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Electric roads in the city of Lund

A cost benefit analysis

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COOPERATION BETWEEN INDUSTRY, UNIVERSITY AND THE PUBLIC SECTOR

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WHY ELECTRIC ROADS?

Utilizes existing roads

Extends range and eliminates the need
for charging stops

Electricity from renewable sources

Advantages with smaller batteries

Reduced need for fast charging stations

Decreased Environmental impact

More goods or passengers

Potential in cities
Limited charging options
+ large volumes of

EVOLUTION ROAD

THE TESTS IN LUND

Road based, conductive electric road

Two variants:
On top or immersed into the road

Up to 300 kW

Short segments

Built-in intelligence

EVOLUTION ROAD

WHY THIS TECHNOLOGY?

Efficient installation and minimal impact
on road and surroundings

Charges all sizes
of electric vehicles

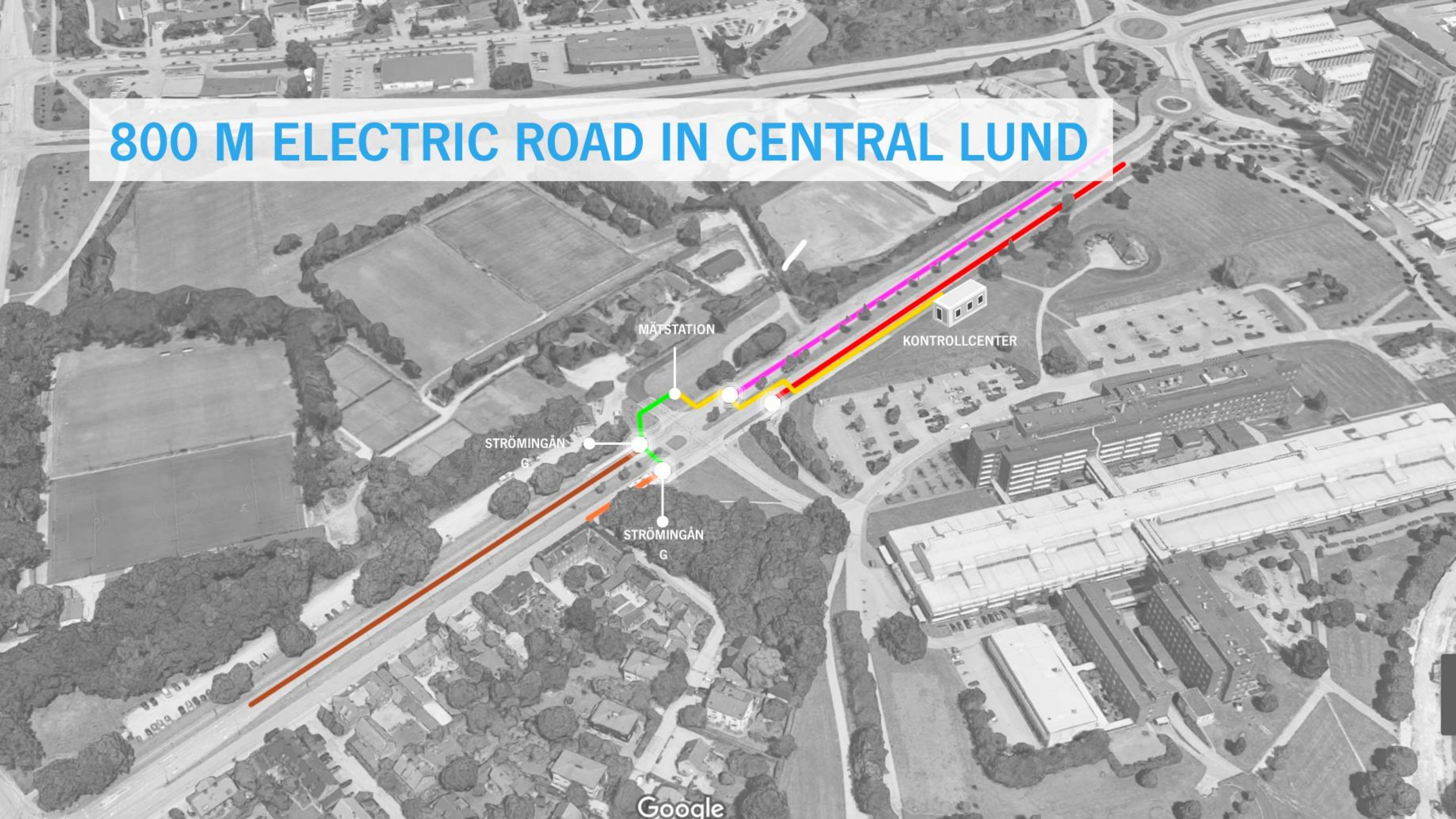
Reduces battery size
by 50-80 percent

Efficient conductive power
transfer up to 300 kW

Smart technology

Safety in the city
or
on the highway

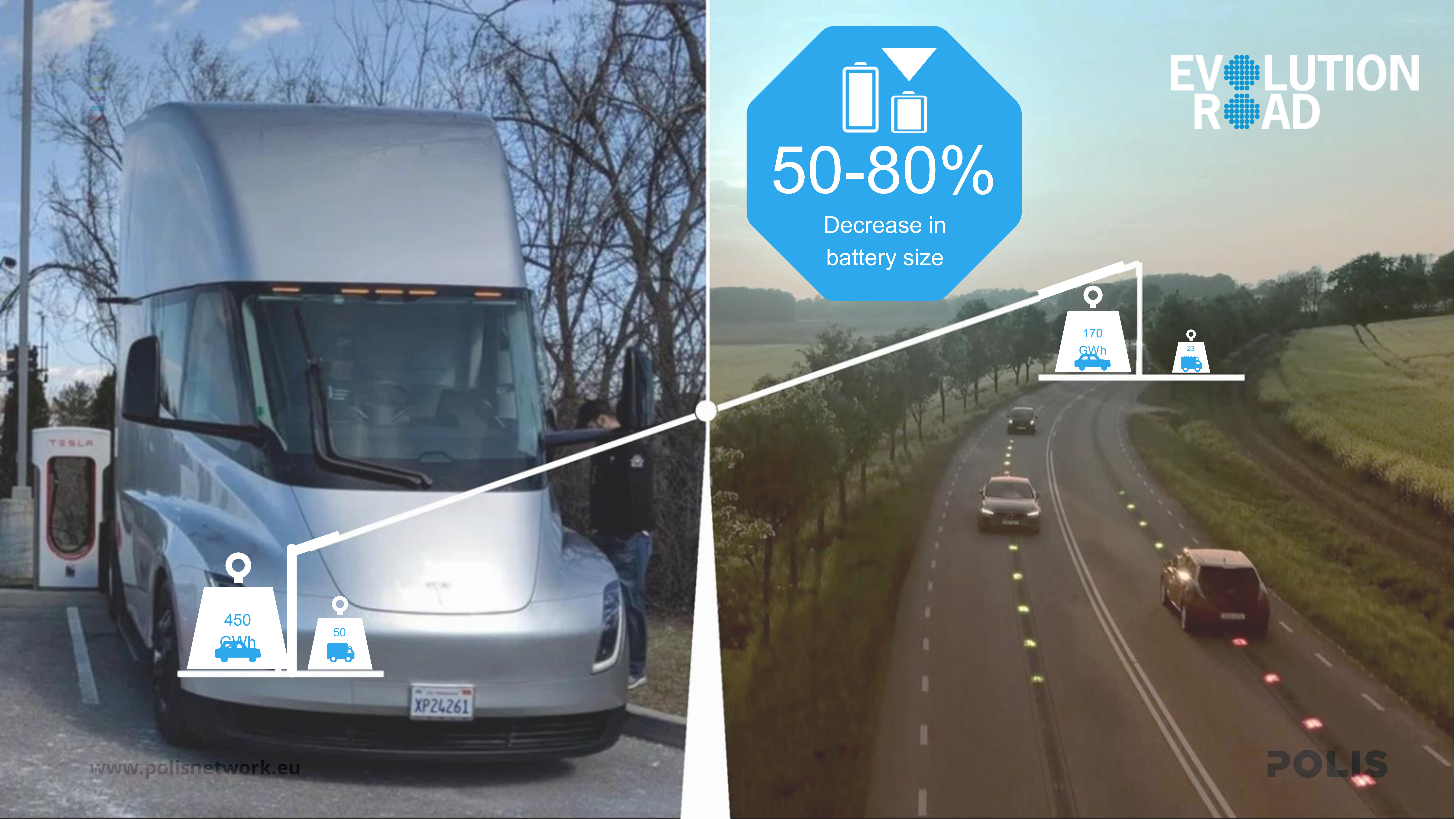
800 M ELECTRIC ROAD IN CENTRAL LUND



EVOLUTION ROAD

On top

Immersed


50-80%
Decrease in
battery size
450
GWh
50
170
GWh
23
EVOLUTION
ROAD
POLIS
www.polisnetwork.eu
TESLA
XP24261

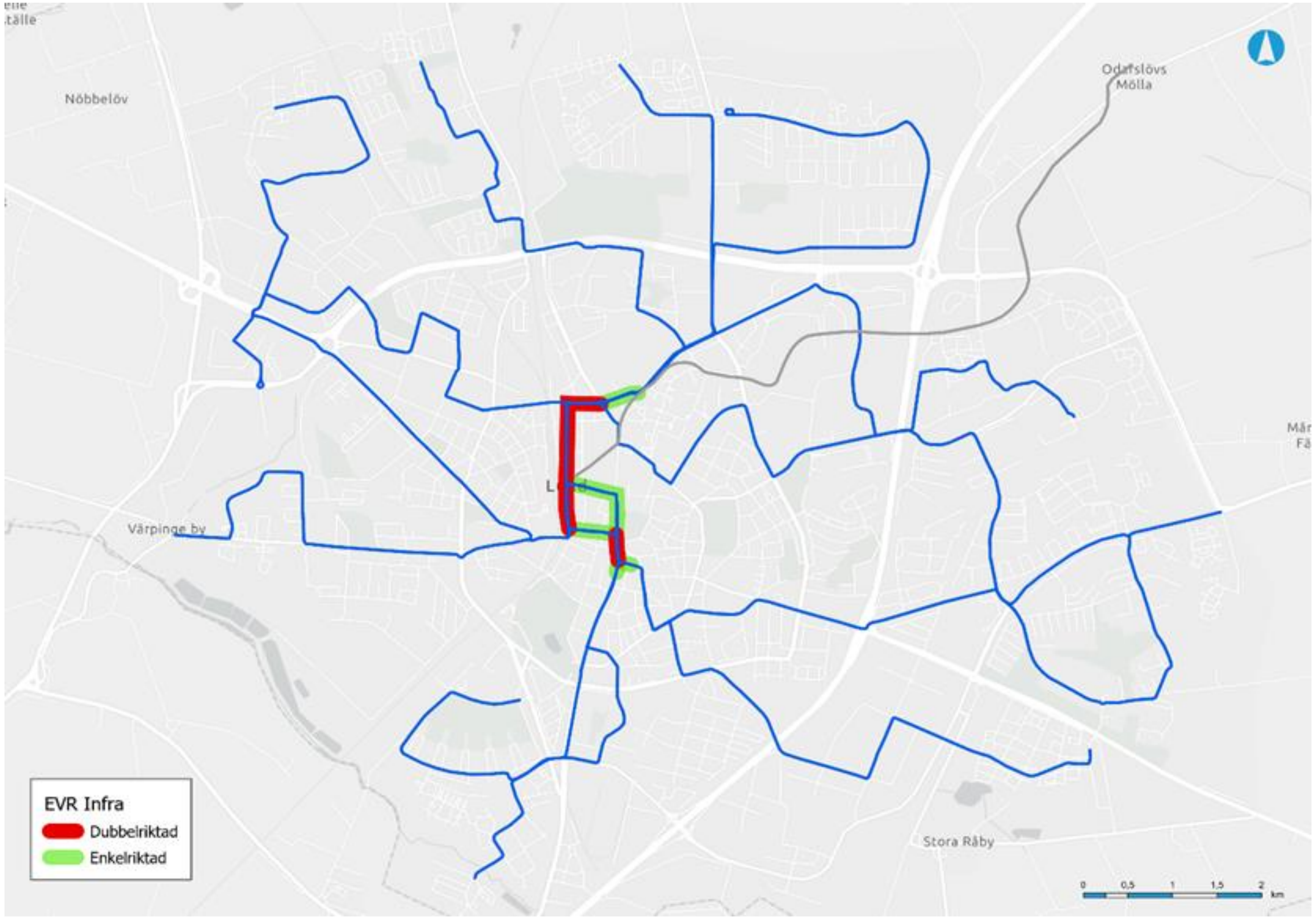
Yes, we’ve done tests in snow and rain!

Cost benefit analysis for a local bus network in Lund

- Current system of buses

Current system, with planned traffic in 2023	
- Number of buses	55
- Fuel type	Biogas
- Number of vehicle km per year	3,8 millions
- Purchase price per bus	4,2 millions
- Longevity, bus	12 year

Line map of current system



- Electric road: 3,4 km
- Terminus chargers: 9

In order to carry out the calculations, the following input data is needed

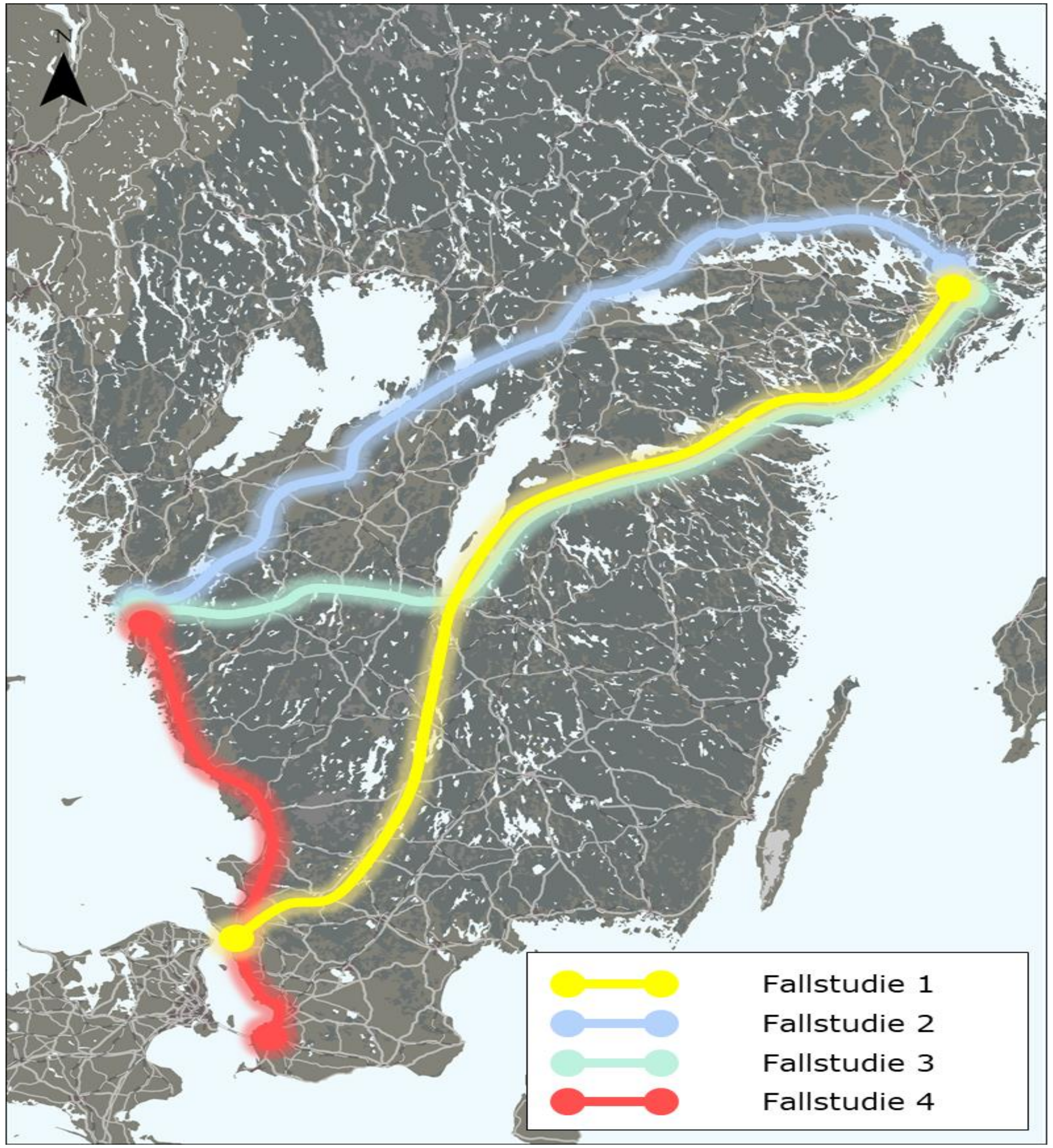
- Trafficking
- Traffic costs
- Emissions
- Noise levels
- Investment cost
- Assumptions about:
  - Calculation period
  - Socio-economics
  - Calculation values
  - Discount rate
  - Etc ..

Calculation results

	Base scenario	Sensitivity analysis, higher inv. cost
Cost benefit analysis	Present value, mkr	Present value, mkr
Costs for the traffic operator	**-103,3**	**-103,3**
Fuel cost (excl. tax)	444,5	444,5
Vehicle cost	-510,7	-510,7
Fuel taxes	-37,1	-37,1
External effects	**499,5**	**499,5**
Climate emissions	0,0	0,0
Exhaust particles (PM2.5)	31,9	31,9
Nitrogen oxides (NOx)	1,2	1,2
Noise	466,4	466,4
Budgetary effects	**37,1**	**37,1**
Fuel taxes	37,1	37,1
Costs for the infrastructure manager	*-48,8*	*-73,5*
Investment	-58,5	-77,7
Operation and maintenance	9,7	4,2
Net present value, NNV	**384,4**	**359,7**
Net present value ratio, NNK	**7,9**	**4,9**

Case studies for trucks

- In order to be able to evaluate the benefits of electric roads for the heavy traffic, a number of road sections where the potential for electric roads is judged to be high have been identified:



For each case study, the following calculations have been made;

- **Traffic scenario high (base scenario)** – 25% of traffic is assumed to switch to electric operation by the year 2040.
  - The base scenario assumes that 1/3-1/2 (41.7%) of the route needs to be constructed with an electric road
- **Traffic scenario low** – 12,5 % of traffic will switch
- **Traffic scenario high –** 50 % of traffic will switch
- **Higher investment cost** – sensitivity analysis to test the robustness of the calculation (30% higher cost).
- **Proportion of electric road = 100%,** i.e. a sensitivity analysis where we assume that the entire route needs to be constructed with an electric road.

General results

- Reduced fuel costs when switching to electric operation
- Increased vehicle costs in the form of increased purchase and maintenance costs
- Increased costs for charging infrastructure
- Reduced emissions of carbon dioxide and other emissions
- Increased costs for the infrastructure holder in the form of investment as well as operation and maintenance
- Profitability largely depends on how much traffic switches to electric operation. The section that will be most profitable is therefore the E6 Gothenburg – Malmö

Case E6 Gothenburg – Malmö

	Length of the route	Length of electric road	Investment cost	Flow Heavy Traffic
E6 Göteborg - Malmö	270 km	115 km	1215 mililons	ÅDT 5900

	Bastrafik	Låg trafik	Hög trafik	Högre inv.	Andel elväg =100%
Carrier	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*
-Fuel cost	*5 906,1*	*2 953,0*	*11 812,1*	*5 906,1*	*5 906,1*
-User fee	*-1 365,4*	*-682,7*	*-2 730,9*	*-1 365,4*	*-1 365,4*
-Charging infrastructure	*-973,6*	*-486,8*	*-1 947,2*	*-973,6*	*-973,6*
-Other costs	*-2 931,4*	*-1 465,7*	*-5 862,8*	*-2 931,4*	*-2 931,4*
Budgetary effects					
- Fuel tax	*-3 012,4*	*-1 506,2*	*-6 024,8*	*-3 012,4*	*-3 012,4*
- User fee	*1 365,4*	*682,7*	*2 730,9*	*1 365,4*	*1 365,4*
External effects					
- Carbon dioxide cost	*5 243,6*	*2 621,8*	*10 487,2*	*5 243,6*	*5 243,6*
- Other emissions	*6,5*	*3,3*	*13,0*	*6,5*	*6,5*
Electric road costs					
-Investment cost	*-1579,5*	*-1579,5*	*-1579,5*	*-2193,8*	*-3790,8*
-Maintenance cost	*-464,7*	*-464,7*	*-464,7*	*-645,4*	*-1115,2*
Net present value, NNV	*2 194,6*	*75,2*	*6 433,3*	*1 399,6*	*-667,3*
Net present value ratio, NNV-r	*1,07*	*0,04*	*3,15*	*0,49*	*-0,14*

Case The whole system

	Length of the route	Length of electric road	Investment cost	Flow Heavy Traffic
E6 Göteborg - Malmö	1470 km	615 km	6615 mililons	ADT 4000

	Bastrafik	Låg trafik	Hög trafik	Högre inv.	Andel elväg =100%
Carrier	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*	*Miljoner kr*
-Fuel cost	*21 800,1*	*10 900,1*	*43 600,3*	*21 800,1*	*21 800,1*
-User fee	*-5 040,0*	*-2 520,0*	*-10 080,0*	*-5 040,0*	*-5 040,0*
-Charging infrastructure	*-3 593,8*	*-1 796,9*	*-7 187,5*	*-3 593,8*	*-3 593,8*
-Other costs	*-10 820,2*	*-5 410,1*	*-21 640,4*	*-10 820,2*	*-10 820,2*
Budgetary effects					
- Fuel tax	*-11 119,3*	*-5 559,6*	*-22 238,5*	*-11 119,3*	*-11 119,3*
- User fee	*5 040,0*	*2 520,0*	*10 080,0*	*5 040,0*	*5 040,0*
External effects					
- Carbon dioxide cost	*19 355,0*	*9 677,5*	*38 710,0*	*19 355,0*	*19 355,0*
- Other emissions	*24,0*	*12,0*	*48,0*	*24,0*	*24,0*
Electric road costs					
-Investment cost	*-8599,5*	*-8599,5*	*-8599,5*	*-11943,8*	*-20638,8*
-Maintenance cost	*-2529,9*	*-2529,9*	*-2529,9*	*-3513,8*	*-6071,9*
Net present value, NNV	*4 516,4*	*-3 306,5*	*20 162,3*	*188,3*	*-11 064,8*
Net present value ratio, NNV-r	*0,41*	*-0,30*	*1,81*	*0,01*	*-0,41*

Conclusions

- Electric roads have a unique competitive advantage over competing technologies in that you can charge the vehicle while driving
- Calculations for both bus and truck indicate that an electric road extension could be profitable
    - Even though it is difficult to produce reliable forecasts regarding future traffic
- The development of electric vehicles today is going at breakneck speed, mainly with regard to passenger cars, but also for heavy traffic, the development is progressing very quickly
    - What was previously not considered possible may become a reality in the not too distant future
- Perhaps there are great potential benefits associated with electric roads in cities that have been overlooked so far – Passengers cars?

Thank you for your attention!

For questions:

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