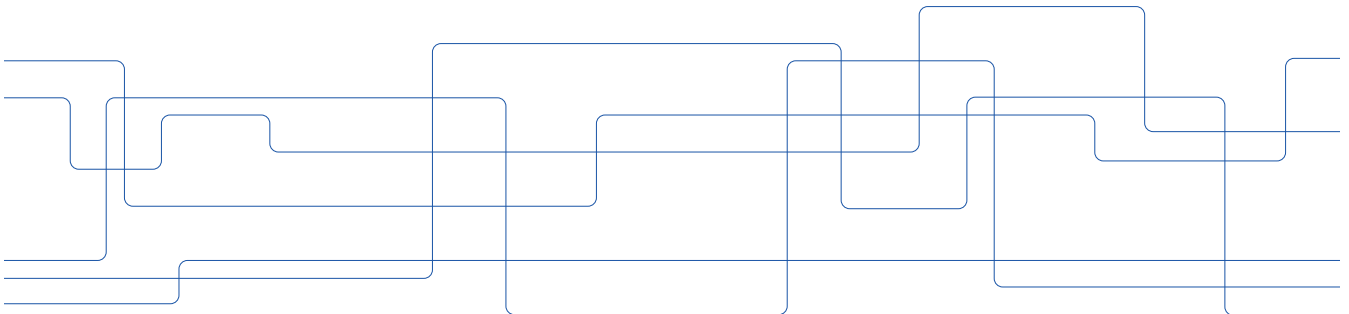




# A climate action plan for the Swedish railways

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# How to reach zero emissions by 2045?

Part of Government's climate action plan

An assignment commissioned by the Transport Analysis agency *Trafikanalys*

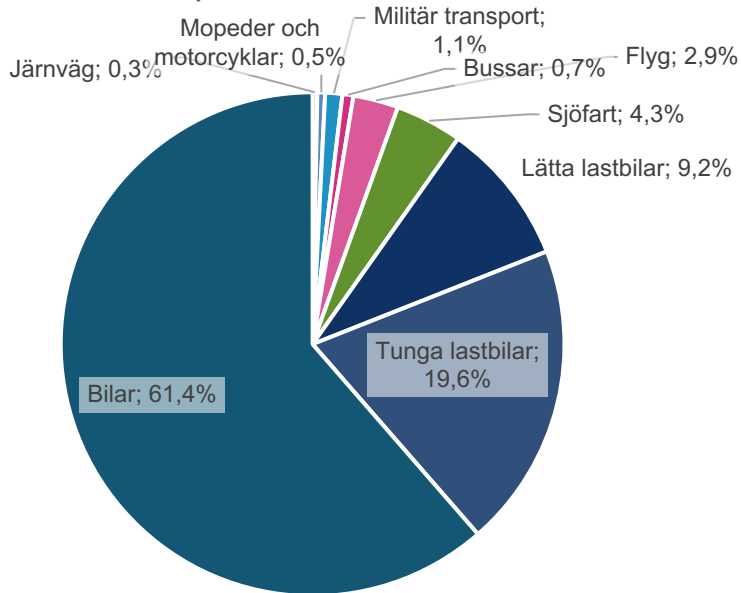
## **Goal for transportation:**

70% reduction of emissions to 2030

100% reduction (Zero emissions) 2045

# Railways 0.3% - What's the problem?

Share of domestic greenhouse gas emissions for transport in Sweden 2019

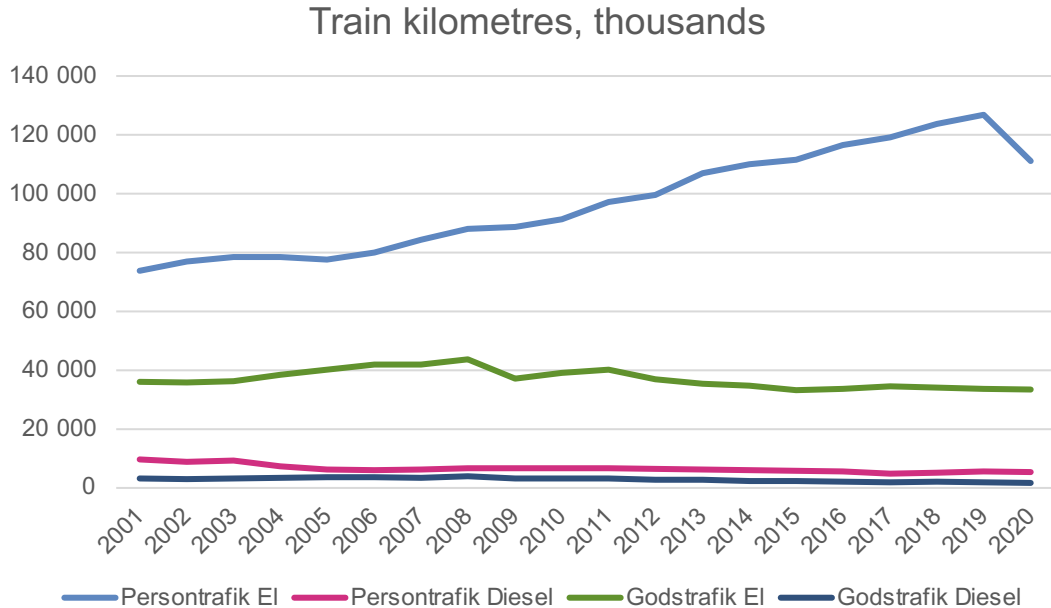


# Why do we need to reduce emissions from rail?

- Railways would lose its status as environmentally friendly transport mode if not the same goals as other modes (preferences)
- All and everyone need to reduce emissions to zero (solidarity)
- Focus on incentives – make users take the right decision (responsibility)



# Electric and diesel traction in Sweden



78% of track kilometres are electrified

Diesel traction on certain lines, and shunting in terminals, harbours and industrial spurs

# Railway electrification

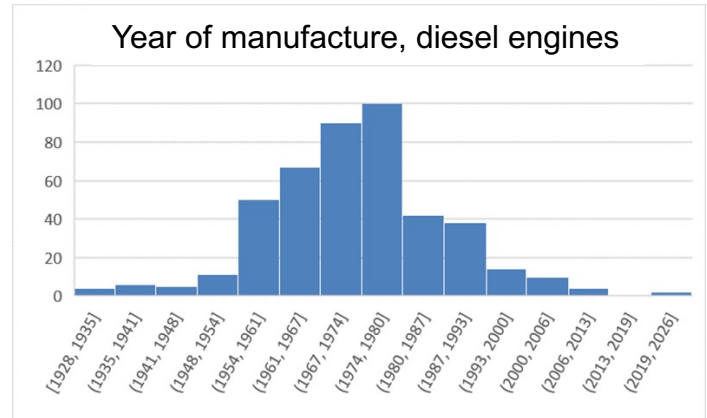
- Electrified by Overhead line equipment (OHLE), 75% of the Swedish network
- 100% renewable energy
- Many secondary lines and the capillary network such as harbours, terminals, industrial spurs not electrified – requires other energy sources
- Strong network effect, i.e. economy of operations best for all-electric haulage



Orange: Electrified railways  
 Blue: Non-electrified railways  
 Courtesy by Trafikverket

# Today's diesel locomotives in Sweden

- Some of the oldest diesels might not work well on biofuel. Rebuild or withdraw (suggested transitional rules)
- A 50 year old second hand electric or diesel locomotive costs in general SEK 4-8 million.
- A brand new standard locomotive costs SEK 35-45 million
- A big bimodal locomotive costs SEK 65-70 million (Green Cargo EuroDual)



- Diesel traction has 40-100% higher operational costs than electric (fuel and maintenance)

**As soon as the line is electrified, there is a strong incentive to run electric traction.**



# Proposal to reduce GHG emissions from railway operations

- Introduce reduction obligation for diesel fuel: 30% biofuel by 2023 and 70% by 2030 (the same rates as for road vehicle fuel)
- Zero emission requirement in public procurement of rail services (Public transport authorities and Trafikverket)
- Continuing electrification of the network, and state subsidies for electrifying the capillary network (terminals, harbours) when appropriate

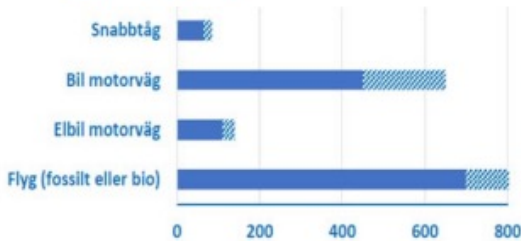
Energy storage/sources for non-electrified lines without direct emissions: Biofuel, biogas, hydrogen electric, battery electric

Bimodal vehicles, i.e. electric with power from OHLE in combination with one above

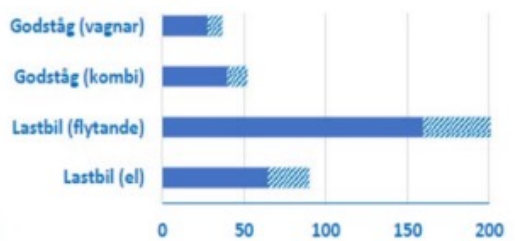


# Energy efficiency in transportation

Energi (Wh) per person och km



Energi (Wh) per ton och km



Freight: 3-5 times more energy (combustion) for road transport than by rail (electric trucks approx. 2 times)

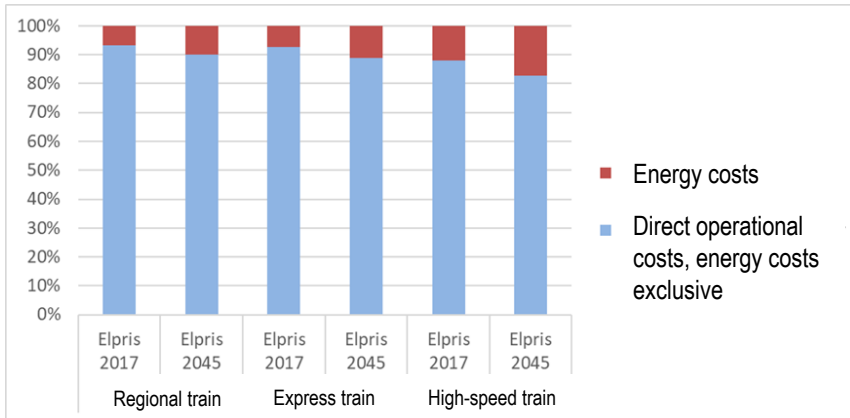
Passenger: 5-10 times more energy for a car or air journey than by rail (electric cars approx. 2 times)

Electrification will significantly improve road transportation – can trains be even better?

# Cost elasticity for energy in train operations

## Model calculated direct operational costs

- Passenger services in general, approx. 0.07 (i.e. 10% higher energy price will result in 0.7% higher direct operational costs)
- High-speed rail 320 km/h, approx. 0.12
- Diesel passenger or freight, 0.10-0.15 (estimate)



Railway operational costs relatively robust to energy prices since the energy usage is more efficient than for competitors

# Energy efficiency in transportation but how about economy?



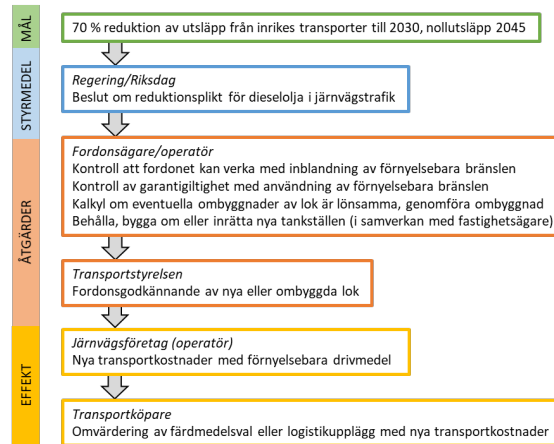
Low wages for truck drivers (or autonomous driving) and increased truck gross weights and lengths, makes road transportation cost efficient.

How to get freight back on track?

# Incentives in two intervention chains: Emissions and mode choice, respectively

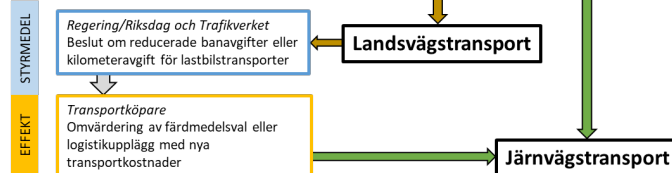
1. To reduce emissions from railway operations

Interventionskedja för utsläppsreduktion i järnvägstrafik



2. To improve energy efficiency in transportation

Interventionskedja för transportmedelsval





## And for executives ...

Possible to reach zero emissions in railway operations, but it comes with a cost

Incentives to prevent suboptimisation and for increased energy efficiency in the transport sector are important



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