Institute of Transport Economics
Norwegian Centre for Transport Research

Summary

Reforming Motor Vehicle Taxation in Norway

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The unprecedented speed at which Norwegian automobile buyers have embraced battery electric technology has taken observers, policy makers, stakeholders and even protagonists by surprise. Vehicle electrification in Norway is brought about, not by generous subsidization, but by charging stiff taxes on conventional cars. Zero emission passenger cars are wholly exempt of registration tax, annual ownership tax, fuel tax and even value added tax. They are partly exempt of road toll, ferry fares, parking fees and income tax on private use of company cars. As businesses and consumers respond to these fiscal incentives, the tax revenue dwindles, and the market correction effect of fuel tax is more or less obliterated. To curb the negative external effects of tomorrow's rising road use demand, a brand new vehicle taxation system is needed. A satellite based system of marginal cost road pricing would do the trick, improving on the present motor vehicle taxation system on at least nine different accounts.

Motor vehicle taxes and incentives in Norway

As of 2019 in Norway, there are at least fourteen different motor vehicle taxes, subsidies and regulations with a bearing on the split between automobile powertrain technologies and on their respective climate footprints:

1. Value added tax, with exemption for zero emission vehicles (ZEVs)
2. One-off purchase (registration) tax, consisting of four components
3. Reregistration tax on second hand sales, with ZEVs exempt
4. Annual circulation tax on cars, now collected through the insurance companies
5. Annual circulation tax on heavy freight vehicles, consisting of two components
6. Fuel tax, consisting of a CO_2 component and a road use component
7. Road toll, sometimes differentiated by the hour or by the vehicle's powertrain
8. Ferry fares, differentiated between zero emission and conventional cars
9. Parking fees, likewise differentiated
10. Income tax on company cars, likewise differentiated
11. Government support for fast charging and hydrogen refueling facilities
12. Free parking and recharging for battery electric cars in public parking lots
13. Scrapping premium for conventional vans being replaced by a zero emission van
14. Bus lanes open to zero emission vehicles, with some exceptions

Some of these taxes have as their explicit purpose to collect public revenue. Others are primarily meant to correct some market failure or stimulate a certain type of demand. Regardless of their stated purpose, all of the taxes 1 thorough 10 provide revenue for the public treasury, while the subsidy schemes 11 through 13 obviously contribute to tap it. Incentive 14 represents neither cost nor benefit to the government, but could affect the travel time of bus passengers unless revoked when the bus lane becomes congested. In some places, the bus lane is closed to zero emission passenger cars in the rush hour, unless the car carry at least two occupants.

Overview of fiscal revenues

The development of government revenue from motor vehicle taxation, adjusted for inflation, is illustrated in Fig. E.1.

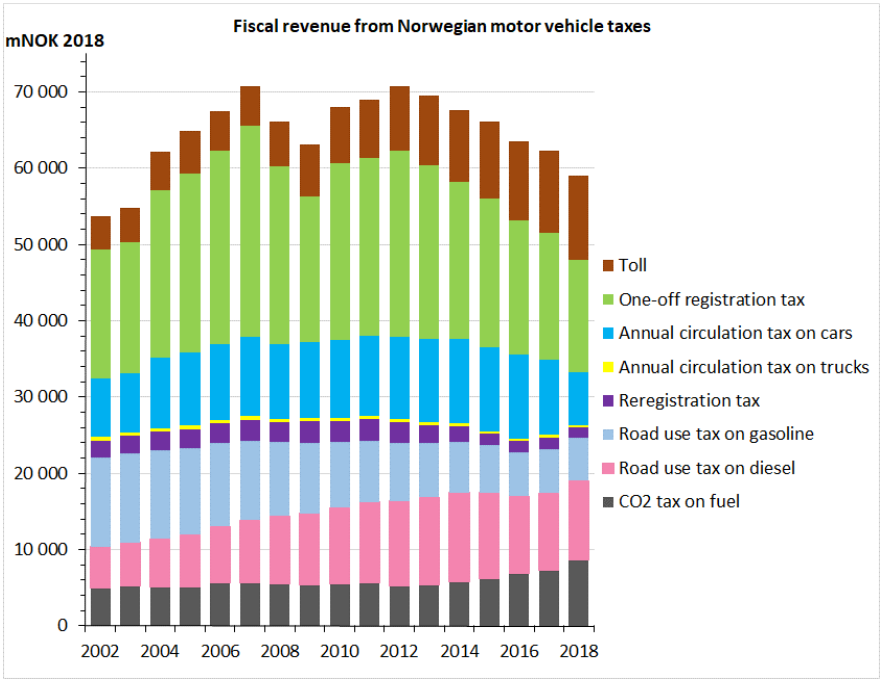

Fig. E.1 Government revenue from principal motor vehicle taxes in Norway 2002-2018, corrected for inflation. As of July 1, 2018, NOK 1 = US$ 0.1225 = € 0.1053.

Traditionally, motor vehicle taxes have represented a major source of revenue for the Norwegian public treasury. In 2018, the total revenue from the eight different taxes shown in Fig. E.1 was around 59 billion Norwegian kroner (NOK), or approximately US$ 7.23 billion, corresponding to around $ 1360 per capita and $ 2200 per vehicle.

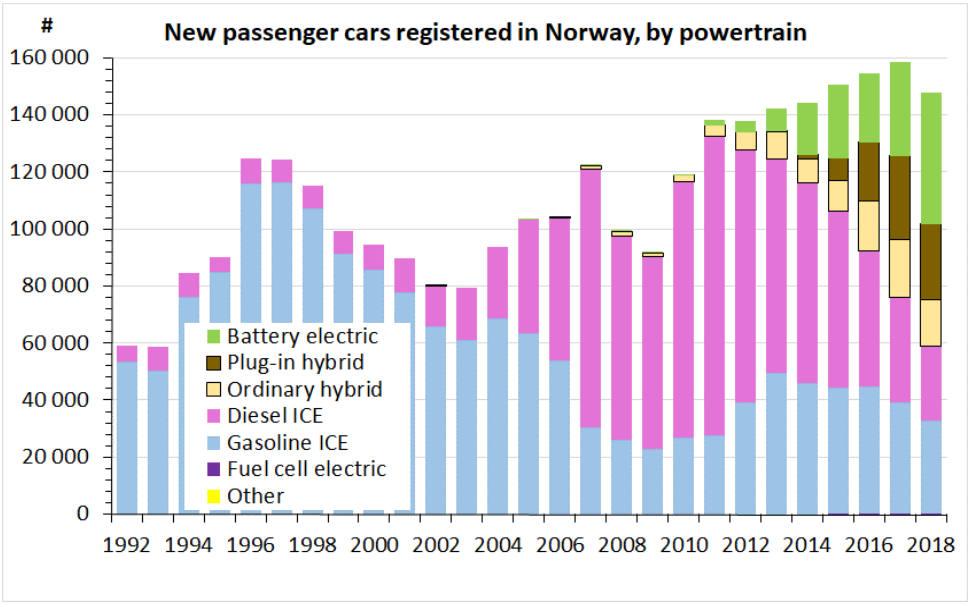

Fig. E.2 New passenger cars registered in Norway 1992-2018, by powertrain technology.

Unlike most other western countries, Norway levies a high one-off registration tax on passenger cars. Its revenue has, however, been dropping in line with the increasing market share of plug-in hybrid and zero emission vehicles (ZEVs), the former of which enjoy certain breaks in the registration tax, while the latter are totally exempt of it. Almost all ZEVs sold are battery electric vehicles (BEVs), only a few being hydrogen fuel cell electric vehicles (FCEVs) (Fig. E.2).

A growing source of public revenue in Norway is road toll, totaling NOK 11 billion in 2018 (Fig. E.1).

The zero emission vehicle incentives

In 2018, 31.2 per cent of all new passenger cars sold in Norway were battery electric vehicles (BEVs) (Fig. E.2). During the first six months of 2019, the BEV market share had risen to 48.4 per cent. Behind this development are strong government incentives (Fig. E.3).

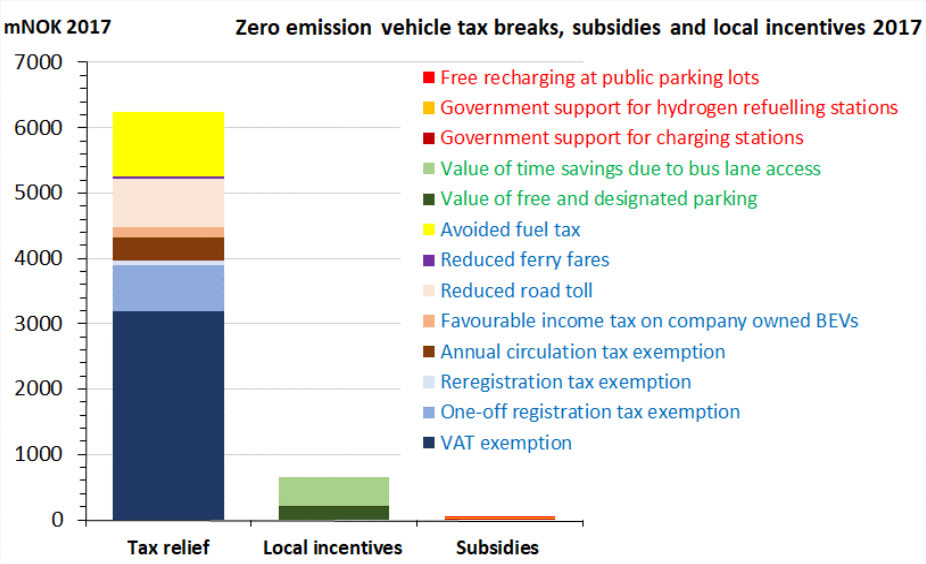

Fig. E.3 Estimated value of tax breaks, local regulatory incentives and government subsidies for zero emission vehicles in Norway 2017.

The value of tax exemptions and reliefs benefiting zero emission vehicles in 2017 has been calculated at approximately NOK 7 billion. The single most important tax measure, in terms of foregone public revenue, is the exemption from value added tax (VAT).

The subsidies are few and relatively unimportant. Some NOK 50 million is being paid out annually in support of fast charging and hydrogen refueling facilities, or to foot the electricity bill at public parking lots. No direct cash subsidies are being paid out to buyers of zero emission passenger cars.

Since 2018 there is, however, a subsidy scheme supporting the substitution of battery electric cargo vans for light commercial vehicles with an internal combustion engine (ICE). The scrapping premium is NOK 13 000 per vehicle. Its total cost to the public treasury is of the order of NOK 30 million per annum.

The fuel tax and the marginal cost of road use

The explicitly stated purpose of the Norwegian fuel tax is to internalize the external costs of road use – or to "correct the market failure" in economic jargon.

How well does it do? Not very well, as judged by Figs. E.4 and E.5.

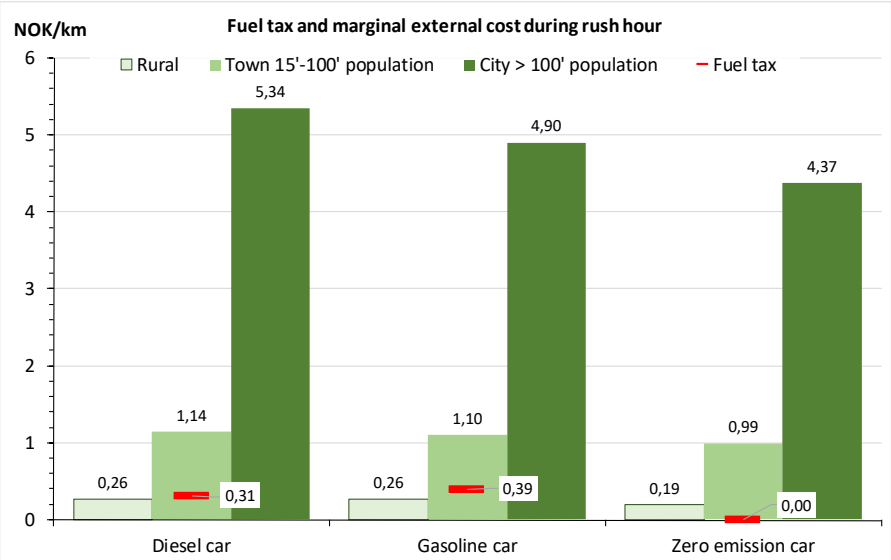

Fig. E.4 Marginal external costs of automobile use during rush hour, compared to fuel tax charged, by population density and vehicle's energy technology.

The fuel tax appears sufficient to cover the external costs of automobile use only in the context of free-flow rural traffic. In the towns and cities, the fuel tax falls far short of its explicit purpose. Battery and fuel cell electric vehicles pay no fuel tax at all, despite giving rise to only 30 per cent less external costs than the gasoline car in free-flow situations, and only 10-12 per cent less under congested conditions (Fig. E.4).

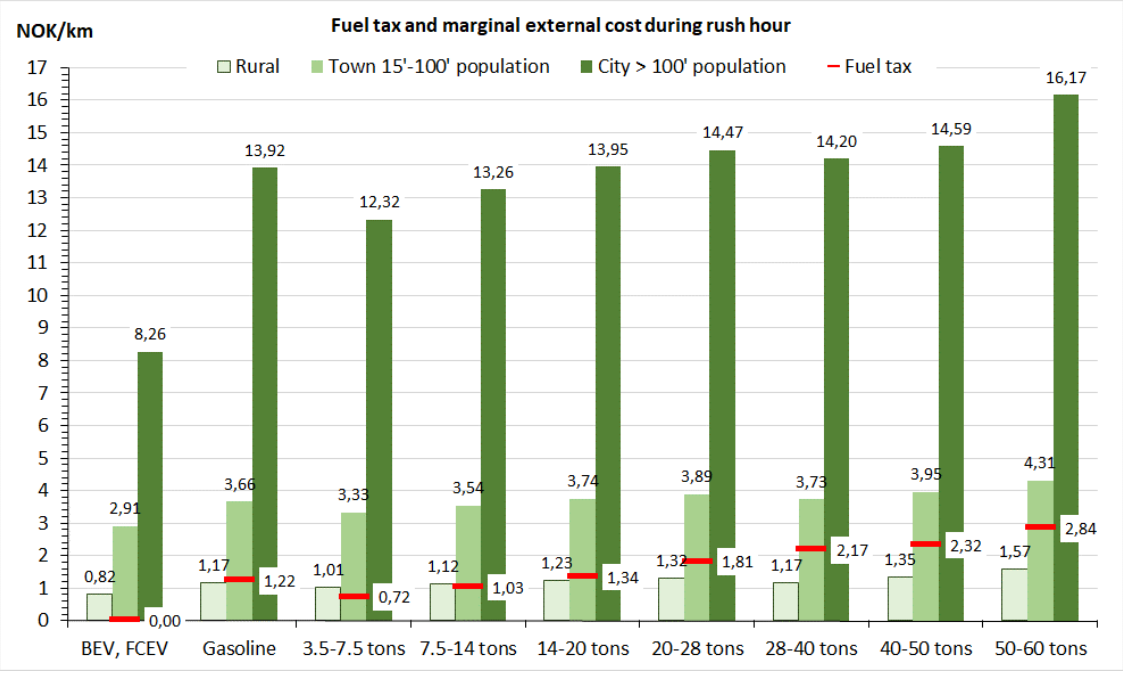

Fig. E.5 Marginal external costs of freight vehicle use during rush hour, compared to fuel tax charged, by population density, vehicle's weight and energy technology (default: diesel ICE).

A similar picture emerges when we look at heavy-duty freight vehicles (trucks). Under congested urban conditions, the external cost is five to fifteen times higher than the fuel tax charge as reckoned per kilometer (Fig. E.5).

The costs and benefits of tolling

An increasing number of road investment projects in Norway are partially funded by toll. A publicly owned toll collection company is set up, obtaining funds from a private financial institution by mortgaging the future toll revenue. A contract is written by which the investment cost is shared between the central government and the road users through their toll payments. When – usually after 15-20 years – the target toll revenue has been collected, tolling is called off, and the road may be used for free.

In essence, this means that the market risk is borne neither by the government nor by the private lender, but by the future road users. Should the toll revenue fall short of expectations, the toll collection period is prolonged.

Tolling has been embraced by local governments as a shortcut avenue to improved road infrastructure. And when the local community offers to share the cost with the central government, the latter gets more value for the taxpayers' money and becomes less reluctant to allocate scarce public funds.

But the drawbacks of tolling are manifold and severe. As pointed out some 175 years ago by Jules Dupuit (1844), the founder of cost-benefit analysis, toll detracts from the economic benefit of the investment project, as a certain share of the potential beneficiaries are deterred from using the road. This "deadweight loss" increases more or less proportionately with the *square* of the toll rate (Fig. E.6).

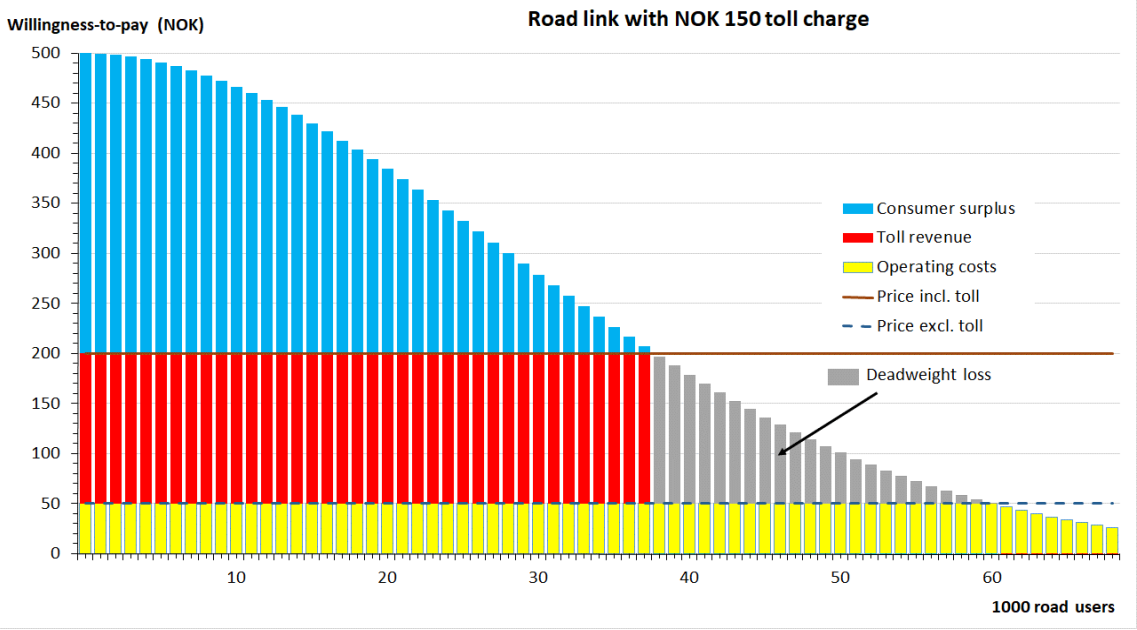

Fig. E.6 Conceptual illustration of road users' response to toll.

In many road investment projects, there is reason to expect certain "wider economic benefits", i. e. gains due to improved accessibility throughout the region. Faster connections expand the geographic labor market, resulting in generally improved productivity. But when the previous barrier due to slow connections is replaced by a new barrier in the form of toll, any wider economic benefits may not occur until the target toll revenue has been collected and the toll is abolished.

Secondly, tolling necessitates a separate payment collection apparatus, the cost of which can be avoided if revenue is instead generated through an increase in the rate of some already existing tax.

Thirdly, the collection of payments at specific points in the road network, regardless of how far each road user is traveling, may be seen as arbitrary and unfair. Parents suddenly finding that their children's nursery school is located beyond a toll cordon, are out of luck. If alternative, toll-free routes exist past the toll collection point, the new road may result in increased rather than decreased nuisance for the local community.

In the cities, cordon toll rings function as artificial barriers crisscrossing the urban community. Consumers and firms adjust their behavior so as to avoid crossing the cordon. Grocery stores on either side of the cordon, which used to compete for the same customers, end up splitting the market between them geographically. For some businesses the loss of local clients may be critical, while others may take the opportunity to raise their prices and profits. Competition is weakened.

It is practically impossible to seal off an urban toll ring so tightly that two-wheelers cannot get through. Hence, in the cities motorcycles are usually allowed to pass the cordon for free. The unintended knock-on effect is a substantial improvement in the motorbikes' competitive position versus the private car. This may be seen as unfortunate, since in most cases the motorbikes give rise to larger external costs than do passenger cars, due mostly to the bikers' higher injury risk.

The purchase taxes and greenhouse gas abatement

The one-off Norwegian registration tax, applicable to all passenger cars and light commercial vehicles equipped with an ICE, consists of four components: a fixed car scrappage deposit of NOK 2400, and three variable components, calculated on the basis of curb weight and type approval CO_2 and NO_X emission rates, respectively (Fig. E.7). The CO_2 component is negative and hence deductible below 70 gCO_2/km. The total purchase tax rate cannot, however, become negative, as in the French or Swedish bonus-malus system.

Certain tax advantages apply also to plug-in hybrid vehicles (PHEVs). As of 2019, their taxable curb weight is to be reduced by up to 23 per cent prior to calculating the weight component. The deduction is contingent upon the vehicle's type approval electric range. Only PHEVs exhibiting an all-electric driving range of at least 50 km are eligible for a full 23 per cent reduction. For these vehicles, each point on the red curve in Fig. E.7 is shifted 29.9 per cent to the right (since $1/(1 - 0.23) = 1.299$). If the range is $r < 50$ km, the weight reduction is set at $23 \cdot r/50$ per cent.

The CO_2 and weight components are convex. At its steepest, above 195 gCO_2/km, the CO_2 component corresponds to a carbon price of NOK 9775 = US$ 1200 per ton of CO_2, assuming a 260 000 km lifetime vehicle mileage and a 40 per cent higher emission rate in real traffic than at the type approval test. The tax rate is thus several times higher than just about any reasonable estimate of the global cost of carbon.

Moreover, greenhouse gas (GHG) emissions are, in principle, already correctly internalized through the CO_2 tax on fuel. A further tax distortion is due to the fact that ZEVs are entirely exempt, not only of the registration tax, but even of the value added tax.

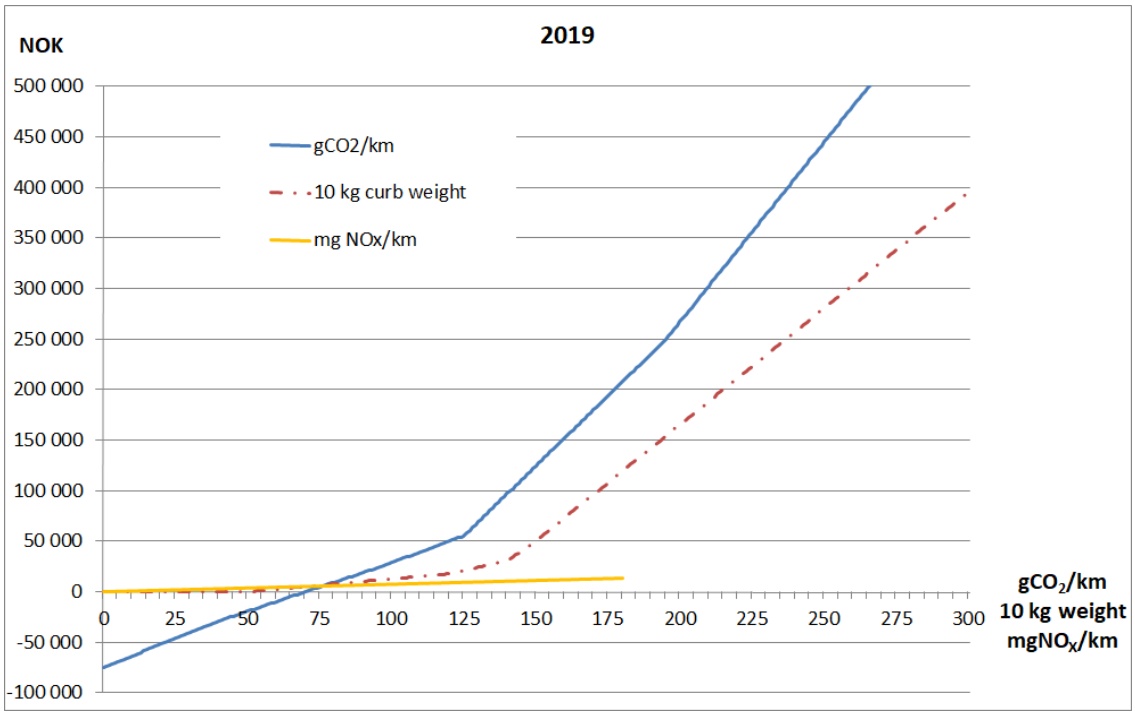

Fig. E.7 One-off Norwegian automobile registration tax 2019, as a function of curb weight and type approval CO_2 and NO_X emission rates.

These tax distortions have an economic cost. But to the extent that GHG mitigation is considered a political imperative, the relevant policy question is not whether the motor vehicle taxation represents a *first-best* economic solution, but whether there are other *second-best* policy options available that will achieve the mitigation goals at a lower social cost.

Economists instinctively consider policymaking in light of their theory of first-best welfare maximization. According to this tenet, an external cost should ideally be internalized by a tax corresponding exactly to the marginal damage caused by the single decision maker. A higher or lower tax than this leads to a welfare loss, i. e. to a deviation from the most efficient (first-best) resource allocation. Economists sometimes argue about climate policy options in general and transportation policy in particular as if it is derived from a goal of maximizing welfare.

However, when the Norwegian Parliament has decided on policy objectives in line with the Paris accord and the climate agreement between Norway and the European Union, this means that the first-best economic solution has already been discarded. Democracy has opted for a constraint on welfare maximization. The present Norwegian government has laid down a target of a 45 per cent reduction in GHG emissions from transportation and other sectors outside the European cap-and-trade system (EU ETS) between 2005 and 2030. The policy challenge is then no longer to find a path towards *first-bes*t economic resource allocation, but rather to identify that *second-best* combination of policy measures which obeys the constraint, thus achieving the mitigation goals at minimum economic cost.

The steep one-off Norwegian registration tax can be seen as one possible second-best strategy striking a balance between the goal of welfare maximization and the climate policy constraints. There is little doubt that the record fast electrification of the Norwegian automobile fleet will have a major long-term impact on the GHG emissions from road transportation (Figs. E.8 and E.9). Whether or not there are cheaper ways to achieve the GHG abatement goals remains an open question.

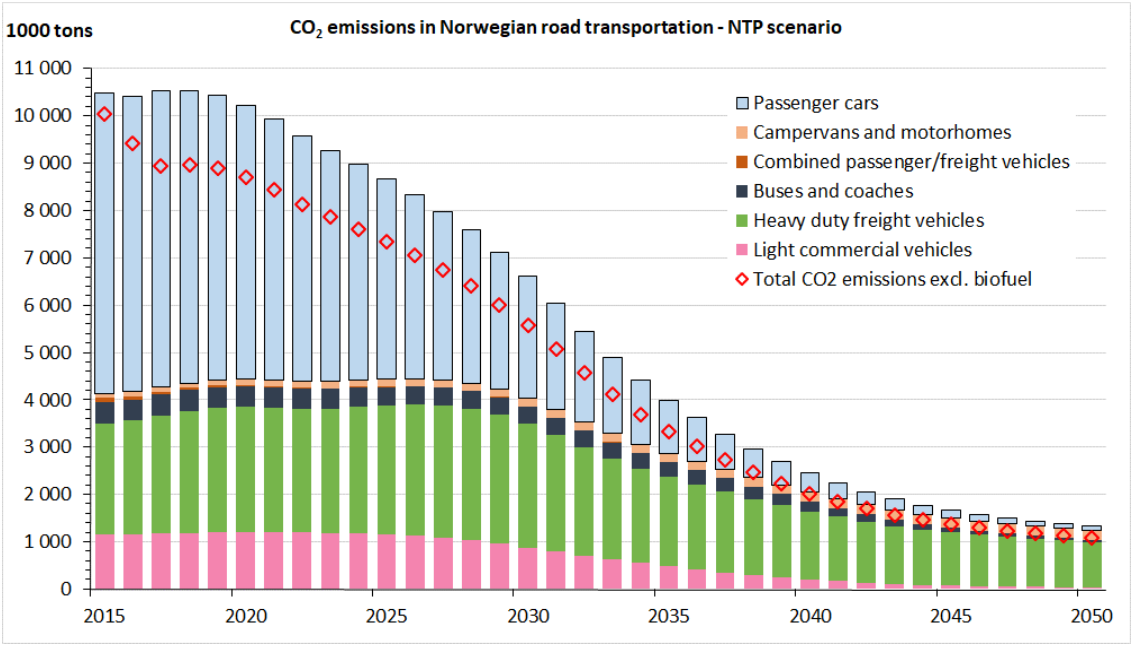

Fig. E.8 CO_2 emissions from domestic Norwegian road transportation 2015-2050 under radical (NTP) GHG abatement scenario, by vehicle class. Source: TØI report 1689.

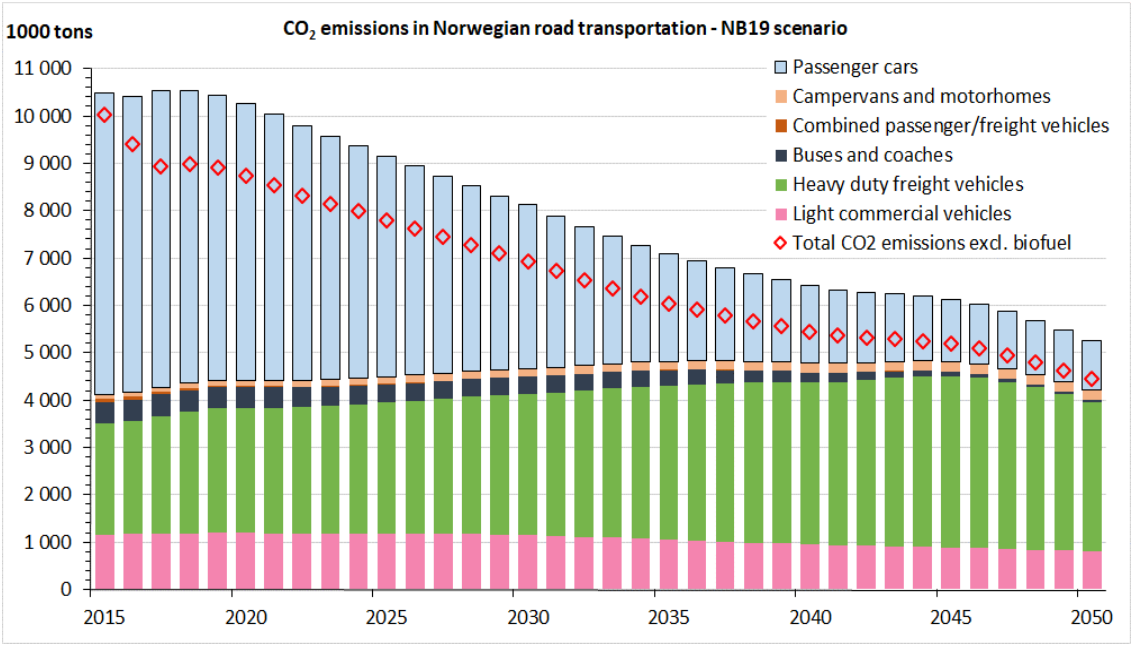

Fig. E.9 CO_2 emissions from domestic Norwegian road transportation 2015-2050 under moderate (NB19) GHG abatement scenario, by vehicle class. Source: TØI report 1689.

Rationale for taxation system reform

In summary, the rationale for a revised and updated system for motor vehicle taxation in Norway is at least sixfold.

(i) The fuel taxes, the explicitly stated goal of which is to internalize the external costs of road use, fall far short of their purpose. The congestion costs in particular are quite poorly reflected in the fuel taxes.

(ii) As an increasing share of the passenger car fleet is electrified, the fuel taxes become even more irrelevant as a market correction mechanism. Although battery and fuel cell electric vehicles are emission free, their marginal external costs of road use are only a third lower than those of ICE vehicles.
(iii) Relying heavily on tolling, the present Norwegian road funding system generates large deadweight losses due to deterred traffic in uncongested areas, in addition to administrative toll collection costs. In the cities, toll cordons give rise to arbitrary barriers across and between neighborhoods, limiting competition between businesses located on either side of the cordon.
(iv) Few incentives exist that stimulate the adoption of zero and low emission technologies in heavy-duty freight vehicles.
(v) The present CO_2 graduated automobile taxation system (in particular, the one-off registration tax) is, in a sense, too effective for its own good. As more and more people respond to the incentives and buy low cost, low tax vehicles, the government revenue from all types of automobile taxation is dwindling.
(vi) The fuel tax and road tolls have undesirable equity effects, especially along the center-periphery dimension. A fairer system would imply higher charges on congested traffic in the urban areas and lower charges on free-flow traffic in rural communities.

Marginal cost road pricing

For maximum economic welfare, the present motor vehicle taxation system should be replaced by a system where road users pay according to the external damage caused. The technological advances of the last couple of decades have made the implementation of an at least approximate marginal cost road pricing (MCRP) scheme more realistic than ever before.

The most elegant – and possibly also most cost effective – way to implement MCRP would be by means of a global satellite navigation system (GNSS). All motor vehicles would be fitted with an onboard electronic unit which communicates with a GNSS, such as the American global positioning system (GPS) or the European Galileo system. The unit should be smart enough to, not only record all movements in space and time, but also calculate the charge incurred on every trip and sum through all charges periodically, e.g. once every month. The aggregate charge due would be conveyed electronically to the agency responsible for payment collection. This way the agency or public authority will not have access to data on the movements of each individual vehicle.

The charge should be measured out in proportion to distance driven (a "kilometer charge"), however with rates depending on (i) the level of congestion, (ii) the vehicle's environmental and road safety characteristics, (iii) the population density in the road corridor, and (iv) the axle load in relation to the road's weight tolerance.

If and when such a road charging scheme has been put into use, it will be possible to greatly simplify the motor vehicle taxation system, abolishing

- all road toll
- the road use component of the fuel tax
- the annual circulation tax on passenger cars
- the annual circulation tax on heavy-duty freight vehicles
- the ferry fares.

If, however, the GHG abatement goals are to be achieved through domestic emission cuts (rather than through international emissions allowance trading), one probably cannot

dispense with the strongly CO_2 graduated one-off registration tax, nor with the exemption from value added tax applicable to zero emission vehicles.

Nine convenient truths

As compared to the present Norwegian motor vehicle taxation system, a prospective satellite based marginal cost road pricing scheme will distinguish itself in terms of no less than nine convenient truths:

(i) large and more robust public revenue,
(ii) massive congestion relief,
(iii) reduced local air pollution,
(iv) less greenhouse gas emissions,
(v) reduced road wear,
(vi) fairer and less arbitrary burden sharing,
(vii) more profitable road investments involving no deadweight losses,
(viii) larger and more productive labor market regions, and
(ix) more efficient competition among enterprises throughout the urban area.