



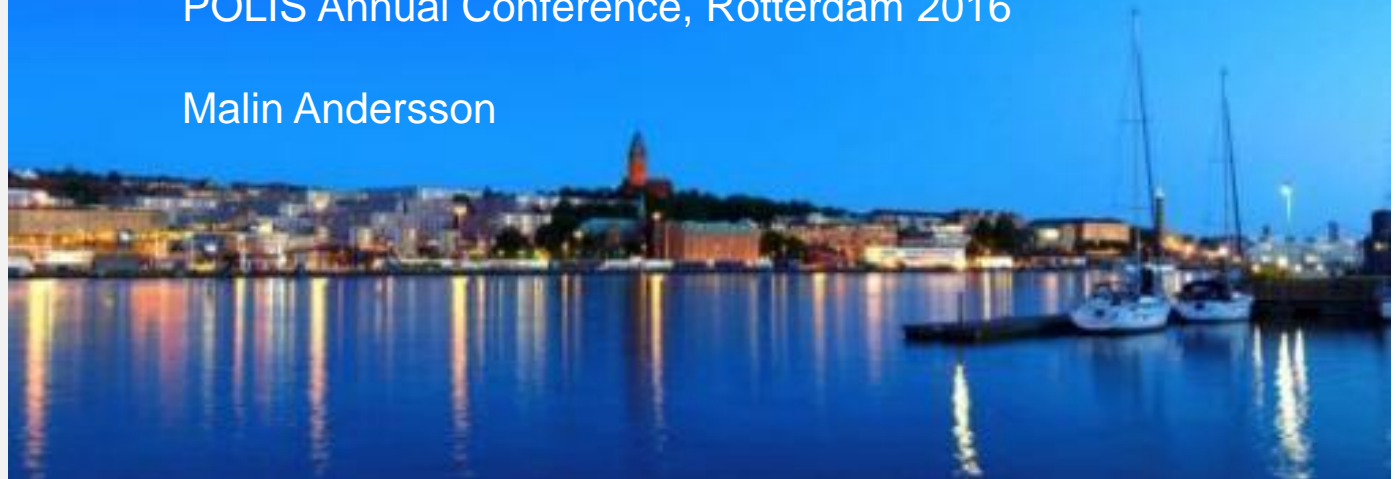
City of  
Gothenburg

# ElectriCity

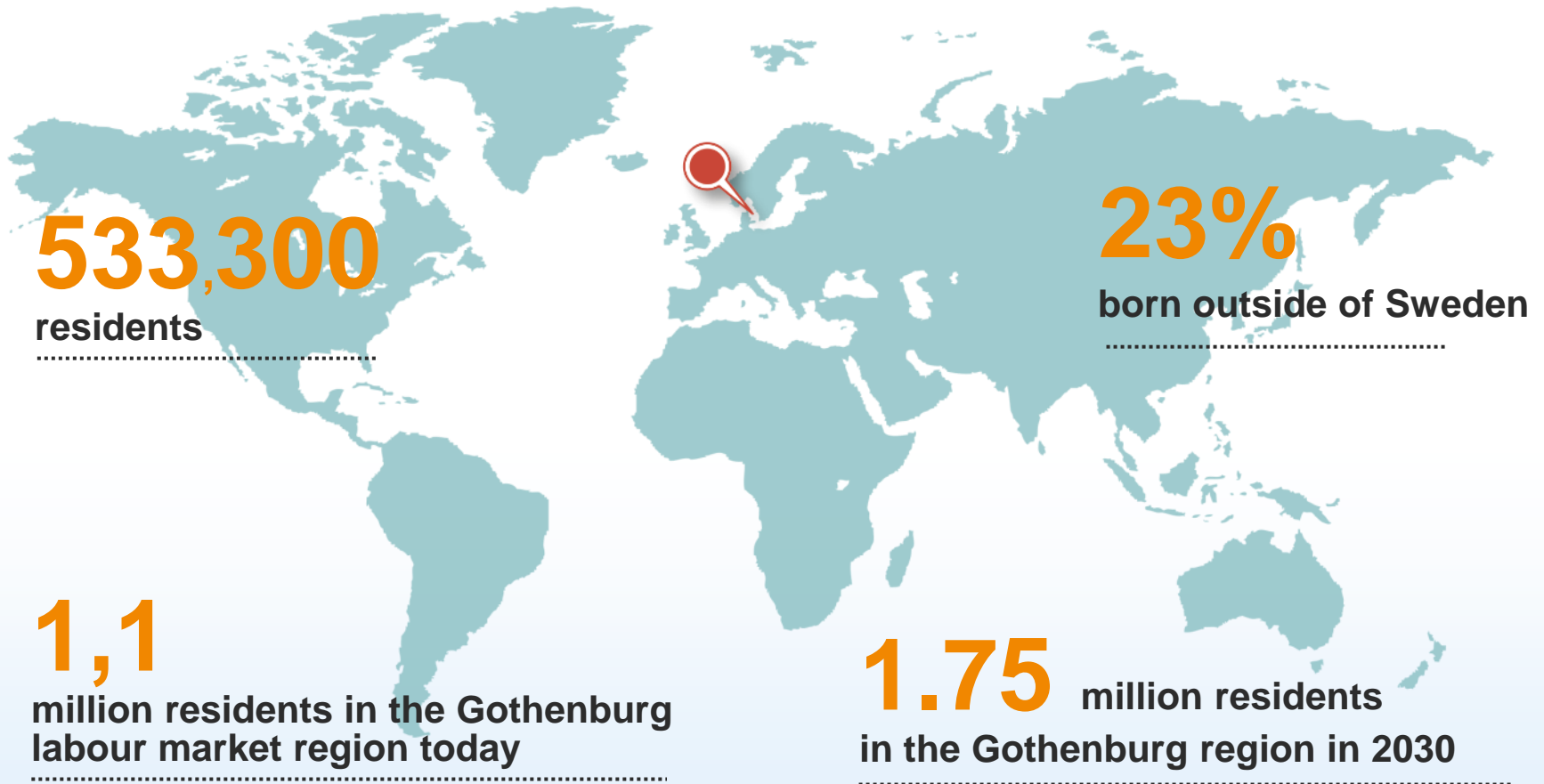
Experiences from one year with  
electric and hybrid buses on route 55

POLIS Annual Conference, Rotterdam 2016

Malin Andersson



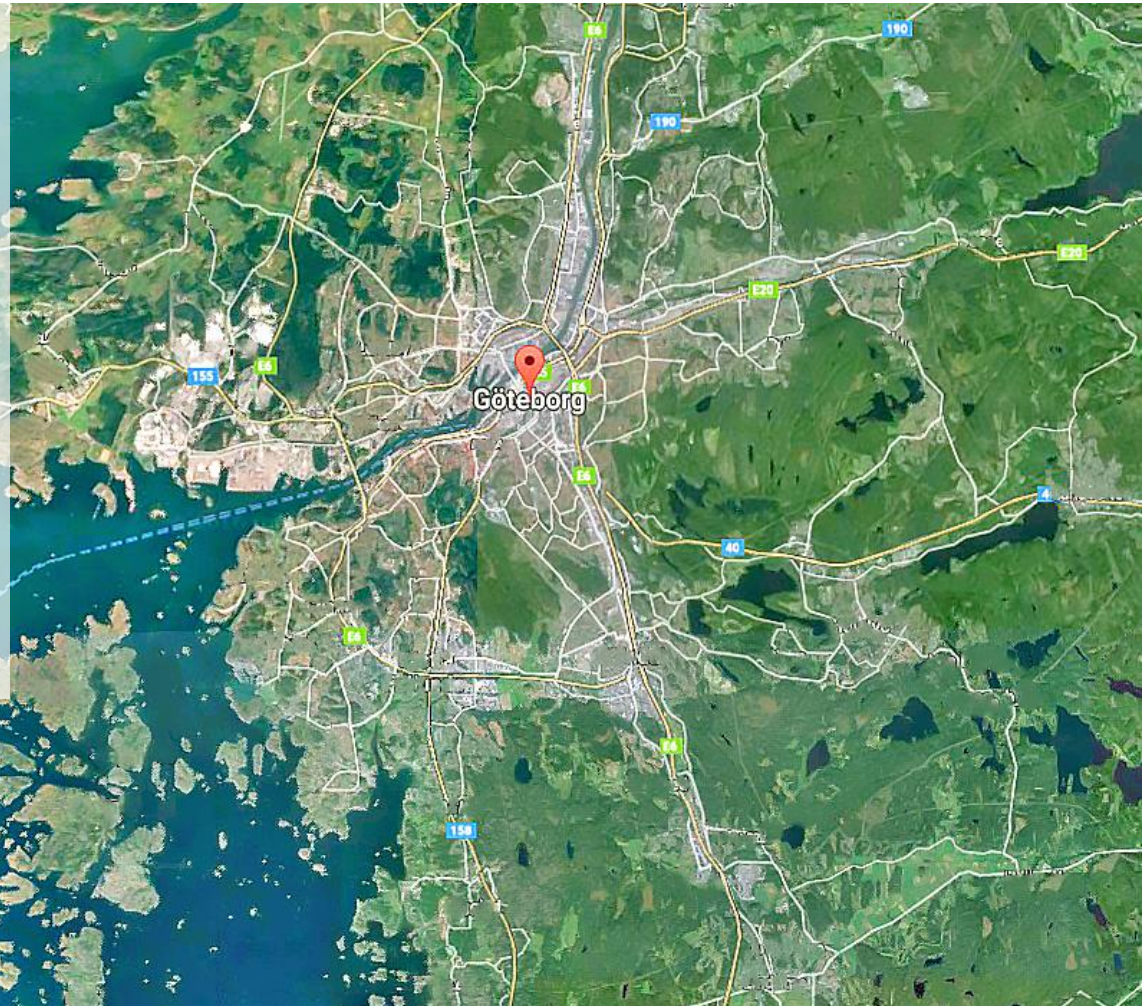
# Gothenburg – an evolving city of the future



# Urban Transport Administration

ca 1400 km	Municipal streets and roads
ca 980 km	Walkways
ca 530 km	Cycle paths (Segregated)
80 km	Tram tracks
15 km	Quays
11 km	Industrial Railway
9,4 km	Noise barriers
259	Pedestrian tunnels and bridges
146	Road bridges
38	Tram Bridges
8	Tram Tunnels
249	Sets of Traffic Lights
98 100	Street lighting
77 460	Road signs
11 200	Parking spaces on the street
ca 8 000	Bicycle stands (City centre)

*Figures from 2014 and 2015*





# Mobility in figures

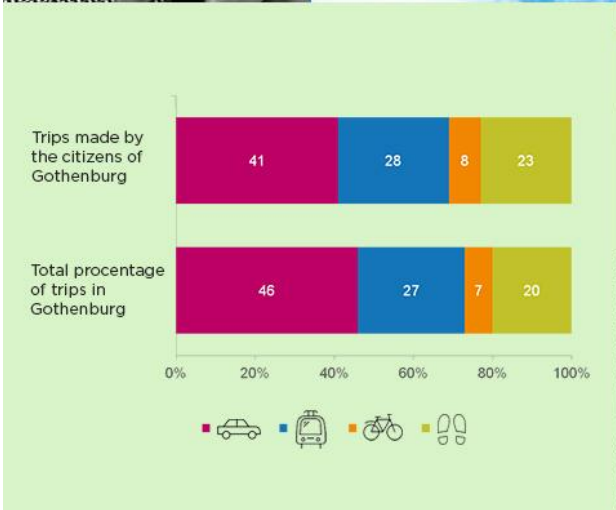


**209 132**  
Public transport travelers /day

**2,9** euro/travel



**700** buses  
**350** biogas  
**3** electric  
**7** electric hybrids  
**263** trams



cars /inhabitants  
**350/1000**  
Average of car ownership in Gothenburg



# ElectriCity: research & demonstration

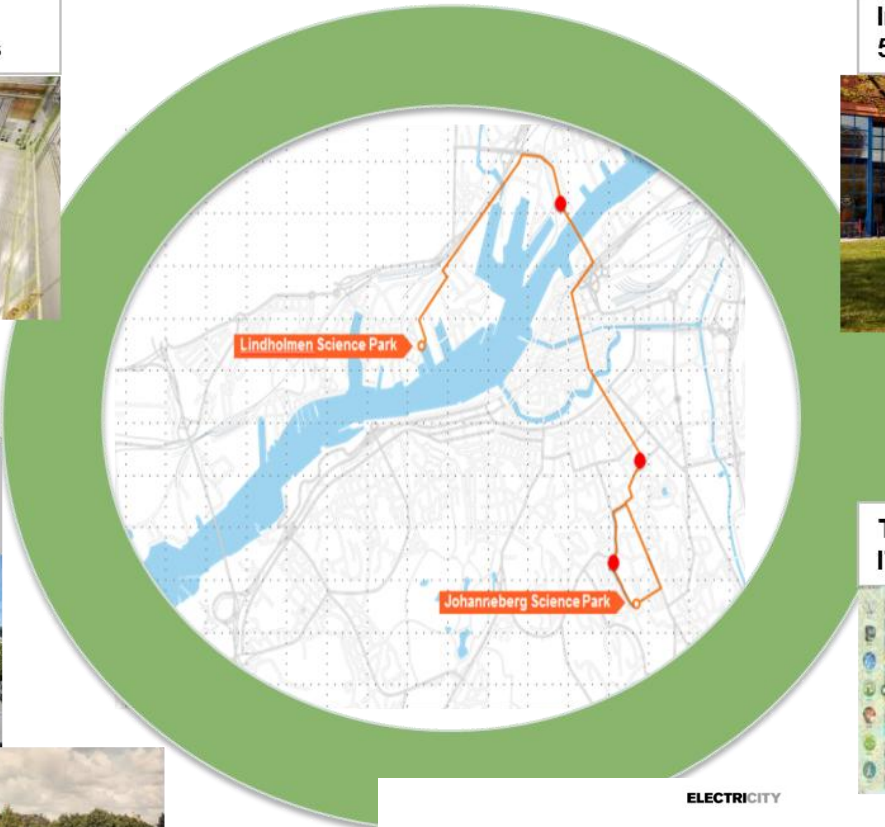
Next generation workshop solutions



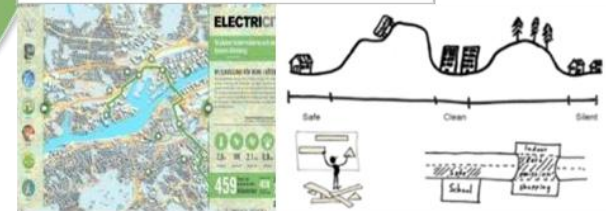
Innovative bus stops  
5 new whereof one indoors



2 new bus types:  
Electric Hybrid  
Fully Electric



Test and development of new IT solutions



Keolis

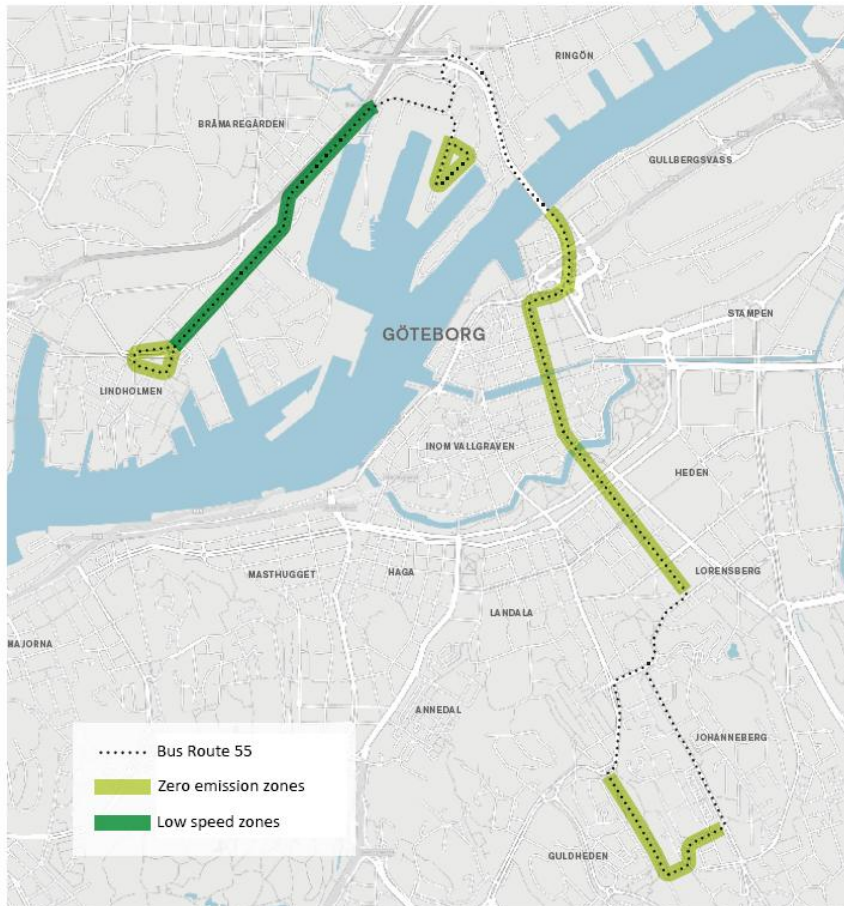


# Route 55 started June 2015

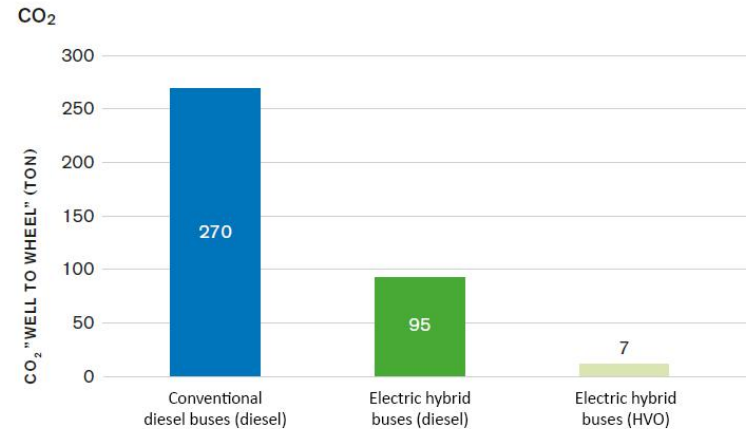
- 3 electric buses, 80% lower energy consumption than diesel
- 7 electric-hybrid buses, silent electric drive on 77% of the route, 50-65% lower energy consumption
- 8 km (5 miles), runs through the city centre, in traffic 6 am – 7 pm weekdays, approximately 100,000 passengers per month
- Charging takes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



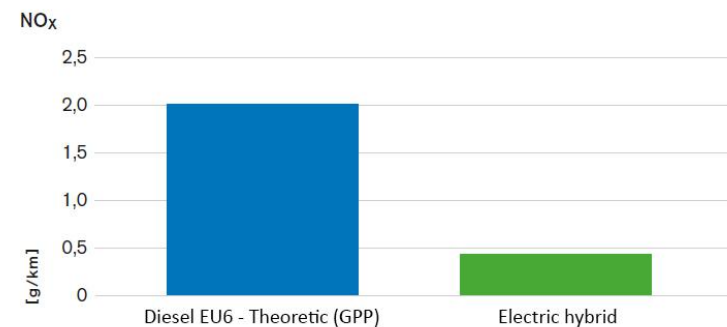
# Geofencing regulate impact



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 zero 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.

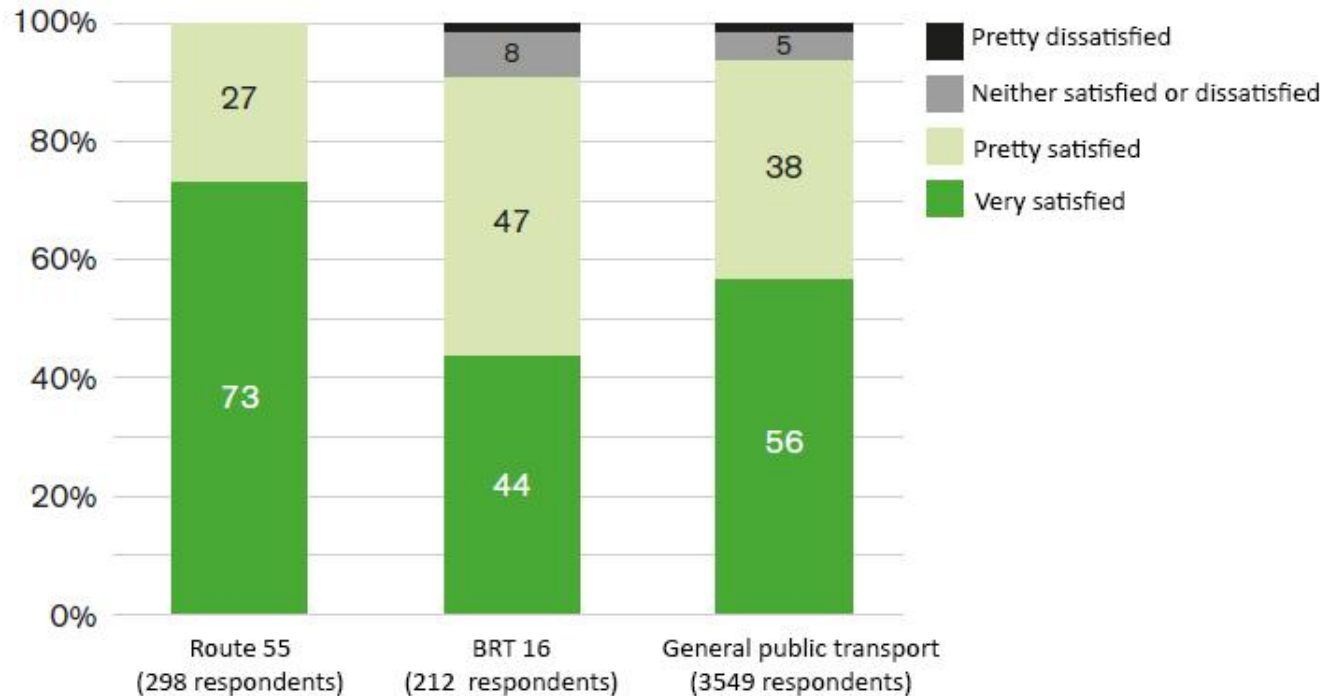


Cumulative NO<sub>x</sub> in grams during two tours on line 55, 2 times Lindholmen - Lindholmen charge on both terminus were converted to grams per kilometer, and compared with a diesel bus in a similar stretch (EURO 6, GPP= Green Public Procurement). The measurement was performed on a hybrid february 3rd 2016. Source: Volvo.



# Attractiveness

How satisfied are you with this bus journey overall? (%)



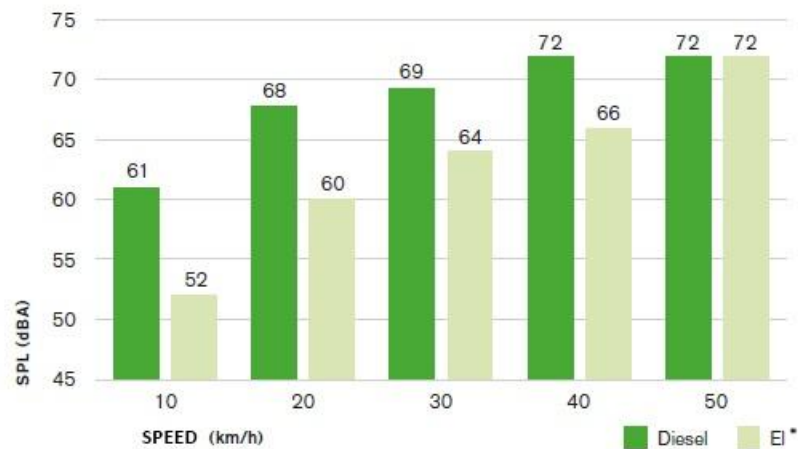
Passengers on Bus Route 55 are generally more satisfied with their bus journey compared to other bus routes.  
Source: Västtrafik.



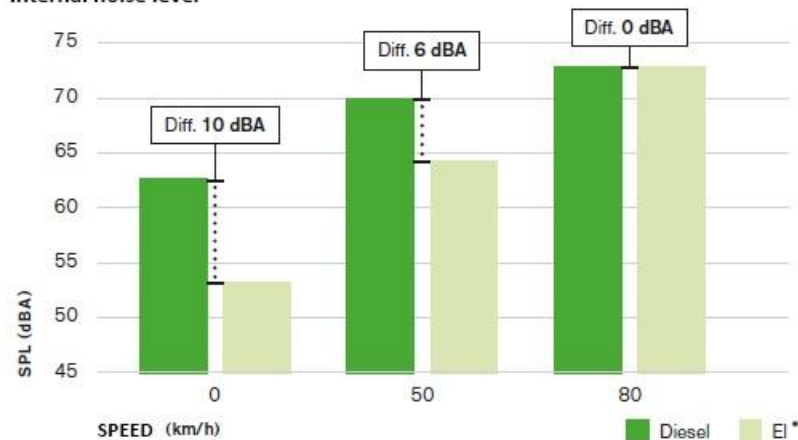


# Livability i dense cities

External noise level



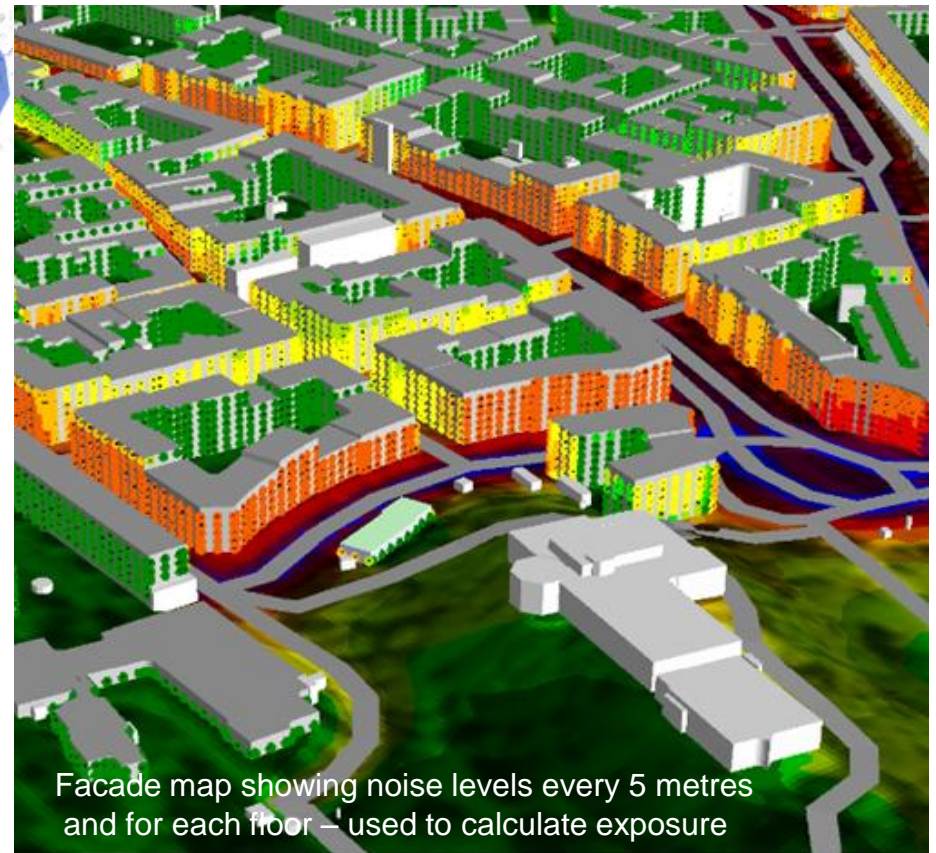
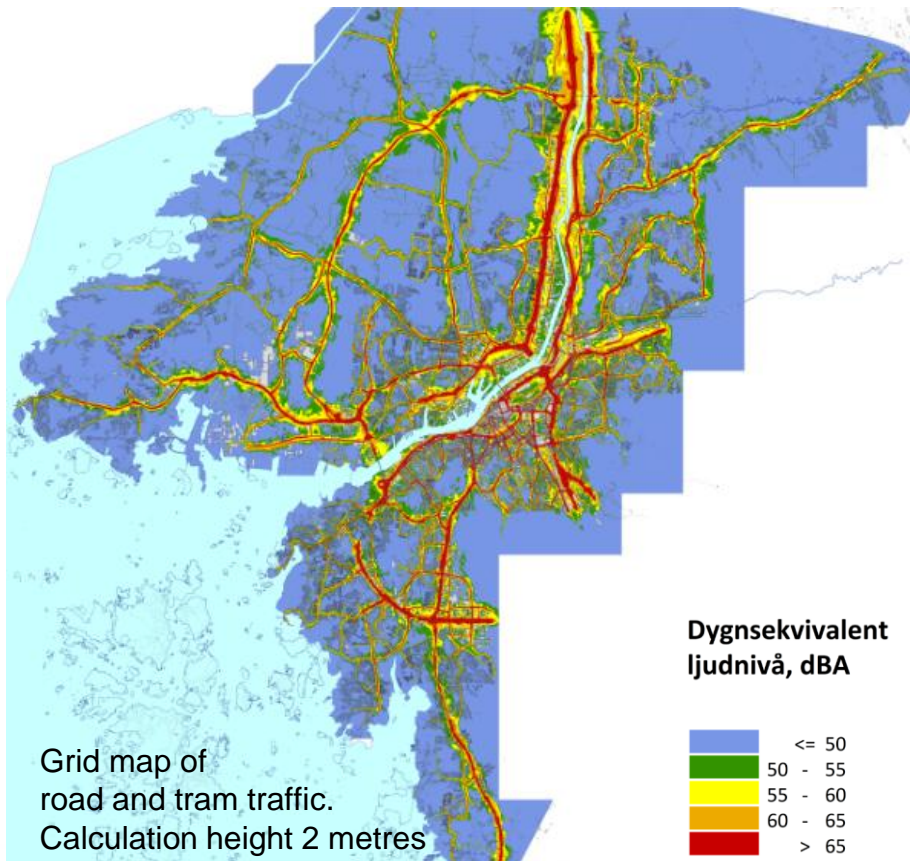
Internal noise level



# Noise exposure in Gothenburg

1000 mkr/year (socio economical costs from road traffic)

1200 Disability adjusted life years

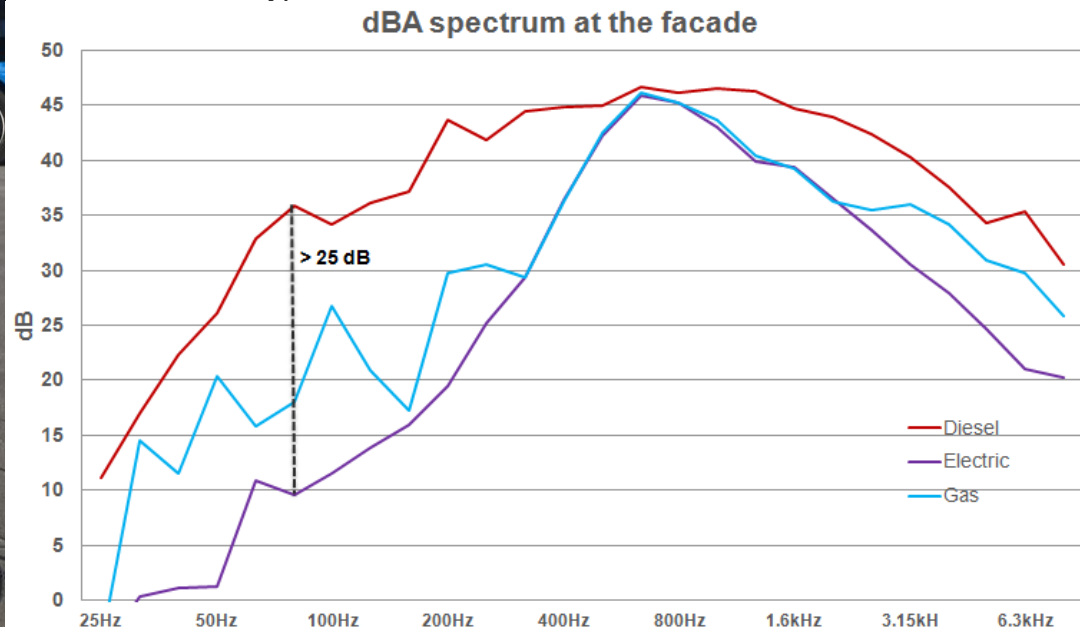




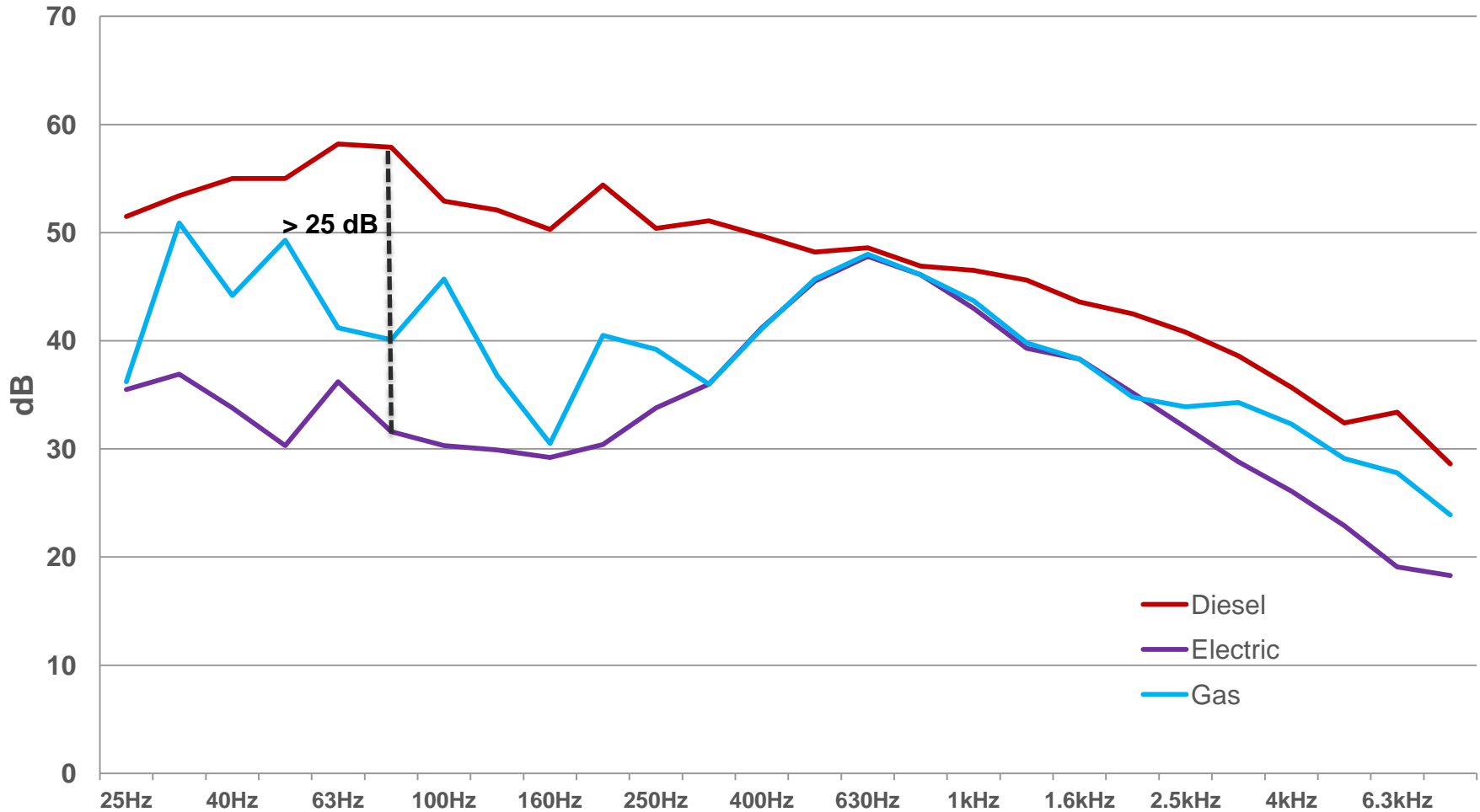
# Comparison of noise emissions



- 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.



## dBC spectrum at the facade





# Conclusions - so far



- 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 fasades 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

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



City of  
Gothenburg



**THANK YOU**  
**WELCOME** to join our journey

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