SIX-HOVE annual seminar

Megawatt charging with MCS in ESCALATE & MACBETH projects

Ville Naumanen/ Kempower
ville.naumanen@kempower.com

Marko Antila/ VTT
marko.antila@vtt.fi

23 Sep 2025

Co-funded by
the European Union

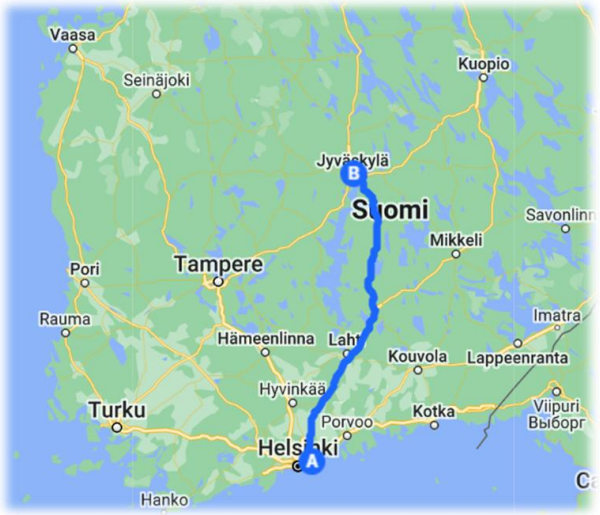
Contents

- ESCALATE project
  - Introduction
  - MCS standardisation and future directions
  - MCS equipment
  - WHR & NVH results
  - Learnings from ESCALATE
- MACBETH project
  - MCS goals
- MCS future

ESCALATE project

ESCALATE MCS piloting

- **ESCALATE** project studies HDV vehicles by running pilots: https://www.escalate-eu.com/
- 37 partners from 13 countries, 2023 - 2027
- Finnish Pilot 1 with MCS, target time spring 2026
- Route: Finland/ Vuosaari Port (Helsinki) – Jyväskylä, round-trip of 520 km
- Mission: Long-haul
- Operator: Transport Jylhä
- Duration: 8 months, in summer and winter
- Charging: MCS 700 kW, 800 km with a single charge + REX

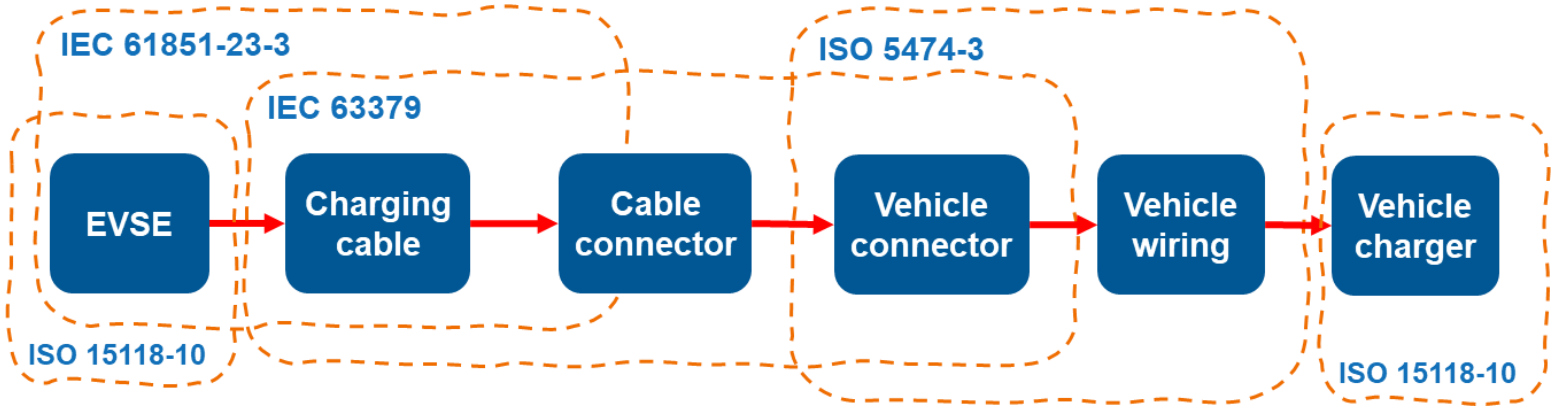


MCS standards roadmap 9/2025

Standard	Target	2024	2025	2026
ISO 5474-3	VEHICLE	★		
IEC TS 63379	CONNECTORS	STANDARDISATION		
IEC 61851-23-3	EVSE		STANDARDISATION	
ISO 15118-10	COMMUNICATION		★	
SAE J3271 (1 – 5)	ENTIRE SYSTEM		★	

★ *published*

- All relevant standards are ready in 2025 or latest in the beginning of 2026
- 2 main standards in the finalization:
  - IEC 61851-23-3
  - IEC TS 63379



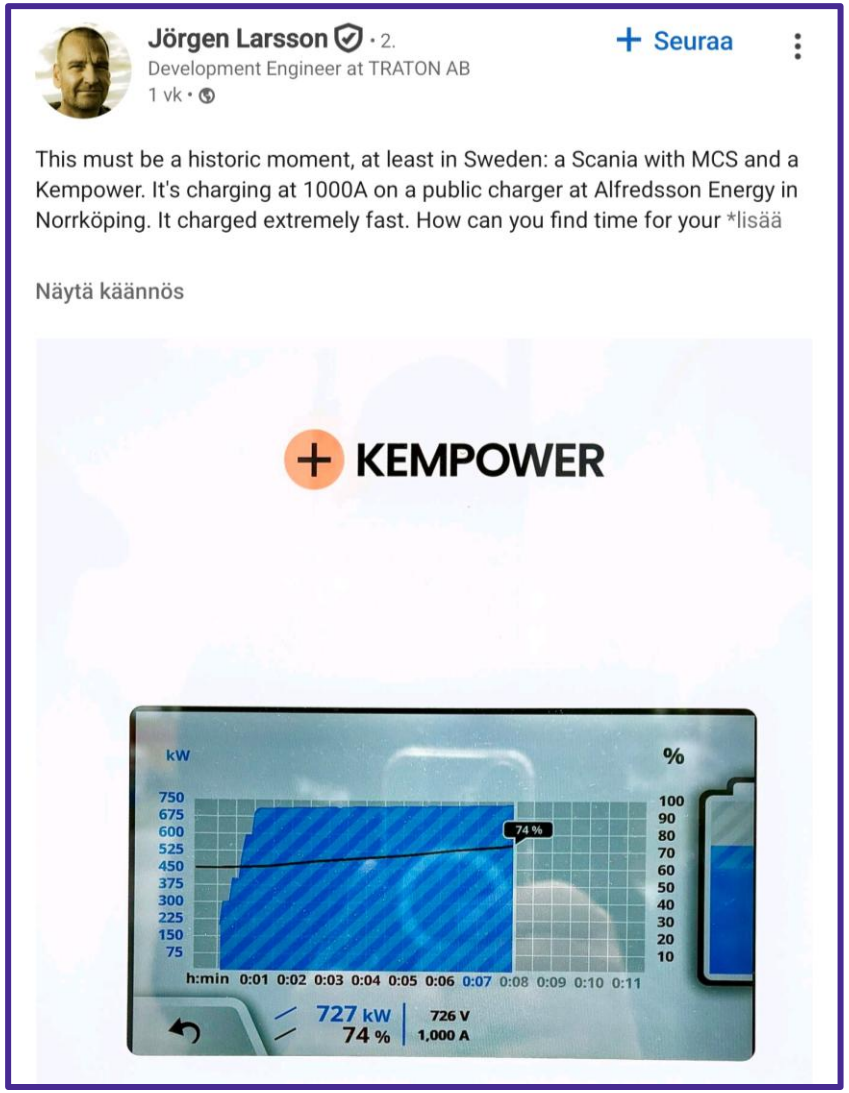
Megawatt charging (MCS) equipment

- The MCS platform consists of
  - 2 or 3 parallel 600 kW power units
  - an MCS satellite dispenser
  - control software
- Mega Satellite MCS
  - Power: Max. 1.2 MW
  - Current: 1,500 A continuous at +40 °C
  - Voltage Range: 150-1,000 VDC
  - Cable reach: Max. 2.7 meters


1800kW Power Unit

MCS satellite

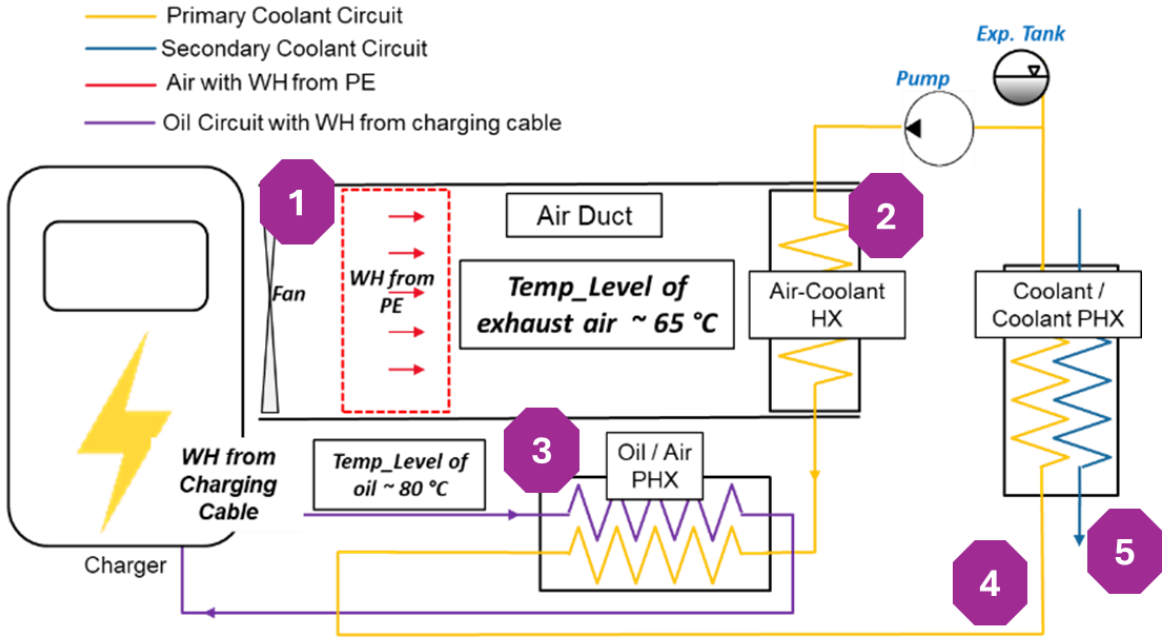
MCS Pilots are active



MCS waste heat recovery (WHR) example

SCENARIO: 8 x 1 MW MCS chargers, 95 % efficiency*

1. WH comes from the **air-cooled power electronics**
2. It is collected by an air-coolant **heat exchanger** (HX)
3. WH from the charging cable is collected by an oil-coolant **plate heat exchanger** (PHX)
4. The **primary coolant circuit** (yellow) collects all WH coming from the charger
5. A **secondary coolant circuit** (blue) delivers the collected WH to the heat sink, and further to the applications

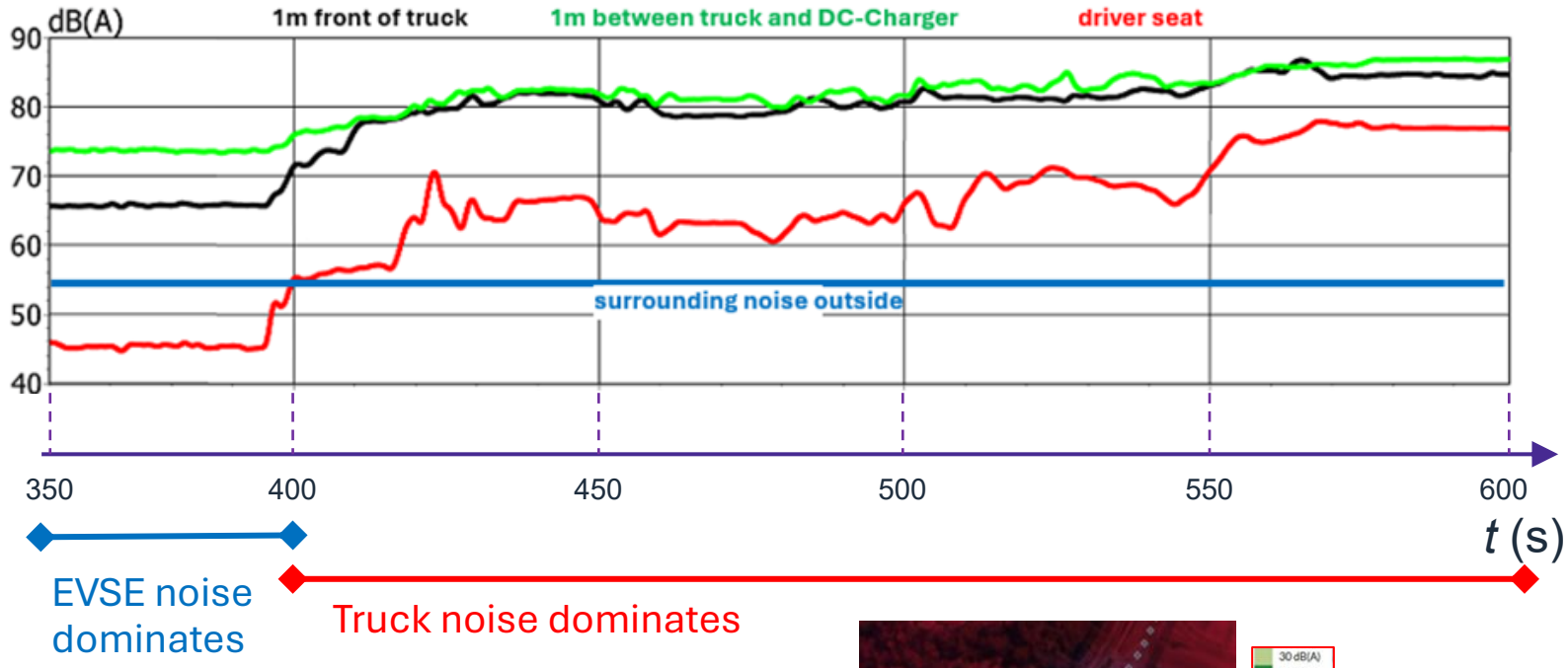


Ambient temperature (°C)	District heating supply temperature (°C)	WH energy recovered (MWh)	Household equivalents
45	65	1095.0	186
45	50	1445.4	228
0	65	613.2	113
0	50	805.9	137

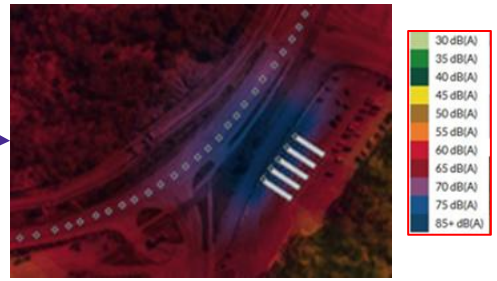
* Antila, M., Naumanen, V., Mladek, A., Kollik, C., Häußler, M., 2025. ESCALATE project: megawatt charging and its impacts on waste heat recovery and noise. Presented at the 38th International Electric Vehicle Symposium and Exhibition (EVS38), Gothenburg, Sweden.

Noise, vibration, and harshness (NVH)

- NVH is important to evaluate
- Effects on the drivers and surroundings
- Example measureremements carried out in real conditions
- Primary noise sources:
  - Truck AC compressor
  - Truck cooling fan
  - EVSE cooling fan



Possible to make noise maps of the simulations and measurements



Adapted from Antila, M., Naumanen, V., Mladek, A., Kollik, C., Häußler, M., 2025. ESCALATE project: megawatt charging and its impacts on waste heat recovery and noise. Presented at the 38th International Electric Vehicle Symposium and Exhibition (EVS38), Gothenburg, Sweden.

Learnings from ESCALATE

- MCS is a feasible and a realistic option
  - Standardisation has been lagging but getting ready NOW
  - Megawatt charging equipment are available for use
  - MCS protocol is better and more robust than CCS
  - Thermal losses are considerable even with high efficiency due to the high currents used
    - especially cables
- Noise, vibration & harshness (NVH):
  - The big picture necessary to understand
    - Noise sources should be ranked
    - Location of the charging power unit & dispensers important
    - The vehicle may also be an important noise source!

MACBETH project

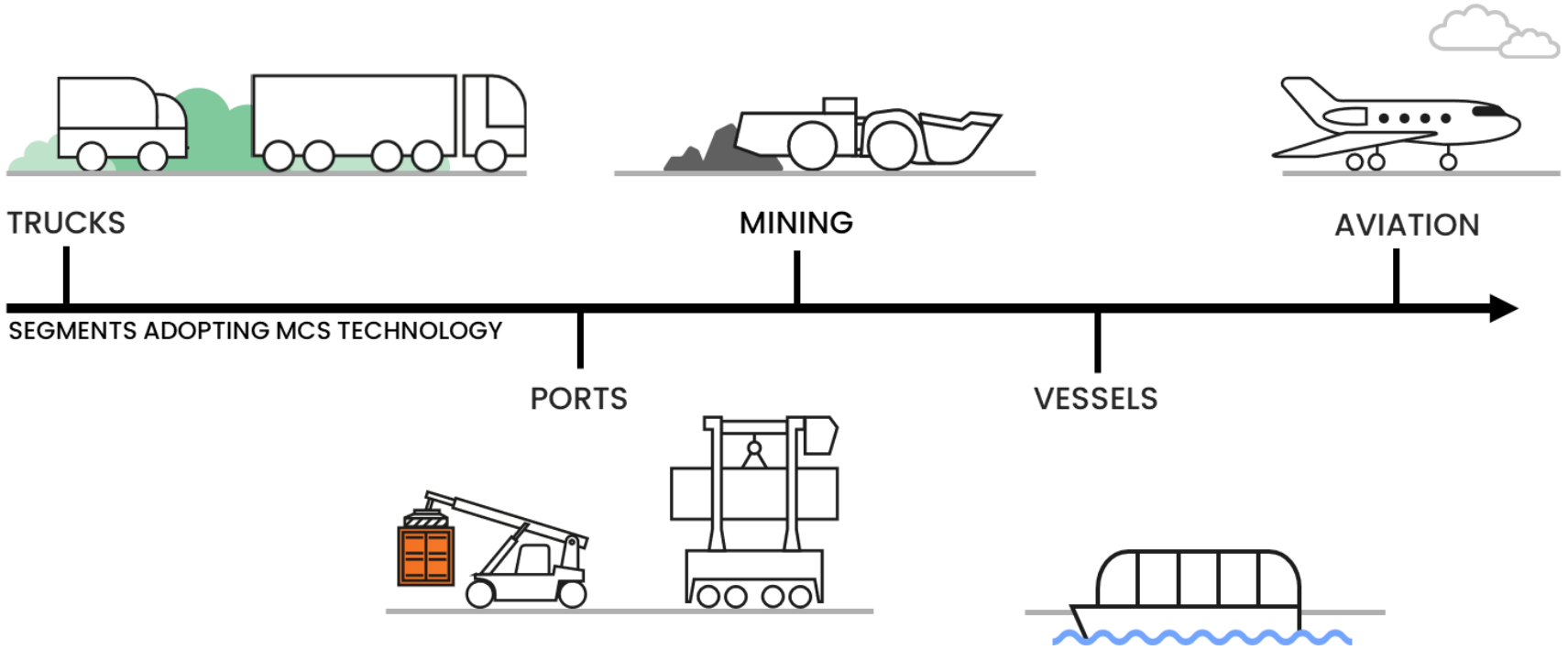
MCS goals for charging infra

- MACBETH will focus on
  - Megawatt charger and charging site design for multipoint and multiuser hubs
    - Piloting 4 MW = 4 x MCS + 16 CCS
    - Focusing on trucks
    - Postnord – Plugit – Kempower Pilot enabling crossborder traffic
  - Automated charging solutions for heavy vehicles
  - Power system architectures
    - Optimised power distribution with minimum losses
    - Interoperability for both heavy and light duty vehicles
  - Standards

MCS future

MCS future


KEMPOWER
KEMPOWER


TRUCKS
MINING
AVIATION
SEGMENTS ADOPTING MCS TECHNOLOGY
PORTS
VESSELS

MACBETH

/macbeth-euproject

https://macbethproject.eu/

ESCALATE

https://escalate-eu.com/

Ville Naumanen/ Kempower
ville.naumanen@kempower.com

Marko Antila/ VTT
marko.antila@vtt.fi

Co-funded by the European Union

ESCALATE project has received funding from the European Union's Horizon Europe innovation programme under the Grant Agreement No. 101096598

Co-funded by the European Union

MACBETH project has received funding from the European Union's Horizon Europe innovation programme under the Grant Agreement No.101192466