

The external costs of freight transport by road and by sea

Updated marginal damage cost estimates - 2022

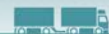
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In connection with range of analyses to be carried out for the forthcoming National Transport Plan 2025-2036, there is a need for updating the knowledge base. It is therefore desirable to update the estimates of marginal external costs stemming from road freight and maritime freight transport. This 2022 update focused on air pollution (both local and global pollution) and the costs of road wear. Other damage costs estimate have only been real-price adjusted to reflect 2022 prices and values. The new damage cost estimates can be considered as small improvements, as there have been improvements in both the underlying data and in the calculations. Nevertheless, we emphasize that the estimates are subject to some uncertainty.

Most of the marginal damage cost estimates have not been of need for updating since TØI-report 1704/2019 *The external costs of transport – Marginal damage cost estimates for passenger and freight transport in Norway* that was compiled between 2018 and 2020 for analyses in the National Transport Plan 2022-2033. Given a tight time schedule, this update in 2022 has only focused on air pollution (both local and global pollution) and the costs of road wear, and only on road freight and maritime freight transport.

For air pollution, there have been several reasons to implement updates. For sea-based freight transport, new data from [the EU's MRV system for reporting CO₂ emissions from ships](#) have been a new data source for calculating emission factors per vessel kilometer and per ton-kilometer. For road-based freight transport, there is a relatively rapid replacement to Euro VI trucks, which means significantly lower emissions of NO_x and PM₁₀ per vehicle km. Furthermore, there is a need to change unit prices per ton of CO₂ in order to comply with new guidance on the valuation of greenhouse gas emissions from the Ministry of Finance (2021b). Unit prices for local air pollution have also been updated both to take into account valuations per exposed person (real price adjustment based on GDP per capita) and the number of potentially exposed people in cities (population growth in cities). Furthermore, we have also made updates and nuances related to how the blending of biofuels affects CO₂ emissions per vehicle km in the road sector.

For marginal damage costs related to road wear and tear, improvements have been made in the calculations compared to those made in TØI report 1704 after input from Bertelsen et al. (2021). In addition, there cost index for road maintenance has had a large increase TØI report 1704, which needs to be taken into account in updated analyses.

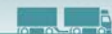
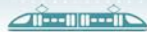


For the other types of damage costs from transport, we have only made real price adjustments to 2022 values with 2022 prices. For road-based freight transport, this is done for noise, accident risk and congestion. For maritime freight transport, this is done for accident risk and accidental spillage to water.

In chapter 5 we compile the updated estimates of marginal damage costs in usable summary tables. The main tables are given here in the summary in Table S.1 and Table S.2. Table S.1 presents the estimated marginal damage costs per vehicle km for heavy goods vehicles (average values throughout the day, i.e. not differentiated between driving during peak and off-peak hours). Similar tables for zero emission vehicles, which are assumed to be identical to the corresponding vehicle types with internal combustion engine (except with regards to emissions), are given in Appendix 2. The last column in Table S.1 presents estimated marginal damage costs per ton-kilometer. Tables with the estimated average transported weight are given in Appendix 1.

Table S.1: Heavy goods vehicles (with internal combustion engine), NOK per km for various damage costs, average throughout the day. CO₂ costs are adjusted for the 2021 biofuels blend (13.2 % reduction compared to pure fossil diesel, 10.3 % reduction compared to pure fossil gasoline). The last column shows total damage costs in NOK per ton-km.

HGV weight class	Area type	CO ₂	Local pollution	Noise	Congestion	Accident risk	Road wear	Damage costs per km	Damage costs per tkm
<=7,5t	Rural	0.22	0.04	0.28	0.00	0.65	0.01	1.20	1.03
<=7,5t	Medium city (Pop. 15.000-100.000)	0.21	0.40	1.93	0.25	0.65	0.01	3.46	2.97
<=7,5t	Large city (Pop. >100.000)	0.21	2.86	2.83	1.76	0.65	0.01	8.32	7.13
>7,5-14t	Rural	0.31	0.04	0.28	0.00	0.65	0.08	1.37	0.81
>7,5-14t	Medium city (Pop. 15.000-100.000)	0.32	0.45	1.93	0.25	0.65	0.08	3.69	2.18
>7,5-14t	Large city (Pop. >100.000)	0.32	3.08	2.83	1.76	0.65	0.08	8.72	5.16
>14-20t	Rural	0.38	0.05	0.28	0.00	0.65	0.21	1.57	0.59
>14-20t	Medium city (Pop. 15.000-100.000)	0.40	0.53	1.93	0.25	0.65	0.21	3.98	1.50
>14-20t	Large city (Pop. >100.000)	0.40	3.42	2.83	1.76	0.65	0.21	9.27	3.50
>20-28t	Rural	0.50	0.05	0.28	0.00	0.65	0.31	1.79	0.42
>20-28t	Medium city (Pop. 15.000-100.000)	0.54	0.56	1.93	0.25	0.65	0.31	4.24	1.00
>20-28t	Large city (Pop. >100.000)	0.54	3.56	2.83	1.76	0.65	0.31	9.65	2.26
>28-40t	Rural	0.60	0.04	0.28	0.00	0.43	0.13	1.49	0.26
>28-40t	Medium city (Pop. 15.000-100.000)	0.65	0.49	1.93	0.25	0.43	0.13	3.88	0.69
>28-40t	Large city (Pop. >100.000)	0.65	3.21	2.83	1.76	0.43	0.13	9.00	1.60
>40-50t	Rural	0.65	0.05	0.28	0.00	0.47	0.54	1.99	0.16
>40-50t	Medium city (Pop. 15.000-100.000)	0.70	0.50	1.93	0.25	0.47	0.54	4.40	0.35
>40-50t	Large city (Pop. >100.000)	0.70	3.26	2.83	1.76	0.47	0.54	9.56	0.75
>50-60t	Rural	0.79	0.07	0.28	0.00	0.47	0.37	1.98	0.14
>50-60t	Medium city (Pop. 15.000-100.000)	0.86	0.62	1.93	0.25	0.47	0.37	4.51	0.33
>50-60t	Large city (Pop. >100.000)	0.86	3.85	2.83	1.76	0.47	0.37	10.14	0.74
Gasoline, all types	Rural	0.31	0.09	0.28	0.00	0.65	0.21	1.54	0.58
Gasoline, all types	Medium city (Pop. 15.000-100.000)	0.31	0.58	1.93	0.25	0.65	0.21	3.94	1.49
Gasoline, all types	Large city (Pop. >100.000)	0.31	3.58	2.83	1.76	0.65	0.21	9.34	3.53




For maritime freight transport, the Norwegian Public Roads Administration and the Norwegian Coastal Administration has received a large number of tables for marginal damage costs in Excel format for use in further analyses. In this report, we limit ourselves to reproducing the tables for the three size categories for container and ro-ro ships under 15,000 deadweight tons. The summary table for marginal damage costs per vessel-km for maritime freight transport is given in Table S.2 and Tabell S.2. Marginal damage costs per ton-kilometer are given in the last column. Tables with estimated average transported weights are given in Appendix 1.

Table S.2: NOK per vessel km for various damage costs for maritime freight transport for selected ship types and size categories (measured by deadweight tons – dwt). The last column shows total damage costs in NOK per ton-kilometer.

Ship type	Size category	Area type	Air pollution	Accident risk	Accidental spillage	Damage costs per km	Damage costs per tkm
Container Lo/Lo	<9'	Rural	126	0.4	42	168	0.05
Container Lo/Lo	9'-11'	Rural	156	0.4	42	198	0.05
Container Lo/Lo	11'-15'	Rural	177	0.4	42	219	0.04
Container Lo/Lo	<9'	Medium city (Pop. 15.000-100.000)	286	0.4	42	328	0.10
Container Lo/Lo	9'-11'	Medium city (Pop. 15.000-100.000)	355	0.4	42	398	0.10
Container Lo/Lo	11'-15'	Medium city (Pop. 15.000-100.000)	425	0.4	42	467	0.08
Container Lo/Lo	<9'	Large city (Pop. >100.000)	1007	0.4	42	1050	0.33
Container Lo/Lo	9'-11'	Large city (Pop. >100.000)	1257	0.4	42	1299	0.32
Container Lo/Lo	11'-15'	Large city (Pop. >100.000)	1538	0.4	42	1581	0.28
Ro-Ro cargo	<9'	Rural	128	0.4	43	171	0.08
Ro-Ro cargo	9'-11'	Rural	319	0.4	43	361	0.07
Ro-Ro cargo	11'-15'	Rural	329	0.4	43	372	0.07
Ro-Ro cargo	<9'	Medium city (Pop. 15.000-100.000)	301	0.4	43	344	0.16
Ro-Ro cargo	9'-11'	Medium city (Pop. 15.000-100.000)	828	0.4	43	871	0.17
Ro-Ro cargo	11'-15'	Medium city (Pop. 15.000-100.000)	867	0.4	43	909	0.18
Ro-Ro cargo	<9'	Large city (Pop. >100.000)	1081	0.4	43	1124	0.52
Ro-Ro cargo	9'-11'	Large city (Pop. >100.000)	3090	0.4	43	3133	0.62
Ro-Ro cargo	11'-15'	Large city (Pop. >100.000)	3248	0.4	43	3291	0.64

These tables should replace corresponding tables from TØI report 1704 for use in analyses in the transport sector, especially with regard to the analyses of the National Transport Plan for 2026-2037. These new tables can be considered as small improvements, as there have been improvements in both the underlying data and in the calculations. Nevertheless, we emphasize that the estimates are subject to some uncertainty. It is good practice to perform sensitivity analysis on these parameters (with both higher as well as lower marginal damage costs), especially if the damage cost estimates are decisive for the analysis result, to ensure that the calculations are robust to this uncertainty.

With updated estimates of marginal damage costs, and with updated figures for taxes, tolls and fees in the freight sector, it has been appropriate to repeat the exercise from TØI report 1704 by comparing the external cost estimates against the tax burden. Here, example calculations have been made for five routes for both road freight and maritime freight transport. Although these are only example calculations, there is a clear pattern that is worth pointing out: 1) The vast majority of the tax, toll and fee burden signals marginal damage cost with low



to medium precision, and 2) For these example calculations, we see that there is considerable variation between road freight and maritime freight transport in terms of the average tax/toll/fee burden relative to the average marginal damage cost.

Like TØI report 1704, this report is primarily a documentation report and a reference book for a large number of marginal damage cost estimates that can be used for cost-benefit analysis in Norway, but this update in 2022 has only focused on road freight and maritime freight transport. The clients at the Norwegian Public Roads Administration and the Norwegian Coastal Administration have also received several of the tables in Excel format in order to easily retrieve the figures for further work.