

# Climate and Environmental Impacts of High-Speed Rail

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Photo: Leif-Harald Ruud

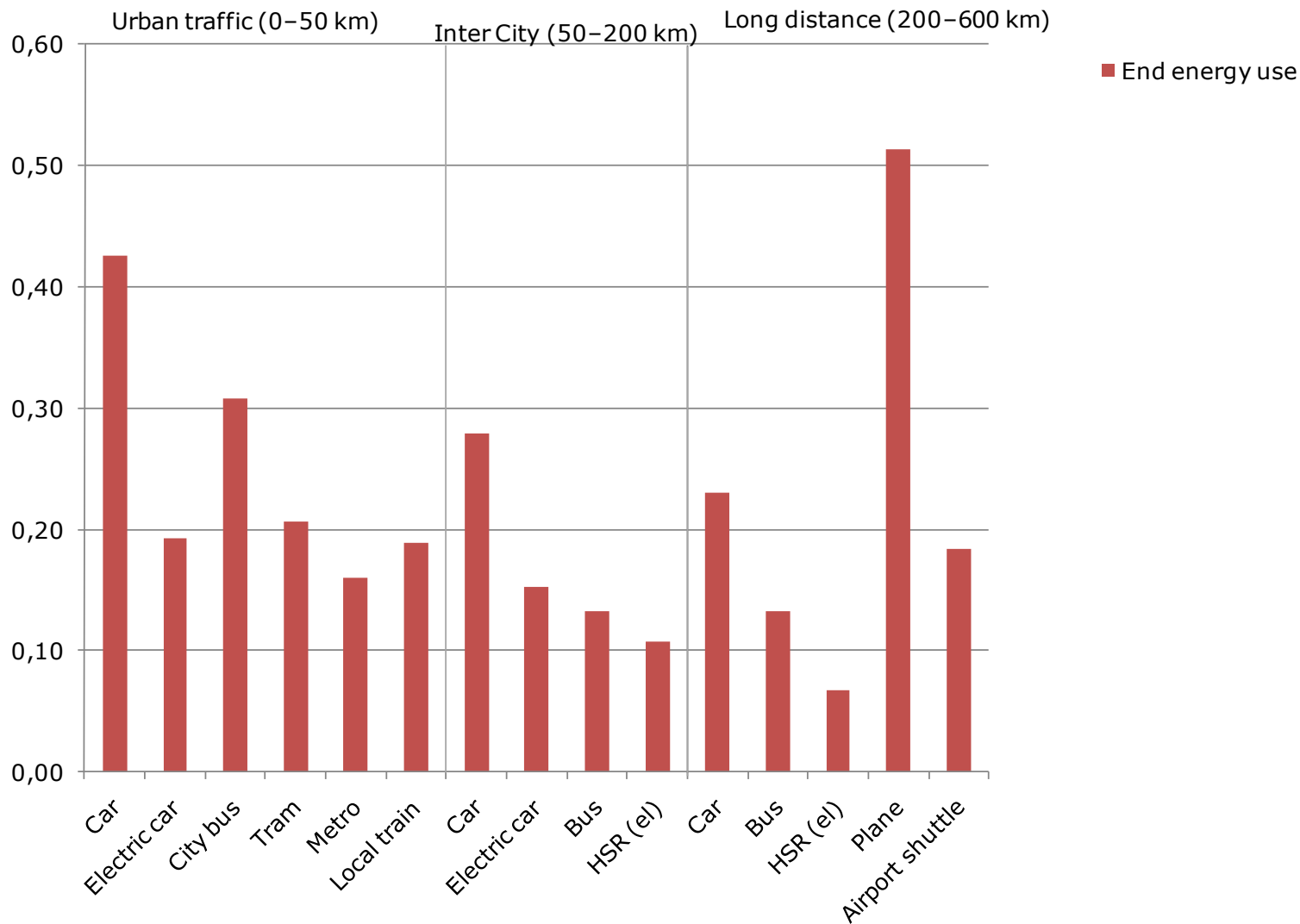
# First: Why railways – from an environmental point of view?

- All transport modes have environmental impacts
- More rail transport is good for the environment if it leads to less use of transport modes with higher environmental impacts
- It means: More rail transport is not a goal in itself
- Different goals: We want to use the railway *in order to reduce* environmental impacts, while others want to increase the mobility. That's a challenge

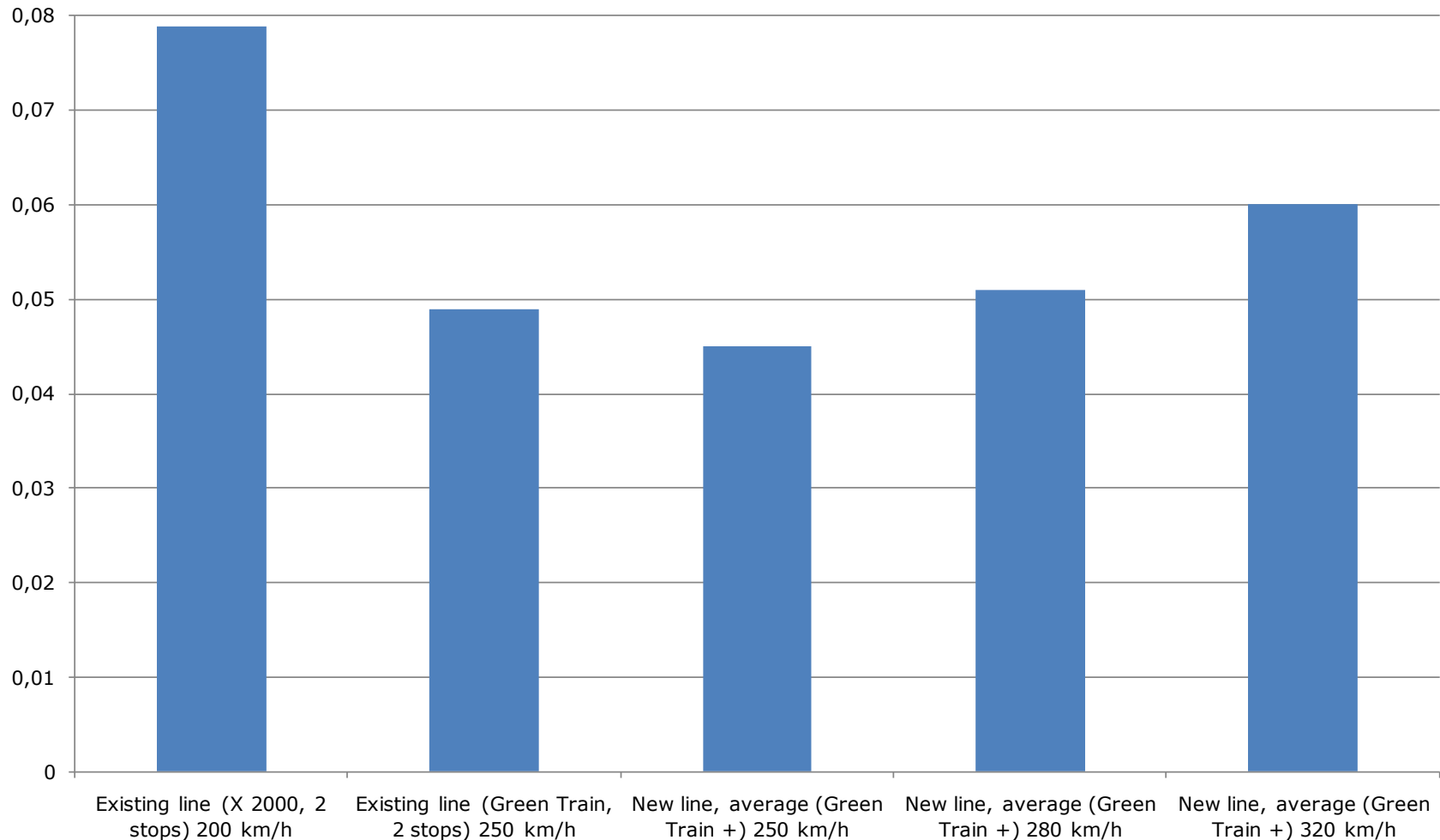
# About this lecture

- To describe the environmental impacts of high-speed rail (HSR), we have to know the impacts of other transport modes too
- Main source: The report "Energy and climate impacts of modern transportation" (2008)
  - Comparing rail, road and air traffic
  - Life cycle perspective (100 years, 2020 and 2030)
  - End energy use + indirect energy use
  - Vehicles + infrastructure
  - Assumptions on shifts in modal split and overall traffic trends
- Additional slides about the impacts on natural environment

# End energy use, 2020 (kWh/pass.km)



# End energy use, different speeds (kWh/pass.km)



"Green Train +" means Green Train with extra low aerodynamic drag

Source: Lukaszewicz, Piotr and Evert Andersson (2009): *Green Train energy consumption – Estimations on high-speed rail operations*. KTH. Stockholm

# Energy production

- Losses in the railway power system is included in end energy use
- Indirect energy use includes losses in energy production and public transmission / distribution
- Electricity: European mix is assumed to be the long time marginal -> 0,25 kgCO<sub>2</sub>/kWh in 2020 (quite lower than today) and 0,10 kgCO<sub>2</sub>/kWh in 2030
- Fuel: 90% fossile fuel mixed with 10% biofuel i 2020 and 15% biofuel in 2030

# Infrastructure –

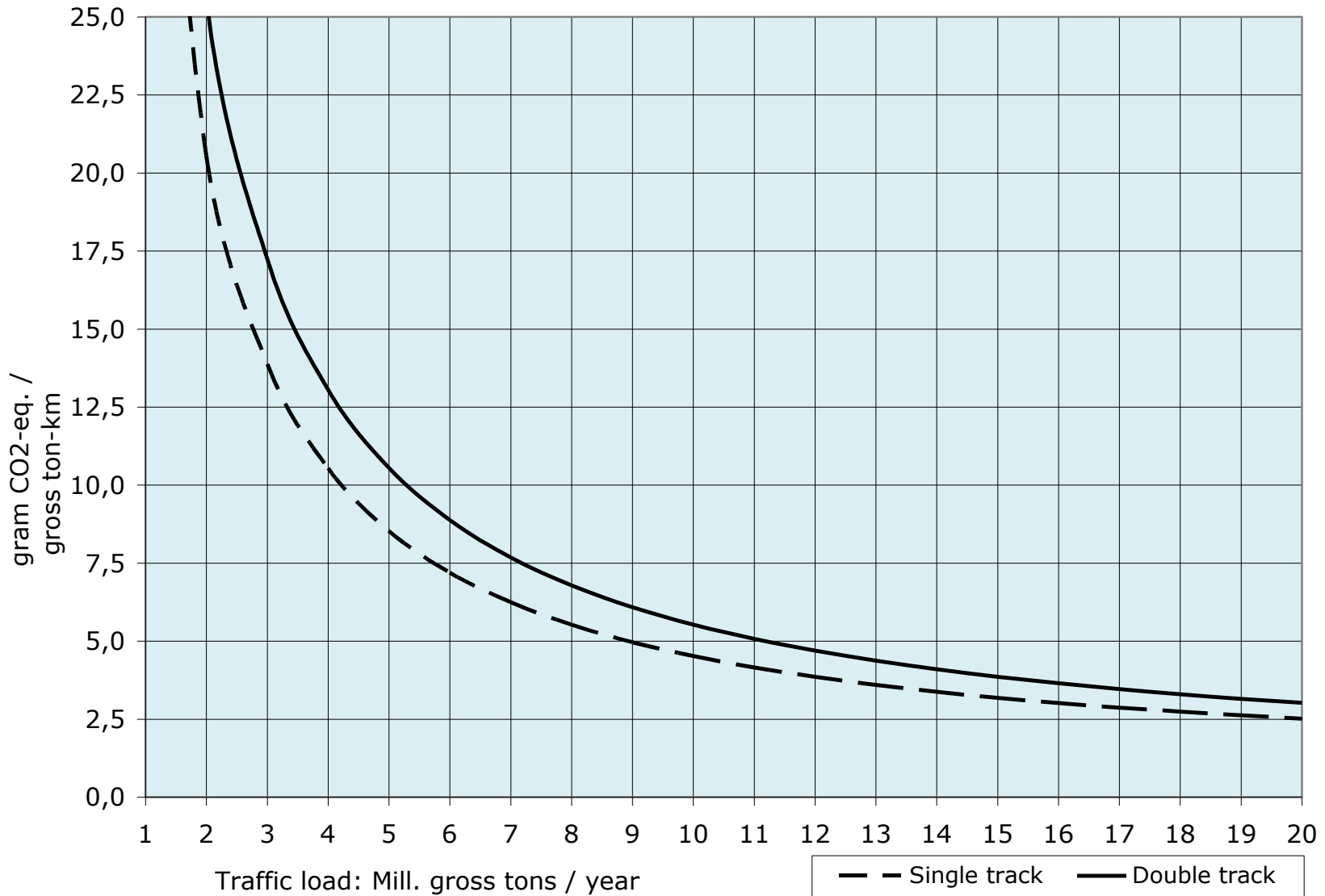
## The hardest part of a life cycle study!

- Norwegian conditions: Makes it difficult to use studies for other countries
- Long lifetime: At least 100 years
- How to allocate the environmental impacts on different types of transportation (passengers versus freight)?
- How do the impacts change when the traffic load varies? It is necessary to identify which impacts are depending on traffic volume and which are not
- Some assumptions:
  - HSR, double and single track for 250 km/h: 37% tunnel, 9% bridge
  - Highway, two–four laned: 5–10% tunnel, 2–5% bridge

# Infrastructure: Some results

- Building highways and HSR:  
About the same energy and climate impacts per kilometre
  - HSR, double track: 4100 kgCO<sub>2eq.</sub>/metre
  - Highway, four laned: 3600 kgCO<sub>2eq.</sub>/metre
- Over the lifetime: Four laned highways have higher impacts than double track HSR
- But, higher traffic load on highways means a lower impacts per pass.km than for HSR

# Climate impacts depending on traffic load

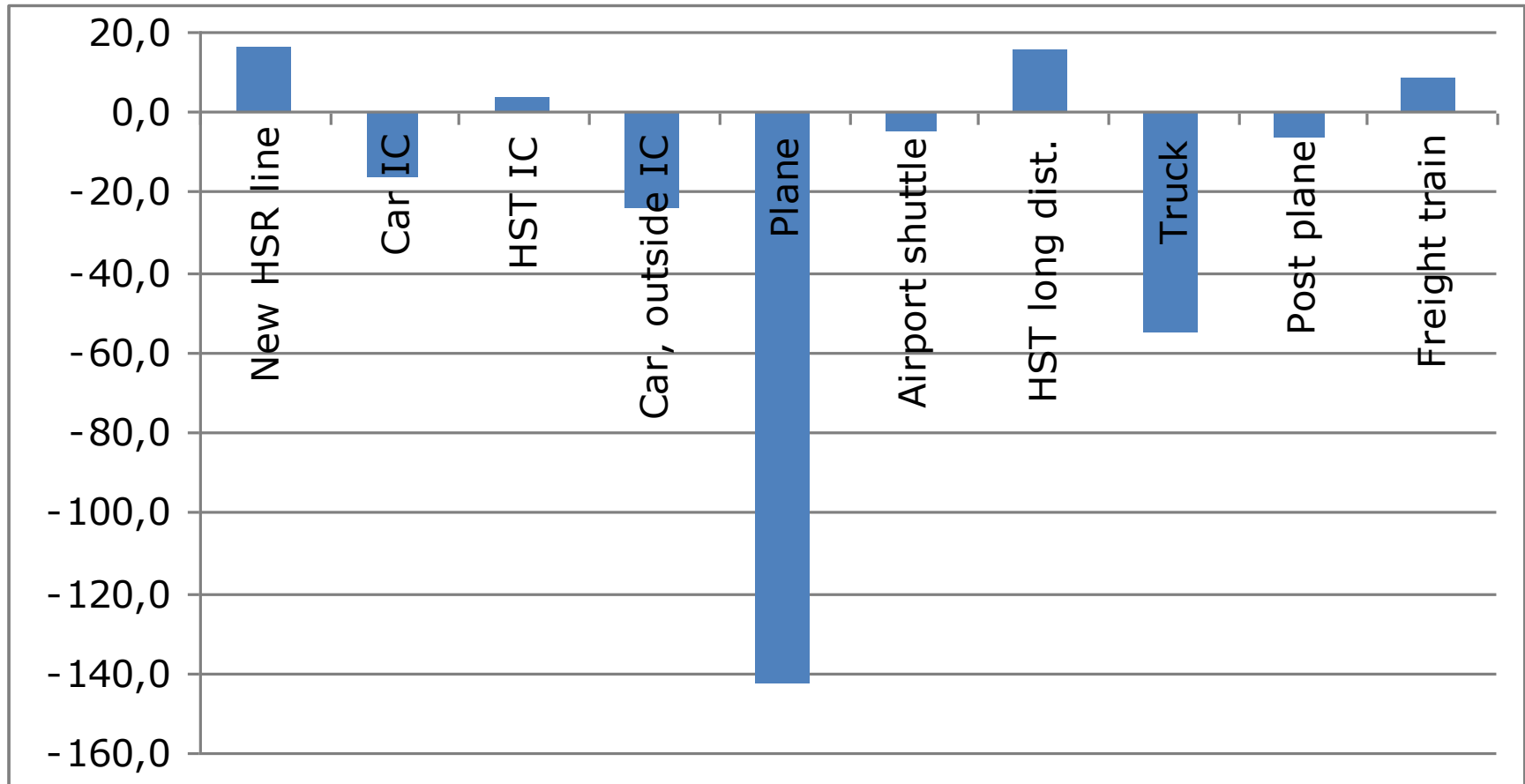


# Shift in modal split etc.

- Important assumption: HSR is a part of a policy to reduce the transport sector's environmental impacts. It means: HSR in combination with other measures
- Two scenarios for Gardermoen–Lillehammer–Trondheim (changes in relation to a situation without HSR):
  - Plane -> HSR: 70% or 90%
  - Car -> HSR: Depending on travelling distance and distance to nearest station: 4–25% or 7–40%
  - Car -> HSR (IC area): 16% or 32% in corridor
  - Truck -> freight train: 40% of long distance road transport
- Additionally changes as a result of induced traffic (positive and negative)

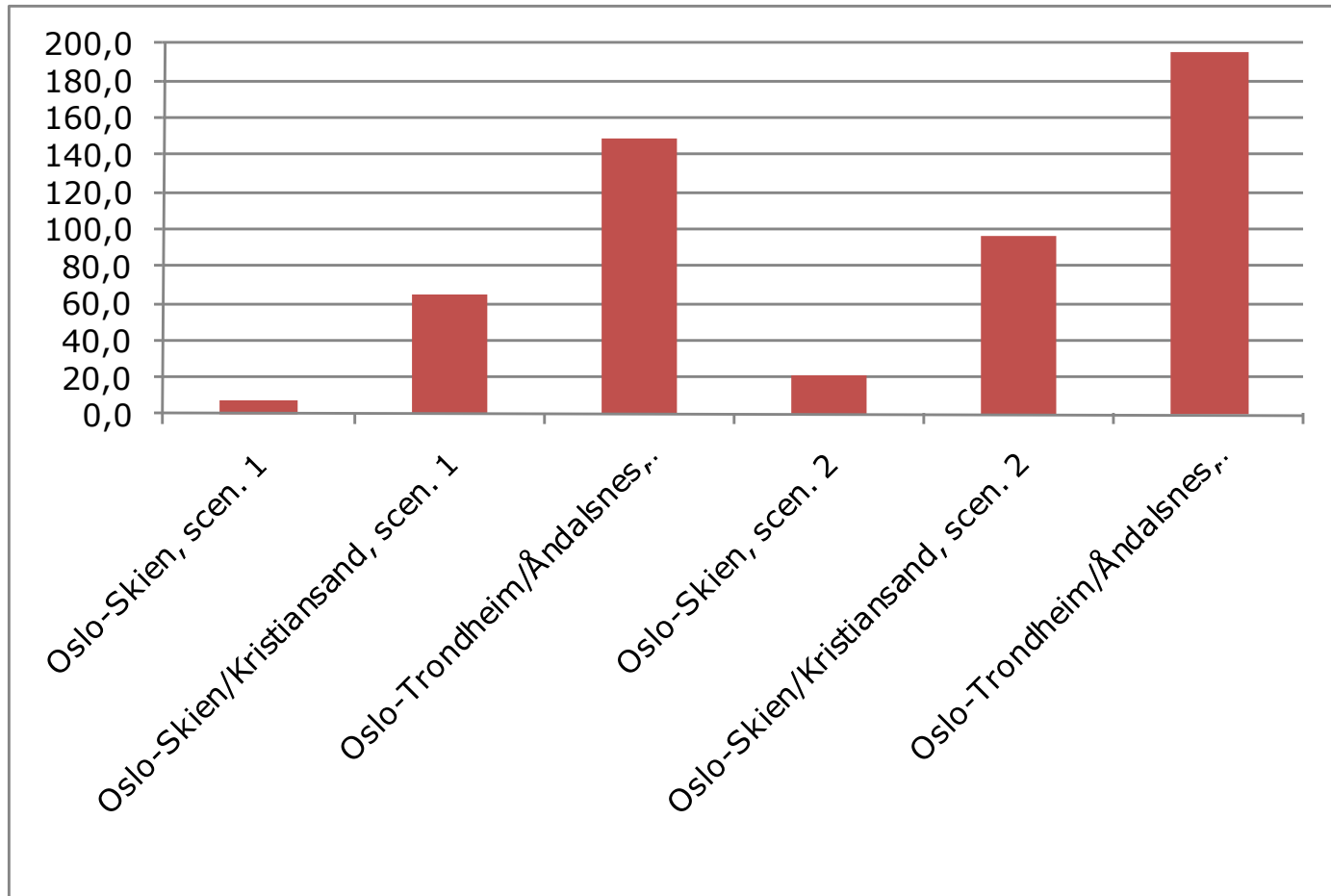
# Result for Oslo–Lillehammer–Trondheim

Scenario 2, 1000 t CO<sub>2eq</sub> / year, average (mix of 2020 and 2030)



# CO<sub>2</sub> reductions for two corridors

1000 t CO<sub>2eq</sub> / year, average (mix of 2020 and 2030)



# Impacts on the natural environment (1)

- Building new infrastructure has significant impacts on the natural environment in many ways:
  - Encroachment on vulnerable areas, barriers, landfills etc.
- For HSR in Norway, a high share of line distances will be tunnel (about 40% Oslo–Lillehammer–Trondheim, and more between east and west)
- Unlike in many other countries, HSR in Norway will partly be built to replace existing lines (e.g. a new line Gardermoen–Lillehammer–Trondheim)
- A high share of line distances in tunnel will reduce the barriers and can lead to positive local effects if the existing line is closed and brought back to nature

# Impacts on the natural environment (2)

- It is easier to avoid nature conflicts by planning and building new lines over longer distances, compared with building "step by step"
- In a policy for reducing the transport sector's environmental impacts, it is important that new HSR lines are built *instead of* new highways and airport extensions
- This will limit the total impacts on the natural environment and also avoid induced road and air traffic
- Can HSR, with "town centre stations", contribute to a less sprawling land use locally (because it is attractive to live and work near the stations)?

# Some conclusions (1)

- The environmental impacts of transportation is huge
- The official goal of preventing a temperature rise of more than two degrees have to change the way of thinking
- The HSR policy must be a part of a bigger policy and be combined with other measures, e.g. higher CO<sub>2</sub> taxes and limits on airport and road capacity
- The economic and environmental impacts of building new railways makes long term planning necessary. Railway lines being built today, have to fit into a future HSR network
- Investments in HSR should contribute to improvements for the rail freight traffic

# Some conclusions (2)

- The passenger traffic on HSR lines between regions could be lower in Norway than in more urban countries. This makes it easier for freight trains to use the same lines
- This and other factors suggest that HSR lines should be constructed for moderate speed levels (250–300 km/h)
- It is hard to stop the population's desire for more mobility. Public money spent on rail can not automatically be used on other climate measures
- In the main transport corridors in southern Norway and to/from Sweden, it would be better to invest in a high-capacity HSR network, rather than continue to strengthen the more energy intensive and environmentally harmful transport modes

# We have a choice ...



Photo: Leif-Harald Ruud

More information:

<http://naturvernforbundet.no/samferdsel>