



# How to reform taxation of road transports for promoting electrification

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The Nordic countries are global forerunners in the development towards fossil-free vehicle fleets. In the first half of 2019, Norway, Iceland and Sweden were top three leaders with Norway reaching 58 percent of new vehicle sales being electrically chargeable, Iceland 18 percent and Sweden 11 percent.

However, electrification generates a new target conflict between greenhouse gas reduction, regulating traffic volume and tax revenues to fund public infrastructure and social costs of traffic. The target conflict calls for a reassessment of the taxation of road transports in the Nordic countries.

In joint studies, financed by the Nordic Energy Research project Shift, researchers at the IVL Swedish Environmental Research Institute and the University of Gothenburg have used mathematical analysis to develop a reformed taxation of road transports in Sweden that resolves the target conflict and fulfils the three targets.

## Key findings

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- A guidance rule is recommended for the adjustment of the bonus-malus system in Sweden. The adjustment rule increases system predictability and makes sure that bonus and malus payments are in balance and sufficiently strong to generate incentives until 2030.
- According to the rule, the levels of the bonus in Sweden need to be adjusted upwards for zero emissions vehicles and plug-in hybrids with long e-range. The malus also needs to be adjusted upwards.
- Adjusted discounts need to be implemented for the benefit value of company vehicles for bonus vehicles at least until 2025.
- 30 000-40 000 public and private charging points are needed until 2025 along highways and in urban areas which lack long-term parking and cannot arrange own charge.
- Zero emissions vehicles and plug-in hybrids with long e-range need to be free from road taxes for approximately another 10 years.
- A national kilometre tax system needs to be introduced for zero emissions vehicles and plug-in hybrids with long e-range when the market share of new sales of these vehicles enters the range of 70-90 percent. Fuel taxes are kept for conventional diesel and petrol vehicles and mild hybrids until they are phased out.
- A reduction commitment corresponding to 40-50 percent for diesel and 25-30 percent for petrol is still needed by 2030. The need for biofuel blending quickly reduces as conventional diesel and petrol vehicle fleet sharply diminishes during 2030-2040.





### Background

## Key questions for a taxation reform of the transport sector in the Nordic countries

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**Electrification calls for reassessing Nordic transport policies as it generates a target conflict between greenhouse gas reduction, regulating traffic volume and tax revenue to fund public infrastructure and social costs of traffic. The target conflict is described by three challenges below.**

#### General instrument for regulating traffic volume

Fuel taxation has since long been one of the most important policy instruments for regulating traffic volume. It effectively alters the relative price of vehicle driving with respect to other traffic modes. Drivers respond to an increase in fuel taxes by reducing vehicle travel and buying more fuel-efficient (or electric) vehicles.

First, consider the effect on travelled distance: when fuel taxes rise, drivers reduce travel in order to save fuel.

Second, national tax exemptions and subsidies to zero- and low-emissions vehicles, tax shifting between low- and high-emissions vehicles and the EU CO<sub>2</sub> emission performance standards increase fuel efficiency and electrification.

These energy-efficiency effects can occur either through buyer or manufacturer decisions about technology and vehicle mix. Finally, there is a rebound effect on vehicle travel distance – an increase in energy-efficiency (by fuel efficiency or electrification) reduces the cost per kilometre which increases vehicle travelled distance.

To understand all the effects of the policy instruments, we need to measure the vehicle kilometre effect, the energy efficiency effect and the rebound effect. Whether each of the climate policy instruments will lead to a decrease or increase in vehicle travel distance depends on how large the rebound effect is in comparison to the vehicle kilometre effect and the energy efficiency effect.

As drivers change their behaviour in line with these instruments, the effects of fuel taxes on vehicle travelled distance decline. Drivers of electric vehicles do not change their vehicle travel distance behaviour to changes in fuel taxes. Thus, electrification requires a new general tax system in the transport sector for regulating traffic volume as well as restoring a socially efficient balance between road capacity and traffic volume.

#### Balance between road capacity and traffic volume

The Norwegian electric vehicle market share reached 58 percent during the first half of 2019 with an aim that by 2025 only cars with zero emissions should be sold. Sweden is heading towards a market share above 50 percent for new electrically chargeable vehicles around 2025 with a slightly reformed tax system in our analysis.

The faster the electrification, the faster grows the gap between declining tax revenues and the need







for funding for road infrastructure and social costs generated by driving. When the current vehicle fleet has been replaced by fossil free vehicles, total tax revenues from fuel taxes are wiped out. Funding for road capacity enhancements risks lagging far behind the increase road traffic with increasing congestion and social costs.

To maintain a long-term road infrastructure in the future also for an electric vehicle fleet, and to match the social costs of traffic, the lost tax revenue from fuel taxes will need to be covered by a new tax base. The solution is to charge vehicles on a per kilometre basis according to the marginal external costs of their driving and thereby restore socially efficient balance between road capacity and traffic volume. And, with advances in GPS-based metering technology, it is now possible to charge drivers on a per kilometre basis.

### Released fuel tax burden in rural areas

Fuel taxation is among the most accurate economic instruments to regulate CO<sub>2</sub> emissions from vehicles. Taxing fuel addresses directly fuel-efficiency and CO<sub>2</sub> emissions per kilometre. If climate change was the only social objective to consider, the choice of instrument would be easy. However, there are other social costs from traffic; for instance, injuries and damages from accidents, health issues from noise and local air pollution in cities and lost productivity from time spent in congestion. With the current knowledge about social costs, these marginal social costs can be seven to nine times higher from driving a kilometre in urban areas compared to driving a kilometre in rural areas.

Since congestion is more common in urban areas the difference can be even bigger than this.

Social efficiency (and often common-sense fairness) requires that road users meet the true social costs of their actions. Accordingly, rural areas are then overtaxed at least seven to nine times. The consequence is that people in rural areas are deterred from some vehicle driving, holding back social benefits and some of the social development in rural areas. In addition to this, the tax burden generates a distribution effect by the transfer of financial resources from rural areas.

To improve social efficiency, a first thought could be to introduce different fuel tax rates in rural and urban areas, but this would create pervasive incentives to travel to rural areas to fill up fuel. Instead, a social efficient tax - to charge vehicles on a per kilometre basis according to the marginal social costs of their driving - can be differentiated as the vehicle fleet transforms to zero emissions vehicles. The development in GPS technology makes it possible to differentiate a kilometre tax between rural and urban areas and charge drivers on a per kilometre basis according to the marginal external costs of their driving. Setting socially efficient tax rates would imply about 50-70 percent reduction of the total cost per kilometre in rural areas compared to urban areas and compared to today. Thus, the faster the electrification goes with a tax reform, the sooner the social benefits from deterred vehicle driving that held back social development in rural areas are released.





### Key findings

#### Strengthened and more predictable bonus-malus system in Sweden

To effectively manage the transition towards zero emissions vehicles, the levels of bonus and malus must be continually reviewed and updated. Our results call for improved long-term predictability in the bonus-malus system. A guidance rule is therefore introduced for the long-term adjustment of the bonus-malus system. The rule makes sure that bonus and malus payments are in balance, and sufficiently strong to generate incentives for the 70 percent target 2030. Policymakers can choose to follow the rule or not in each review and update of the system. The more often policymakers choose to follow the rule, the more predictable the system as the rule builds common expectations among actors.

The rule follows the development of the relative price index and the ratio of the market shares of zero emissions vehicles and plug-in hybrids. For instance, under 2019 conditions the rule prescribes a maximum

bonus of SEK 100 000 for zero emissions vehicles, indicating that the current bonus is too low.

For companies, the bonus for zero emissions vehicles needs to increase to maximum 40 percent of the price difference between the bonus vehicle price and the price for the most comparable vehicle. The break-even point between bonus and malus, 50 g/km, corresponds to e-ranges around 50-60 km. With an e-range of at least 50-60 km, almost 75 percent of all driving can be done on electricity. As in the current system, the bonus cannot exceed 25 percent of the price of the vehicle. All vehicles receive either a bonus or a malus which simplifies the system.

Figure 1 below illustrates the rule for the reformed bonus-malus system if it would have been introduced 2020. The position "Post 2020" illustrates an example of a later phase of the system, likely around 2025, when prices of zero emissions vehicles has fallen and their market share increased.

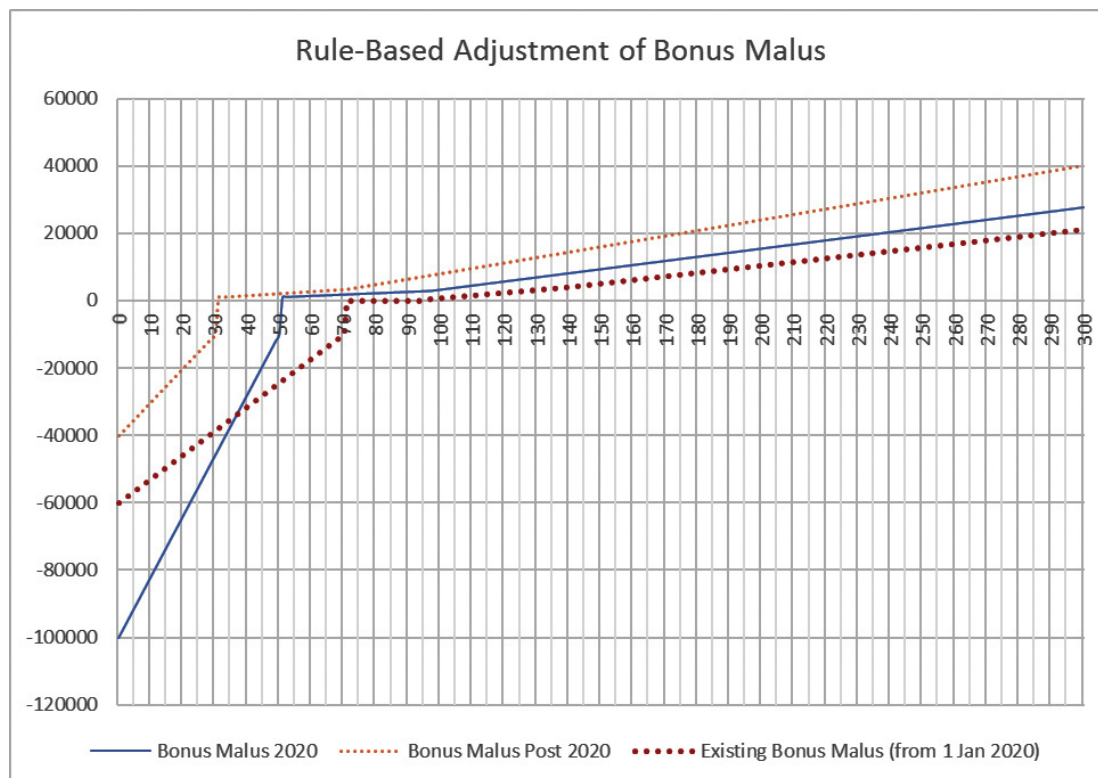


Figure 1 Illustration of Rule-Based Adjustment of Bonus Malus



The discounts for the benefit value of company vehicles as well as the environmental car definition for procurement in the public sector have been harmonized with bonus vehicle definition when it comes to CO<sub>2</sub> emissions performance.

### **A successful climate policy calls for a kilometre tax**

A bonus-malus system that promotes electrification must work in tandem with a new road tax system that generates public revenue to cover long-term road infrastructure, road wear and social costs from traffic. The kilometre tax system is imposed on zero emissions vehicles and plug-in hybrids with long e-range. Fuel taxes are kept for conventional diesel and petrol vehicles until they are phased out, mainly during 2030-2040.

Still, this implies that zero emissions vehicles and plug-in hybrids with long e-range, in all periods, maintain on average at least 50 percent cost advantage for zero-emission driving over fossil-fuel driving. This also retain incentives for charging before filling up fuel in plug-in hybrid electric vehicles.

The road tax exemption for zero-emission driving in the coming 10 years plays an important role for electric vehicles to gain market shares. The kilometre tax is introduced when the market share of zero emissions and plug-in hybrid vehicles enters the range 70-90 percent. The range is an optimal balance between generating tax revenues and incentives for electrification. The range is estimated to be reached within the period 2027-2032 which also nails down the optimal time for the introduction of the tax.

Social efficiency requires that each road user pays for the true social costs she causes on others in society. In urban areas, the social costs of driving are extensively larger than in rural areas because of health issues from local air pollution, accidents, noise etc. and the tax level should be higher. With tax levels set at the social cost levels the total cost per kilometre in rural areas is about 40 percent of the cost in large cities.

### **Public charging points**

More than 40 percent of Sweden's population lives in single-family detached dwellings and have good opportunities to arrange their own charging points compared to the population living in multi-family dwellings. It is essential that property owners, employers and municipalities initiate an expansion

of the infrastructure during 2020-2025. As part of the reformed policy 30 000-40 000 private and public charging points are needed by 2025 and 70 000-90 000 charging points by 2030.

### **The reduction commitment still important**

If Sweden is to achieve a 70 percent reduction in CO<sub>2</sub> emissions from road transport by 2030, both electrification and biofuels are needed. Even with this reformed policy program, the 70 percent reduction target on CO<sub>2</sub> emissions needs a reduction commitment of 40-50 percent for diesel and 25-30 percent for petrol by 2030. However, the need for biofuel soon reduces as the conventional diesel and petrol vehicle fleet diminishes faster during 2030-2040.

### **Vehicle fleet composition**

In the reformed bonus-malus system with kilometre tax, zero emissions vehicles and plug-in hybrid electric vehicles with long e-range gain a considerable increase in market shares; between 38-55 percent in 2025 and between 52 and 94 percent in 2030.

While the existing bonus is large enough to create parity with small-size zero emissions vehicles during 2021-2024 it is not large enough to do this with mid-size ones which implies that the increase in mid- and large-size zero emissions vehicles will be delayed. Compared to the reformed tax system, mid-size and large-size vehicles will to a larger extent be plug-in hybrids in the existing bonus-malus system.

The road tax exemption on zero-emission driving in the coming 10 years, together with fuel taxes on conventional diesel and petrol vehicles are essential in the tax reform. For instance, with the kilometre tax introduced at a point within the optimal range during the period 2027-2032, the e-Golf is almost at parity with the petrol Golf after three years ownership. A kilometre tax introduced at an earlier stage undermines the incentives of the bonus-malus system, also counteracting real effects.



Table 1 illustrates the counterfactual example if the reformed bonus-malus with a national kilometre tax had been introduced with today's price index for zero emissions vehicles and plug-in hybrid electric vehicles (existing policy instruments in parenthesis). Total fuel cost and total energy cost are borrowed from table 2.

<b>Volkswagen Golf GT TSI 150</b>	<b>After 1 year</b>	<b>After 3 years (present value)</b>
Purchase price (SEK)	251 900	251 900
Bonus-Malus (SEK)	8 940 (4 799)	26 684 (14 324)
Total fuel cost 15 000 km/year intermediate zone (SEK)	15 600	46 563
Net (SEK)	<b>276 440 (272 299)</b>	<b>325 147 (312 787)</b>
<b>Volkswagen e-Golf</b>		
Purchase price (SEK)	418 900	418 900
Bonus-Malus (SEK)	- 100 000 (-60 000)	- 100 000 (-60 000)
Total energy cost 15 000 km/year intermediate zone at free-flow traffic (SEK)	8 589 (3 339)	25 636 (9 966)
Net (SEK)	<b>327 489 (362 239)</b>	<b>344 536 (368 866)</b>
Additional cost for Volkswagen e-Golf with kilometre tax from 2020	<b>51 049 (89 940)</b>	<b>19 389 (56 079)</b>
Additional cost for Volkswagen e-Golf with kilometre tax introduced within the period 2027 - 2032	<b>45 799 (89 940)</b>	<b>3 719 (56 079)</b>

**Table 1. Purchase decision with reformed tax system (existing policy in parenthesis)**





Table 2 illustrates the reformed bonus-malus with the national kilometre tax system for free-flow traffic (without any congestion) in three zones.

National tax system for free-flow traffic	Rural area	Intermediate zone	Urban area
<b>Volkswagen Golf GT TSI 150</b>	(SEK/km)	(SEK/km)	(SEK/km)
Petrol cost	0.35	0.41	0.52
Energy tax on petrol	0.22	0.25	0.32
CO2 tax on petrol	0.15	0.17	0.21
VAT on petrol	0.18	0.21	0.26
Total cost	0.90	1.04	1.31
Total cost per 15 000 km (SEK)	<b>13 500</b>	<b>15 600</b>	<b>19 650</b>
<b>Volkswagen e-Golf</b>			
Electricity cost	0.10	0.11	0.14
Energy tax on electricity	0.05	0.06	0.07
VAT on electricity	0.04	0.04	0.06
Kilometre tax at free-flow traffic	0.06	0.35	0.49
Total cost	0.25	0.57	0.77
Total cost per 15 000 km (SEK)	<b>3 776</b>	<b>8 589</b>	<b>11 562</b>
Total cost per km incl. energy tax reduction in Norrbottens län, Västerbottens län och Jämtlands län	0.22	0.54	0.73
Total cost reduction per 15 000 km in Norrbottens län, Västerbottens län och Jämtlands län (SEK)	419	485	613
<b>Total tax payments</b>	(SEK/km)	(SEK/km)	(SEK/km)
Total tax payment (excl. CO2 tax) per km with Golf TSI 150	0.36	0.42	0.53
Total tax payment per km at free-flow traffic with e-Golf	0.14	0.45	0.61
<b>Comparisons</b>			
Cost reduction per 15 000 km with e-Golf (SEK) instead of Golf TSI	9 663	7 011	8 117

**Table 2. Use decision with reformed national tax system for free-flow traffic**

## References

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