4 Assessment: Road transport

Driving is a major source of carbon emissions, local air pollutants, congestion and noise and can contribute to road accidents. Particular in urban areas, congestion and air pollution are of key concern. Such damage on the environment and on society – commonly referred to as *external costs* – are typically not reflected in an individual's or a firm's decision to own and drive a car. Tax policy can contribute to reflecting the full costs from environmental damage in drivers' and vehicle owners' decision making process by relating a price to it, thereby improving transport and environmental outcomes.

This section assesses how taxes that apply to road transport in Andalusia (passenger vehicles) may better align with environmental and tax policy objectives, such as the management of external costs. The focus of the project is on GHG emissions and air pollution from passenger vehicles. Other external costs (e.g. accidents, congestion and noise) will also be discussed.

The section provides strategic reform suggestions for better management of external costs. It also proposes and discusses an alternative view of environmental tax reform, namely reform that supports reaching relevant policy objectives, such as Andalusia's objective to reduce GHG emissions by 30-43% in 2030 (PAAC 2021) or the nation goals to reach a zero GHG emissions fleet of passenger cars by 2050 and air pollution reduction of 62% for of NOx and 50% for PM by 2030 (compared to 2005) or the reduction in the consumption of petroleum derivatives in transport of at 30% by 2030 (compared to 2019) expressed in the Andalusia Energy Strategy 2030.

Section 4.1 sets the scene, Section 4.2 discusses the Tax policy objectives in road transport. Section 4.3 introduces the main categories of external costs and estimated magnitudes. Section 4.4 lines out the principles of sound environmental tax policy. Section 4.5 assesses the alignment of Andalusia's tax framework with sound environmental tax principles and lays out strategic reform options.

4.1. Setting the scene

While CO_2 emissions in Andalusia's road transport sector increased by 12% over 2011-2019, air pollutant emissions have followed a downward trend. Road transport overall is responsible for 27.6% of Andalusia's total CO_2 in 2019 according to the Junta de Andalucia's Institute of Statistics and Cartography (Junta de Andalucia, 2022[1]); a share that is rather stable over time (28.2% in 2011). Andalusia's NOx emissions in road transport continuously decreased from 50 960 tonnes in 2011 to 34 671 tonnes in 2019 accounting for 12.6% of Andalusia's total NOx emissions in 2019 (34.7% in 2011). Road transport was also a major source of fine particles in Andalusia, accounting for 22.7% and 21.5% of Andalusia's total PM2.5 and PM10 emissions in 2011 but decreased towards 2.7% and 3.2% in 2019. While CO_2 is a global pollutant contributing to global warming with impacts across the world (see discussion in Section 3.1), NOx and fine particles contribute to air pollution with repercussions at a local level. Although pollution from vehicles has been decreasing, it remains an important source of pollution which affects population, especially in urban environments.

In 2021, Andalusia counted 4,277,106 registered passenger vehicles ("Tourismo") of which 61% were diesel and 38% gasoline cars. The remaining 1% used other energy types, including electricity (0.12% in total) (Junta de Andalucia, 2022[1]). The emissions profiles of diesel and gasoline cars differ. While gasoline cars emit relatively more CO_2 and CO per km driven, diesel cars emit relatively more NOx, black smoke and particulates (Crawford and Smith, 1995[2]). Often diesel cars drive more and risk to emit more CO_2 in total compared to gasoline-driven cars. Due to the difference in pollution profiles, it is not straightforward to assess the relative total damage of gasoline vs diesel cars. Other car characteristics, such as weight and engine size, are to be taken into consideration too when assessing pollution outcomes, as heavier cars and cars with larger engines typically emit more per kilometre driven.

Vehicle turnover has a significant impact on how quickly new technology penetrates the fleet. The average lifespan of a car varies, and it is not straightforward to understand how quickly polluting cars may be replaced by clean ones – in particular relatively young cars. According to Held et al. (2021[3]), the mean lifespan of a car settles at 18 years in Western European countries. In Andalusia, 36% of all personal vehicles are younger than 10 years in 2021, and 21% even younger than 5 years, while 45% are older than 15 years.

Emissions in road transport do not only relate to passenger cars that are registered in the region. There also is drive-through traffic, tourist and company cars. Beyond passenger car use, there is traffic from other vehicle types, like heavy and light duty vehicles, motorcycles, etc. Looking at the Andalusia vehicle dataset 2021, registered vehicles other than passenger cars ("tourism") include trucks, trailers and semi-trailers (537 228, i.e. 8% of all registered vehicles), vans (436 002, i.e. 6.5%), motorcycles and mopeds (1 294 529, i.e. 19.4%) and other vehicles, including buses and industrial tractors (130 770, i.e. 2%).

4.2. Tax policy objectives in road transport

Tax policy objectives in road transport may be multiple. They can relate to raising revenues, increase tax system efficiency including through a better management of external costs, to manage distributional consequences or contribute to specific policy goals such as driving a transition to net-zero emissions or achieving a certain share of alternative fuel vehicles in the vehicle fleet, for example. While some of these policy objectives may reinforce each other, others may be less well aligned with each other. For example, when tax policy is used to create incentives to expedite the transition to net zero, it comes with budgetary impacts in the short and long run, either because the instrument provides for forgone revenue (e.g. CIT and PIT deductions for electric vehicles) or because they explicitly aim to erode the tax base by reducing carbon-based fuel use.

Different tax instruments and designs may be better suited to address specific objectives. For example, a carbon tax may be a good tax instrument to internalise the external costs related to emitting carbon emissions, while raising revenue in the short to medium term. However, given recent elasticity estimates, it may not be able to drive the net-zero transition by 2050 if applied in isolation.

The present analysis focuses on the project's objective to increase tax system efficiency through a better management of external cost. External costs from air pollution and GHG emissions are of particular interest to the Andalusia authorities. The analysis discusses how external costs are managed in the current tax policy framework of Andalusia and ways to improve it. Besides this focus, the analysis encompasses a discussion of other policy considerations where necessary (e.g. distributional consequences, revenues) and sets the external cost focus in context of other pressing policy goals. Focusing purely on the discussion of external cost pricing may be too narrow at a time where the transition to net-zero calls for a full review of tax (and non-tax) policy instruments in view of supporting the transition of the energy base towards clean fuels and mobility options.

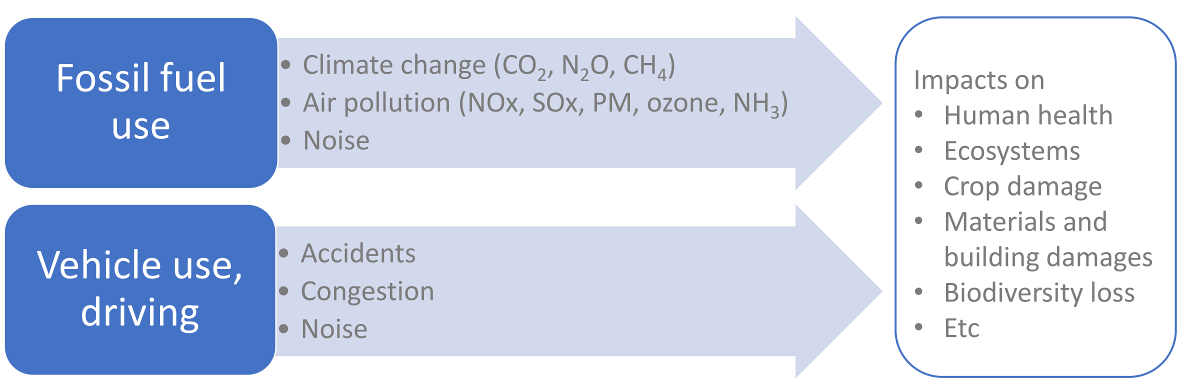
In Andalusia, policy objectives on climate change relating to the road transport sector are clear and enshrined in specific targets. The region has taken a leading role in this area being the first autonomous region in Spain to develop a regional Climate Change Strategy in 2002. The most recent Andalusia Climate Action Plan (PAAC 2021) aims for a 30-43% reduction of GHG emissions by 2030 (compared to 2008 levels) in the transport and mobility sector. The PAAC is established in the context of the Spanish Climate Change and Energy Transition law, which sets the objective of reaching a zero GHG emissions fleet of passenger cars and light commercial vehicles by 2050, with the central government, the autonomous communities and local governments asked to contribute within the scope of their responsibilities. Spain also committed to put a halt on the sales of new passenger cars and light commercial vehicles that emit GHG emissions after 2040. To support autonomous communities and cities to promote electric mobility, the central government launched the Moves III Plan, which provides funding to encourage the purchase of electric vehicles and to finance the deployment of charging facilities. Prior to the Moves III Plan, the government launched the Moves I and Moves II Plans managed by the Andalusian Energy Agency.

On air pollution, no explicit regional targets exist, but the Andalusia Strategy for Air Quality builds a framework to facilitate the preparation of air quality improvement plans by local governments in Andalusia. Reduction targets exist at the national level, including a reduction commitment for NOx at 62% and for PM 2.5 at 50% by 2030 (compared to 2005). For more details on policy objectives and specific reduction targets in the area of climate change and air pollution see Section I.2).

4.3. External costs in road transport

Optimal tax theory predicts that an efficient tax system would tax behaviours that generate external costs. In the context of road transport, fuel and vehicle use as well as driving would ideally be taxed at a rate that reflects external costs induced by these behaviours. Currently, the full range of external costs from driving are under-priced in many countries (Van Dender, 2019[4]). This includes estimates of external costs which relate to using fossil fuel technologies during driving (e.g. GHG emissions, air pollution and noise), but also those costs that are unrelated to fossil fuel use and would remain present even under a fully decarbonised vehicle fleet (in particular, accidents, congestion, road damage, noise, use of public space and reduced mobility for non-drivers). Figure 4.1 summarises the different external costs in road transport and their impact categories, such as impacts on human health, ecosystems, material and building damages, etc. Section 4.4 discusses in detail the suitability of different tax types to cover these costs.

Figure 4.1. Main external costs in road transport relate to fossil fuel use, vehicle use and driving



Source: Own representation based on Mottershead et al . (2021[5]) and Van Dender (2019[4]).

External costs in road transport can be substantial but are uncertain and often vary according to time and location of driving. Van Dender (2019[4]) presents and discusses the main external costs related to road transport and compares literature estimates of such costs expressed by kilometre. The study shows ranges of estimates for those costs in the European Union. Due to the large uncertainty on the estimates, it does not depict single numbers (Figure 4.2).

Figure 4.2. External cost estimates for the use of passenger cars

Summary of estimated ranges of external costs of passenger cars in the European Union (in Eurocents per vkm)

Note: Approaches to value external costs are reviewed, for example, by Mottershead et al. (2021[5]).
* For illustrative purpose only. The external cost related to climate change is proportional to fuel consumption so is more naturally expressed per litre. The range shown covers fuel consumption between 5 and 10 litre per 100 km and a social cost of carbon of EUR 60 per tonne of CO_2.
Source: Van Dender (2019[4]).

External cost estimates from driving in the European Union vary from zero to 20 Euro-cent per vehicle-kilometre (vkm) driven as indicated in the first line of Figure 4.2, which highlights the dominance of congestion costs. The high end of costs estimates is relevant to congestion cost only, while other related costs range from zero to five cents per vehicle-kilometre. For illustrative purpose, the figure includes external costs from CO_2 emissions to allow a comparison of orders of magnitudes of different cost categories only. The external cost related to climate change is proportional to fuel consumption so is more naturally expressed per litre and not in vkm.

External cost estimates are driven by assumptions on the level of congestion, on the amount of carbon and number and severity of accidents, the location of driving (urban, rural), fuel use (gasoline vs diesel) and interaction of these. For example, climate and congestion costs dominate for gasoline cars, whereas air pollution costs are more than twice as large for diesel than for gasoline cars. External costs related to air pollution and congestion vary widely with the location and time of driving (Box 4.1). Air pollution cost depend on population exposure which is different at different locations and time of day as well as its social and demographic characteristics (with children, the elderly and people with previous pathologies being particularly vulnerable). Impacts of air pollution on health accumulate in the long term and are less affected by temporary circumstances. Congestion cost (i.e. time loss) depend on levels of congestion that are different in urban and rural areas and at different times of the day. This differs from climate change which increases temperatures at a global level.

Box 4.1. Health impacts from air pollution related to driving: time and place matters

The health effects deriving from transport-related air pollution is complex and a key concern. WHO (2005[6]) provides an in-depth review of the channels and extent to which air pollution from road transport affects health. For example, road transport was estimated to cause about 70 000 premature deaths in the European Union in 2018 (European Commission, 2022[8]). Additional details are provided in Box 3.2.

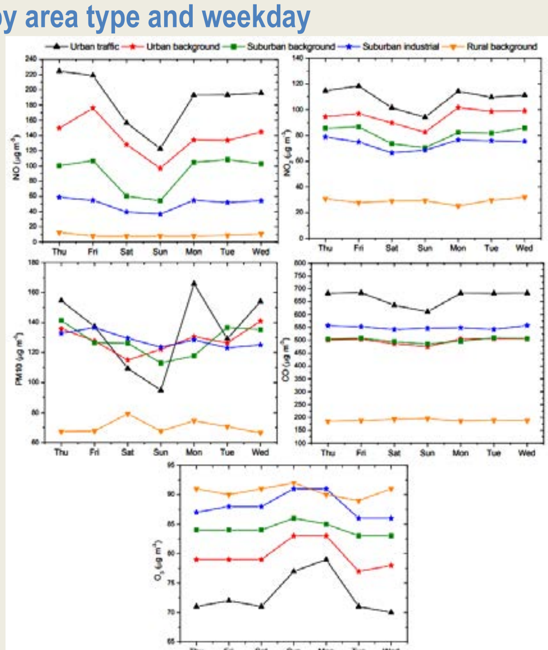
Complex pattern of pollution concentration

In the Andalusia context, Adame et al. (2014[7]) evaluate air pollutant concentration (O_3, NO and NO_2, CO and PM_{10}) during 2003-2008. The study does not focus on transport-related pollutants specifically but cites traffic as one of the main sources of pollution in the region (together with industrial activities and biogenic emissions). Pollution concentration displays strong variation according to key dimensions, such as the area type where emissions are measured (urban, suburban including in industrial areas, and rural), the time of day and the day in the week.

Urban areas that are characterised by high traffic intensity and located mainly in the city centres report consistently higher CO, NO and NO_2 values (Figure 4.3). PM 10 concentration are typically high in urban centres too, in particular on weekdays. Only for O_3, concentration in urban areas appears to be lower than in all other area types.

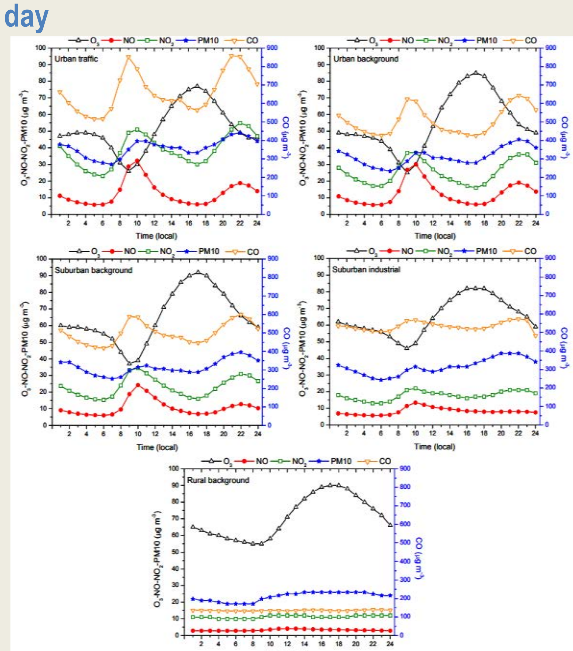
The study also shows that pollution concentration varies according to the time of day. Focusing again on the traffic-heavy urban area category, CO, NO and NO_2 concentrations peak in the morning (9:00-11:00) and the evening hours (21:00-23:00), whereas the peak for O_3 arises between 15:00-20:00. PM10 displays a more evenly concentration over the day. Similar patterns, but of different amplitude and levels, can be observed for the other geographic areas (Figure 4.4).

Figure 4.3. Concentration of main pollutants, by area type and weekday



Source: Adame et al. (2014[7]).

Figure 4.4. Daily pollution concentration across area types, by air pollutant and time of day



Source: Adame et al. (2014[7]).

Insights for Andalusia

When considering the external costs of air pollution concentration through health or ecosystem impacts, these numbers would need to be crossed with population and ecosystem exposure in the different geographic areas and estimates of their impact on health. Because urban areas are relatively dense, total external costs relating to the pollution profiles discussed in Adame et al. (2014[7]) are expected to be relatively higher in urban areas.

The complexities in air pollution concentration shown in the figures are not straightforward to reflect in a simple vehicle tax or an air pollution tax. A combination of instruments may reach superior results. For example, regulating cars (e.g. via air pollution standards that increase in stringency over the years, such as the Euro standards) together with well-designed congestion charges (i.e. that charge vehicles for circulating in particular areas or cities) or distance-based pricing that reflect pollution concentration, population exposure and their time effects, may be preferable.

Overall, the study shows that air pollution has very local effects which may call for policy action at the local level, where opportunities exist to follow the spatial variation of pollution and their impacts relatively better. For example, the local governance level may be well-equipped to implement congestion charges in areas where effects are likely most important, by combining information of density in different cities with traffic and air pollution data.

A recent study by the European Commission's Directorate-General Environment (Mottershead et al., 2021[5]) presents external *environmental* cost estimates in different countries per unit of emission based on literature. For driving the study focuses on costs related to air pollution and climate change. It also includes estimates of *internalisation rates* that compare the revenues collected from taxes or other economic instruments to their estimated external costs. For the household sector, which includes revenues and costs related to driving passenger vehicles, the study reports an EU-wide internalisation rate above 100%. Such levels could be interpreted to indicate that the external *environmental* costs from driving are fully covered by taxation and the polluter pays principle is met. However, certain caveats apply when interpreting this number as the actual internalisation rate may be substantially lower:

The authors of the study note that the internalisation rate as reported in Mottershead et al., (2021[5]) likely represents an over-estimate of external cost coverage in the case of road transport for several reasons. First, the study includes *external* costs related to GHG emissions and air pollution but does not cover other driving-related external costs from accidents, congestion, and noise, which can have important impacts. Second, cost estimates for air pollution are conservative because they only cover part of all toxic substances. For GHG emissions cost estimates are uncertain and can be much higher compared to those used in the comparison. Third, revenues for infrastructure drive up the revenue estimates in road transport (and thus put upward pressure on the internalisation rate) although they do not provide a signal that pollution is costly to economic actors. Finally, the EU-wide numbers may hide important differences across EU member states, regions, and cities.

The discussion in this section shows that focussing the project on "taxes for gas emissions from road transport" is narrow as it only covers part of the external costs related to road transport. External costs can be substantial but are uncertain and often vary according to time and the location of driving. Finally, action at the subnational level may be justified to cover air pollution and congestion-related external costs, because the local level may be better equipped to monitor the necessary variation in traffic and air pollution data across different cities.

4.4. Principles of sound environmental tax policy

If well-designed, taxation can signal drivers the actual costs of their behaviour and incentivise them to reduce harmful effects on society. This section summarises the different tax-policy instruments available in road transport, how they relate to the three main tax bases in the sector: energy use, vehicle stock and road use, and how they currently apply to drivers in Andalusia (Section 4.4.1). It then discusses to what extent different tax types are suitable to cover driving-related external costs (Section 4.4.2). The section closes by mentioning additional aspects of a sustainable tax policy strategy in road transport, taking behavioural effects, revenue stability and distributional consequences into account (Section 4.4.3).[1]

4.4.1. The tax framework in road transport and applications to Andalusia

A driver engaged in road transport, may be liable to pay taxes or fees on three tax bases: energy (*E*), vehicle stock (*V*) and road use (*M*), which can be summarised in the following country-wide revenue function:

$$\begin{aligned} Tax\ revenue_{\ c} &= R_E + R_V + R_M \\ &= \sum\nolimits_i (tax_i * Joule_i) + \sum\nolimits_j \left(tax_j * nb\ vehicles_j\right) + \sum\nolimits_k (tax_k * km\ driven_k) \end{aligned}$$

Revenue from energy (R_E) relates to energy purchases in country c. It includes all energy types, i, such as gasoline, diesel and electricity, used in road transport. Currently, energy use in road transport derives predominantly from fossil fuels, but may shift towards alternative fuels following technological advances, falling prices for alternative fuel vehicles and stringent climate or air pollution policies. The energy base comprises fuel that is bought (and taxed) within the country, even if combusted abroad. Fuel that is bought outside the country will not fall in the tax base of country c, even when combusted there. Countries tax energy in road transport generally via excise duties per litre of fuel or specific taxes on the carbon content of the fuel. Sometimes emissions from road transport and electricity production are instead, or additionally, covered by an emissions trading system. (OECD, 2022[8]) On top of these excise duties VAT is typically payable.

A driver in Andalusia, pays excise duty on fuels at the national level. Spain levies their hydrocarbon tax within the framework of the EU Energy Tax Directive (2003/96/EC), which sets minimum rates for the taxation of energy products in member states of the EU. For gasoline, Spain applies an excise duty of EUR 0.5078 per litre. For diesel, the excise duty amounts to EUR 0.379 per litre. Electricity use is subject to an ad-valorem tax (5.1%, which was reduced to 0.5% in 2022) that is based on the taxable amount established for the purpose of VAT. VAT on fuels is levied at the full rate of 21%.[2]

Revenue from motor vehicles, R_V, typically relate to all vehicles, j, that are registered in country c. Tax rates typically depend on a combination of specific vehicle characteristics, for example, a vehicle's type (i.e., whether the vehicle is a bus, passenger car, truck, motorcycle), engine power, weight, type of fuel used, whether the vehicle is used for commercial or personal purpose, or according to the environmental performance of the vehicle. Countries tax motor vehicles, for example, via one-off registration or sales taxes and via recurrent taxes on vehicle use or ownership. These taxes usually take the form of specific taxes or ad valorem taxes on the price (OECD, 2022[9]).

Drivers in Andalusia are liable for the national registration tax when they first register a motorised vehicle in Spain, based on the car price. The tax rate is a function of CO_2 emissions with exemptions applying, for example, to industrial, commercial and agricultural two-seat vehicles and rental cars. Rates vary from 0% for vehicles emitting up to 120 g CO_2 per km, to 14.75% for vehicles emitting 200 g CO_2 per km and more (OECD, 2022[9]). Since 2002, tax revenue collected through the vehicle tax is distributed to the autonomous communities. In addition, Andalusian drivers are liable annually for the municipality-specific circulation tax that remains regulated by the central government. Tax rates depend on multiple criteria, such as the vehicle category, the engine power, and the number of seats, but do not consider environmental aspects explicitly.

Revenue can also be derived from road use (R_M). Country c may tax the number of kilometres driven by driving type, k. The type of driving can relate to specific vehicle characteristics, specific roads (tolled vs non-tolled), a specific time of the day, or can depend on an area's population exposure or congestion level. Typical road-pricing systems take the form of distance charges (e.g. motorway or city tolls) or congestion charges. Alternatively, taxation can take an access charge approach, for example in form of a vignette or some types of congestion charging (e.g. cordon fees). Such systems require fees to be paid to access the public road network for a specific period of time but have no direct link to the amount of kilometres driven.

Drivers in Andalusia currently do not face road tolls, although pricing driving on national roads as of 2024 was announced in 2021 as part of the Spanish recovery plan under the European Recovery and Resilience Facility (see Section 2).

The three tax bases in road transport are connected. For example, driving a given distance with a specific vehicle technology determines the amount of energy that a vehicle uses; e.g. driving 100 km with an efficient internal combustion engine requires less energy than driving the same amount of kilometres with an inefficient engine. In this context, improving the fuel-efficiency of internal combustion engines will reduce the amount of fuel used to drive a given distance everything else equal. Technology shifts towards electric vehicles will affect the vehicle and energy tax base. Finally, tax reform in one of the three areas will necessarily affect the other tax bases. For example, increasing fuel taxes will have the immediate effect of increasing tax revenues via the impact on R_E. However, drivers may reduce fuel consumption as a consequence of higher fuel taxes, either by driving less or by driving more efficiently (e.g. through shifting towards more fuel-efficient vehicles or alternative fuel vehicles) or both. Taking the public transport or sharing private vehicles can contribute to less driving. (OECD/ITF, 2019[10]) develops scenario analysis for the penetration of alternative fuel vehicles and models the effects of tax reform on CO_2 emissions and revenues for the case of road transport in Slovenia.

The tax framework discussed in this section does not apply in isolation but operates in the context of other tax and non-tax instruments that likely impact the different tax bases. Important regulatory elements include the European CO_2 emission performance standards for new passenger cars and light commercial vehicles (Regulation (EU) 2019/631). The European Parliament and Council recently agreed (October 2022) to further increase the stringency of these standards and to include a zero-emission target for all new vans and cars sold in the EU in 2035 (European Parliament, 2022[13]). Complementary to the regulation of CO_2 emissions from cars and vans, is the regulation of air pollution via EURO standards. In November 2022, the European Commission presented a proposal of a new Euro 7 standard to further reduce air pollution from vehicles and to improve air quality (European Commission, 2022[11]).

Finally, other tax and non-tax policy provisions may affect decisions of vehicle use and driving. For example, the personal tax treatment of company cars may encourage increased vehicle ownership, more driving and the use of larger and heavier vehicles (Crawford and Smith, 1995[2]). This risks to be the case, when employee compensation related to company cars used for private purposes is taxed more lightly than cash wages and was estimated for Spain to result in significant revenue forgone and environmental costs (Harding, 2014[11]).

4.4.2. What tax types are suited to cover different external costs?

Some tax types account better for external costs than others (Figure 4.5), which should be considered in the tax instrument choice beyond political and administrative feasibility (Van Dender, 2019[4]; OECD/ITF, 2019[10]). Some of the external costs are driven by characteristics of vehicles and fuel types, others relate to the location of driving, the time of day, or the intensity of their harmful effects through population and ecosystem exposure. None of the traditional tax bases alone (fuels or vehicles) may be enough to reflect the full estimate of costs (Crawford and Smith, 1995[2]). Including other tax bases, such as distances driven, into the policy consideration may be useful to cover external costs more comprehensively, as well as using alternative policy instruments, such as subsidies, fuel and emissions standards (Crawford and Smith, 1995[2]).

This section first shows that some tax types are better suited to fit specific tax bases in general, and then discusses the Andalusia case specifically. Additional aspects to be considered for a sustainable tax policy in road transport include behavioural reactions, revenue stability and distributional consequences and will be discussed in Section 4.4.3.

Figure 4.5. Some tax types account better for specific external costs than others

	Fuel or carbon tax	Vehicle tax	Distance-based charges
Long-run revenue stability	☹	☺	☺
External cost management			
• CO_2 emissions	☺	😐	☺
• Air pollution	😐	😐	☺
• Driving-related external costs (e.g. accidents, congestion, noise and air pollution exposure, road damage, use of public space)	☹	☹	☺
Administrative and implementation costs	☺	☺	☹

Source: Adapted from OECD/ITF (2019[10]).

Fuel and carbon taxes are a very well suited to account for the external costs related to CO_2 emissions, because CO_2 emissions are proportional to fuel consumption and can be reflected in the tax rate applicable to the consumption of the fuel. Fuel taxes account less well for air pollution and congestion costs, which depend heavily on aspects that cannot be covered by the fuel tax: vehicle technology (e.g. engine type), driving behaviour (e.g. acceleration, risk taking), the specific driving location and pollution exposure that varies across geographic areas – although some of these dimensions can influence air pollutant levels through variation in fuel consumption and thus the tax may relate to health impacts.

Fuel excise and carbon taxes are relatively easy to administer, as the number of fuel producers or importers is low. Compliance costs for taxpayers are usually low too, in particular for passenger vehicles. Compliance costs increase when fuel used for commercial purposes obtains benefits in form of reduced rates, as it requires truck companies to either file refund claims in all countries where fuel was purchased or to adjust tax returns and respond to audits.

Vehicle taxes on the other hand are less efficient in targeting external costs in road transport, particularly driving-related external costs, such as accidents, congestion, noise and air pollution or road damage. A reason for this is that they can only account for average vehicle characteristics (e.g. average level of pollutant emissions per km) but not the externalities related to driving behaviour, the amount and the place of driving, which affects pollution levels and exposure. Despite their lack of covering driving-related costs, vehicle taxes can reflect the average emissions profile of a vehicle. The vehicle purchase tax in Israel, for example, accounts for a large set of emissions, including CO_2, PM and NOx (Box 4.2).

Box 4.2. Israel's vehicle purchase tax

In 2009, Israel's Green Tax Reform modified the existing vehicle purchase tax to better align with external costs related to climate change and air pollution. Cars were associated to one of 15 categories each with a specific tax rate, ranging from category 1 (no emissions) to category 15 (the most polluting cars). The maximum tax rate was set for category 15 at 83% of the purchase price. Lower rates applied to cars in the other categories.

The tax rates for categories 1-14 were calculated by deducting a certain amount from the maximum rate. The amount of the deduction depended on a specific formula that associated the pollution profile of the car (in particular, NOx, CO, PM, HC and CO_2 emissions) to estimates of the negative impact those pollutants have on society. The goal was to create a differentiation between various levels of emission.

Note: More details in Annex Table 4.A.5.
Source: Roshal and Tovias (2016[12]) and OECD (2016[13]; 2020[14])

Distance-based charges, if carefully designed, have the potential to deliver more efficient road transport because they can reflect external costs related to driving (Parry and Small, 2005[15]). For example, distance-based charges can vary depending on the average pollution profile and weight of a vehicle and as such reflect the costs related to air pollution and road damage. They can also mirror spatial and temporal variation in driving; thereby reflecting population exposure to external costs, such as noise and air pollution, and integrating costs from congestion during peak hours and locations (Van Dender, 2019[4]). However, if the introduction of distance-based charges displaces traffic from highways in less populated areas towards roads that pass close to or inside of highly populated areas, the exposure of population to pollution may increase and lead to a detrimental effect on health. Congestion charges, on the other hand, if they deter access to congested and highly populated areas have the potential to improve pollution exposure and therefore health effects. The Belgian region of Brussels has recently launched the plan to introduce a road pricing system based on distances driven, as well as on the location and time of driving (Box 4.3). Congestion charges are successfully used in a number of different cities, including Stockholm (Box 4.4). Both case studies show that political economy considerations need to be managed well for successful reform.

Benefits from distance-based charging are also evident in terms of their revenue stability, as driving likely adjusts less quickly to pricing and taxation than energy use. A downside of distance-based charging involves the high administrative and implementation costs. Van Dender (2019[4]) reviews the literature on the costs of electronic tolling systems, concluding that distance-based charging systems have historically been expensive, but that historical data may not be a good indicator to predict costs in the future. Technological progress in charging techniques allows systems to become fine-tuned to particular circumstances and be run efficiently to bring costs down compared to historical estimates. In countries where tolling infrastructure already exists, benefits to extending distance-based charges to a wider tax base may outweigh additional costs.

Privacy concerns about data collection through distance-based charging system should be addressed. For example, simple odometer readings can assess distances travelled by a vehicle without collecting detailed information on the driving. Odometer reading cannot implement rates that vary with location and congestion levels, it can only be directed to cars registered in a country and not cover tourist driving (except if visitor's use cars rented from local agencies) and drive-through vehicles entering a country from neighboring regions. A minimum charge levied on non-residents could be discussed in this respect. GPS-based pricing systems, which track a vehicle's position and driving, can accommodate differentiated rates.

Carefully designing GPS-systems may reduce potential privacy concerns. In some existing programmes, driving-related data are destroyed as soon as drivers paid their road user charge (e.g. in Oregon's experimental distance-based charging programme and the German truck tolling system, see (Kirk and Levinson, 2016[16]; Langer, Maheshri and Winston, 2017[17]). The The White Book for Tax Reform in Spain (Comité de personas expertas, 2022[18]) offers a medium term proposal in this sense, namely a tax on the actual use of vehicles, taking account of location, time and type of vehicle.[3]

Box 4.3. The Region of Brussels' plan to implement road pricing

A road tax reform was proposed by the government of the Belgian Region of Brussels with the objective to replace an existing tax on the ownership of vehicles by a road user tax that charges the use of vehicles below 3.5 tonnes based on the amount and the time of distances driven. Heavier vehicles are not covered as already included in the Belgian-wide road user charge for heavy vehicles. If coming to life, the scheme would be the first European system that charges light vehicles based on distances.

The approach chosen seeks to combine road pricing with some form of congestion charging, by including rates that vary by distance, by time of day and location. No exemptions are foreseen at this stage. The charge would include electric vehicles on the grounds that they contribute to congestion. All the information needed to inform the amount of tax due would be recorded through the SmartMove app and rely on camera technology that is currently being used for the region's low emission zone.

The policy was announced in July 2020. The announcement has led to strong opposition from the other Belgian regions (Flanders and Wallonia) as the scheme would also cover all vehicles entering Brussels, including drivers from those regions, and not focus only on vehicles registered in Brussels. In August 2022, the start of a test phase has been announced as the region is looking for volunteers to test the technology SmartMove, including Brussels' inhabitants but also commuters from Wallonia and Flanders.

Note: See Annex 4.A
Source: L'Echo (2022[22]), SmartMove (2022[23]) and Wilson (2020[24])

Box 4.4. The Stockholm congestion charge

Congestion charges are implemented in many different cities, including in Europe (e.g. Gothenburg, London, Milan, Stockholm, Valetta) and beyond (Singapore). These schemes differ in their designs but typically serve the main objective to cover external costs from congestion and improve traffic management.

The Stockholm congestion charge was implemented in 2007, with a trial period in 2006. A vehicle is liable when passing tolling stations installed in the city centre during charging hours. The tax applies to vehicles registered in and outside of Sweden. Exemptions apply to specific vehicle types, including electric vehicles and hybrids.

The rate of the charge varies according to the time of day when the vehicle passes toll stations located in the city and whether driving occurs during peak or off-peak season. Rates are higher during peak commuting times (6:30-9:00 and 15:30-18:00) and from 1 March to the day before Midsummer Eve as well as between 15 August and 30 November.

Some public and political resistance with the introduction of the charge had to be manged ahead of the introduction of the scheme. Opposition was based on privacy and equity concerns. For example. it was argued that lower-income households living outside the city would have to pay for the benefits of wealthier inner city residents. Other concerns related to the risk of errors from misidentifying licence plates.

Source: See Annex Table 4.A.6.

4.4.3. Additional implications from transport taxation: behavioural effects, revenue stability and distributional consequences

Covering external costs is one of different potential tax policy objectives in road transport, as discussed in Section 4.2. Other policy considerations may concern questions about the extent to which taxation can contribute to reaching environmental goals, such as specific air pollution levels, and the net zero transition, or how instruments perform with respect to revenue stability or distributional concerns.

Behavioural effects: reaching environmental goals and revenue stability

Whether countries reach their specific air pollution or GHG reduction goals will depend on the responsiveness of tax bases to changes in tax rates, and this varies with specific design features of a tax and the broader economic context. For example, consumer responsiveness to taxation varies with the original price level (i.e., are prices high or low before the tax reform), household characteristics (such as income and geographical location), and the availability of substitutes, e.g. public transport and car-pooling (Douenne, 2018[25]; Gillingham and Munk-Nielsen, 2019[26]; Spiller, Stephens and Chen, 2017[27]). If substitutes are expensive or unavailable, behavioural responses may only occur at very high price levels. In contrast, where substitutes are readily available at small additional cost, price response can be substantial even at relatively low prices.

Increasing the **price of fuel or fuel taxes** typically lowers the demand for it, for example because drivers reduce travel or change the means of transport (e.g. switch from car to train or bus). Meta-analyses of backward-looking elasticities by Graham and Glaister (2002[28]) and Labandeira, Labeaga and López-Otero (2017[19]) find that gasoline consumption typically reduces around 2-3% in the short run when fuel prices rise by 10%, while the responsiveness is larger in the long run. Recent research shows an average long-run price elasticity of -0.44 in road transport, indicating that a EUR 10 increase in the fuel or carbon tax, decreases emissions from road transport by 4% (D'Arcangelo et al., 2022[20]). A 4% responsiveness to price increases may not be enough to fulfil the national objective of reaching a zero GHG emissions fleet of passenger cars and light commercial vehicles by 2050 (Spanish Climate Change and Energy Transition law) or the regional objective of reducing GHG emissions by 30-43% in the transport and mobility sector in 2030 compared to 2008 levels (PAAC) and achieving air pollution targets. Additional instruments, including non-tax instruments, can usefully support fuel and carbon taxes in this respect. For example, explicit objectives for the penetration of electric vehicles combined with strong financial support to enhance the substitution of technologies through tax and subsidy policies, has proven successful (but also costly) in the case of Norway (Box 4.7 and Section 4.6).

Few caveats apply to the interpretation and transferability of fuel tax elasticity estimates: First, the percentage estimates typically derive from a cross-country analysis and may not be transferable to single countries. Some countries in the sample of D'Arcangelo et al., (2022[20]) tax transport fuels at a relatively low level, which risk pushing the estimates upwards. In a region like Andalusia where taxes on transport fuels are relatively high compared to some of the non-EU countries in the sample, the response to rate increases may be much more limited. Second, evaluating the responsiveness to price or tax rate increases via backward-looking elasticities is less informative in the present situation, where the likelihood of deep change is significant. The applied techniques infer consumer behaviour that is associated with the circumstances prevalent at the sample time, such as income levels and available substitutes, and can evaluate future trends only to a limited extent. For example, they cannot consider the take-up of electric vehicles, when such variation is not yet observed in the data used in the analysis. Yet, the electrification of road transport is supposed to gradually raise the responsiveness of fossil fuel demand to energy and carbon pricing as clean electricity generation increases. The remarkable lack of reaction to the important jump of transport fuel prices due to the recent energy crisis is worth mentioning.

The responsiveness of consumers to price and tax rate changes will also impact the governments' capacity to raise revenues. Excise duties on fuel used in road transport represent a significant share of tax revenue in several countries. Under current policy settings, this tax revenue base is projected to shrink as the fuel-efficiency of internal combustion engines improves and the electrification of the transport sector progresses, driven by policy commitments or the declining costs of electric vehicles. Eroding tax bases lead to declining revenues, which puts stress on government budgets in the long run. Policymakers need to anticipate such potential decline. OECD/ITF (2019[10]) analyses the potential tax revenue erosion from reduced fuel use in road transport and investigates alternative tax policy reform scenarios to compensate for the loss Box 4.5.

In Andalusia, revenues from the hydrocarbon tax represents 8.9% of the region's total tax revenue in 2020 (see Section 2), indicating the size of potential revenue loss if fuel taxes are not replaced by alternative instruments. Revenues may be sustained in the long run by gradually increasing fuel or carbon taxes that cover the external costs closely related with fossil fuel use in vehicles and by phasing-in distance-based charges for cars to reflect external costs closely related with distances driven.

Limitations of behavioural responses to pricing also exist in the context of public transport services. Recent evidence for Spain suggests that a reduction in the price of public transport (as introduced in 2022 across Spanish cities) did not affect air quality – whereas better provision of public transport can improve their uptake (Albalate, Borsati and Gragera, 2022[31]). Comfort and availability seem to matter more for the use of public transport than price.

Box 4.5. Tax Revenue Implications of Decarbonising Road Transport

The OECD jointly with the International Transport Forum (ITF) has developed a model to analyse countries' potential revenue erosion in road transport due to reduced fuel consumption through decarbonisation and to estimate orders of magnitude of alternative tax policy response to compensate for the revenue loss.

"Tax Revenue Implications of Decarbonising Road Transport: Scenarios for Slovenia" provides an in-depth assessment of the transport tax system in Slovenia, where 14.6% of total tax revenue in 2016 was based on fuel and carbon taxes levied on diesel and gasoline used in road transport. It explores revenue impacts under current policy settings and for different scenarios on the take-up of new vehicle technologies. Against this background, the study analyses tax policy reforms with a 2050 horizon. The tax reforms include changes to fuel and carbon taxes, vehicle taxes and distance-based charges, and consider the potential behavioural responses to tax reform.

Key findings

- Under current policies, tax revenues from diesel and gasoline use in private cars is likely to decline substantially in the coming decades in Slovenia. The decline is driven by fuel-efficiency improvements of internal combustion engines and the penetration of alternative fuel technologies in the private car fleet.
- Gradually reforming the tax system, starting now, allows for a smooth adaptation to technological changes in the vehicle fleet and the timely implementation of accompanying measures. Fuel tax revenues from private cars erode only gradually over time as technological changes take time to percolate through the fleet, which leaves leeway to adapt tax policy.
- Shifting from taxes on fuels to taxes on distances driven can contribute to more sustainable tax policy over the long term, improving environmental and mobility outcomes. Such a tax system would gradually shift revenues to an alternative and likely more stable tax base, distance driven.

While the analysis focuses on the specific case of Slovenia, most of the recommendations are transferable to countries with comparable economic and tax system structure.

Source: OECD/ITF (2019[10])

Vehicle taxes can inadvertently set up a tension between revenue raising and environmental objectives. For example, one-off registration taxes for polluting vehicles may reduce fleet turnover and thereby technology take-up, because it can push households to delay buying a new car. Ad valorem taxes, which apply as a percentage on the sales price of a vehicle, that do not vary with environmental criteria tend to incentivise price-sensitive households to choose relatively cheaper or second-hand cars instead of cars with new and expensive technologies. Recurrent annual taxes, on the other hand, can provide regular incentives to invest in clean cars, either by providing lower rates or full exemptions. It has been argued though that vehicle purchase or registration taxes may be more effective in steering consumers' purchasing decisions than annual taxes, due to the myopia of consumers, who tend to attach greater importance to the immediate costs incurred through the registration tax and due to uncertainty about future circulation taxes (Comité de personas expertas, 2022[18]).

When vehicle taxes are used to reflect average emissions profiles of cars, they should include both local air pollution and carbon emissions. Focusing vehicle taxes only on fuel efficiency or CO_2 emissions can stimulate the sale of diesel cars despite their negative impact on health and the environment through air pollution, as has been experienced in the French feebate case (Box 4.6). The vehicle purchase tax in

Israel, for example, accounts for different emissions, including carbon dioxide, particulate matter and nitrogen oxides (Box 4.2).

These characteristics also affect the stability of revenue from vehicle taxation. A recurrent tax on vehicle ownership or circulation induces a stable revenue flow, whereas the one-off character of a registration tax renders revenue dependent on fleet turnover and the business cycle.

Box 4.6. The French feebate programme for CO_2-efficient motor vehicles

In 2008, France introduced a *Bonus/Malus* écologique on passenger vehicles registered in France. It levies a fee (malus) on the purchase or registration of highly polluting vehicles based on the CO_2 emission rate per kilometre as indicated on the vehicle registration certificate, while the revenues collected from the fee are used to support (bonus) clean vehicles.

In 2022, the bonus for new passenger cars with official CO_2 emissions of 0g per kilometre is EUR 6 000, while it is EU 1 000 for cars with emissions up to 50g of CO_2 per kilometre The malus applies to vehicles emitting 128 g of CO_2 per kilometre or more and ranges from EUR 50 to EUR 40 000. In 2022, a new weight component has been introduced to the fee to account for importance of external costs related to heavy vehicles, in particular sport utility vehicles (SUVs).

Feebates can be an effective tool to stimulate purchases of zero- and low-emission vehicles in a revenue neutral way. For example, Durrmeyer (2022[21]) finds that the French policy reduces average CO_2 emissions but came at the cost of creating more emissions of local pollutants. When designed carefully, feebates can be revenue neutral and not add pressure to the public budget. For example, the French feebate is achieving a positive balance since 2014, thanks to a careful design and regular revisions to account for recent developments.

One downside of such systems is that manufacturers can design vehicles in ways that lead to bunching, i.e. characteristics to situate just below the step increase (an alternative is to choose continuous and not a step function to define the rates of the fee) or the pivot point, which transforms the malus into a bonus. In addition, the French system is said to have led to increases in non-climate effects such as air pollution. Singapore's feebate includes air pollution in addition to CO_2 emissions.

Source: D'Haultfœuille, Givord and Boutin (2014[22]), Durrmeyer (2022[21]), ICCT (2022[34]) and Teusch and Braathen (2019[23]).

Current vehicle taxes do generally not account for the observed gap between real-life emissions and the advertised emission profiles derived from test cycles. For given tax rates, the increasing gap between test and real-world emission values leads to substantial amounts of tax revenue forgone in 11 European member states (Forum Ökologisch-Soziale Marktwirtschaft and Green Budget Europe, 2018[24])

Distributional consequences

The potential distributional consequences stemming from transport taxation need to be considered. Estimating and presenting the distributional effects along income and spatial dimensions can form a basis for designing policy measures to accompany tax reform. Accompanying measures may support households that are affected disproportionally by the reform in the short run but cannot easily adjust to the reform due to financial constraints or lack of alternatives. Another way could be to advertise and encourage the use and development of alternative travel modes (such as public transport or car-pooling). Bento (2009[37]) shows that different support measures (flat transfers, income-based transfers or distance-based transfers) can have important and different impacts on the distributional impacts of gasoline taxes.

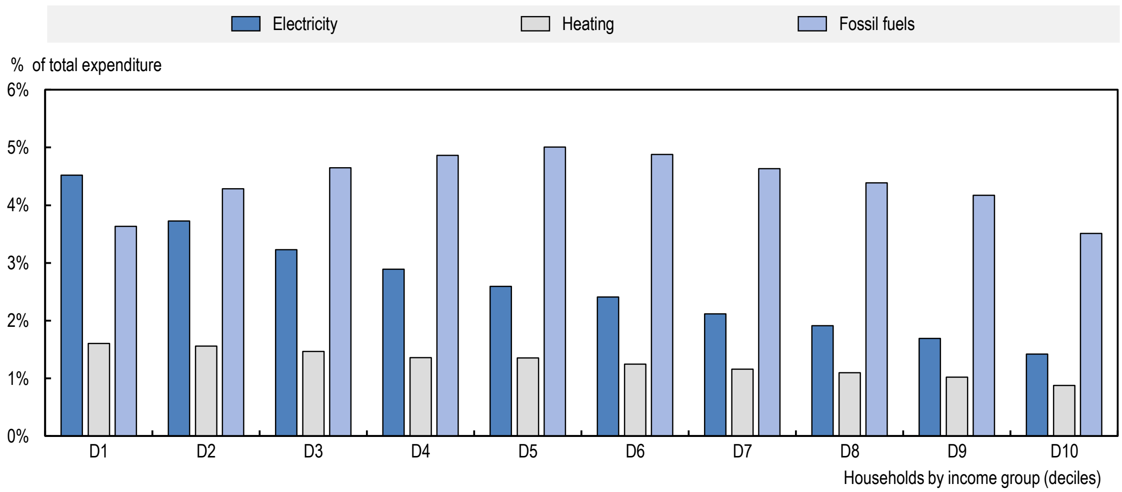
In the context of the recent energy price crisis, governments use different types of support to help vulnerable populations deal with raising prices, where well targeted support preferrable over price support. Supporting households is costly, but necessary for equity and energy affordability reasons and to sustain political support for the transition towards net-zero emissions. Many countries use price support, which seeks to reduce energy prices paid by consumers (e.g. through price controls, broad energy tax or VAT cuts). Price support seems easier to implement and avoids some of the political economy discussions but puts important pressure on government resources, in particular when it is not targeted but supports all types of households even those that can deal with the crisis by their own means. Price support would better be transformed into well-targeted income support that can contain expenditures and distributional concerns, although it may be administratively more costly. Targeting would best consider several dimensions, such as income, location, patterns of consumption (OECD, 2022[25]; OECD, 2022[26]).

Distributional effects of **fuel taxes** differ across countries, income levels (Sterner, 2012[27]; Flues and Thomas, 2015[28]) and geographic areas within a country, because differences in work distances play an important role in driving patterns. For example, fuel taxes may place a disproportionally high burden on households living in rural areas (see simulation in Bureau (2011[29]) and Spiller, Stephens and Chen (2017[30])), who cannot reduce driving needs in the short run by substituting towards public transport, moving location or changing jobs. Similarly, in the absence of revenue recycling, **distance-based charges** may have adverse effects on households with long commutes and that cannot easily adjust driving patterns in the short run. (Levinson (2010[31]) reviews the equity effects of road pricing.)

Recent studies by Alonso-Epelde et al. (2022[32]), for Spain, and Gore (2022[33]), across EU member states provide insights into distributional patterns of energy consumption across income, location and other socio-economic characteristics of households based on information collected through the EU Household Budget Surveys. They show that energy expenditures in total constitute a significantly larger share of total expenditure for lower-income compared to higher-income households. Looking at the expenditures for transport fuels specifically, they represent the largest share of total expenditure for middle-income households, because low-income households tend to own private cars relatively less often (Figure 4.6). When looking at the distribution across EU member states, household location (rural, intermediate, urban) has stronger implications for energy expenditure than household income. Middle-income households in rural areas spend a much larger share of their total expenditures on energy (notably on transport fuels) than low-income households in an urban context, due to commuting needs and less availability of good public transport alternatives. Similarly, expenditures can vary importantly with household size and composition.

Vehicle taxes may also have distributional consequences. Ad-valorem vehicle taxes may be progressive if low-income households purchase less expensive cars more often. If vehicle taxes are differentiated by emission bands, providing lower rates for more efficient vehicles, and if high-income households predominantly drive fuel-efficient cars, the tax could be regressive. Fully exempting electric vehicles from taxation likely benefits predominantly high-income households that can afford purchasing these vehicle types.

Figure 4.6. Structure of household energy consumption, Spain (% of total expenditure)



Note: Average household expenditure on different energy products (electricity, heating, fossil fuels – mainly private transport) as a share of total expenditure from the lowest-income decile (1) to the highest-income decile (10).
Source: Alonso-Epelde et al. (2022[32]).

StatLink https://stat.link/dc1b5j

Providing tax exemptions and benefits for electric vehicles are not only expensive in terms of government revenue foregone but are likely to be regressive too. Borenstein and Davis (2016[34]) show that an income tax credit in the United States for plug-in electric vehicles disproportionately benefits the top income quintile, receiving 90% of all credits. The authors explain this strong regressive effect by the fact that low-income households may not invest in expensive electric vehicles and by the non-refundability of the credit. A study by Muehlegger and Rapson (2018[35]) shows that means-tested subsidies directed towards low- and middle-income buyers in California achieve electric vehicle take-up in this segment of the market, but that the revenue cost is large.

Leroutier et Quirion (2022[36]) show that policies targeting local pollution of vehicles (e.g. low-emission zones) may be more regressive than policies that regulate CO_2 emissions of vehicles, such as CO_2 emission standards, in an urban context. This finding is likely driven by the observation that low-income households use pollution-intensive cars more often in the sample, while high-income households typically use car types with attributes that are associated with higher CO_2 emission factors, e.g. heavier, larger and more powerful vehicles.

Distance-related charges may have regressive impacts, as they typically do not consider the economic capacity of different drivers or their access to alternative travel modes (Labandeira, 2022[49]). Such risks could be mitigated by using part of the revenue for public transport improvements or direct transfers to low-income drivers that have no other choice in the short-term than using their car to reach work or school.

4.5. Alignment of Andalusia framework with sound environmental tax principles and strategic reform options

Based on the considerations of a good environmental tax policy framework outlined throughout Sections 4.2 to 4.4, this section discusses how the tax framework applicable in Andalusia aligns with such sound environmental tax policy principles. This section first assesses the alignment of the different tax types with external costs estimates. It then considers how the current framework compares against other important tax policy principles and policy objectives to finally develop strategic reform recommendations.

*4.5.1. **Fuel excise and external cost management***

As discussed in Section 4.4.2 fuel and carbon taxes are well suited to account for the external costs related to CO_2 emissions, because CO_2 emissions are proportional to fuel consumption. The current fuel excise rates that apply in Andalusia exceed a low-end estimates of climate costs (EUR 30 per tonne of CO_2). Translating this EUR 30 benchmark into fuel tax rates requires a diesel tax at 7.99 eurocent per litre and a gasoline tax at 6.86 eurocent per litre. The rates that a driver in Andalusia currently pays settle at 37.9 eurocent per litre for diesel and 50.4 eurocent per litre for gasoline, much above the low-end benchmark of climate costs.

This does not mean the Spanish fuel tax rates are necessarily too high. First, the EUR 30 per tonne of CO_2 reflects a low cost benchmark. Climate cost estimates are uncertain, many studies suggest higher costs already today or costs that increase in the future (Box 3.5). Second, external costs from fuel use are broader than climate costs and include air pollution and noise. Higher fuel taxes may be justified to cover these additional costs. As noted above though, the fuel tax is not an optimal instrument to cover non-climate costs from air pollution, noise or congestion. Such categories depend heavily on aspects that a fuel tax cannot map, such as vehicle technology (e.g. engine type), driving behaviour (e.g. acceleration, risk taking), or the specific driving location and pollution exposure that varies across geographic areas and the time of the day. Countries may use vehicle taxes to reflect average vehicle characteristics and cover location and time specific characteristics through distance-related fees or congestion charges.

Fuel excise rates as they apply in Andalusia vary across fuels and users, which leads to an unequal treatment of taxpayers, potential distortions, and inefficiencies relating to the objective of aligning the tax with external costs. Current rates reveal a common problem: the diesel-gasoline differential describing a situation where diesel use is subject to a much lower rate than gasoline, which cannot be justified on a pure energy basis, nor on a km driven basis, nor on an external costs basis. Equalising the rates is therefore a key policy recommendation (Crawford and Smith, 1995[2]; OECD, 2019[37]). In addition, agricultural fuels are taxed at lower levels and biofuels are exempt although they emit CO_2 emissions at the combustion level.

The unequal treatment of fuel taxation is common across countries (OECD, 2019[37]; OECD, 2022[8]) and Andalusia has little room for manoeuvre to adjust these rates since the fuel excise is regulated at the national level and in the framework of minimum rates set out in the EU Energy Tax Directive (EU ETD). The White Book for Tax Reform in Spain (Comité de personas expertas, 2022[18]) also suggests equalising the taxation on diesel with the one on automotive gasoline at the national level, in line with the currently proposed revision of the EU ETD.

4.5.2. Vehicle taxation and external cost management

Current vehicle taxes applicable on cars registered in Andalusia could be improved to better cover external costs. The annual ownership taxes levied by Andalusia's municipalities do not vary with CO_2 emissions and air pollution. The registration tax at the national level varies by vehicle type and CO_2 profile of car, but it does not differ according to air pollution profiles and is not updated regularly to account for technological advances. As noted in Section 4.4.2, vehicle taxes that only vary with CO_2 emissions, but not with other pollutants have been found to stimulate the sale of diesel cars despite their negative impact on health and the environment (see the French example, Box 4.6). Extending the vehicle taxes to cover *average* and updated emissions profiles of vehicles (CO_2 and air pollutants), may be useful to reflect environmental costs in the decision making of Andalusian car owners and encourage the purchase of less polluting vehicles or electric vehicles. Assuming that the number of trips will be the same, a vehicle with lower emissions would mean an improvement in terms of CO2 and air pollution levels. The use of electric vehicles would also improve noise pollution levels. Phasing-out the current exemption for rental cars, would allow to also incentivise tourist drivers using those cars.

However, such a reform would not cover spatial and time variation of air pollution and population exposure to it (Box 4.1). Similarly, vehicle tax reform will not be able to cover driving-related external costs like congestion and accidents that can be substantial. Distance-based charges would be a better option to cover such variation in external costs (as discussed below).

The possibility mapping in Section 2.4.2 points towards a potential opportunity to create a regional tax in Andalusia on vehicle emissions. If such a possibility is pursued, it is advisable to consider both CO_2 emissions and air pollution at the same time. The vehicle registration tax in Israel, for example, accounts for different emissions, including carbon dioxide, particulate matter and nitrogen oxides (Box 4.2) and could serve as example. A downside of this approach is the administrative complexity related to fine-tuning tax rates to many different emissions and related external costs. Varying tax rates according to environmental indicators such as the vehicle Euro standard could be an alternative approach.

The creation of an additional vehicle tax at the regional level, as implemented in Catalonia (Annex Table 4.A.2), requires careful thinking. From a taxpayer perspective the compliance burden may increase significantly when vehicle owners are subject to three different, but similar taxes (the existing national registration tax, the potentially new regional tax and the existing municipal tax on circulation). In addition, the White Book for Tax Reform in Spain suggested amending the existing national vehicle tax to include environmental criteria. If such reform took place, the potentially new national tax would make a regional tax on vehicle emissions redundant and replace existing regional taxes covering the same taxable event. If the national reform is not pursued, several of the experts' recommendations may be useful to advance action at the regional level.

The White Book for Tax Reform in Spain suggests different reform options of the registration tax at the national level: either to modify the existing national registration tax or to change the entire tax structure. In the *modification scenario*, the experts suggest adapting the rate of the tax to reflect recent technological advances in the sector. Specifically, they suggest extending the number of brackets and to raise tax rates in order to provide a stronger incentive for the purchase of low-emission vehicles. As the tax has not been modified in a long time, its capacity to provide incentives to invest in clean vehicles is limited. In addition, they suggest adding a surcharge based on vehicle weight, which increases external costs, like in the recent reform of the French feebate (Box 4.6). In the *reform scenario*, the experts suggest replacing the ad-valorem levy applicable on the vehicle price by a unitary tax levied on the reported emissions of the vehicle to avoid low tax rates driven mainly by low vehicle prices. Similarly, for the annual circulation tax, the experts suggest incorporating environmental considerations in the calculation of the rates, including a vehicle's category under the Euro standards for example or other environmental impact indicators.

An interesting alternative approach to provide strong incentives to buy and drive clean vehicles through a revenue-neutral approach, is the feebate structure discussed above. While a fee would penalize the use of polluting vehicles, the revenues collected from the fee would be used to support the purchase of clean vehicles. If such an approach is chosen it would best cover external costs from both CO_2 and air pollution and provide support to zero-emissions vehicles only. (Current feebates typically apply support to clean vehicles and efficient internal combustion engines that still emit CO_2 and air pollution (ICCT, 2022[39]).)

4.5.3. Distance-based charges and congestion charging

Currently no distance-based charge or congestion charging exist in Andalusia, although distance-based charges are a superior tool to manage road transport thanks to their ability to reflect external costs related to driving as mentioned throughout the analysis (Section 4.4.2). Potential reasons for the lack of distance-related pricing may relate to political expediency, as such measures may be seen as unpopular, in particular when the public transport system is perceived as a suboptimal alternative to car travel due to concerns about quality of service and travel time. Other reasons may be related to efforts to develop certain activities (tourism for example) or geographic areas. When introduced, such charges can vary depending on the average pollution profile and weight of a vehicle and as such reflect the costs related to air pollution and road damage. They can also mirror spatial and temporal variation in driving; thereby reflecting population exposure to external costs, like air pollution and noise, and integrating additional costs related to congestion during peak hours and in specific locations.

Benefits from distance-based charging are also evident in terms of their revenue stability. The tax base driving likely erodes less quickly than the tax base energy use (Box 4.5). Shifting from taxes on fuels to taxes on distances driven can therefore contribute to more sustainable tax policy over the long term, improving environmental and mobility outcomes.

A downside of distance-based charging is their complexity, high administrative and implementation costs, as well as privacy concerns. Technological progress in charging techniques allows systems to become fine-tuned to particular circumstances, drive costs down in the future and remedy privacy concerns (see Section 4.4.2). An alternative means to charge distances driven is to apply simple odometer readings which assess distances travelled by a vehicle without collecting detailed information on when and where the driving took place. However, charging based on odometer reading cannot implement rates that vary with location and congestion levels and will only be able to cover cars registered in Andalusia. Nevertheless distance-related charging based on odometer reading aligns better with external costs than not having distance-related charging at all.

Emissions in road transport that relate to tourist driving or vehicles entering the region from outside and drive through are currently not covered by the ownership tax, for example because rental cars are exempt. They will also not be covered by distance-based charges that are implemented through odometer reading, although a fixed fee could be applied to non-resident drivers. Removing the vehicle tax exemption of rental cars would be a first step in aligning tourist activity with external costs. Tourist drivers can also be included in distance-based systems or congestion pricing if carefully designed. For example, the road tolling system on expressways and motorways in France (péage) charges all vehicles that pass toll gates independently of their origin, including tourist drivers. In France, most of the roads are operated by commercial companies, who manage the network and set the rates.

In addition, local congestion charging should be considered to reflect the external costs of road transport in urban areas, related to congestion and air pollution. Adame et al. (2014[7]) show that air pollution from CO, NO, NO_2 and PM10 is highest in Andalusian urban centres – where in addition, population density and as such exposure to pollution is highest (Box 4.1). Well-designed congestion pricing that charges vehicles for circulating in particular areas or cities can translate the health-related costs from air pollution and congestion costs in charges for drivers to affect their behaviour. Congestion charges can be usefully combined with the implementation of low emission zones, as is the case of London for example, or other regulatory measures to decongest urban areas (e.g. pedestrianisation of spaces, creation of green areas, densification and improvement in the accessibility of public transport, improvements of infrastructure for alternative means of transport – such as bicycles).

Because air pollution is a very local effect, congestion charging may best be implemented at the regional or local level, where opportunities exist to follow the spatial variation of pollution and their impacts relatively better, and to implement such charges in those cities or areas where negative effects from driving are most important. Congestion charges can usefully be combined with air pollution standards, such as Euro standards, that increase in stringency over the years.

Congestion charges are also recommended in the White Book for Tax Reform in Spain to charge for the external costs related to congestion and air pollution in urban centres. To mitigate the potentially regressive effects of such measures, part of the revenue is suggested to be invested in public transport improvements or transferred to the most affected population through direct compensatory solutions (e.g. transfers, aid for changing vehicles).

Political and social resistance to tax reform that focuses on implementing and improving distance-based charges and congestion pricing requires well-designed policies supported by a tailored and effective communication campaign, which is essential for the success of comprehensive tax reform in the road sector, given the involvement of numerous stakeholders. Early and careful preparation and implementation is required to manage resistance and opposition. Discussions with stakeholders and a gradual implementation approach (e.g. through trial periods, roundtables) will help reduce the risk of disruptions. (See experiences with discussing road pricing in Brussels (Box 4.3) and implementing congestion charging in Stockholm (Box 4.4).) It will also create room for carefully designing policies, developing the necessary accompanying measures and tailoring communication.

Accompanying measures could encourage the development of alternative travel modes, such as public transport, or take the form of support to those households that are affected disproportionally by the reform in the short run but cannot easily adapt to the reform due to budget constraints or missing public transport opportunities. A good understanding of the potential negative consequences needs to be developed (e.g. how changes in tax liability from reform are distributed along income and spatial dimensions) to design appropriate policy the short run, but cannot easily adapt to the reform due to budget constraints.

4.6. Key findings and strategic recommendations

On a pure external cost basis, the alignment of the current Andalusia tax framework could be improved. The design of existing tax instruments does not align well with external costs considerations. Fuel taxes, for example, apply heterogeneously and are not based on carbon content. Also, no specific tax instrument applies to incorporate costs from air pollution. And although external costs related to congestion and accidents risk to be substantial – in particular at the local level, they are not considered explicitly in the current tax system applicable in Andalusia. Distance-based charges or congestion pricing is currently not considered for passenger cars although they align better with most of the external costs in road transport than fuel and vehicle taxes do.

While fuel excise rates are regulated at the national and EU level, the sub-national level is well-placed to manage pricing of air pollution and congestion. Taxes (or feebates) targeted to the emissions of vehicles or congestion pricing in urban centres can help manage local congestion problems and improve local air quality.

Focusing tax reform on trying to mimic external costs perfectly provides only little answers to additional policy considerations, such as the transition to a zero-emission transport sector. It also risks binding administrative resources that are scarce and may better be spent on focusing on key aspects of the most pressing policy needs. Policy considerations going beyond external costs management are discussed in Section 4.2.

The policy objective to implement the zero-emissions transition in the road transport sector is likely the most pressing need. This aligns with countries' commitments made under the Paris Agreement to limit increases in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degree Celsius. National climate neutrality, i.e. reaching net zero-emissions by 2050 country-wide, is also a key objective for the Spanish national government. In this context, the 2021 Andalusia Climate Action Plan aims for a 30-43% reduction of GHG emissions by 2030 (compared to 2008 levels) in the transport and mobility sector but misses precise objectives for 2050. Accelerating progress towards achieving the planned reductions by 2030 is necessary, as well as a plan for 2050 objectives. Spain has also committed to phase-out the sales of passenger cars and light commercial vehicles that do not qualify zero-emissions vehicles by 2040.

The Andalusia government is encouraged to decide on a ranking of policy objectives before starting a comprehensive tax reform process. If the main goal is to be serious about climate policy and decarbonising the road transport sector, administrative resources may better be spent in designing a reform that pushes zero-carbon vehicles on the street, instead of engaging in marginal but burdensome reform to align the vehicle tax better with external cost estimates. To tackle air pollution relying on emissions standards of cars and regulating low emission zones for example can prove administratively less burdensome than aligning tax rates with external costs

Different policy levers need to be pulled to achieve zero-carbon in the necessary timeline, which come with different costs and benefits. For example, through a combination of policy instruments, Norway became a leader with respect to electric vehicle penetration in the fleet. Their toolbox comprises clear objectives for the penetration of zero-emissions vehicles combined with well-designed carbon and energy taxation and technology support for zero-emission vehicles through subsidies and tax incentives (Box 4.7). The instruments have been reviewed regularly to avoid excessive spending and align support. Nevertheless, important fiscal resources are behind these efforts.

A combination of tax elements may help Spain and Andalusia to push for a clean passenger vehicle fleet. It will be important to expand and adapt the use of tax approaches while the future policy mix evolves including changes in regulatory approaches, e.g. implementation of low emission zones, upcoming Euro 7 standard, etc.

First, consistent fuel excise and carbon pricing will align climate incentives across the economy and provide strong signals that fossil fuels are not the future. These, considerations are relevant for the national or even the EU level.

Second, vehicle taxes could be reformed to favour only zero-emission vehicles (and not internal combustion engines, even the very efficient ones, as they are still responsible for external costs, which may delay a shift towards full decarbonisation) and to reflect air pollution costs. Relying on Euro standards that increase in stringency over time may be preferable to chasing the nitty gritty of air pollution costs. The vehicle tax could also be transformed into a feebate that penalises ICEs and large vehicles and subsidises zero-emissions vehicles of regular size. Whether such reform would best happen at the national or regional level depends on advances of vehicle tax reform at the Spanish level.

Otherwise, tax incentives provided through the CIT or PIT system can further push the adoption of clean vehicles. Tax incentives can help overcome consumer myopia, financial constraints and other constraints that prevent households from making the relevant investments. But they come with costs that need to be considered. Tax incentives involve forgone tax revenue - akin to expenditures from direct subsidies - but with the downside to be less transparent to the broader public. They also risk to predominantly benefit rich households. Means-tested subsidies that are directed towards low- and middle-income buyers may overcome such shortcomings.

Third, implementing congestion pricing at the regional or local level will help manage local congestion problems while improving local air quality.

Finally, preparing for increased use of distance-based charges. If not pursued at the national level, local level action in this area can bring local benefits (better traffic management, reduced congestion, fewer accidents, lower air pollution, revenue).[4]

While the principal objective of such tax policy choices may be to direct drivers and car-owners towards buying and using zero-emission vehicles to expedite the transition to net zero, they have budgetary impacts that should be considered when designing environmental policy, as should be their potential distributional effects. For example, if the zero-emissions objective in transport is pursued successfully, revenues from energy taxes are likely to erode.

Finally, taxation is not the only instrument in the climate policy toolkit. Synergies and coordination with other policy instruments will be needed to reach success. Several other policy instruments are set at the national level or at the level of the European Union. These include the European regulation on GHG emissions from vehicles, regulations on emissions of air pollutants, Euro standards, the EU Energy Tax Directive, the EU Emissions Trading System, including the potential extension to road transport, and the Spanish National Fund for the Sustainability of the Electricity System (FNSSE). These policies are currently being reviewed with the intention of increasing environmental policy-stringency, particularly in relation to carbon neutrality. It national level policies become more ambitious, the scope for regional level activity declines.

Electrification of the car fleet can only be successful, if accompanied by significant investment in charging infrastructure for electric vehicles, and will contribute to the net-zero transition only if electricity production is decarbonised.

Box 4.7. Decarbonising road transport in Norway

Norway is one of the leading countries to adopt electric vehicles. Over the last 10 years, the country increased the share of electric vehicles in vehicle sales from 1% to 65% in 2021. A national objective asks new passenger and light-duty vehicles sold in 2025 to be zero-emission (electric or hydrogen).

The ambitious policy objective is supported by an extensive instrument package that explains the success of electric vehicles (EVs) in the country. These include but are note restricted to

- Excise taxes and an explicit carbon tax on fuel used in road transport;
- Registration tax based on CO_2 and NO_x emissions; exemptions for EVs;
- Annual motor vehicle tax based on fuel and particulate filter use; exemptions for EVs;
- VAT exemptions and reduced VAT rates: since 2001, electric vehicles are VAT exempt. Fossil fuel vehicles pay the standard 25% rate. As of 2023, the VAT exemption for EVs will be amended. The VAT rate increases with the price of the car, including EVs;
- Exemption and reduced charges on toll roads and ferries: until 2017, EVs were exempt from paying for their use of roads or ferries. The Parliament has agreed on implementing a 50% rule: counties and municipalities cannot charge more than 50% of the price that fossil fuel cars pay on ferries, public parking and toll roads. A rule of maximum 50% parking fee at public parking for zero-emission cars is not yet implemented; and
- Additional preferential treatment of EVs has applied or still applies in the context of the taxation of company cars and for charges at the local level, e.g. use of bus lanes and free municipal parking.

These instruments have been combined with policies that promote investments in charging infrastructure and public procurement that favours zero-emission vehicles. For instance, between 2017 and 2021, legislation established a “charging right” for people living in apartment building. A well-organised charging network has been established to ensure feasibility of long-distance trips with fast charging stations on all main roads in Norway. As of February 2022, more than 470 000 EVs and 4 600 cars can fast-charge at the same time in Norway.

Source: Annex 4.A

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Annex 4.A. Detailed case studies: road transport

This section presents selected case studies in the area of greenhouse gas emissions and air pollution across the world with a focus on passenger cars.

France: Vehicle Purchase Feebate

Annex Table 4.A.1. Vehicle Purchase Feebate (France)

Legal bases	Energy code Articles D255-1 to D251-13
Objective	To reduce transport CO_2 emissions by providing consumers with incentives to purchase more fuel-efficient vehicles.
Level of responsibility	Central government (France)
Tax setter(s)	Central government (France)
Revenue beneficiary(ies)	Central government (France)
Tax payer(s)	Vehicle buyers or lessees (with contracts greater than two years)
Tax base (including main exemption(s), credits or deductions)	The buyers of vehicles emitting CO_2 above the fixed threshold pay a fee for their emissions, whilst the purchasers of electric or hybrid vehicles receive a rebate depending on the vehicle price, capped to a maximum.
Tax rate(s) (including their calculation)	The French government establishes vehicles' CO_2 emission thresholds. More specifically, in 2022: • Fee: buyers of vehicles emitting more than 127g/km must pay a fee between EUR 50-40 000 according to the level of emissions. Vehicles over 1 800kg also need to pay an additional EUR 10 per kg exceeding the 1 800kg threshold. • Rebate: purchases of electric or plug-in hybrid vehicles emitting less than 20g/km receive a rebate of 27% up to EUR 6 000 or EUR 1 000, respectively. The thresholds are updated annually and are linked to the values established by European Union.
Governance and implementation	The system is calibrated to be cost-neutral, and all tax income collected from the sales of higher-emission vehicles should be used to subside the purchase of less-emitting cars. Nevertheless, the system ran in deficit until 2014, when it was recalibrated and achieved a constant positive balance since then.

Environmental, social & health impacts	The policy seems to have supported a shift towards sales of cleaner cars. For example, the market share of class B vehicles (lower emitting) increased from 20% to 50% one year after the scheme's implementation. Over the same period, the share of class E vehicles (higher emitting) decreased from 15% to 5%. However, the average emission of new vehicles decreased by only 5% as many buyers made only marginal adjustments in their purchase decisions (Teusch and Braathen, 2019[38]). Between 2008 and 2016, the average CO_2 emission from French vehicles declined from 150g/km to 110g/km (Wappelhorst, 2022[39]) (Wappelhorst, 2022[39]). The feebate also employed multiple marketing strategies that contributed to its effectiveness (Kassirer, 2020[40]).

Source: (Legifrance, 2018[41]; Yang, 2018[42]; Teusch and Braathen, 2019[38]; Kassirer, 2020[40]; Wappelhorst, 2022[39]).

Spain: Catalonian Tax on Emissions from Motor Vehicles

Annex Table 4.A.2. Catalonian tax on emissions from motor vehicles (Spain)

Legal basis	Catalonian Law Decree 33/2020
Objective	To tax the CO_2 emissions from motor vehicles (Agencia Tributaria de Catalunya, 2022[43]).
Level of responsibility	Region (Autonomous Community of Catalonia)
Tax setter	Region (Autonomous Community of Catalonia)
Revenue beneficiary	Region (Autonomous Community of Catalonia)
Tax payer	Vehicle owners that reside in the region
Tax base (including main exemptions, credits or deductions)	The tax base are the CO_2 emissions, measured in grams of CO2 per kilometer, from vehicles of the following categories: (1) Vehicles of categories M1 (vehicles mainly for the transport of people and their luggage) and N1 (vehicles mainly for the transport of goods with a maximum mass not exceeding 3.5 tons); and (2) Vehicles of categories L3e (two-wheel motorcycles), L4e (two-wheel motorcycles with sidecar), L5e (motor tricycles) and L7e (heavy quadricycles). Old classic vehicles (removed from the Vehicle Registry due to the age of the model) and those not generating emissions (e.g. 100% electric vehicles) are not subject to the tax. Exemptions apply to official public vehicles, public service vehicles (e.g., ambulances), vehicles of reduced mobility owners, and consular and international organisations' vehicles.
Tax rate(s) (including their calculation)	The tax is paid annually. The tax rate is progressive and depends on the CO2 emissions profile presented in the certificates issued by the vehicle manufacturer. The Catalonian government publishes the rates annually. The tax rates for 2022 are presented in Annex Table 4.A.3 for vehicle categories M1, L3e, L4e, L5e and L7e and Annex Table 4.A.4 for vehicle category N1. A formula applies when vehicles do not have official pollution data issued by the manufacturers.
Governance and implementation	There was a debate about the constitutionality of this annual tax and its potential overlaps with the Spanish national tax on the first registration of motor vehicles (a one-off registration tax that also varies with the CO_2 emissions profile of the vehicle). Nevertheless, this tax was ruled constitutional by the Spanish Constitutional Court (STC 87/2019, 20 June, FJ 19), which declared: "The regional tax is linked to the "polluter pays" principle. As its periodic nature encourages, insofar as possible in a high-value good such as motor vehicles, not only the first purchase of low-polluting vehicles, but also the replacement of existing vehicles with less polluting ones. It thus aims to change behaviour or at least make people pay for it [STC 53/2014, FJ 6 c)], an aim absent in the State tax at least in this second case of renewal of the vehicle fleet, since, being an instantaneous tax, the State tax is levied at a single stage on the first registration of the vehicle, boat or aircraft, so that its replacement would always involve the creation of a new taxable event that would be avoided, however, if the vehicle already owned and for which its owner has already paid the tax is kept" (STC 87/2019, FJ 19).

Source: (Generalidad de Cataluna, 2020[44]; Agencia Tributaria de Catalunya, 2022[43]).

Annex Table 4.A.3. Tax rates for vehicle categories M1, L3e, L4e, L5e and L7e per (2022)

Level of CO_2 emissions as advertised in the official emissions profile CO_2	Marginal rate (in EUR per g CO_2/km)
Until 95 g/km	0
More than 95 g/km and until 120 g/km	0.70
More than 120 g/km and until 140 g/km	0.85
More than 140 g/km and until 160 g/km	1.00
More than 160 g/km and until 200 g/km	1.20
More than 200 g/km	1.40

Source: (Agencia Tributaria de Catalunya, 2022[43])

Annex Table 4.A.4. Tax rates for vehicle category N1 (2022)

Official emissions of carbon dioxide	Marginal rate (in EUR per g CO2/Km)
Until 140 g/km	0
More than 140 g/km	0.70

Source: (Agencia Tributaria de Catalunya, 2022[43])

Israel: Vehicle Purchase Tax

Annex Table 4.A.5. Vehicle purchase tax (Israel)

Legal basis	Green purchase tax reform from 2009
Objective	To internalise the external costs that vehicles pose to society (OECD, 2016[45]).
Level of responsibility	Central government (Israel)
Tax setter	Central government (Israel)
Revenue beneficiary(ies)	Central government (Israel)
Tax payer(s)	Vehicle owners
Tax base (including main exemption(s), credits or deductions)	The tax base is the vehicle purchase, with rates differing with the pollution grade. In order to incentivise the purchase of hybrid and electric cars, the tax rate was simplified and limited to 30% of the car price for hybrids and 10% for plug-in vehicles in 2009. Tax credits are also given to additional safety mechanisms, such as ABS+4 airbags and emission-lowering devices (e.g. catalytic converters and diesel particulate filters).
Tax rate(s) (including their calculation)	The tax is paid once at the purchase of the vehicle, at a rate of 83% of the price of the vehicle. Deductions (up to NIS 16 629 or EUR 4 722) apply to all vehicles with pollution ratings (reflecting their emission levels) below 15. The pollution grades are calculated using a formula incorporating the five most relevant and harmful pollutants (CO, HC, NOx, PM, HC and CO2), as defined by the central government, with parameters reflecting their estimated social costs. These are updated every two years to reflect the changes resulting from real GDP and population changes. Since the effective purchase tax is a function of the car price and the pollution rating, the cheaper and the less pollutant the car, the lower the tax.
Governance and implementation	In 2006, a pluri-disciplinary commission was established to design the tax. The commission includes different ministries, such as the Ministries of Finance, Transport and Road Safety, National Infrastructure and Environmental Protection, as well as car engineers, industrial engineers and economists. The objective was to formulate a policy to reduce air pollution by estimating and internalising several externalities of transportation. After reviewing alternatives, the commission opted for the tax on vehicle purchases, which differentiated the tax by the pollution level they caused per litre of fuel. Opposition and general uncertainty about the tax were overcome by comprehensive dialogue and public relations campaigns led by the authorities targeting the general public and those particularly against the tax, such as car importers who pushed for a tax based solely on CO2 emissions, like in Europe. To gather support from this group, the governments worked with them to build a full and comprehensive database of all car models and pollution volumes, which took over a year. To effectively generate the intended increase in the share of less polluting vehicles, it became mandatory to mark the green grade and fuel consumption at every advertisement, point of sale and the Ministry of Transport website. Additional measures were taken to renew the fleet, including a scrapping scheme for disposing of vehicles older than 20%. This successful scheme was renewed in 2013.
Environmental, social & health impacts	The share of heavy-polluting cars (bands 13-15) was reported to have been reduced from 23.5% in 2009 to 7.4% in 2014, while the share of low-polluting vehicles increased from 1.8% to 47.2% (OECD, 2016[45]).

	The inclusion of local air pollutants in addition to CO2 seem to have reduced CO2 emissions, while avoiding a shift towards sales of diesel cars, which impose a higher damage to public health through air pollution compared to gasoline cars (OECD, 2020[46]). However, by decreasing the final prices of cars, the tax may have contributed to an increase in car ownership in Israel (17% between 2013 and 2016), exacerbating related issues like congestion, infrastructure erosion, noise, and pollution.

Source: (OECD, 2016[45]; OECD, 2020[46])

Sweden: Stockholm Congestion Tax

Annex Table 4.A.6. Stockholm congestion tax (Sweden)

Legal bases	Act (2004:629) on the congestion tax
Objective	To reduce congestion and improve accessibility (Transport Styrelsen, 2021[47])
Level of responsibility	Central government (Sweden)
Tax setter(s)	Central government (Sweden)
Revenue beneficiary(ies)	Central government (Sweden) and municipality (Stockholm)
Tax payer(s)	Vehicle owners
Tax base (including main exemption(s), credits or deductions)	All vehicles passing tolling stations in the city centre during charging hours are liable. The tax applies to vehicles registered in and outside of Sweden. The system works with automatic number plate recognition technology. Payment gates are equipped with number plate recognition cameras which photograph vehicles' plates and cross-references with Sweden's National Vehicle Registry to record the charge. Vehicles that are exempt from the tax include emergency vehicles, buses, diplomatic vehicles, disabled person vehicles, military vehicles, hybrid or electric cars, motorcycles and mopeds, and foreign-registered vehicles. Furthermore, traffic to and from Lidingö connected is exempt from the tax, provided that the vehicle passes the Ropsten payment station and some other payment station within 30 minutes of each other. The reason is that vehicles can reach the area of Lidingö from Stockholm only through roads that are part of the congestion charge zone. The Essingeleden motorway (E4) that passes through the charging area is also exempt because it is the main road when travelling past central Stockholm.
Tax rate(s) (including their calculation)	The rate of the charge varies according to the time of day when the vehicle passes toll stations and according to driving during peak or off-peak season (see Annex Table 4.A.7). The peak season is from 1 March to the day before Midsummer Eve and between 15 August and 30 November. The rest of the year is off-peak season. The tax is not charged on public holidays, as well as certain days before a public holiday and during July (except the first week of July). The maximum amount per day and vehicle is SEK 135 (EUR 9.6).
Governance and implementation	The Stockholm congestion tax was introduced as a trial in early 2006. The trial was followed by a period without taxation and a referendum, where Stockholm residents voted for the permanent implementation of the tax. Before the trial, the main barriers to congestion charging were public and political opposition which feared that license plate numbers would be misidentified (resulting in cour appeals or refusals to pay) or that the system would favour wealthier inner-city residents and punish lower-income people living outside the city (Tools of Change, 2014[48]). None of the public objections materialised: false plate identifications were kept to a minimum (97% accuracy) and calculations showed that the wealthier population in the inner city paid more charges than residents. The Royal Institute of Technology conducts repeated surveys to evaluate the public support for the tax, which was lowest just before the trial, increased after it began, and reached about 70% of public support in 2011. All driver categories demonstrate support for the charge, with "have no

	car" and "pays often" demonstrating the highest and lowest support rates, respectively (Tools of Change, 2014[48]).
Environmental, social & health impacts	It is reported that the congestion charge has come with traffic reductions of around 20% that have held constant over time (Annex Table 4.A.8). The highest decline was reported in the afternoon (-23% between 4pm and 6pm) followed by the morning (-18% between 7am and 9am), which demonstrates that a larger share of travels is made in the afternoon and that there is a higher flexibility in the departure from working hours. Additionally, the net social benefit of the congestion tax was estimated at approximately EUR 65 million per year, with the main drivers being the shorter and more reliable commutes, lower GHG emissions (between 10-15% compared to 2005 levels), improved traffic safety, public transit revenues and health and environmental impact (airborne pollutants reduced between 10 and 14%) (Tools of Change, 2014[48]). Finally, the system is said to have led to many drivers switching from private to public transport, which increased the number of passengers in the public transit system by approximately 4-5%. Due to investments in public transport capacity, this increase was reported to not result in a general crowding in the public transport (Tools of Change, 2014[48]).

Source: (Tools of Change, 2014[48]; Road Traffic, 2020[49]; Transport Styrelsen, 2021[47])

Annex Table 4.A.7. The Stockholm congestion charge, amount of the charge per time interval and peak vs. off-peak season in SEK and EUR

Hours	Off-peak season tax amount in SEK (EUR)	Peak season tax amount in SEK (EUR)
6:00-6:29	15 (1.37)	15 (1.37)15
6:30-6:59	25 (2.28)	30 (2.74)
7:00-8:29	35 (3.19)	45 (4.11)
8:30-8:59	25 (2.28)	30 (2.74)30
9:00-9:29	15 (1.37)15	20 (1.83)
9:30-14:59	11 (1.00)	11 (1.00)
15:00-15:29	15 (1.37)15	20 (1.83)20
15:30-15:59	25 (2.28)25	30 (2.74)30
16:00-17:29	35 (3.19)35	45 (4.11)
17:30-17-59	25 (2.28)	30 (2.74)30
18:00-18:29	15 (1.37)15	20 (1.83)20

Source: (Transport Styrelsen, 2021[47]).

Annex Table 4.A.8. Estimated yearly reduction of traffic (in vehicle kilometers) compared to 2005 levels

	2006a	2007b	2008	2009	2010	2011	2012	2013
Traffic reduction from charges, compared to 2005	-21.0%	-18.7%	-18.1%	-18.2%	-18.7%	-20.5%	-21.4%	-22.1%

Note: Charged weekdays are 6am to 7pm. Calculations are not available for 2012-2013 for the second row.
2006a is the trial period from January to July 2006 and 2007b is after the tax was introduced in August.
Source: (Tools of Change, 2014[48])

Norway: Electric Vehicle Support in Norway

Norway is leading the world in electric car adoption. Over the last 10 years, the country increased the share of electric vehicles in automobile sales from 1% to 65% in 2021 (Time, 2022[50]) (Time, 2022[50]). Additionally, in the National Transport Plan for 2018-2029, the Norwegian government presented three main goals to achieve "a transport system that is safe, enhances value creation and contributes to a low-carbon society": (i) improving the mobility within the country, (ii) reducing accidents in line with the Vision Zero plan, and (iii) reducing climate emissions towards a low-carbon economy and decreasing other negative environmental impacts (Norwegian Ministry of Transport and Communications, 2017[51]) (Norwegian Ministry of Transport and Communications, 2017[51]). Among this plan, the government set several targets to decarbonise the national fleet (Regjeringen, 2021[52]) (Regjeringen, 2021[52]):

- New cars and light vans must be zero-emission vehicles from 2025 (including electric cars and hydrogen cars),
- New city buses must be zero-emission vehicles or use biogas in 2025,
- New heavy vans, 75% of new long-distance buses and 50% of new trucks must be zero-emission vehicles by 2030,
- The distribution of goods in the largest city centres must be close to zero emissions by 2030.

The ambitious policy objective is supported by multiple policy instruments, including tax incentives and perks over fossil fuel car owners, which explain the success behind the increasing electric vehicle fleet in the country (Elbil, 2022[53]) (Elbil, 2022[53]). These include:

- Excise taxes and an explicit carbon tax on fuel used in road transport: explicit carbon prices, which include both ETS permit prices and carbon tax, covered 80.8% of greenhouse gas emissions in CO_2 eq in 2021 (51.2% and 54.3% respectively), while the fuel excise taxes, which are an implicit type of carbon pricing, covered 26.5% of emissions in 2021 in Norway. The explicit carbon price represented EUR 60.3 per tonne of CO_2 eq on average in 2021 (EUR 33.2 for the carbon tax) and EUR 33.2 per tonne of CO_2 eq for the fuel excise taxes (OECD, 2022[54]; OECD, 2022[55]).
- Registration tax: rates vary according to weight, CO_2 and NOx emissions. When information about emissions is unavailable, the tax is calculated based on cylinder capacity. Exemptions apply to electric vehicles, while plug-in hybrid and flexifuel (i.e. that can use fuel with at least 85% ethanol) benefit from rebates (OECD, 2020[56]).
- Traffic insurance tax (replaced the annual motor vehicle tax since 2018): the tax is based on fuel and particulate filter use. The daily charges are NOK 9.47 (EUR 0.92) for diesel cars without factory-fitted particle filters and NOK 8.12 (EUR 0.79) for other cars, NOK 5.65 (0.55) for motorbikes and NOK 1.31 (EUR 0.12) for mopeds and tractors. Electric vehicles are exempt (OECD, 2020[56]) (OECD, 2020[56]).
- Exemptions and reduced VAT rates: since 2001, electric vehicles are VAT exempt in contrast to fossil fuel vehicles, which pay a standard 25% VAT. As of 2023, the VAT exemption for electric vehicles will be replaced by a new VAT scheme where the VAT rate increases with the price of the car (i.e. the more expensive the car, the higher the VAT rate).
- Exemption and reduced charges on toll roads and ferries: between 1997 and 2017, electric vehicles did not have charges to pay for their use of roads or ferries. The Parliament has agreed on implementing a 50 % rule: counties and municipalities cannot charge more than 50 % of the price that fossil fuel cars pay on ferries, public parking and toll roads.

These instruments have been combined with policies that promote investments in charging infrastructure. For instance, between 2017 and 2021, legislation established a "charging right" for people living in an apartment building. A well-organised charging network has been established to ensure the feasibility of long-distance trips with fast charging stations on all main roads in Norway. Since 2015, the state has invested over NOK 136 million (EUR 13.2 million) in charging infrastructure, and as of February 2022, more than 470 000 of electric vehicles and 4 600 cars can fast-charge at the same time in Norway (Elbil, 2022[53]) (Elbil, 2022[53]).

Belgium: Brussels Road Pricing

SmartMove is a tax project, which aims to improve mobility in the Brussels Region. The goal is to reduce the externalities that traffic imposes on the environment, health, economy and quality of life (time lost in traffic jams), and the government hopes to reduce individual car trips by 25%. To this end, it aims to substitute the current “ownership tax” levied on vehicle possession for a tax based on actual kilometres driven. The tax is planned to be based on the distance driven, time of driving and engine capacity of the vehicle to better capture the negative environmental impact of driving (Politico, 2020[57]) (Politico, 2020[57]). Reduced rates would be offered outside peak hours. All the information needed to inform the amount of tax due would be recorded through the SmartMove app and rely on camera technology currently used in the region’s low emission zone (Reveal, 2020[58]) (Reveal, 2020[58]).

The basic levy is planned to be EUR 1 in off-peak hours and EUR 2 during peak hours, which would be corrected for engine power (from 20 fiscal horsepower onwards, the multiplication becomes six, the highest rate and for those who drive an average car the rates become two or three) and added to an additional charge per kilometre driven (17 cents per kilometre during peak hour and 9 cents during off-peak hours). Driving at night or over weekends and holidays would be free of charge, and all income would be reinvested in mobility measures (The Brussels Times, 2020[59]) (The Brussels Times, 2020[59]).

This tax would substitute the vehicle ownership tax in the Belgian Region of Brussels. Drivers from the other two Regions (Flanders and Wallonia) risk being subject to both taxes, which has led to strong opposition in these Regions. The implementation of the project will depend on finding an agreement with the other Regions and is currently stalled. In recent months, the Region of Brussels has been considering a large-scale test phase (Bruzz, 2022[60]).

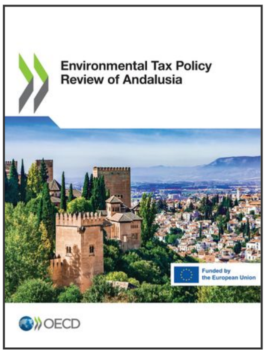
Notes

[1] The entire Section 4.4 draws importantly from OECD/ITF (2019[10]).

[2] During the ongoing energy price crisis in 2021/22, Spain has adjusted downward some of these rates. For example, a reduced VAT rate of 5% applies to electricity use. Additionally, the Royal Decree-Law 20/2022 of 27 December on measures to respond to the economic and social consequences of the war in Ukraine and to support the reconstruction of the island of La Palma and other situations of vulnerability was approved (Gobierno de Espana, 2022[72]).

[3] A non-official English summary of these suggestions were recently published (Labandeira, 2022[73]).

[4] The White Book for Tax Reform in Spain (Comité de personas expertas, 2022[18]) offers a medium term proposal in this sense, namely a tax on the actual use of vehicles that varies according to location, time and type of vehicle. Such a charge would replace most of the existing taxes in road transport (fuel, vehicles) and also those on congestion and infrastructure should they be introduced. Introducing such taxation would best be implemented gradually and considering potential distributional impacts – likely through the help of pilot evaluations (Labandeira, 2022[73]).



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