ElectriCity

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City of Gothenburg

ElectriCity: research & demonstration

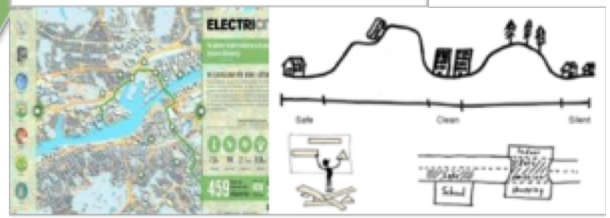
City of Gothenburg

Next generation workshop solutions

Innovative bus stops
5 new whereof one indoors

2 new bus types:
Electric Hybrid
Fully Electric

Test and development of new IT solutions



ELECTRICITY

VOLVO · CHALMERS · Göteborg Energi · Västtrafik · ERICSSON · Keolis

Route 55 started June 2015

City of Gothenburg

- 3 electric buses, 80% lower energy consumption than diesel
- 7 electric-hybrid buses, silent electric drive on 77% of the route, 50-65% lower energy consumption
- 8 km (5 miles), runs through the city center, in traffic 6 am – 7 pm weekdays, approximately 100,000 passengers per month
- Charging takes place at the end stations. Fast charges in 3-6 minutes, 300 kW
- Indoor bus stop and silent (acoustic) bus stop
- Shared spaces, adaptive safety
- Free wi-fi and USB charging

Two bus models on the route

City of Gothenburg

7 electric hybrids

- Quiet, electrically powered 70% of the route
- 80% less CO_2
- 60% lower energy consumption
- Low speed safety and zero emission zones

3 fully electric buses

- Quiet, electrically powered the entire route
- 80% lower energy consumption
- Zero emissions when using renewable electricity
- Low speed safety zones

Customized bus depot and workshop

City of Gothenburg

- New depot and after market facility developed
- Real time tracking and monitoring of buses for optimized operation and maintenance
- Work platform for easy access to the roof of the buses
- Competence development

Indoor bus stop at Lindholmen

City of Gothenburg

- Charging with renewable energy sources such as water and wind power
- Heat recycling from a transformer in the basement
- Café
- Free wifi and USB charging stations
- Interactive information screen
- ”Goods on demand” package delivery

Geofencing regulate impact

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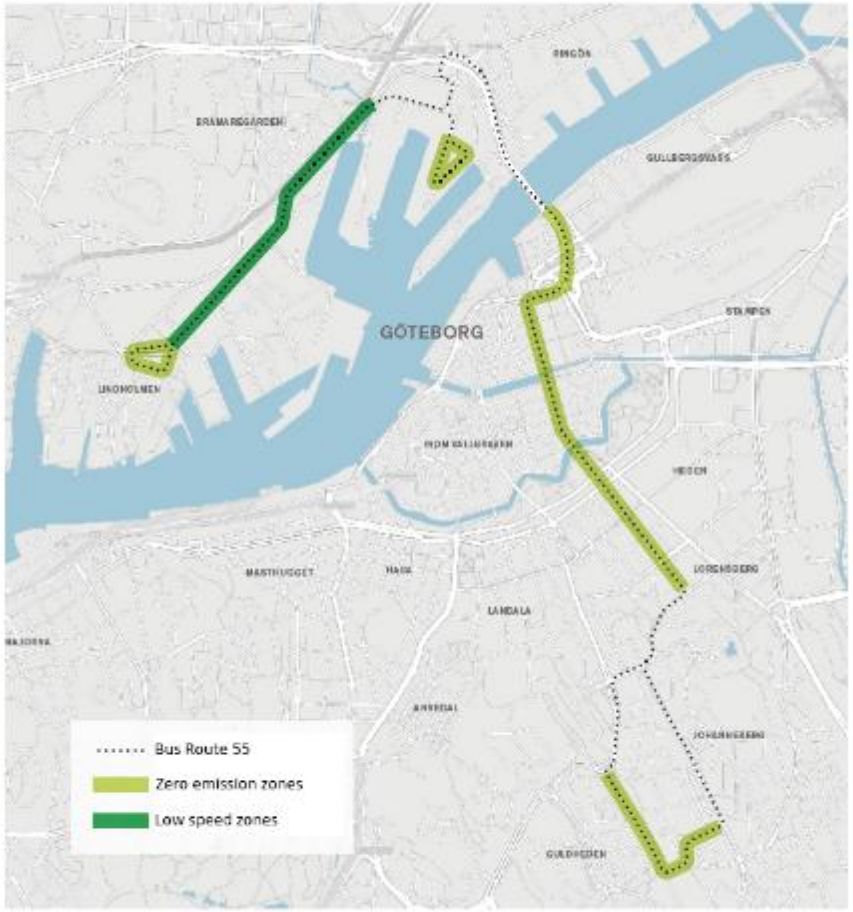
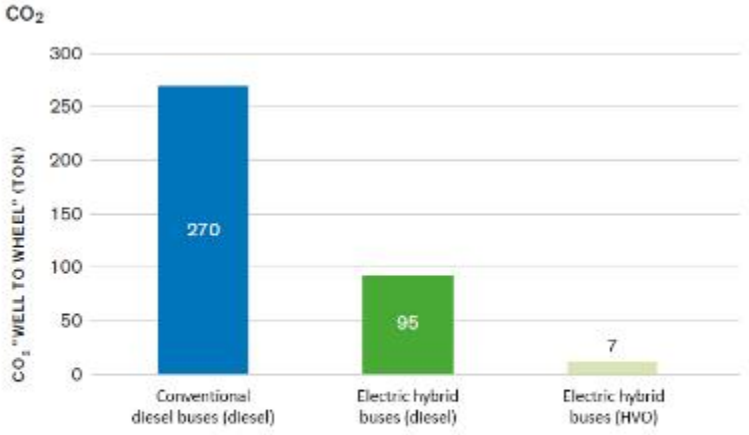
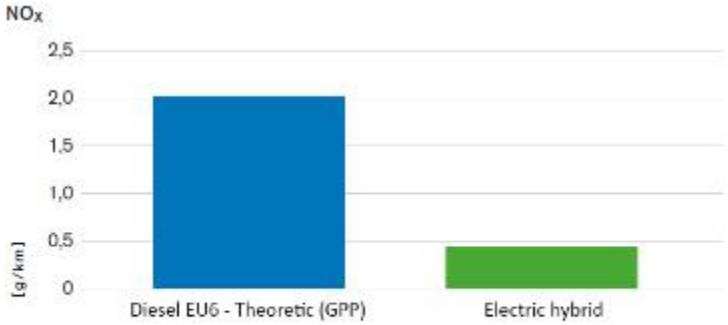


Map of Bus Route 55 showing in which areas the zone management system is set to electric drive and where max speed is limited. Dark green shows low speed zones. Light green shows zreo emission zones.



Comparison of carbon dioxide emissions from the electric hybrid buses on Route 55 (far right) who runs the HVO fuel and numbers illustrating if the electric hybrid buses on the same route where driven on fossil diesel (middle column) as an alternative to conventional diesel buses (EURO 6) (far left). Source: Volvo.



Cumulative NOx in grams during two tours on line 55, 2 times Lindholmen - Lindholmen charge on both terminus were converted to grams per kilometer, and compared with a diesel bus in a similar stretch (EURO 6, GPP= Green Public Procurement). The measurement was performed on a hybrid februari 3rd 2016. Source: Volvo.

Noise exposure in Gothenburg

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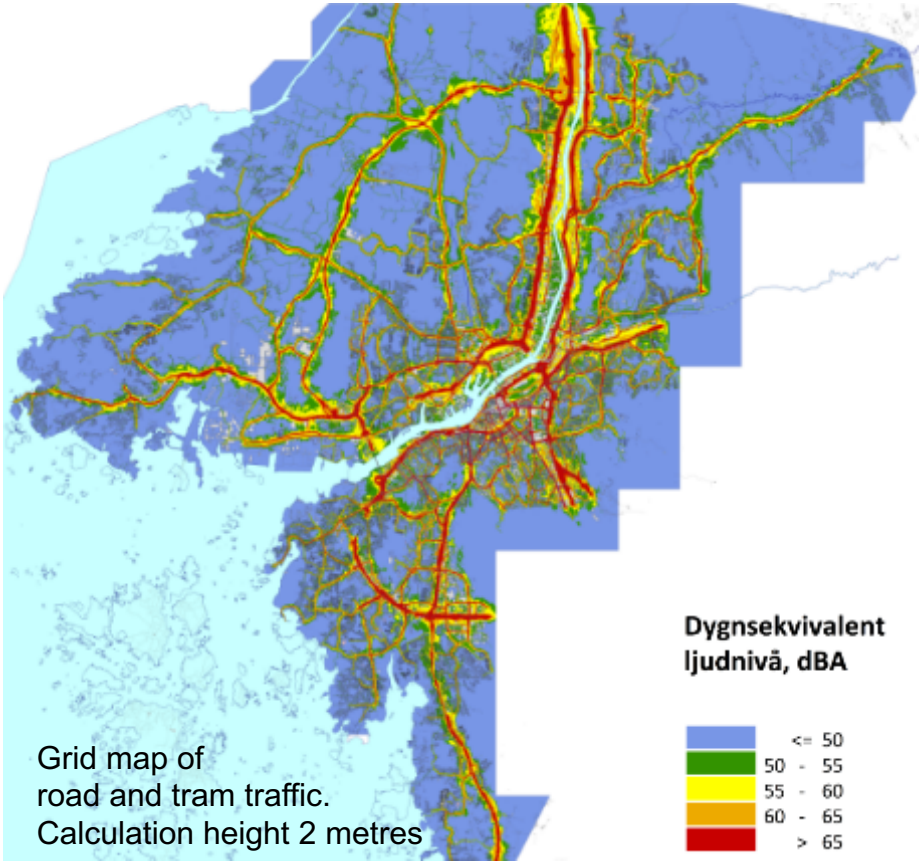
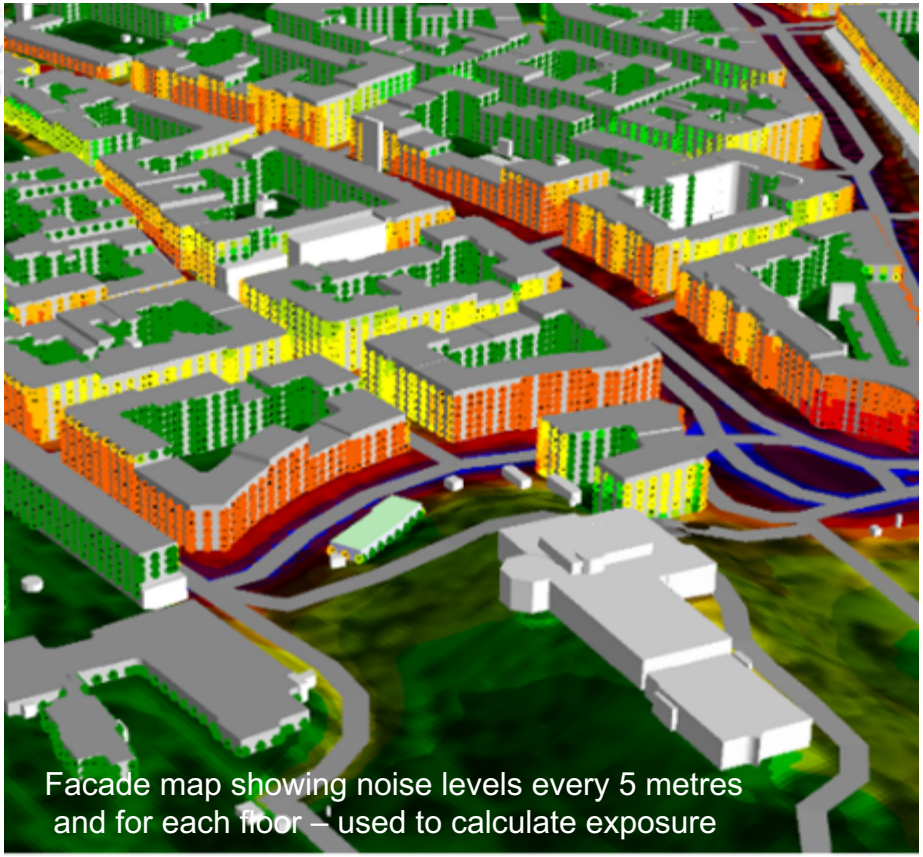
1000 mkr/year (socio economical costs from road traffic)
1200 Disability adjusted life years



Grid map of
road and tram traffic.
Calculation height 2 metres



Facade map showing noise levels every 5 metres
and for each floor – used to calculate exposure

Comparision of noise emissions

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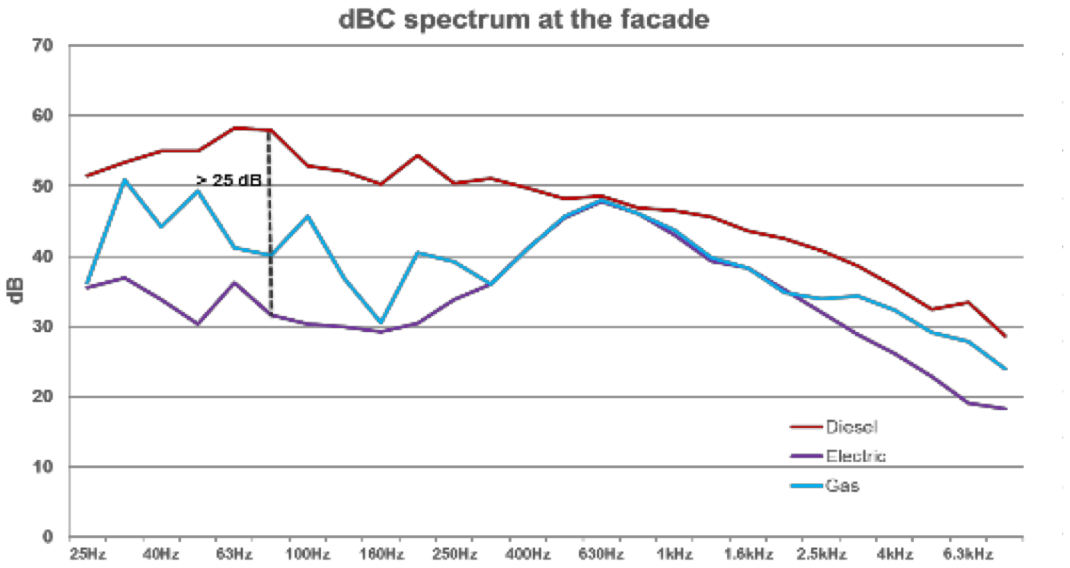
- Standard measurements on test track with electric, electric hybrid, gas, diesel buses.
- Based on measured indata, detailed calculations (Nord 2000) of a residential area.
- Calculating noise exposure in the whole city (RTN), for each power train, in order to compare the calculated health and socio-economic costs between the four bus types.



Conclusions - so far

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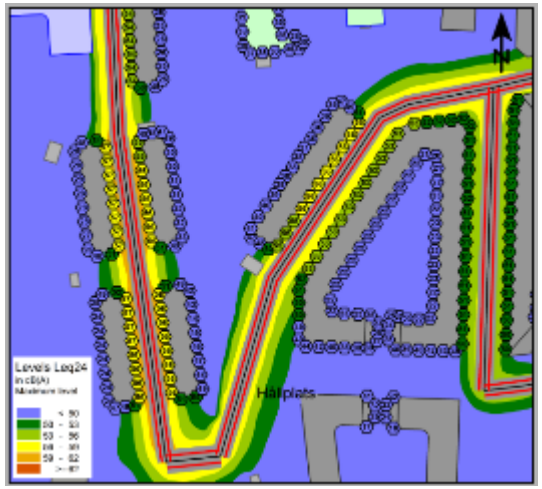

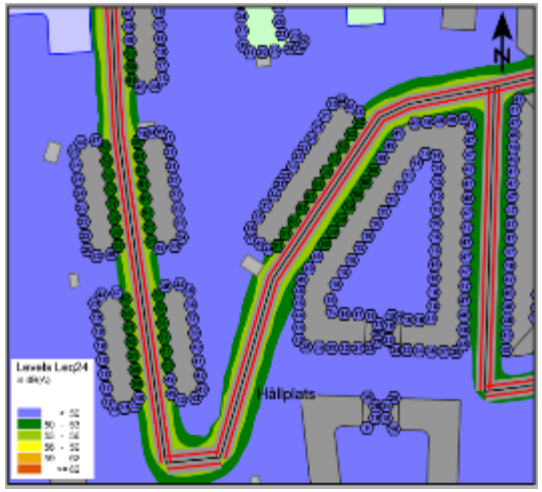

- Diesel bus engines emit a lot more sound in the low frequency range than electric buses.
- Low frequency noise is difficult to block by barriers and facades and tend therefore to be more dominant inside dwellings compared to outside
- We don't have standards or calculating models that can handle the complexity of low frequency noise – still we assume this is a very important factor concerning public health
- 100-150 m safety distance to reduce low frequency noise disturbances is a problem in dense cities
- This will be further investigated and the calculations and maps will be updated according to the findings in ElectriCity. This will in turn let the city build in new ways and on places previously deems to noisy!

Example from Bäckegatan – a residential area close to the city centre.
Above: Diesel, below electric

ElectriCity EL16

City of Gothenburg

In June, two new articulated electric busses was introduced at VOR

- Event busses to the VOR-area
- Now runs on high capacity line 16 between Sahlgrenska and Eriksberg
- High capacity chargers are installed on both end stops
- We will test different charging strategies
- The bus stop at Lindholmen is rebuilt to test high capacity solutions

Automated city busses

City of Gothenburg

We test partly automated busses

- Automated bus stop docking
- Automated depo driving
- Bus train

Together with safety function this will improve comfort and internal as well as external safety. Bus train can increase the capacity of a bus line greatly while keeping the cost down

Heavy electric trucks

City of Gothenburg

During VOR Volvo presented two heavy electric trucks

- Refuse truck
- Delivery truck

These trucks can have different battery sizes installed and we will test different charging strategies

We will also test how the work performed by the trucks can be as silent as the trucks

Transformation of public transport

City of Gothenburg

- Three bus lines will be electric next year, 30 electric busses will be introduced, together with three high capacity overhead chargers and fast chargers at the depot. This is done within present procurement

- The city of Gothenburg will support the development and building of charging infrastructure on city streets
- Over the next 5 years, all city busses will be procured, and Västtrafiks policy is that they shall be electric (primarily)

Charging infrastructure in the city

City of Gothenburg

- There will be a need for charging infrastructure built on city streets (end stops and hubs)
- There is also a need for more space at the end stops and hubs
- The electric grid must be checked

  This may be built by the city, by the PTA or by the traffic company, but in either case there must be a close cooperation between the parties involved and a clear agreement on what will happened after the procurement time ends!

Future of electric bus traffic

City of Gothenburg has signed the EU declaration for Clean buses, where the city commits to promoting large-scale deployment of clean, alternatively fueled buses in Europe.

The city is now developing our strategy for the upcoming bus procurement, to answer a number of questions

- Speed of transformation
- Charging infrastructure model
- Bus depot development
- Education

THANK YOU
WELCOME to join our journey

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