1

Prominent and distigueshed speakers for today´s webinar

The Swedish side

- Mr. Jan Pettersson, **The Swedish Transport Administration,** TRV, Director of the electrification program.
- Dr. Jonas Jansson, **Swedish National Road and Transport Research Institute,** VTI, Research director.
- Mr. Per Lindahl, **Logistikia,** Director.
- Professor Mike Danilovic, **Halmstad & Lund University, Sweden-China Bridge.**

The Chinese side:

- Mr. Zhang Yong Wei, Vice president and secretary general of **EV 100.**
- Yang Yi Xiu**,** Director of Carbon Trading Research Division, Green Electric Transportation Industry Innovation Center, **SPIC** (State Power Investment Corporation).
- Mr. Li Yu Jun, General manager of **Mobile Energy GCL New Energy Holdings.**
- Mr. Yu Xin Rui, R&D Vice president, **Aulton New Energy (Battery swapping technology).**
- Mr. Li Tao, General manager of **Star Charge,** Special vehicles charging solution.
- Professor Li Li Guo, **Qing Hua University,** secretary general of battery swapping EHT promotion alliance of China.
- Zhang Xing, Vice general manager of Power Energy Technology, **Sany Heavy Truck.**
- Mr. Gao Yi, Vice president of overseas business, general manager of Europe business, **Foton Heavy Trucks.**
- Wang Bo, Vice president, Beijing Highway & Railway Green Chain Multimodal Transportation Company, **Battery swapping truck operator.**

2

Thank you very much for your attendance and attention.

I wish all of us the best experiences and learning during the webinar!

3

Sweden-China Bridge: Collaborative Academic Platform for the Electrification of Transportation Systems

Professor Mike Danilovic
Project manager

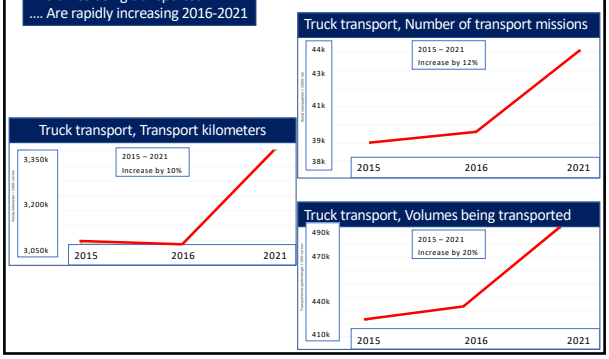
International research program funded by
The Swedish Transport Administration (Trafikverket, TRV)

vti TRAFIKVERKET LUND UNIVERSITY

4

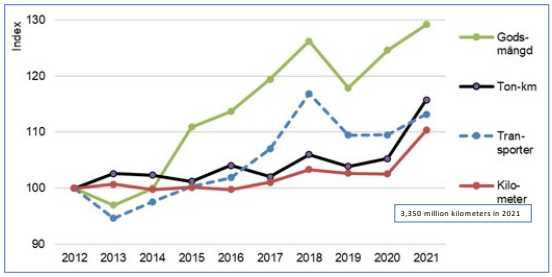
Some key figures of truck transport in Sweden 2015-2021

- Number of transport missions
- Transport kilometers
- Volumes being transported
.... Are rapidly increasing 2016-2021



5

Some key figures of truck transport in Sweden 2012-2021



6

Number of registered EHTs in Sweden 2015-2021 (2022)

	2019	2020	2021	April 2022
Heavy trucks, >16t	2	8	79	104

7

Total number of EHT, and share of the entire HT fleet in Sweden by 2030

2030	Local trafic	Regional trafic	Long hault trafic	Total
Total number of vehicles (HT & EHT)	18,200	17,700	48,300	**84,200**
Share of EHT	50%	30%	15%	**15-50%**
Number of EHT	9,100	5,310	7,245	**21,655**

8

Number of expected registered EHTs in Sweden 2040

- TRV is estimating that by 2040 there might be 70,000 EHTs in Sweden (>3,5t).
- Charging piles needed by 2040:
  - 70,000 private piles in depots
  - 5,000 – 14,000 semi public and
  - 3,000 – 6,000 public piles

9

Needs for stationery EHT charging 2030-2040

	Step 1 2030	Step 2 2035	Step 3 2040
Local trafic 18,200 EHT	50%	60%	75%
Regional trafic 17,800 ETH	30%	50%	75%
Long hault trafic 48,300 EHT	15%	30%	50%

ACEA estimate that Sweden might need by 2025
- 350 public & semipublic high capacity charging piles

ACEA estimate that Sweden might need by 2025 by 2030
- 1,200 public & semi public high capacity charging piles

For time being we have almost none!

(ACEA - The European Automobile Manufacturers' Association)

10

The lead in charging infrastructure for heavy trucks in Europe

TRATON GROUP (Scania, MAN, Volkswagen Caminhões e Ônibus, Navistar, and RIO), Daimler Truck AG & Volvo Group:
- To create and invest in Joint Venture together.
- To invest 500 million Euro to install and operate at least 1,700 high-performance charging points, within five years from the establishment of the JV

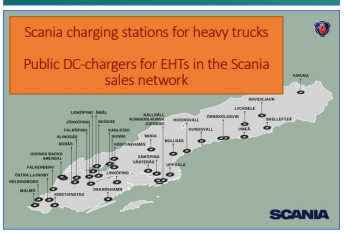
The public charging for EHTs is seen by OEMs as suitable for places where drivers take a break, refueling stations etc. close to restaurants, toilets etc.

However, cable charging is not what transport operating companies want and need!!!
They need profitablity, efficiency, speed, operational performance, flexibility & adaptability, accesability, predictability ...

Operators need what is not being offered to them yet!

Scania charging stations for heavy trucks

Public DC-chargers for EHTs in the Scania sales network



11

Insightfull industrial leaders!

Herbert Diess at the Financial Times Event "Future of the car", 9-12 May 2022.

- We are hesitating to go *"all the way in"* with EVs.
- Customer demands is there but the industrial value chain and charging infrastructure is not yet in place.

Who is responsible for the development of charging infrastructure?
What technology shall be utilised and how to establish it?

12

Our focus today

In todays webinar we are adressing the battery swapping as one complementary technology to the prevailing cable based charging technology!

We want to explore, and deeper understand, the entire value chain of the battery swapping technology from energy production, distribution, swapping srtations, swapping based trucks and operations.

13

NIO Norway in 2022

The vast majority (95%) of the Norwegian NIO customers opt for the Battery as a Service (BaaS) - which means that they are **purchasing the car without battery** and they pay a **monthly subscription to use the battery** and **access to the battery swap network**.

14

Customer headache

1. Operational limitations for cable-based charging
   1. recharhing time (1-3h) is too long
   2. recharging availability (few stations in general and even fewer for EHTs)
2. Operational efficiency of cable-based charging is low. Every charging pile can charge about 8-12 EHTs per day!
3. Short operational distances for todays EHT (150-250km).
4. Lack of availability of heavy EHT.
5. Todays EHTs and cable charging is inflexible, not adopted to needs of tight operational schedule, driving habits and driving demands of operators.
6. Today´s EHTs are usable for short distance operations, intra-city operations, but not regional and long hault transport and not for heavy transport and high intensive transport.
7. Today´s EHTs OEMs donot have a system perspective. They focus on optimizing single EHT instead of fleet optimization.
8. Few other recharging technology or systems are being discussed in EU countries.
   1. Electric roads systems are being tested in Sweden and in Germany
   2. Inductive wireless charging being tested
9. Chicken and Egg syndrome.
   1. What comes first?
   2. EHTs or charging infrastructure!

15

Scenarios for battery swapping in Sweden

16

Towards Green Ports & Green Launghault Transportation

17

Establishing battery swapping technology in Sweden & Europe

Developing battery swapping total system solutions, and battery swapping heavy trucks

- Customized design of battery swapping based **tractors and trucks**
- Wide spread battery swapping **charging infrastructure**
- 24/7 service and maintenance operations and customer support
- R&D for training, knowledge and practice development
- **Innovation driven business;** Develop future **innovation** in battery swapping based transportation with our customers and partners
- Flexible and mobile system solutions

Establishment steps

1. Battery swapping demonstration project in Sweden
2. Diffusion of battery swapping to south of Sweden
3. Battery swapping based in-harbor transportation in Europe
4. Battery swapping based charging infrastructure across Europe
5. Retrofitting ships and boats for canal and river transport in Europe based on battery swapping technology

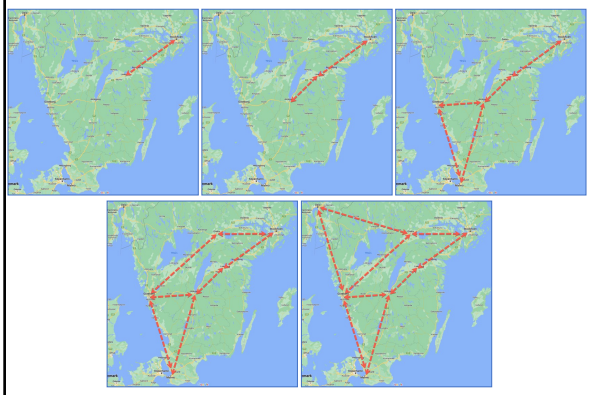
18

Green transport in south Sweden

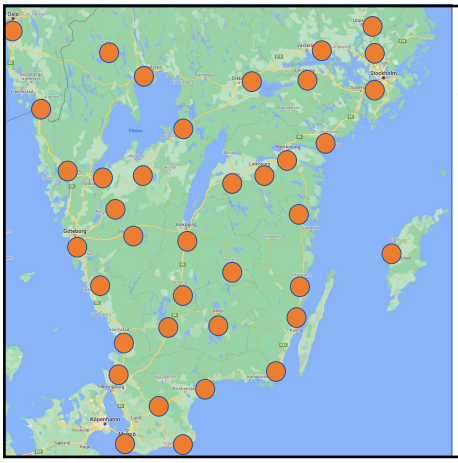
System approach to green fleet optimization.

19

Battery swapping for heavy trucks in Sweden



20



40 battery-swapping stations could cover the south part of Sweden with swapping stations to support truck operations along the main roads in the south of Sweden.

Battery-swapping in South Sweden serving >4,000 trucks daily

For the estimated cost of >80 million EURO it would be possible to establish at least 40-50 battery-swapping stations along the main roads in Sweden

21

Green Rotterdam harbour

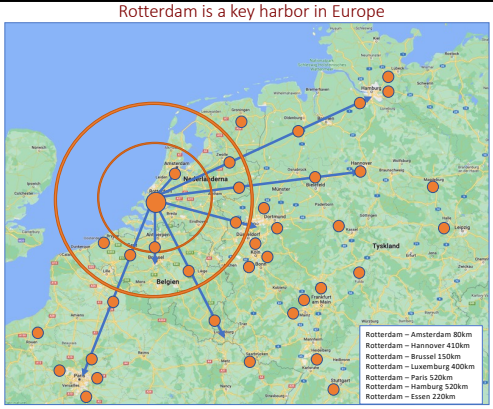
22

Towards Green Ports & Green Launghault Transportation

- Total system solution of
  - trailers, tracktors & AVG and
  - charging infrastructure based on integrated battery swapping and cable charging solutions.
  - Integrate *"Green canal"* transport with
  - *"Green harbour"* and
  - "Green launghault" transport.
- 24/7 optimized service solutions for vehicles and swapping stations.
- 24/7 emergency mobile service & recharging solution.
- Develop long hault battery swapping based transport along main corridors in Europe starting from key harbors.
- Support customers and users in their development of business models to optimize their green business based on electric transport vehicles.
- Design optimised and customized integrated digital business solutions.

23

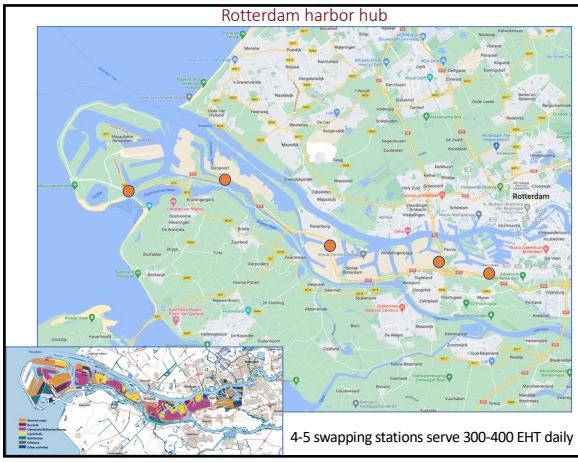
Rotterdam is a key harbor in Europe



Battery swapping stations on every 150-200km distance along the roads & highways

24

Rotterdam harbor hub



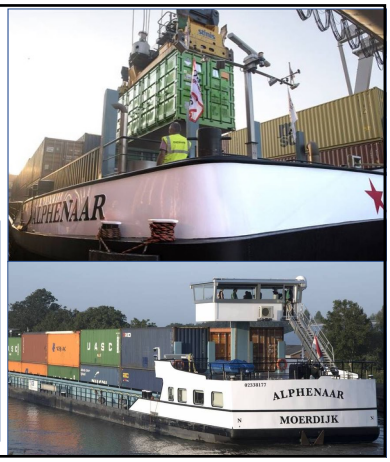
4-5 swapping stations serve 300-400 EHT daily

25

Retrofitting European canal and river operating ships.

From diesel to battery swapping!

- Netherlands has received its first electric canal barge for goods.
- It stores its swappable batteries in a container on board.
- Version with a battery pack of 2,000 kWh gives a driving time of 2-4 hours depending on load.
- This corresponds to a distance of 60-120 km.
- A battery change takes 15 minutes.
- Empty battery pack is charged in 2.5 hours.



26

What is needed to achieve this?

- Collaboration with customers & operators in Sweden and in Europe.
- Transport operators that want to lead the green transport development
- Global partners in R&D of battery-based tractors, trucks and retrofitting canal & river ships
- Global partners in R&D of battery swapping based stationary and mobile stations
- Design new ECO-system för battery swapping solutions.
- Design new business model for battery swapping solutions.
- Green investors with long term investment interest

Tentative timetable:
- Demonstration project in Sweden summer 2023
- Roll-out in South of Sweden 2024
- Demonstration project in Rotterdam 2024
- Retrofitting first ships and boats for canal and rivers 2025
- Roll-out along European main road corridors 2026
- Roll-out ships and boats for canal and rivers 2026

If you and your company would like to have more information, please contact:
Mike Danilovic, mike.danilovic@hh.se, +46 708157588

27

Thank you very much for your attention

28

ww

29

BATTERY SWAPPING FOR HEAVY TRUCKS

30