Summary

Double-track railway between Oslo and Gothenburg: An analysis using the Norwegian Freight Transport model

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In this report we model the effects in the freight sector of implementing double-track railway for the entire distance between Gothenburg and Oslo, reducing transport times from 7.5 hours to 4 hours. The time savings lead to cost savings, benefitting transport chains that are already using rail on this freight relation. The possibility of improved rail freight will also attract freight volumes from some other transport chains using competing routes and modes, i.e. sea and road transport, as it opens up for reducing costs. "Pulling" freight volumes away from road transport will lead to lower CO_2-emsissions and external costs. We also model scenarios with higher fuel taxation for road transport. Here, some transport chains will shift to competing modes such as rail, i.e. "pushing" away volumes from road transport in order to reduce cost. These scenarios also result in lower CO_2 emissions and external costs.

The main focus of this report has been to assess the likely effects in the freight sector of implementing double-track railway for the entire distance between Gothenburg and Oslo. We stress that we have not made any assessment of the necessary investment costs and operations and maintenance costs of implementing double-track railway for the entire distance. We also stress that we only look at the freight sector, so any benefits to passenger travel, will be additional.

Our main scenario is where double-tracks are introduced in 2040 and transport times for freight trains are reduced from 7.5 hours as it is in the current situation, down to 4 hours. We use the Norwegian Freight Transport Model to simulate the effects this infrastructure improvement would have for the freight sector. The modeled impacts can be summarized as follows:

- **Reduced transport time for rail** freight leads to a reduction in the cost of using rail for transporting goods on the freight relations between the Gothenburg and Oslo areas.
- It is the time-based transport costs (salaries etc.) and cargo time costs (the owner of goods' willingness to pay for receiving the goods faster) that are reduced when the speed of rail transport is increased. We assume unchanged distance-dependent costs, e.g., no changes in distance-dependent rail user fees for capital cost recovery for the infrastructure owner/operator.
- These cost reductions are a benefit to transport operators and their customers (the owners of goods) who are already using rail on these freight relations.
- The new opportunity of faster rail transport allows for e-optimization for all agents in the freight transport sector, in the pursuit of minimizing their overall costs. This increased competitiveness for rail transport leads to rail freight **"pulling" goods from competing modes** and competing routes.
- Some transport chains that before the infrastructure improvements would have used either road transport with heavy goods vehicles (HGVs) or sea transport, will find it beneficial to switch to rail transport for parts of their transport chain. Those

who make the switch are reducing their costs. **The net effect is more demand for rail freight and lower costs in the freight sector.**

- The model finds that amount of goods transported by train over the Norwegian-Swedish border at Kornsjø **increases by roughly 40%** compared to the baseline.
- As some parts of transport chains switch from HGVs and sea transport, which are largely powered by fossil fuels, to rail freight, which is powered by electricity, CO_2-emissions from the freight sector are reduced.
- Other external costs, such as accidents and local pollution, are also reduced.

Although faster rail freight would lead to changes in various transport chains in other parts of the freight sector, the largest changes will be on the directly affected relations between the Gothenburg and Oslo areas. The main change is that parts of some transport chains make a shift to rail transport, away from road transport. The model finds that implementing double-tracks here will reduce the number of HGVs crossing the Norwegian-Swedish border at Svinesund by about 2% in 2040 compared to the baseline. While this may seem like a small number in relative terms for road transport, which transports many times more volume than rail transport between Oslo and Gothenburg, the mode shift would represent a significant percentage increase in freight volumes by rail.

As the reduced transport time makes the use of freight train more attractive, we find that in this scenario the amount of goods by train transported over the Norwegian-Swedish border at Kornsjø increases by roughly 40% compared to the baseline.

This would be the result of the freight transport sector re-optimizing when facing this new transport improvement, i.e. how much rail freight will "pull" from road and sea transport.

The **main social benefits of this transport improvement** are transport user benefits, i.e., reductions in overall costs in the freight sector, and the reductions in external costs. With regards to user benefits, the freight transport sector reduces its overall costs, both for existing users of rail freight and new users.

The shift to rail away from HGVs and sea transport for some transport chains leads to lower external costs, mainly those stemming from CO_2-emissions. The reduction in HGVs on the distance between Oslo and Gothenburg alone leads to an estimated reduction in CO_2-emissions of about 66,000 tons over the period 2040-2062[1].

- When summing up, the gross benefits of this transport improvement (for the years 2040-2079) has a present value of **776 MNOK** in the year 2021. This is shown in Table 1.
- The largest benefit component is the reduction of CO2 costs, with a present value of **483 MNOK**, which represents a reduction of about **289 000 tons of CO_2** over the period 2040-2079[2]. These are the sum of reductions in the entire transport chain, from both road and sea transport, reductions occurring in Norway, Sweden and other countries involved in the transport chains.

[1] Opening year of the double-tracks is assumed to be 2040, and 2062 is the year furthest into the future for which there was made projections for the Norwegian Freight Transport Model in the analyses underpinning the National Transport Plan 2022-2033.

[2] Note that we have not done any calculations of the increase in CO_2-emissions from the construction phase of implementing double-track railway.

Table 1: Present value of gross freight sector benefits from introducing double tracks between Gothenburg and Oslo.

Benefit category	Present value, MNOK
Transport user benefits	278
Government finances	-22
Revenues of toll and ferry companies	-23
Reduced CO_2 costs	483
Reductions in other external costs (in Norway)	69
Cost of public funds	-9
Present value of benefits	776

What happens if fuel taxes increase?

Most countries in the world, including Norway and Sweden, have ratified the Paris Agreement. In order to fulfill this agreement, more assertive climate policy will be needed. Some of the most efficient climate policy is to tax the emissions directly, e.g., through fuel taxation. By using the Norwegian Freight Transport Model, we investigate different scenarios with major increases in fuel taxation for road transport, and how this can be expected to affect mode choice for freight between Gothenburg and Oslo.

We expect Swedish fuel prices to be reflected in the cross-border transport costs between Sweden and Norway. Extrapolating the fuel tax trajectory in the past years, with some additions for more aggressive climate policy, we apply fuel prices that are 36% higher in 2040 than in 2018. At the same time, we expect continued fuel efficiency improvements, with fuel use per km for HGVs to be 21% lower in 2040 than in 2018. The modeled impacts can be summarized as follows:

- With fuel taxes rising faster than efficiency improves, the cost of transporting goods by road increases.
- This change costs for the road sector compared to the baseline, forces the agents in the sector to e-optimize in order to minimize their overall costs. This leads to a "push" away from road transport and over to other modes, i.e., sea and rail transport.
- This switch away from road transport to other modes, in particular where shifting to electricity powered rail transport, leads to relatively large reductions in CO2-emissions from the freight sector.
- Other external costs from road transport, such as accidents and local pollution, are also reduced.

In this scenario HGV traffic over Svinesund is reduced by 4.4% in 2040, and further to 5.7% in 2062, compared to the corresponding years in the baseline simulations. Removing these HGVs leads to the removal of 226,600 tons of CO_2 (tCO_2) between 2040 and 2062. And the reduced competitiveness for HGVs leads to a mode shift that implies a 22% increase in the amount of goods transported by train over Kornsjø in 2040, and 32% in 2062, compared to the baseline.

Our analysis contains additional scenarios with higher fuel taxation. In one scenario, we add the implementation of double-tracks into the high fuel tax scenario, we get additional reductions in HGVs crossing at Svinesund and corresponding emission reductions. Compared to the baseline, HGV traffic over Svinesund will be reduced by 5.1% in 2040 and 6.4% in 2062, with total emission reductions for this period totaling 245,000 tCO_2. Freight volumes by train over Kornsjø will also be 59% higher in 2040 and 75% higher in 2062 compared to the baseline.

We also had a stress-test where we assumed higher fuel taxes, but no efficiency improvements, which from a modeling perspective is equivalent to simply more aggressive fuel tax policy. With 36% higher fuel prices in 2040 and no increased fuel efficiency over time, we get 20% lower HGV traffic over Svinesund in 2040 and 40% lower HGV traffic in 2062 compared to corresponding years in the baseline. The aggressive fuel taxation will also drive increases in freight volumes by train over Kornsjø, pushing these to be 60% higher in 2040 and 110% higher in 2062 compared to the baseline. The modeled effect on transported volumes by rail is shown in Figure 1.

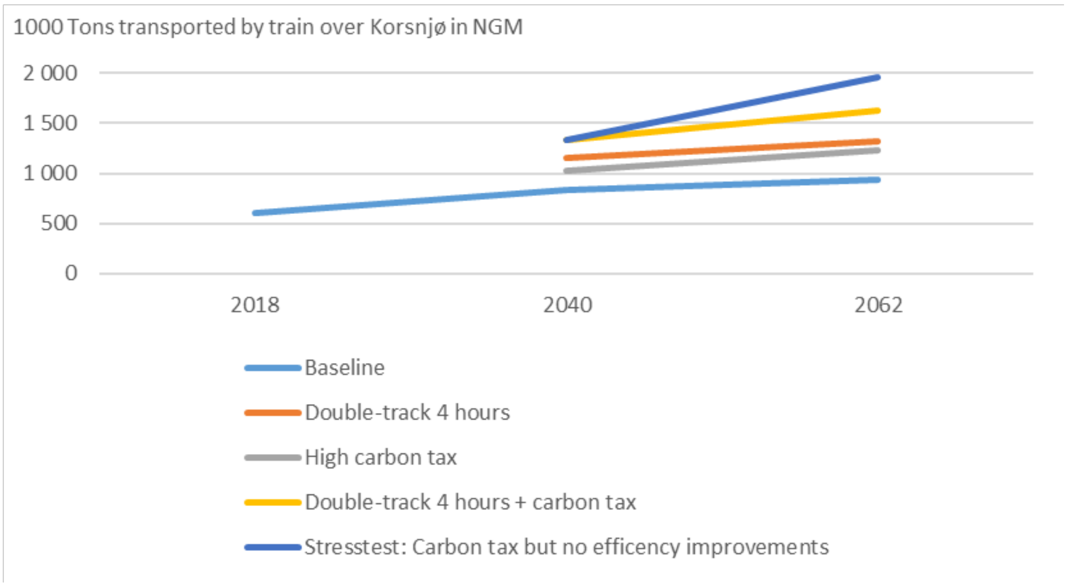

Figure 1: Freight transport volumes (1000 tons) per year transported by freight train over Kornsjø (both directions) in different scenarios.

Figure 1 shows us that **both shorter rail transport times and higher fuel taxes contributes to a shift to rail freight**. The former "pulls" volumes from other modes, whereas the latter "pushes" goods away from road transport. If both are implemented, even higher volumes will be shifted to rail transport. And as the stress-test shows, the more aggressively carbon is priced, the more drastic the changes in the freight sector will be.