Electric bus sustainability, cost and customer performance in southeast Sweden

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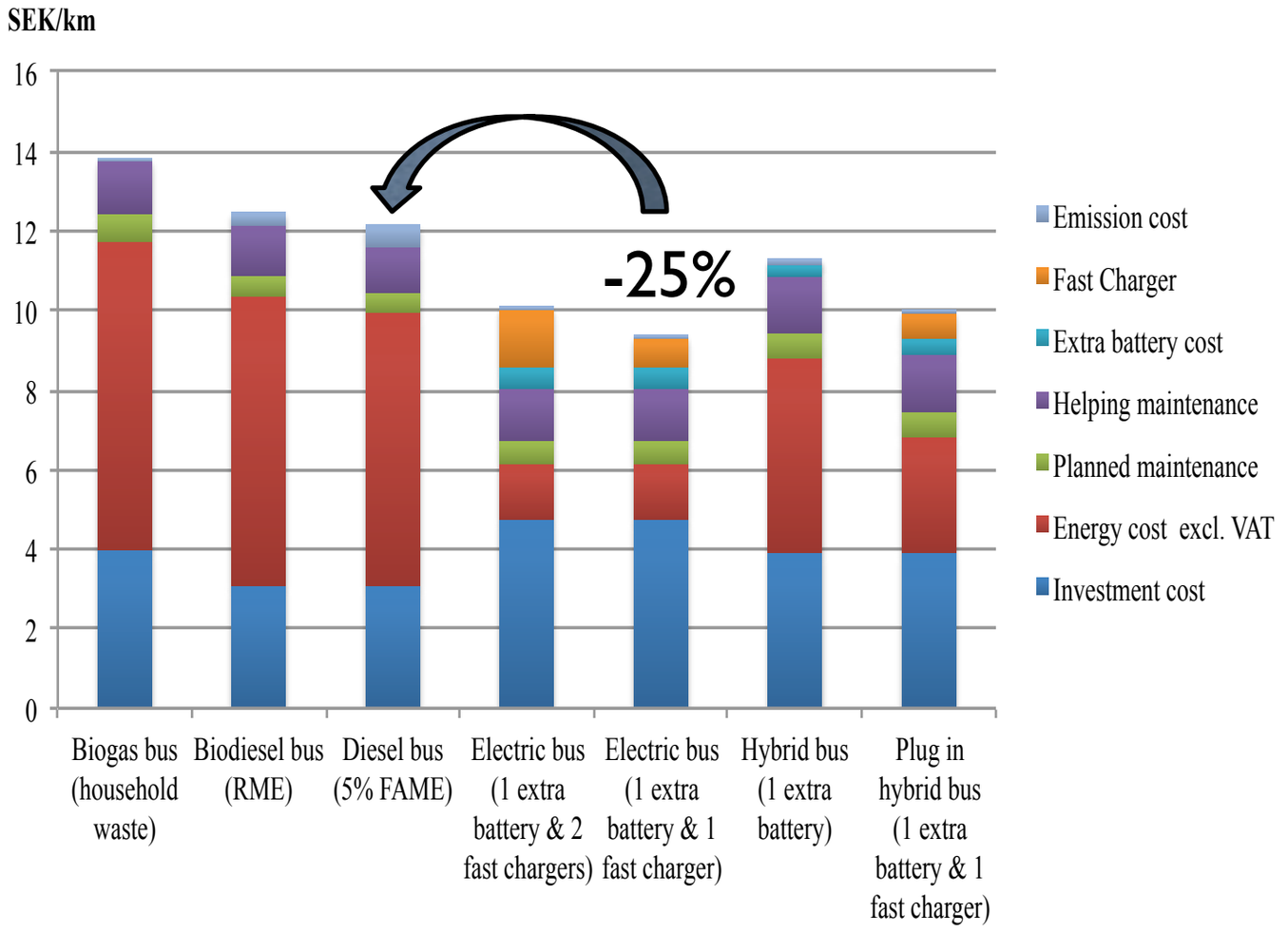
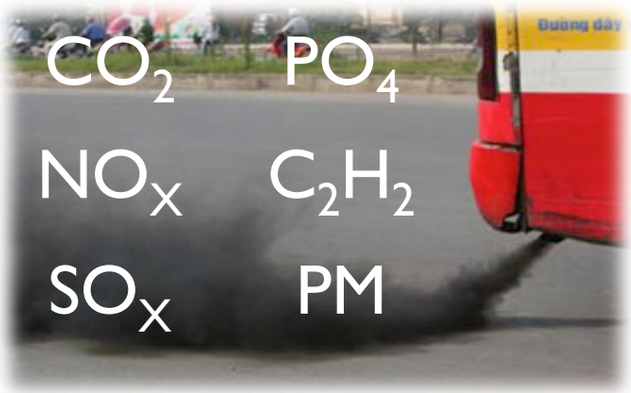
Source: http://www.barometern.se/kalmar/tysta-elbussar-imponerade-pa-passagerarna/
Photo: Stefan Nilsson



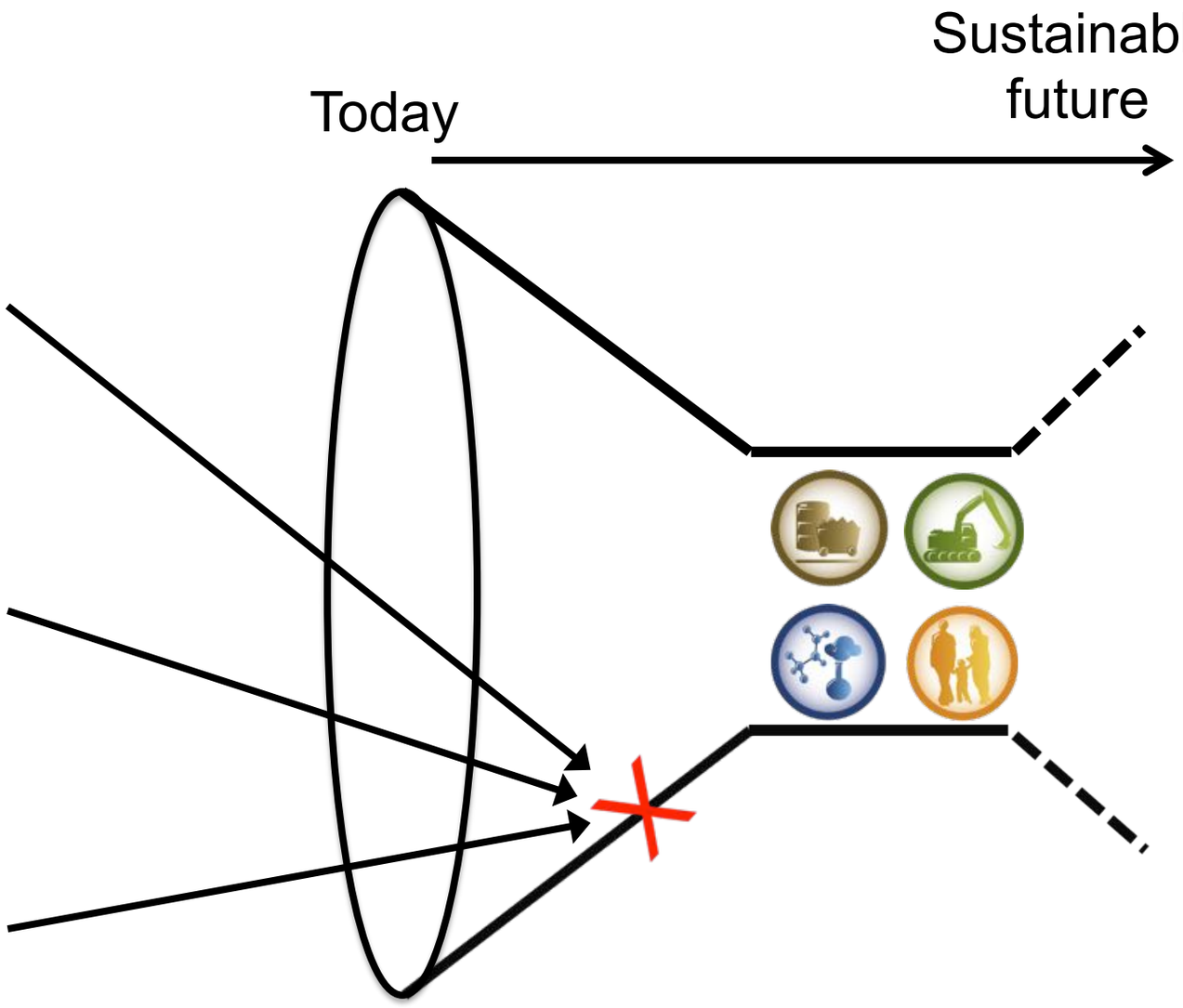
3 huge road (bus) traffic sustainability challenges

http://sports.yahoo.com/blogs/fantasy-roto-arcade/first-down-graham-brady-wilsons-inquiring-fantasy-minds-161129890.html



http://www.moitruongdulich.vn/en/index.php?itemid=2806

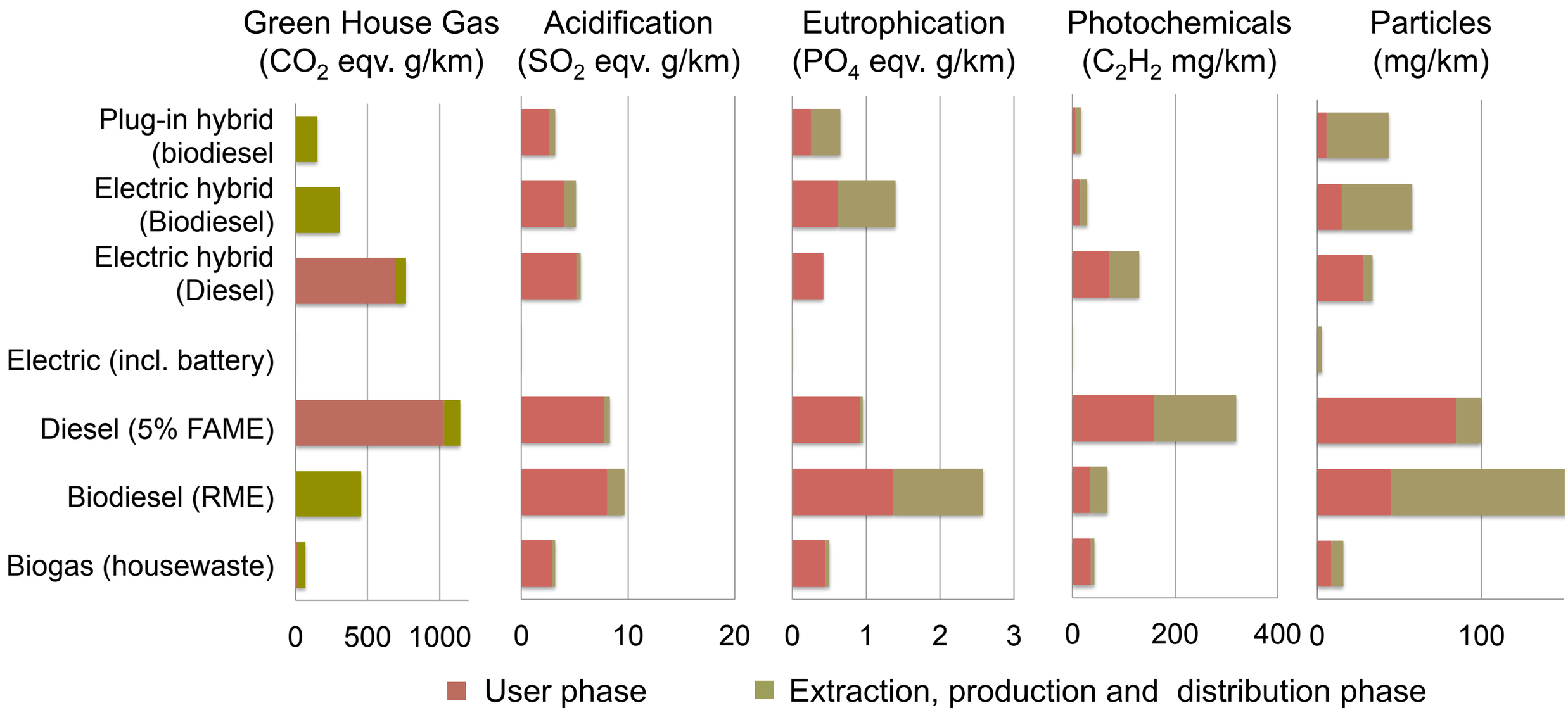
http://theallegiant.com/foreign-oil-dependency/



Bus study 1: lifecycle emissions

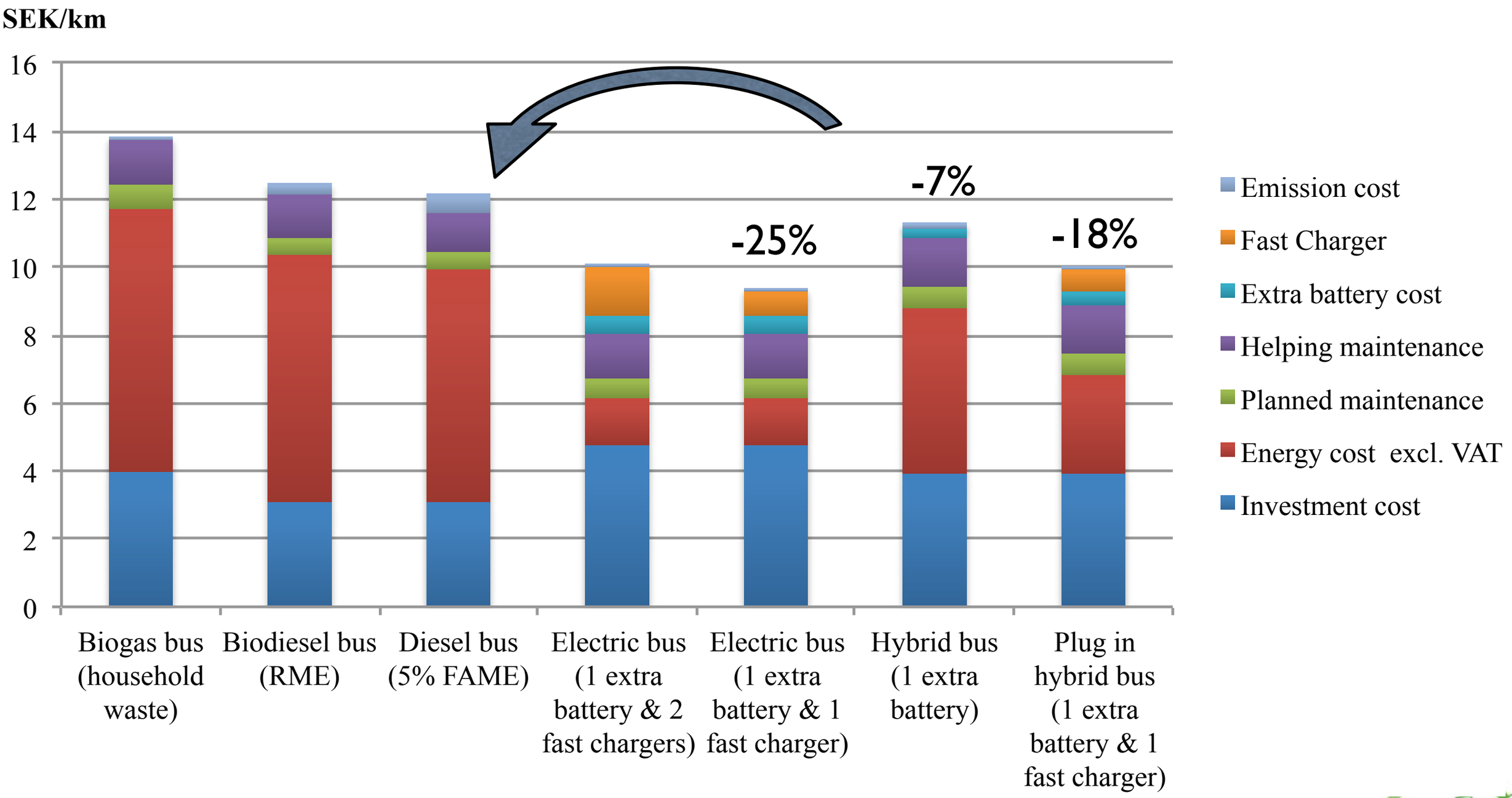
Renewable fuels = CO_2 neutral

Only new renewable electricity



(Börjesson et al., 2010; Gode et al., 2012)

Bus study 1: Total Cost of Ownership in Karlskrona (2013 - 2020)



Bus study 2: Field testing in 8 municipalities

Karlskrona, Kalmar, Jönköping, Borås,
Lerum, Falun, Eskilstuna, Orust,
Public transport authorities and Operators

Source: http://greencharge.se/aktiviteter/keolis-och-lanstrafiken-i-jonkoping-kor-nu-elbussen/
Photo: Stefan Nilsson

Nov-April 'in real life' 2014-15:

- Verify calculations (energy)
- Noise, range, feedback
- Possibilities fast charging
- Show case and testing

Ebusco 2.0:
12 meter, 90 passengers (45 seats)
311kWh battery => 300 km range

Bus studies: Electric bus benefits

- Electric = - 25% TCO (8 years)
- More sustainable and less pollutions if charged with new green electricity
- Low energy use (0,96 kWh/km urban, 0,88 rural)
- Less noise (-6 dBA during acc.)
- ☺ Passengers, drivers and other stakeholders
- Great possibilities to charging infrastructure (heavy traffic = 350-600kW, low = depots)
- Account for operator's risks
- Possible to run @ many lines today

Bus studies: Next possible step

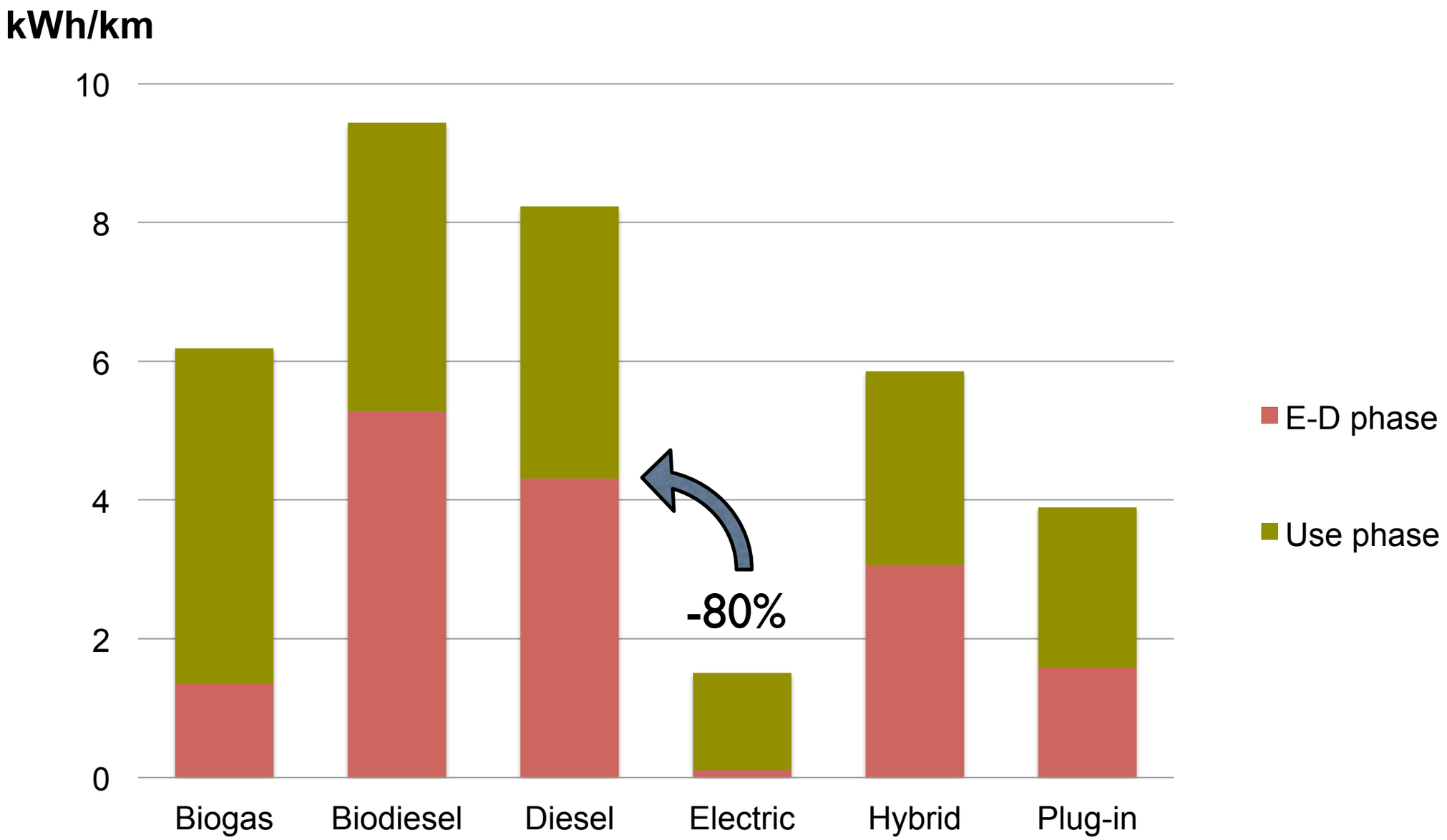
2 year electric bus project in real traffic:

? Business model between stakeholders
? Actual risks for operators
? Energy use throughout the whole year
? Test charging infrastructure
? …

Bus study 1: Energy use

Electric use 1,04 kWh/km

Diesel heater excluded



Bus study 1: Total cost of ownership assumptions

Calculations according to Net Present Value

Price increase electric	6,24% per year enligt trend 10 år tillbaka
Price increase oil	6,28% per year ”-”
Real interest rate	1% per year
Price electric bus	3,7 MSEK
Price diesel bus	2,4 MSEK
Maintenance electric	+15% (compared to diesel)
Maintenance hybrid	+25% ”-”
Battery change	1 within 8 years

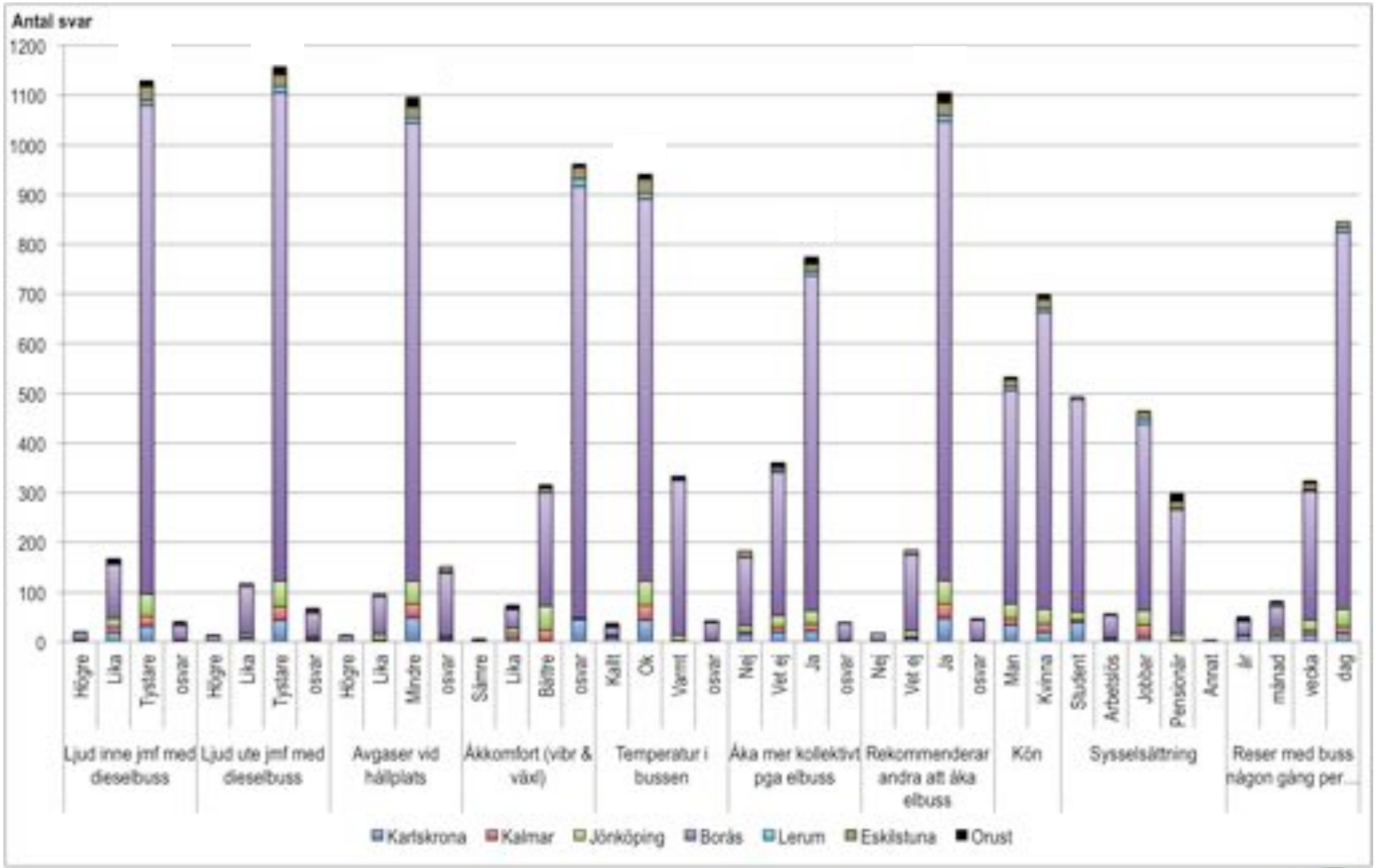
Bus study part 2: Results energy use

- City traffic => 0,96 kWh/km ~~(1,04kWh/km=300km)~~
- Rural traffic @ Orust => 0,88 kWh/km
- Mixed traffic @ Lerum => “between”

Bus study part 2: Noise

- Passengers appreciates the silence
- Drive-by 30, 40, 50km/h => small differences
- “Full throttle” => much higher for diesel
- Acceleration => - 6dBA (US data)

Bus study part 2: Passenger's Feedback



Bus study part 2: Driver's & stakeholders Feedback

- 77 drivers 🙂 in general
- Slow upphill (settings)
- Non driveline related "-": no parking brake, too powerful brakes (settings), mirrors, only one stroller, etc
- Better driving performance than diesel/gas busses
- Reduce operator's risk (technical, education)

Bus study part 2: Charging infrastructure

- Great possibilities for fast charging (350-600 kWAC) @ end/central stations for heavy traffic
- Slow charging (25-100 kWAC) @ depots
- Ensure enough grid capabilities

http://opbrid.info/gothenburg-reference-site

Mange takk!

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see you @ www.greencharge.se