results: Charging demands maps (3/4)

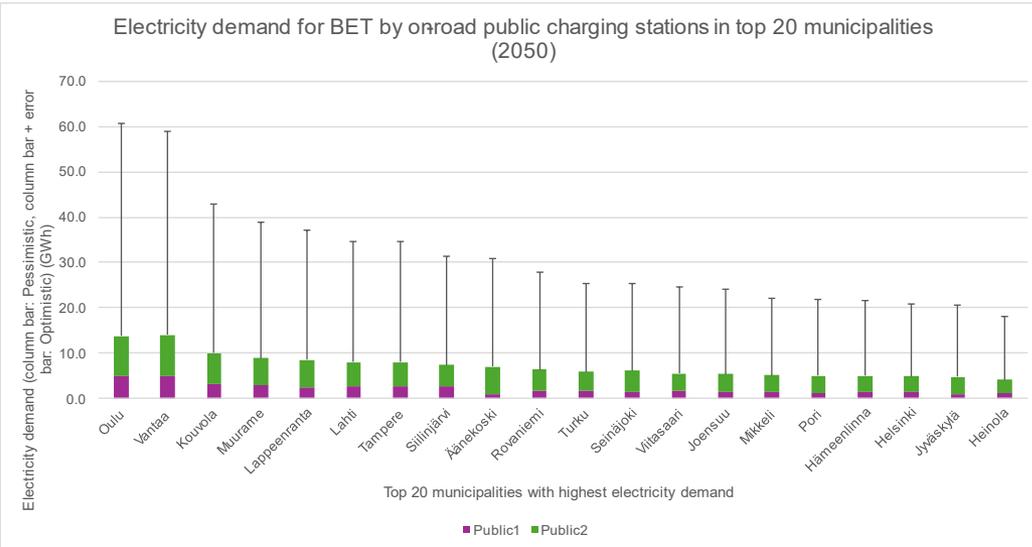


**Figure 19.** The electricity demand (GWh) of on-road charging stations for the top 20 municipality areas with the highest demand in 2030 in Finland.

**Figure 20.** The geospatial distribution of the electricity demand (kWh) for MT (2030) horizon of Optimistic electrification scenarios based on public on-road charging groups in 10 km to 10 km grids in Finland.

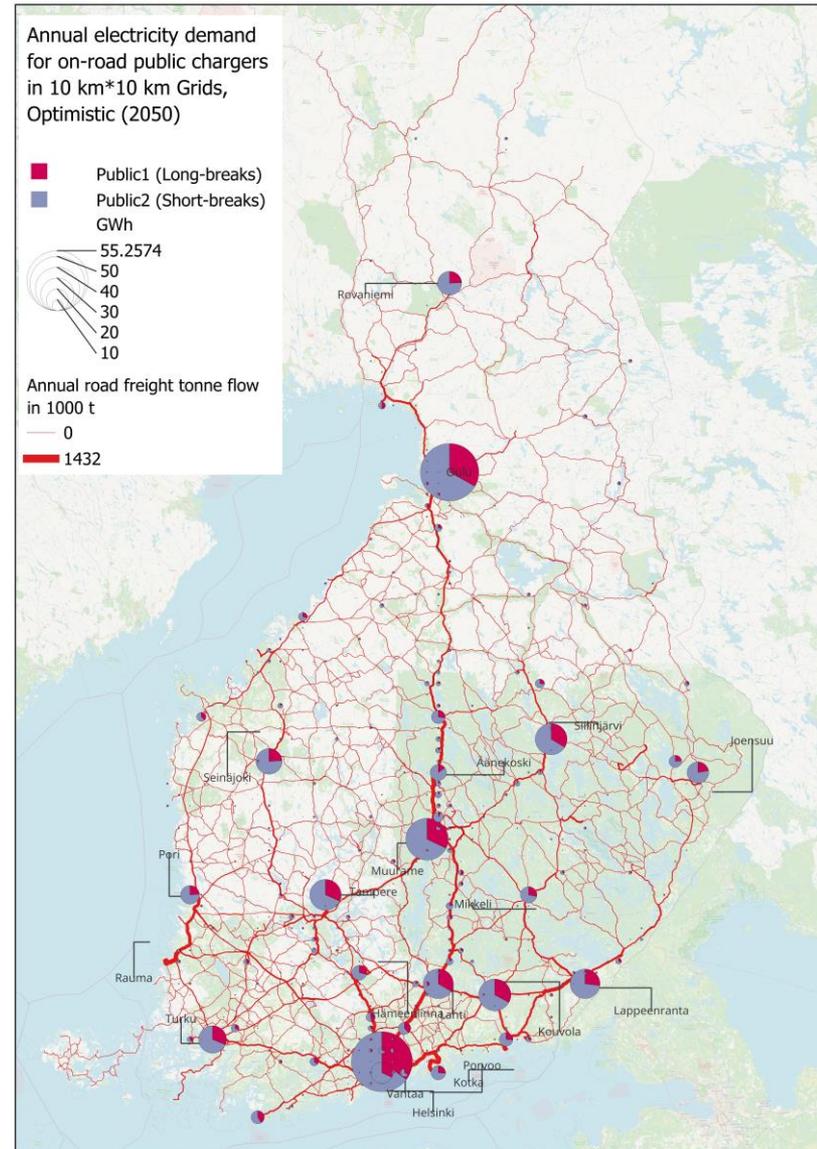


# Results: Charging demands maps (4/4)



**Figure 21.** The electricity demand (GWh) of on-road charging stations for the top 20 municipality areas with the highest demand in 2050 in Finland.

**Figure 22.** The geospatial distribution of the electricity demand (kWh) for LT (2050) horizon of Optimistic electrification scenarios based on public on-road charging groups in 10 km to 10 km grids in Finland.



# Highlights of research results

1. The consolidation of the on-road charging activities over different GVWs and operational trip profiles for BETs is the most realistic approach for planning the public charger infrastructures.
2. Around 20% of the electricity demands for MHD BET in Finland might require MCSs that are located in on-road charging stations.
3. With the assumption of 391.5 km driving range and using MCSs at mandatory short breaks, around 35% of MHD BET trip demands (in tonne-kilometre) might get delayed because of the extended charging time for the “mid-shift” charging activities.
4. Opportunity charging at loading/unloading might cover the lack of MCSs in the road network for MHD BETs, but it will hardly replace “mid-shift” charging by CCSs.

# Kiitos!

Further information:

[mehdi.jahangirsamet@tuni.fi](mailto:mehdi.jahangirsamet@tuni.fi)

[heikki.liimatainen@tuni.fi](mailto:heikki.liimatainen@tuni.fi)