Cost models for transport and logistics - 2021

An important component of the Norwegian National Freight Model (in short NGM), is the cost model covering the different transport modes and means. This report is a documentation of the various cost elements used in NGM, and the values that applies for 2021. The cost covers the cost for moving the transport units, terminal costs and other logistical costs. The work is a part of a major revision of NGM in 2021. The transport units are to a large degree the same as in the previous version of NGM. For sea transportation, a few ships sizes have been adjusted to better fit AIS data.

Cost models for transport and logistics

Background

In 2021, a work was initiated by the NTP authorities (NTP = National Transport Plan) to develop updated cost models for transport and logistics to 2021 level. The previous existing cost model was on 2016 level.

The cost models are based on development work over several years. The goal is to have the best possible cost assumptions for the model calculations in the National Freight Model (NFM), as well as for other analysis and calculations for freight transport.

The first version of these cost models was made for 2005, based on historical data at that time. The costs were revised to 2010 level in 2011/2012. A revision in 2015 (Grønland 2015) was based on the cost level in 2012, and a new revision in 2017/2018 was based on the cost level 2016 (Grønland, 2018).

The present version and report are based on updated assumptions for transport units and cost components to 2021 level, with the aim to have up-to-date data for the cost modelling.

We have also included results from research projects finished in 2021 (Hovi et. al. 2021).

Transport units and cargo groups

Many transport modes and units are covered. For cars, we cover:

- LGVs
- light distribution lorries
- heavy distribution lorries (closed)
- heavy distribution lorries for containers
- semitrailers (closed)
- semitrailers (container)
- 2525 trucks
- tank lorries (wet bulk)
- dry bulk lorries
- timber lorries
- thermo lorries

For rail, we cover:

- wagon load trains (electric)
- trains for transport of cars (electric)
- combi trains for containers, flat racks and trailers (electric and diesel)
- thermo trains (subgroup of combi trains)
- timber trains
- bulk train for dry bulk (ore and lime)
- bulk train for wet bulk (oil products and chemicals)

For sea transport, we cover:

- container ships: 9 000, 12 000 and 21 000 dwt
- break-bulk ships (box ships): 1 000, 3 200, 5 000, 8 500, 15 000 and 40 000 dwt
- dry bulk vessels: 2 500, 6 200, 26 000, 40 000, 60 000 and 80 000 dwt
- roro vessels: 10 700 and 15 990 dwt
- reefer: 3 000 dwt
- tankers: 2 500, 6 500, 40 000, 73 000, 110 000 and 160 000 dwt
- gas tankers: LNG 5 200 m3 (3 900 dwt), LNG 29 000 m3 (20 300 dwt), LPG 30 000 dwt, LNG 67 400 m3 (50 000 dwt) and LNG 150 000 m3 (95 000 dwt)
- vessels for chemicals: 8 000 and 44 500 dwt
- coastal side port vessels: 1 250 dwt and 2 530 dwt
- coastal LNG driven vessel: 5 000 dwt
- side port vessel for life stock: 2 530 dwt
- offshore supply vessel: 4 000 dwt

There are also updated cost models for:

- international ferries
- air transport (medium sized with capacity 60 tons and a larger with capacity 119 tons)

There are also calculated cargo dependent costs like inventory holding and order costs for the various cargo groups.

Calculated cost elements

Cost for transport units

The cost for moving a transport unit is split between time dependent and distance dependent cost. Wages and social costs as well as capital cost for transport units are the most important time dependent cost components, while cost related to energy and maintenance are the most important distance dependent costs. For sea transport, maintenance has been allocated to time dependent costs so time dependent costs for ships are in line with what is normally covered by a time-charter contract.

For each transport unit, cost per km and cost per hour are calculated. The costs are in NOK and reflects cost for operating in Norway or in Norwegian waters in 2021.

Total cost for moving a transport unit between two locations are found by summing up the time and distance dependent costs. Alternatively, time dependent cost could be transformed to distance dependent cost by diving with average speed on a transport relation, but this alternative is not chosen here.

In addition to the cost for moving the units, there are costs for loading/unloading and transfer of goods between units. These costs will also depend on several other factors than the transport units, such as number of shipments per ton and total tonnage handled on the terminal. Therefore, for different practical situations there will be variation around the representative costs calculated here as:

- Loading and unloading cost per ton
- Loading and unloading cost per shipment

In the loading and unloading costs calculated here, the time costs for the involved transport units are included.

The transfer costs between units are calculated as the sum of loading and unloading costs for the transfer. For transfer of containers, flat racks and semitrailers, cost for stripping and stuffing of the cargo units are subtracted from the sum.

The SECA directive was implemented in 2015, regulating sulphur emissions from ships in certain waters. The additional cost this causes are calculated separately.

Cargo dependent cost

There are calculated three different types of cargo dependent cost. One is time cost for cargo in transport. WTP-values[2] for cargo time utility are used in combination with capital cost for the cargo, based on averaged values for the cargo within each cargo group. The second type are inventory costs, with calculations of order and holding cost. The holding cost is the sum capital cost and cost for physical storage for the cargo

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[2] WTP – Willingness To Pay

type. The third type is cargo fee in port, which are paid per ton dependent on cargo type. The size of the table covering all Norwegian port is such that it is given in the appendix to the report.

Differentiated terminal costs

Terminal costs varies depending on the geographical locations. On this basis, the terminal costs are differentiated between various terminals. Much of this differentiation is based on   a research project, Demolog (Madslien, Hovi, Grønland 2013), and was implemented in the 2016 model. The differentiation for rail has been updated based on observations and project results. For port terminals, the differentiation of costs is to a large degree based on a separate project which analysed the efficiency in several Norwegian ports (Grønland, Rødseth 2018).

The implementation is mostly based on a classification of terminals in 3 classes, depending on the technical solution and expected efficiency. For container sea terminals, there are 4 classes with class IV (the highest efficiency) used for the Port of Oslo.