

External cost of rail transport

An update of marginal damage cost estimates - 2025

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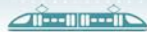
This report presents new estimates of the external costs of rail transport – i.e., damage costs caused by emissions, noise, accidents and infrastructure wear and tear. While transport generates societal benefits, welfare can be increased if associated damage costs are taken into consideration when transport decisions are made. The purpose of this report is to provide better foundations for political decisions and cost-benefit analysis in the transport sector. The new estimates utilize data on fuel use, emissions, noise, accident statistics and infrastructure wear and tear and employ novel methods that provide more precise estimates than those of comparable studies. We focus on marginal damage costs, i.e. the cost per train kilometer. They vary substantially, depending on whether the train is being operated in sparsely populated areas or in cities. In areas where more people are exposed to noise and local air pollution from diesel trains, marginal damage costs are higher. The societal cost of transport noise varies by time of day, with significantly higher costs at night. As most train kilometers in Norway are operated in sparsely populated areas and during the day, the results show that infrastructure wear and tear constitutes the largest component of marginal damage costs.

Transport is essential for a modern society, and welfare gains from transport are vast. At the same time, the transport market is characterized by market failure: transport users impose costs on other actors – so-called damage costs – that they do not internalize in their decision making. When damage costs are left unchecked, such as in the absence of corrective taxes or regulation, they are dubbed external costs. The presence of external costs means that the transport sector does not exploit its full potential to maximize welfare.

To ensure an optimal design of infrastructure, maintenance and other transport services, damage costs must be quantified. These estimates can be used to design fees and regulations to ensure that users account for their damage costs when making transport decisions. In this way, damage costs are internalized, which contributes to more efficient use of resources.

Which damage costs are being considered?

This report presents estimates of marginal damage costs associated with rail transport, covering both passenger and freight trains. In line with TØI report 1704/2019 External costs of transport in Norway – Estimates of marginal damage costs for passenger and freight transport (Rødseth et al., 2020), this report presents damage costs related to CO₂ emissions, local air



pollution, noise, accidents and wear and tear on infrastructure (maintenance and renewal). Advances stem from the use of new data, some methodological developments and real price adjustments. Like TØI report 1704/2019, the current report focuses on damage costs that occur in the operational phase (i.e., during transport, often dubbed tank-to-wheel), and does not consider damage costs occurring upstream in the supply chain (e.g. related to the production of fuel).

New damage cost estimates

Similar to TØI report 1704, this report provides methodological documentation and functions as a reference work for damage cost estimates for transport cost-benefit analysis in Norway. The current update is delimited to rail transport.

Because the societal costs of noise pollution differ for transport during the day, evening and night, we present results tables that distinguish between the time of day. The different tables suit different types of analyzes. However, we emphasize the results associated with the daytime (Table S 1), since this is when the majority of transport activities take place. Corresponding tables for damage costs of rail transport during the evening and at night are provided by Table S 2 and Table S 3, respectively. We consider “average” passenger and freight trains for the subsequent results summary, where the latter train type assumes a gross weight of 1 010 tons and a cargo weight of 313 tons.

Table S 1: Marginal damage costs for an average passenger and freight train (NOK2025 per vehicle kilometer), daytime (07:00-19:00).

Train	Energy	Area	CO ₂	Local air pollution	Noise	Accident	Maintenance	Renewal	TOTAL
Passenger	Electric	Rural	0,00	0,00	0,00	2,23	24,01	30,95	57,19
Passenger	Electric	Small urban	0,00	0,00	0,00	2,23	24,01	30,95	57,19
Passenger	Electric	Large urban area	0,00	0,00	0,00	2,23	24,01	30,95	57,19
Freight	Electric	Rural	0,00	0,00	0,50	1,21	24,01	30,95	56,67
Freight	Electric	Small urban	0,00	0,00	1,30	1,21	24,01	30,95	57,47
Freight	Electric	Large urban area	0,00	0,00	1,80	1,21	24,01	30,95	57,97
Passenger	Diesel	Rural	6,42	1,06	0,00	2,23	24,01	30,95	64,67
Passenger	Diesel	Small urban	6,42	7,40	0,00	2,23	24,01	30,95	71,00
Passenger	Diesel	Large urban area	6,42	45,36	0,00	2,23	24,01	30,95	108,97
Freight	Diesel	Rural	19,15	3,17	0,50	1,21	24,01	30,95	78,99
Freight	Diesel	Small urban	19,15	22,08	1,30	1,21	24,01	30,95	98,70
Freight	Diesel	Large urban area	19,15	135,38	1,80	1,21	24,01	30,95	212,50

Rural areas encompass up to 15 000 inhabitants, small urban areas hold 15 000 – 100 000 inhabitants, while large urban areas span more than 100 000 inhabitants.

Table S 2: Marginal damage costs for an average passenger and freight train (NOK2025 per vehicle kilometer), evening (19:00-23:00).

Train	Energy	Area	CO ₂	Local air pollution	Noise	Accident	Maintenance	Renewal	TOTAL
Passenger	Electric	Rural	0,00	0,00	0,00	2,23	24,01	30,95	57,19
Passenger	Electric	Small urban	0,00	0,00	0,10	2,23	24,01	30,95	57,29
Passenger	Electric	Large urban area	0,00	0,00	0,10	2,23	24,01	30,95	57,29
Freight	Electric	Rural	0,00	0,00	1,40	1,21	24,01	30,95	57,57
Freight	Electric	Small urban	0,00	0,00	4,20	1,21	24,01	30,95	60,37
Freight	Electric	Large urban area	0,00	0,00	8,00	1,21	24,01	30,95	64,17
Passenger	Diesel	Rural	6,42	1,06	0,00	2,23	24,01	30,95	64,67
Passenger	Diesel	Small urban	6,42	7,40	0,10	2,23	24,01	30,95	71,10
Passenger	Diesel	Large urban area	6,42	45,36	0,10	2,23	24,01	30,95	109,07
Freight	Diesel	Rural	19,15	3,17	1,40	1,21	24,01	30,95	79,89
Freight	Diesel	Small urban	19,15	22,08	4,20	1,21	24,01	30,95	101,60
Freight	Diesel	Large urban area	19,15	135,38	8,00	1,21	24,01	30,95	218,70

Rural areas encompass up to 15 000 inhabitants, small urban areas hold 15 000 – 100 000 inhabitants, while large urban areas span more than 100 000 inhabitants.

Table S 3: Marginal damage costs for an average passenger and freight train (NOK2025 per vehicle kilometer), night (23:00-07:00).

Train	Energy	Area	CO ₂	Local air pollution	Noise	Accident	Maintenance	Renewal	TOTAL
Passenger	Electric	Rural	0,00	0,00	1,60	2,23	24,01	30,95	58,79
Passenger	Electric	Small urban	0,00	0,00	1,00	2,23	24,01	30,95	58,19
Passenger	Electric	Large urban area	0,00	0,00	2,70	2,23	24,01	30,95	59,89
Freight	Electric	Rural	0,00	0,00	21,20	1,21	24,01	30,95	77,37
Freight	Electric	Small urban	0,00	0,00	68,80	1,21	24,01	30,95	124,97
Freight	Electric	Large urban area	0,00	0,00	119,80	1,21	24,01	30,95	175,97
Passenger	Diesel	Rural	6,42	1,06	1,60	2,23	24,01	30,95	66,27
Passenger	Diesel	Small urban	6,42	7,40	1,00	2,23	24,01	30,95	72,00
Passenger	Diesel	Large urban area	6,42	45,36	2,70	2,23	24,01	30,95	111,67
Freight	Diesel	Rural	19,15	3,17	21,20	1,21	24,01	30,95	99,69
Freight	Diesel	Small urban	19,15	22,08	68,80	1,21	24,01	30,95	166,20
Freight	Diesel	Large urban area	19,15	135,38	119,80	1,21	24,01	30,95	330,50

Rural areas encompass up to 15 000 inhabitants, small urban areas hold 15 000 – 100 000 inhabitants, while large urban areas span more than 100 000 inhabitants.