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PART 1/2

# COMMISSION STAFF WORKING DOCUMENT

# IMPACT ASSESSMENT

## Part 1

*Accompanying the document*

**Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

**amending Regulation (EU) 2019/631 as regards strengthening the CO2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition**

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# Glossary

| *Term or acronym* | *Meaning or definition* |
|---|---|
| ACEA | European Automobile Manufacturers Association |
| AFID | Alternative Fuels Infrastructure Directive 2014/94/EU |
| BEV | Battery Electric Vehicle |
| CNG | Compressed Natural Gas |
| CTP | Climate Target Plan |
| $CO_2$ | Carbon dioxide |
| ESR | Effort Sharing Regulation |
| EED | Energy Efficiency Directive |
| EIB | European Investment Bank |
| EU ETS | EU Emission Trading System |
| EV | Electric Vehicle: covers BEV, FCEV and PHEV |
| FCEV | Fuel Cell Electric Vehicle |
| FQD | Fuel Quality Directive 98/70/EC |
| GDP | Gross domestic product |
| GHG | Greenhouse gas(es) |
| HDV | Heavy-Duty Vehicle(s), i.e. lorries, buses and coaches (vehicles of more than 3.5 tons) |
| ICEV | Internal Combustion Engine Vehicle(s) |
| IEA | International Energy Agency |
| JTF | Just Transition Fund |
| LCA | Life-Cycle Assessment |
| LCF | Low-carbon fuels |
| LCV | Light Commercial Vehicle(s): van(s) |
| LDV | Light-Duty Vehicle(s), i.e. passenger car(s) and light commercial vehicle(s) |
| LPG | Liquefied Petroleum Gas |
| LNG | Liquefied Natural Gas |
| NEDC | New European Driving Cycle |
| $NO_x$ | Nitrogen oxides (nitric oxide (NO) and nitrogen dioxide ($NO_2$)) |
| PHEV | Plug-in Hybrid Electric Vehicle(s) |
| PM | Particulate Matter |
| RED | Renewable Energy Directive |

| | |
|---|---|
| RFNBO | Renewable Fuels of Non-Biological Origin |
| R&D | Research and Development |
| TCO | Total cost of ownership |
| TEN-T | Trans-European Transport Network |
| TFEU | Treaty on the Functioning of the European Union |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WLTP | Worldwide Harmonised Light Vehicles Test Procedure |
| ZEV | Zero-Emission Vehicle(s) |
| ZLEV | Zero- and Low-Emission Vehicle(s) |

# 1 INTRODUCTION: POLITICAL AND LEGAL CONTEXT

## 1.1 Overall context

The **European Green Deal**[1] puts climate action at its core, by setting an EU climate neutrality objective by 2050. With its **Communication on stepping up Europe's 2030 climate ambition**[2], the Commission proposed to raise the EU's ambition on reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030. The European Council endorsed this ambitious target, and the EU formally submitted it as its updated nationally determined contribution to the UNFCCC Secretariat. The **European Climate Law**, as agreed with the co-legislators, will make the EU's climate neutrality target legally binding, and raise the 2030 ambition by setting the target of at least 55% net emission reduction by 2030 compared to 1990.

In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the Commission has reviewed the climate and energy legislation currently in place that is expected to only reduce greenhouse gas emissions by 40% by 2030 and by 60% by 2050.

This 'fit for 55' legislative package, as announced in the Commission's Climate Target Plan, is the most comprehensive building block in the efforts to implement the ambitious new 2030 climate target, and all economic sectors and policies will need to make their contribution, including road transport.

Through the revision of the $CO_2$ emission standards, **this impact assessment addresses the necessary contribution of passenger cars and light commercial vehicles (vans) to achieve the emission reduction target for 2030 and the climate neutrality objective.**

The $CO_2$ emission standards currently set out in Regulation (EU) 2019/631 will not deliver the emission reduction needed for road transport to contribute to the new 2030 emission reduction target and the climate neutrality objective.

The GHG emissions from road transport represent almost 20% of total EU GHG emissions and have significantly increased since 1990. Air quality continues to be impacted by traffic and congestion, leading to increasing number of cities introducing low and zero emission zones limiting local access to vehicles with internal combustion engines and certain Member States announcing phase-out of sales of internal combustion engine cars.

At the same time, the automotive industry is of key importance for the EU economy and accounts for over 7% of the EU's GDP. It provides jobs to 14.6 million Europeans - directly or indirectly, in manufacturing, sales, maintenance, construction and transport and transport services - representing 6.7% of total EU employment[3]. The EU is among the world's biggest producers of motor vehicles and demonstrates technological leadership in this sector[4]. EU automotive investment in R&D amounts to €60.9 billion annually[5], making it the largest private investor in R&D, responsible for 29% of total R&D spending in the EU.

[1] COM(2019)640 final
[2] COM(2020)562 final
[3] https://www.acea.be/automobile-industry/facts-about-the-industry
[4] On automobile production plants in Europe, information is available at https://www.acea.be/statistics/tag/category/european-production-plants-map
[5] *idem*

The COVID-19 pandemic has had a severe impact on Europe's economy and automotive sector[6]. In 2020, the EU new passenger car market contracted by 23.7% to 9.9 million units, which is 3 million units less than in 2019[7]. At the same time, the market share of electric vehicles (EVs) surged spectacularly throughout the year 2020 in many countries. While in 2019 3.5% of the total new car sales were EVs, this increased to 10.5% in 2020. In terms of absolute numbers, new EV registrations almost tripled compared to 2019[8].

EU economic activity is forecast to moderately pick up again in the second and more vigorously in the third quarter of 2021, in light of the vaccination campaigns and the expected gradual relaxation of containment measures, the agreement reached with the UK on future cooperation, the endorsement of the Recovery and Resilience Facility and the overall resilience of the European economy[9]. Similarly, EU automotive manufacturing should continue to recover in 2021, provided that supply chains remain functional. A recovery of demand of new vehicles sales in the EU at the same level as 2019 is foreseen by 2023[10]. For an overview of the impacts of the COVID-19 crisis on the automotive industry, see Annex 6.

Member States and the Commission have announced a series of measures to support the economic recovery of the private sector, including the automotive segment. The **Next Generation EU**[11] sets the direction for Europe's recovery, including for sustainable mobility. Europe must invest in protecting and creating jobs and in the competitive sustainability of its transport sector by building a fairer, greener and more digital future for it. Measures are in place in a number of Member States to stimulate the recovery of the automotive sector, aimed in particular at demand and supply of zero- and low-emission vehicles and recharging infrastructure. These stimulus packages and recovery measures, alongside continued investments in battery and other zero emission technologies, have been instrumental for attenuating the negative economic impacts, have ensured that zero emission cars become increasingly price competitive compared to fossil fuelled cars and have contributed to the increase of the market for zero- and low-emission vehicles (see Annex 6).

At the same time, it is clear that the automotive sector is undergoing a significant **structural transformation**. This transformation includes changes in clean and digital technologies, in particular the shift from internal combustion engines towards zero- and low-emission technologies as well as increasingly connected vehicles. Alternative business models such as vehicle sharing and mobility as a service linking different travel options are also appearing on the market, as well as increasing efforts to develop other forms of mobility, be they public, or last mile individual, for passengers and for goods. All these trends are challenging the traditional business models of manufacturers, suppliers and service providers and increasing the need for more zero emission cars and vans entering the market. They offer business opportunities and benefits for early adopters.

As highlighted in the **New Industrial Strategy for Europe**[12], sustainable and smart mobility industries have both the responsibility and the potential to drive the twin green and digital

[6] SWD (2020) 98 final
[7] https://www.acea.be/press-releases/article/passenger-car-registrations-23.7-in-2020-3.3-in-december
[8] https://www.acea.be/press-releases/article/fuel-types-of-new-cars-electric-10.5-hybrid-11.9-petrol-47.5-market-share-f
[9] ECFIN winter 2020 economic forecast; it projects that the EU economy will grow by 3.7% in 2021 and 3.9% in 2022. The speed of recovery will vary across Member States. There projections, however, are subject to significant uncertainty and risks.
[10] BCG COVID-19's Impact on the Automotive Industry (December 2020)
[11] COM(2020)456 final
[12] COM(2020)102 final

transitions, support Europe's industrial competitiveness and improve connectivity. The **Energy System Integration Strategy**[13] also sets the framework for accelerating the electrification of energy demand, building on a largely renewables-based power system.

The Commission's **Strategy for Sustainable and Smart Mobility**[14] has put forward comprehensive and integrated measures to put European transport on track for the future. It addresses the broader challenges of the transition to zero-emission mobility and sets out a roadmap for putting European transport firmly on the right track for a sustainable and smart future. It aims to make sustainable alternatives widely available to enable better modal choices and put in place the right incentives. It puts forward a number of measures grouped under 10 flagships, many of which are aimed at reducing GHG emissions in the road transport sector. The Strategy also sets out various milestones showing the European transport system's path towards achieving the objectives of a sustainable, smart and resilient mobility. It includes in particular the milestones that nearly all cars and vans will be zero-emission by 2050.

The Strategy's accompanying Action Plan includes policies aimed at boosting the uptake of zero-emission vehicles, renewable and low-carbon fuels and related infrastructure; addressing the sustainability of urban mobility; internalisation of externalities by pricing carbon; providing better incentives to users; boosting multimodality, including by making use of smart digital solutions and intelligent transport systems; and making mobility just and fair to all. The shift toward zero-emission vehicles will prevent pollution and improve the health of our citizens. This is also supporting the Zero Pollution Ambition of the European Green Deal as articulated in the recently adopted Zero Pollution Action Plan.

The **$CO_2$ emission standards for light-duty vehicles** are key drivers for reducing $CO_2$ emissions in the sector, as also shown in the Communication on stepping up Europe's 2030 climate ambition. This impact assessment will focus on specific issues linked to the $CO_2$ emissions standards of new cars and vans. Further policies envisaged by the Strategy for Sustainable and Smart Mobility will address broader sustainability issues of the transport sector, at the EU, international, national and local levels. The revision of the $CO_2$ emission standards for heavy-duty vehicles will be proposed by the Commission in 2022 as foreseen in this legislation and in view of the need to review and extend, as a prerequisite, the underlying legislation on the certification of CO2 emissions and fuel consumption of heavy-duty vehicles.

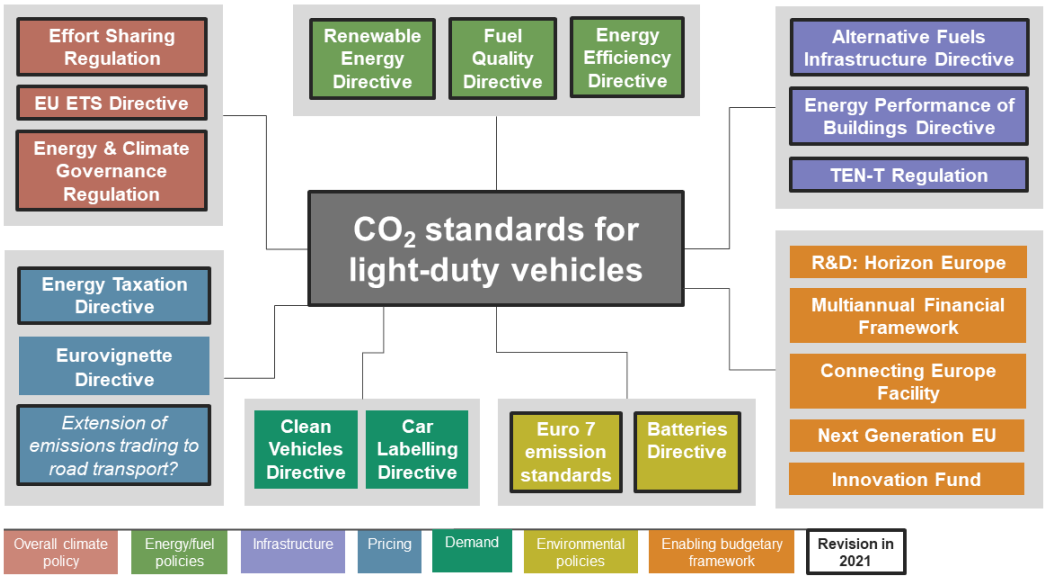
## 1.2 Interaction between $CO_2$ emission standards for cars and vans and other policies to deliver increased climate ambition in the road transport sector

The policy measures to deliver on the increased climate ambition interact in many ways, and should be seen in combination.

As displayed in **Figure 1**, the $CO_2$ emission standards for new cars and vans addressed by this impact assessment interact with several other EU legislative instruments and policies. Many of these policies are also revised as part of the 'Fit for 55 Package'.

**Figure 1: Policy context and overview of interactions**

[13] COM(2020) 299 final
[14] COM(2020)789 final




The interactions can be summarized along the following lines:

- Overall climate policy: this concerns in particular the Effort Sharing Regulation (ESR)[15] which sets binding greenhouse gas emission reduction targets per Member State. The current ESR covers emissions of road transport and the $CO_2$ emission standards for vehicles help Member States meeting their ESR targets. Under the Energy and Climate Governance Regulation, Member States have to adopt National Climate and Energy Plans which, inter alia, cover the policies and measures aiming at reducing emissions from light-duty vehicles.
- The EU ETS caps emissions from the sectors within its scope, including power generation, and therefore ensures (i) that the additional electricity consumption from the zero-emission vehicles does not lead to additional upstream emissions, and (ii) that the electricity used in zero-emission vehicles is decarbonised over time. Depending on the carbon price, the EU ETS can impact the operating cost for zero-emission vehicles. Emissions trading for building and road transport would further internalise climate externalities and provide incentives for consumers to reduce emissions. Therefore it can be a complementary demand-side action to the $CO_2$ emission standards.
- Energy and fuels policy: the Renewable Energy Directive as well as the Fuel Quality Directive set obligations on the supply of liquid renewable transport fuels and on the reduction of the GHG emission intensity of liquid transport fuels. The $CO_2$ emission standards for cars and vans ensure the increased supply and affordability on the market of new efficient and zero-emission vehicles, and therefore they are the key policy-driver for the transition towards zero-emission mobility in road transport. Fuels related legislation provides an additional contribution by incentivising the use of renewable and low carbon fuels in existing vehicle fleets that are not zero-emission. As zero emission vehicles, in particular battery electric vehicles, provide significant energy efficiency gains compared to fossil fuelled cars, the $CO_2$ emission standards also contribute to achieving the targets set in the Energy Efficiency Directive (EED) and wider benefits of the Energy System

[15] Regulation (EU) 2018/842

Integration Strategy which will help to maximize the use of renewable electricity and keep energy system costs down. The uptake of zero-emission vehicles will contribute to accelerating the electrification of energy demand and, through smart charging, can also contribute to balancing the electricity grid. The EED is an enabler of achieving reductions of GHG emissions including in transport by providing a framework for stimulating the uptake of specific transport policies such modal shift and urban mobility planning. The Governance Regulation requires to implement energy efficiency measures first, whenever cost-effective.

- Infrastructure policy: the Alternative Fuels Infrastructure Directive (AFID), the TEN-T Regulation, as well as the Energy Performance of Buildings Directive incentivise the rollout of recharging and refuelling infrastructure and thus contribute to facilitating the uptake of zero-emission vehicles. The European Green Deal has at this stage set the indicative target of 1 million public recharging and refuelling points by 2025 and 3 million by 2030. The Impact Assessment for the AFID will provide an analysis on the numbers and types of recharging and refuelling points that are needed.
- Other pricing policies: the Eurovignette Directive and the Energy Taxation Directive may support the decarbonisation of road transport by contributing to the internalisation of the climate externality. The revised Eurovignette Directive will most likely include the option for Member States to vary road charges based on the environmental performance, including the CO2 emissions of light-duty vehicles.
- Policies addressing demand: The Clean Vehicles Directive promotes clean mobility solutions and supports the demand for zero- and low-emission vehicles through public procurement. The Car Labelling Directive requires EU countries to ensure that information on emissions is provided to consumers.
- Other environmental policies: air pollutant emission standards ensure the placing on the market of clean internal combustion engine vehicles with respect to $NO_x$, particles and other pollutants. The European Green Deal roadmap includes a proposal for more stringent air pollutant emissions standards for combustion engine vehicles by 2021 (Euro 7). While the $CO_2$ emission standards incentivise the market deployment of zero-emission technologies, the Euro 7 standards will aim at further reducing the pollutant emissions from internal combustion engine vehicles, which will still be used until nearly all cars and vans on the road will be zero-emission. Most pollutants covered by Euro 7 are also regulated under the National Emission reduction Commitments Directive (NECD), which requires Member States to reduce their emissions of main air pollutants for the periods 2020-29 and more drastically after 2030. The European Green Deal also commits the Commission to a revision of ambient air quality legislation, notably to align air quality standards more closely with the World Health Organization recommendations. Furthermore, the proposed Batteries Regulation[16] addresses the sustainability of batteries and sets requirements for the collection, treatment and recycling of waste batteries. It will also help addressing the issue of availability of raw materials for batteries, such as lithium, cobalt, and natural graphite, which are critical raw materials (see Annex 7 for details).
- The budgetary framework with the Multiannual Financial Framework and the Next Generation EU, including funding instruments for infrastructure investments (Connecting Europe Facility, Cohesion and Structural Funds, InvestEU, blending with EIB instruments), for the demonstration of innovative low-carbon technologies (Innovation

[16] COM(2020) 798

Fund) and for research and development (Horizon Europe, Battery Alliance) are also important components of the enabling framework for clean vehicles and technologies.

In light of the above, the revision of $CO_2$ standards for cars and vans needs to be viewed in the broader policy context of the planned revision of all the key legislation for delivering the 'fit for 55% package'.

**The interactions between this impact assessment and the impact assessments supporting the revision of the EU ETS, the Renewable Energy Directive, the Effort Sharing Regulation, the Energy Efficiency Directive, the Alternative Fuels Infrastructure Directive and the Energy Taxation Directive are most relevant in this context. This impact assessment is therefore building on the analytical work of the Climate Target Plan, which takes into account the interaction and combination of the various policies. The interactions are further explored and assessed in the next sections.**

### 1.3 Legal context

Based on Article 192 of the Treaty on the Functioning of the European Union (TFEU) (Title XX on Environment), the EU has adopted legislation setting mandatory $CO_2$ emission targets for new passenger cars and vans, since 2009 and 2011, respectively.

On 17 April 2019, the European Parliament and the Council adopted Regulation (EU) 2019/631 setting $CO_2$ emission performance standards for new passenger cars and for new light commercial vehicles, replacing and repealing the previous Regulations (EC) No 443/2009 (cars) and (EU) No 510/2011 (vans). Regulation (EU) 2019/631 maintained the existing EU fleet-wide $CO_2$ emissions targets that entered into force on 1 January 2020 and added new targets that apply from 2025 and 2030 respectively. The applicable EU fleet-wide $CO_2$ targets are defined as a percentage reduction from the EU fleet-wide target in 2021, as shown in the below table (**Table 1**).

**Table 1: Current EU fleet-wide $CO_2$ targets in 2025 and 2030**

| **EU fleet-wide $CO_2$ targets (% reduction from 2021 starting point)** | | |
|---|---|---|
| | **2025** | **2030** |
| Passenger Cars | 15% | 37.5% |
| Vans | 15% | 31% |

Each year, a specific emission target is set for each manufacturer on the basis of the applicable EU fleet-wide target and taking into account the average mass of the manufacturer's fleet of new vehicles registered in that year. If the average specific emissions of a manufacturer exceed its specific emission target in a given year, an excess emission premium is imposed.

Additional details on targets and the way compliance is assessed, the incentive mechanism for zero- and low-emission vehicles (ZLEV)[17], as well as further elements of Regulation (EU) 2019/631 and its implementation are outlined in Annex 5.

[17] '*Zero- and low-emission vehicle'* (ZLEV) means a passenger car or light commercial vehicle with tailpipe emissions from zero up to 50 g $CO_2$/km, i.e. battery electric vehicles (BEV), fuel-cell electric vehicles (FCEV) and certain plug-in hybrid electric vehicles (PHEV).

No evaluation of the new obligations that were introduced in Regulation (EU) 2019/631 was carried out as they have not yet entered into application, in particular with regards to the new targets and the incentive mechanism for zero- and low-emission vehicles. For the other elements of the Regulation, the conclusions of the 2015 evaluation study[18] reflected in the 2017 impact assessment[19] remain valid.

The issue of the growing discrepancy between emissions measured with the former NEDC laboratory test and the real world $CO_2$ emissions, which was identified in the 2017 impact assessment as a driver of the growing 'emissions gap'[20] has been addressed by the introduction of a new test procedure (WLTP), the revision of the type approval framework and through specific governance provisions in Regulation (EU) 2019/631. Implementing legislation to operationalise these provisions has been put in place[21] and will be further developed. In particular, the monitoring and reporting of the real-world $CO_2$ emissions of cars and vans, which will start from 2021 onwards, will ensure a more robust and effective implementation of the legislation. Furthermore, the Commission plans to amend the type approval legislation[22] to better reflect the real-world $CO_2$ emissions of PHEVs under the WLTP test procedure. More information can be found in Annex 5.

[18] https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf

[19] SWD(2017) 650 final

[20] The main concern is that a growing gap, which was not anticipated in the policy design, would undermine the effectiveness of the $CO_2$ targets. By monitoring the evolution of the gap based on data from on-board fuel consumption monitoring, as foreseen under the Regulation, the Commission will be able to mitigate this impact in case it would materialise.

[21] Commission Implementing Regulation (EU) 2021/392 of 4 March 2021, see Annex 5

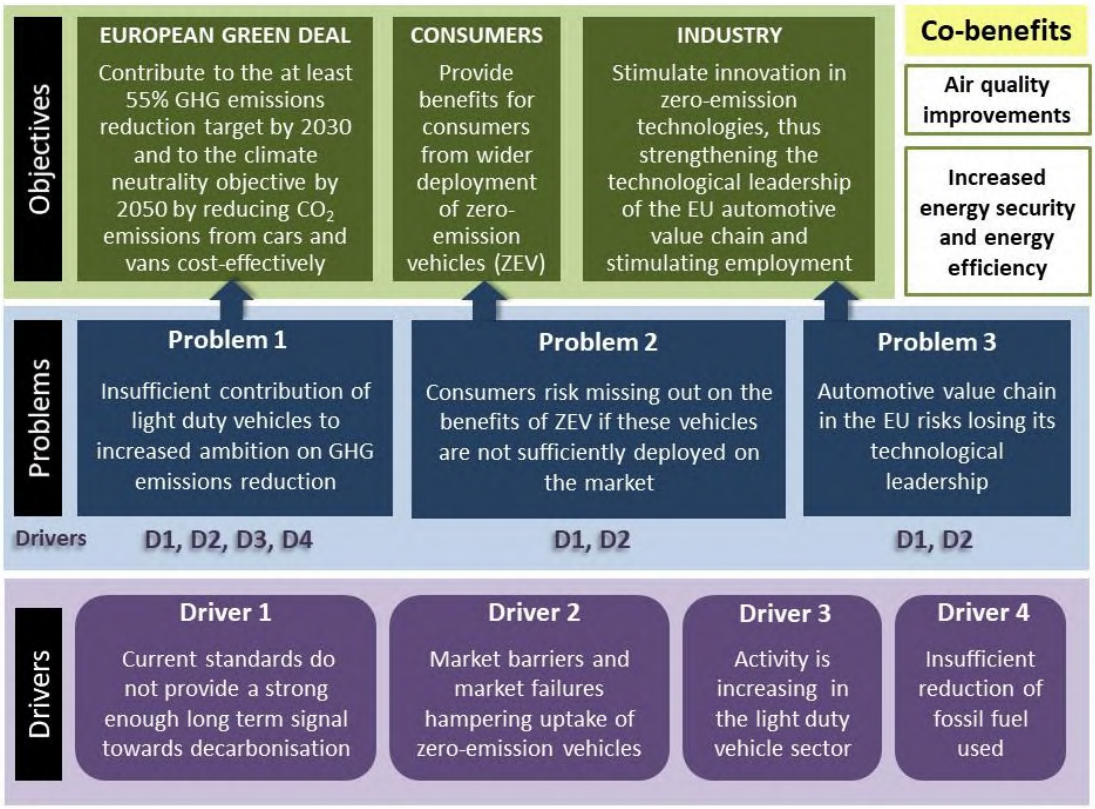
[22] Amendment of the WLTP Regulation (EU) 2017/1151 setting out the $CO_2$ emission test procedure for light duty vehicles

## 2 PROBLEM DEFINITION

The drivers and problems that are relevant for the revision of $CO_2$ standards for cars and vans, the co-benefits and the objectives pursued are presented in

**Figure 2.**

**Figure 2: Drivers, problems, objectives**




### 2.1 What are the problems?

Three key problems have been identified.

#### *2.1.1 Problem 1: Insufficient contribution of light-duty vehicles to increased ambition on GHG emissions reduction*

While this problem is not entirely new, and it was one of the problems tackled in the current legislation setting $CO_2$ emission standards for vehicles, its relevance and importance have been enhanced in view of the higher climate ambition for 2030 and 2050, as set out in the European Climate Law. This new context also underpins the continued relevance of the other two problems described below.

Overall transport GHG emissions (including international aviation and international maritime) represented 27% of total EU emissions in 2018, with road transport accounting for around 70% of transport emissions. Within road transport, emissions of cars and vans in turn represented around 70%. Carbon dioxide contributes around 99% of the total amount of greenhouse gases emitted by cars and vans, with methane and nitrous oxide emissions only playing a minor role. Measures tackling those other GHG emissions, which are also pollutants

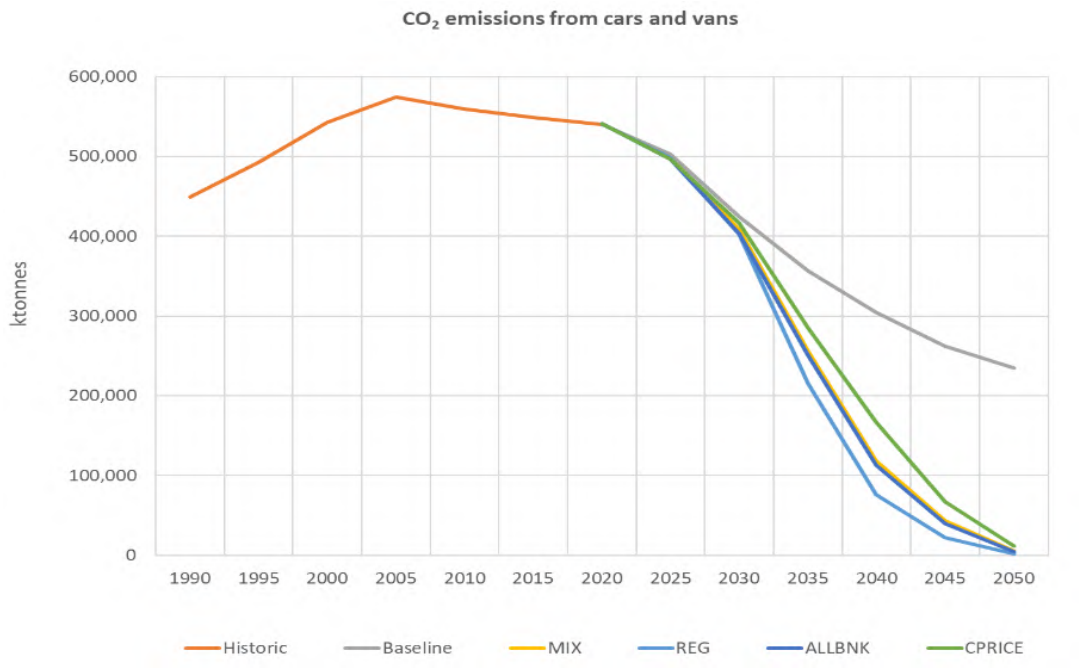
that pose a threat to human health, will be considered in the context of the impact assessment supporting the revision of the air pollutant emission standards.

The $CO_2$ standards for cars and vans set in Regulation (EU) 2019/631 for the years 2020, 2025 and 2030 will stimulate the gradual uptake of more efficient vehicle technologies and of zero- and low-emission vehicles, making them more affordable through increased supply and will drive emission reductions in the sector to the benefit of society.

According to the findings in the Communication on stepping up Europe's 2030 climate ambition, with the standards of Regulation (EU) 2019/631, $CO_2$ emissions from road transport would diminish by around 16% by 2030 and by 44% by 2050 compared to 2015, with emissions diminishing by 23% by 2030 and 56% by 2050 for cars and by 13% and respectively 57% for vans.

In the scenarios of the Climate Target Plan, in order to reach the at least 55% emission reduction target by 2030 and climate neutrality by 2050, emissions of road transport would need to diminish by between 19% and 21% by 2030 and by between 98 and almost 100% by 2050. **Figure 3** shows the historic and projected evolution of $CO_2$ emissions of cars and vans in the EU.

**Figure 3: Historic[23] and projected[24] $CO_2$ emissions (kt) from cars and vans under the scenarios of the Climate Target Plan**




This shows that maintaining the $CO_2$ emission standards of Regulation (EU) 2019/631 would be insufficient to drive down emissions to the levels consistent with the 2030 at least –55% target and the 2050 climate neutrality objectives. In addition, early action is needed to ensure that the necessary emission reductions for 2050 are achieved, in consideration of the long lead

[23] EEA GHG data viewer (http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer), extracted on 06/10/2020

[24] Scenarios from the analysis of the Climate Target Plan - COM/2020/562 final and SWD(2020) 176 final

time needed for changes, especially for the fleet renewal. Early action also ensures a smooth pathway towards the emission reductions for 2050 and no overly steep action with its socio-economic consequences being required in later decades.

### *2.1.2 Problem 2: Consumers risk missing out on the benefits of zero-emission vehicles if these vehicles are not sufficiently deployed on the market*

As shown in the Climate Target Plan, over the coming decade a large deployment of zero-emission vehicles (ZEV) is necessary for significantly reducing the GHG emissions of light-duty vehicles and achieving the increased climate ambition.

Such vehicles perform better from a life-cycle assessment perspective (see Annex 8). They do not only contribute to achieving Europe's climate objectives, but will also offer advantages to the consumers and companies buying and/or using them. Firstly, ZEV are cleaner as they do not have tailpipe emissions of air pollutants such as nitrogen oxides and particles. Secondly, as electric motors are more efficient than combustion engines, less energy is needed to drive an electric car and users may save on fuel/energy costs.

The implementation of the $CO_2$ emission standards of Regulation (EU) 2019/631 is projected to deliver around 25% battery electric vehicles in the EU new fleet by 2030 (see

Table 4 in Section 6.1). Also globally, according to analysts, the market uptake of these vehicles is projected to further increase over the coming years[25, 26].

However, without further action, due to a number of market barriers and failures (see Section 2.2.2, driver 2), there is a risk that the scale of future uptake of ZEV may not reach sufficient levels so that all households and businesses could reap those benefits. In particular, in case the affordability of ZEV does not become comparable to that of internal combustion engine vehicles, zero-emission mobility would risk remaining accessible to too few consumers and companies. The role of $CO_2$ emission standards in incentivising the market uptake of ZEV to the benefits of consumers is key, as demonstrated by the surge in sales of zero-emission vehicles in 2020. While EV sales were growing slowly (by 1 percentage point or less) in the preceding years, they significantly increased from around 3% to 11% in one single year once the stricter 2020 targets came into force. This is a strong indication of the risk that, even if the ZEV share can be expected to continue to rise in the coming years, the steep increase in their uptake needed to reach climate neutrality in 2050 will not materialise without further action.

While it is not possible to predict the evolution of future consumers purchasing behaviours, there is strong evidence that a regulatory framework acting on the supply side is a key factor to increase the number of efficient and zero-emission vehicles models coming to the market. This framework can influence marketing strategies from manufacturers and, as a consequence, impact consumers demand, together with the necessary flanking measures, especially the availability of recharging infrastructure.

### *2.1.3 Problem 3: Automotive value chain in the EU risks losing its technological leadership*

Europe is a global leader in overall automotive R&D investment. Global automotive R&D is heavily concentrated in a few European countries, Japan and South-Korea, with these countries accounting for 70% of total R&D expenditure. At the same time, China's presence in automotive R&D is becoming more evident than before, especially due to their investments in developing EV technologies[27].

The EU automotive industry has traditionally led the way in technological developments for internal combustion engines. However, demand for new zero-emission powertrains, including electric ones, is surging globally as countries and companies are committing to decarbonise their economies, target climate neutrality and put forward actions to improve air quality. At the same time, the digital transformation and trends such as autonomous driving, car sharing and integration of road transport into digital multimodal and mobility as a service offerings also require a refocusing of R&D efforts.

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[25] Source: IEA, Global EV Outlook 2020 (https://www.iea.org/reports/global-ev-outlook-2020). In the IEA's Stated Policies Scenario (illustrating the likely consequences of existing and announced policy measures and the expected effects of announced targets and plans from industry), the sales of so-called 'electric' LDV (light duty vehicle) - i.e. both BEV and PHEV - reach almost 25 million by 2030 (17% of total sales); 'electric' LDV stock would increase from 7.5 million vehicles in 2019 to almost 50 million by 2025 (3% of the total stock) and to 135 million by 2030 (120 million cars and 15 million vans; 8% of the total stock). In 2030, about two-thirds of the global 'electric' vehicle fleet are BEV.

[26] Source: Bloomberg, Electric vehicle outlook 2020 (https://about.bnef.com/electric-vehicle-outlook/). Sales of BEV and PHEV are expected to reach 10% of global passenger vehicle sales in 2025, rising to nearly 30% in 2030 and close to 60% in 2040; around three quarters of these sales in 2030 are BEVs and their share is expected to increase further in 2040.

[27] https://www.eib.org/en/publications/investment-report-2020.htm

Looking at the top players' patents of green, as well as green-digital technologies over the period of 2000-2008, European automotive companies have had a strong and dominant presence, followed by companies from Japan and the U.S. (see Annex 7)[28]. Over the past decade, world-wide patenting in green transportation technologies has continued to grow[29]. In the period 2005-15 the most important vehicle technologies all related to electrification, i.e. hybrid vehicles, charging stations for electric vehicles, and electric propulsion technologies with off-vehicle charging. Three countries, Japan, China and the U.S. accounted for 63% of all patent families in green transportation technologies in 2005-15. China has become a world leader in the patenting of green transportation technologies, in particular as regards charging stations.

The global market for ZEV specifically is growing rapidly, with electric car sales topping 3.1 million globally in 2020[30], with Europe, China and the United States accounting for over 90% of sales[31]. In 2020, Europe has emerged as a leading market for EVs, surpassing China in terms of market share of new electric vehicle registrations - around 10% of total sales in Europe[32] as compared to only 5.7% in China[33]. However, the global race to electrify light-duty vehicles will be a close one as China has the fastest growth of charging infrastructure, and a competitive advantage in EV battery production: in 2019, China produced above 1 million batteries for electric vehicles, whereas Europe produced just above 200,000, also falling behind the US producing almost 400,000 in the same year[34]. In terms of EV technology and battery capacity, the US is developing the fastest, followed by Europe that fluctuates around the global average[35].

In 2020, a particularly strong surge in ZEV sales has been observed in Europe, mainly driven by the tighter $CO_2$ standards and in some cases also by financial incentives. This trend can be expected to continue with the application of stricter $CO_2$ emission standards (as described in problem 2).

The trend towards ZEV is creating new business opportunities for automotive manufacturers, which have already started adding a broader range of such vehicles to their portfolios. However, the mounting international competition in the development of ZEV risks negatively affecting the competitiveness of parts of the EU automotive industry.

As zero-emission technologies have developed rapidly, new players focusing on ZEV have emerged across the globe, some of which have started entering the EU market. Those particularly successful in taking up a share of the EU EV fleet have been achieving this by offering a combination of electric driving with innovative vehicle design and advanced data management. This showcases how an innovative approach in manufacturing, promoting and selling electric vehicles is important.

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[28] https://www.eib.org/en/publications/investment-report-2020.htm

[29] WIPO, 2018, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_44.pdf

[30] IEA, Global Electric Vehicle Outlook 2021, https://www.iea.org/reports/global-ev-outlook-2021?mode=overview

[31] IEA, Global electric car sales by key markets, 2010-2020, IEA, Paris https://www.iea.org/data-and-statistics/charts/global-electric-car-sales-by-key-markets-2015-2020

[32] https://www.acea.be/press-releases/article/fuel-types-of-new-cars-electric-10.5-hybrid-11.9-petrol-47.5-market-share-f

[33]. IEA, Global Electric Vehicle Outlook 2021, https://www.iea.org/reports/global-ev-outlook-2021?mode=overview

[34] https://theicct.org/publications/china-green-future-ev-jan2021

[35] *idem*

Policy developments towards lower carbon emissions have been a key driver for investments in zero emission technologies. During the years 2017-2018 when ambitious EV policies were adopted in China, investments in e-mobility were reported to be seven times higher in China (€21.7 billion) than in the EU (€3.2 billion). In 2019, with the forthcoming new $CO_2$ standards for 2020/21, the EU attracted large investments (around € 60 billion) in EV and batteries, nearly 20 times more than in 2017/2018 and 3.5 times more than in China[36].

Clear regulatory signals sent to the automotive industry have therefore proven to be crucial for delivering EV investment decisions. Without such clear signals, manufacturers and their suppliers may delay investment decisions with long-term implications, both concerning R&D and manufacturing in Europe, as well as in terms of developing the necessary charging infrastructure for zero-emission vehicles.

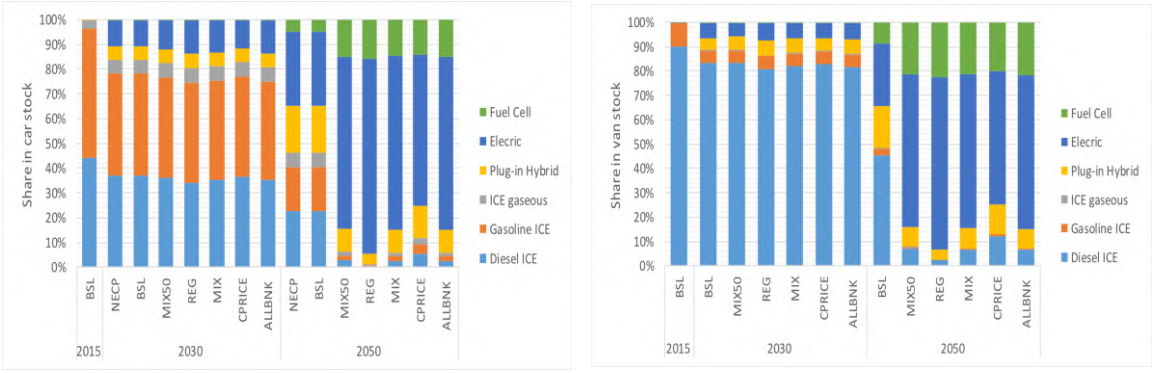
Such delays could create a risk that the automotive industry in the EU could lose its technological leadership by not investing sufficiently rapidly and even lose market share in the EU market itself, and not be the front runner in the fast growing new market of zero-emission vehicles. As a result, the automotive industry value chain in the EU would risk not fully reaping the benefits of the economies of scale offered by its home market, which would otherwise increase its competitiveness also in global markets.

## 2.2 What are the problem drivers?

### *2.2.1 Driver 1: Current standards do not provide a strong enough long term signal towards decarbonisation*

The analysis of the Climate Target Plan shows that with the current $CO_2$ emission standards of Regulation (EU) 2019/631, the share of zero emission cars and vans in the total vehicle stock is projected to be 11% and 7%, respectively, by 2030. With existing policies and targets reflected in the baseline (BSL), zero- and low-emission vehicles are projected to reach 54% of the stock in 2050, but internal combustion engine vehicles remain common in the fleet. However, to reach the climate neutrality objective, the analysis shows that by 2050, almost all cars (between 88-99% of the vehicle stock) and almost all vans (between 87-97% of the vehicle stock) would need to be zero- or low- emission (**Figure 4**).

**Figure 4: Car and van stock by type of drivetrain in 2030 and 2050** [37]




In absence of stricter $CO_2$ emission standards and clear longer-term regulatory signals, there is therefore a significant risk that manufacturers may not produce and offer enough zero

[36] https://www.transportenvironment.org/sites/te/files/publications/2020_05_Can_electric_cars_beat_the_COVID_crunch.pdf . The investments targeted mainly 8 countries, with €40 billion in Germany mainly from the VW Group, also investment made by Tesla. €6.6 billion also invested in the Czech Republic by VW Group

[37] Source: Climate Target Plan

emission vehicles for the EU market to contribute to the new overall 55% GHG emission reduction target for 2030 and the 2050 climate neutrality objective.

**This initiative will help address this driver.**

### *2.2.2 Driver 2: Market barriers and market failures hampering the uptake of zero-emission vehicles*

***Market barriers***

** Affordability*

Over the past years, the market for ZEV has steadily developed rapidly and costs of batteries have fallen faster than anticipated, by 87% in 2019 compared to 2010[38]. However, current prices of ZEV are still significantly above those of comparable ICEV and there is little offer at the lower end of the price range (see Annex 7).

According to the automotive market analyst JATO[39], in the first half of 2019, the retail prices for the five top selling ZEV models in Europe were all above the average new car retail price. While the interest rates for loans are historically low and new business models may help to lower the amount of upfront spending, e.g. by offering a lease contract for the battery, the affordability of ZEV risks continuing to be a barrier to their uptake, in particular in Member States with lower GDP per capita.

Furthermore, JATO[40] noted that ZEV retail prices have not been falling over the past years. As illustrated in Annex 7, battery electric cars became more affordable during the last decade only in China, mostly due to government incentives, and the launch of small and very cheap models. In Europe, the average Battery Electric Vehicles (BEV) price increased by more than 40% between 2011 and 2019 as manufacturers were focusing on premium and larger mid-size cars, leaving very few offerings in the entry-level segments. The average retail price (excluding any kind of incentive) of BEV sold in Europe and the US in 2019 was 58% and 52% higher than in China, respectively.

With the production of ZEV increasing and zero emission technologies - in particular batteries - developing at scale, the production costs are expected to decrease over the coming years. Adding increased numbers of smaller models should thus make ZEV more affordable for more consumers.

Nevertheless, the trends seen in the past decade show that there is a risk that this may not fully materialise as anticipated and that the offer of ZEV which are affordable to a broad range of consumers may remain limited.

Also, while some analysts consider that ZEV could achieve cost parity with ICEV in the mid-2020s across most segments[41], the risk remains that this will not materialise so soon[42]. The

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[38] Bloomberg, 2019: Battery pack prices fall as market ramps up with market average at $156/kWh In 2019 https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/

[39] https://www.jato.com/electric-cars-cost-double-the-price-of-other-cars-on-the-market-today/

[40] https://www.jato.com/ev-prices-have-been-growing-during-the-last-8-years/

[41] Bloomberg, 2019: Electric Car Price Tag Shrinks Along With Battery Cost https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost

[42] Fleeteurope, 2020: EV price parity may not arrive until 2030s https://www.fleeteurope.com/en/new-energies/europe/features/ev-price-parity-may-not-arrive-until-2030s?a=FJA05&t%5B0%5D=Electrification&curl=1

evolution of the battery prices, which decreased dramatically over the last years, and which are projected to continue decreasing significantly, will have a positive impact on the production cost of vehicles, but there is a risk that this may not be fully reflected in the vehicle retail price, as manufacturers may aim to maximise their return on investments made for the development of conventional technologies and/or on their R&D expenditures for new technologies.

Up to now, most of the zero-emission vehicles put on the market have been in the higher segments, with however little choice amongst the more affordable models and segments. While this is changing as more and more manufacturers are starting to produce ZEV and broaden their ZEV portfolio, as shown by the market evolution in 2020, the regulatory framework will continue to play a key role in determining the speed by which the marketing of ZEV models will evolve in the future. All of this means that, even in case of reaching cost parity, there is no guarantee that access to individual zero-emission mobility will become affordable for all consumers, quickly enough to ensure the necessary uptake of ZEV in view of the increased climate ambition. The risk is highest for lower income groups, as they also have less access to financing possibilities. This puts at risks the milestone that by 2050 nearly all cars and vans on European roads will need to be zero-emission in order to reach climate neutrality, as highlighted by the Climate Target Plan. Achieving this milestone is premised on the need to ensure that such vehicles are supplied to the market and affordable for all EU citizens and businesses.

** Lack of information, uncertainties, lack of vehicle models*

Furthermore, when facing a shift to a new technology requiring to adapt long standing habits, the uncertainties faced may prevent consumers to make this switch. In the case of ZEV, they might have anxiety over its electric range and on where and how to recharge or refuel it *(see also below),* uncertainty on the battery life and on the resale value of the vehicle given expected further technical improvements[43]. Also, buyers may find it difficult to understand or quantify the benefits of using the technology, including the fuel or energy cost savings from ZEVs.

The smaller number of ZEV models on the market compared to their ICEV counterparts across the different segments and price categories may also create a barrier for consumers.

** Lack of recharging and refuelling infrastructure*

A particularly critical barrier to the market uptake and consumer acceptance of ZEV is the limited availability of infrastructure to recharge or refuel them, as the level of current infrastructure deployment is only sufficient to serve the rather low number of alternatively fuelled vehicles currently on the road[44]. While gas stations offering diesel and petrol are abundant across the EU, in many countries electric charging points have only started appearing recently in the public domain[45]. Furthermore, the infrastructure is not deployed evenly across the EU, leading to parts of the EU transport network being not sufficiently equipped while issues with regards to interoperability and user information persist. In view of the expected uptake of ZEVs by 2020 and beyond[46], the pace of recharging infrastructure roll-

[43] European Environment Agency (2016): Electric vehicles in Europe, EEA Report No 20/2016

[44] See impact assessment on AFID revision.

[45] https://www.eafo.eu/alternative-fuels/electricity/charging-infra-stats (at the end of 2020, around 225,000 public electric charging points were installed in Europe, up from around 48,000 in 2015)

[46] Commission Staff Working Document (2019), Report on the Assessment of the Member States National Policy Frameworks for the development of the market as regards alternative fuels in the transport sector and the deployment of the relevant infrastructure pursuant to Article 10 (2) of Directive 2014/94/EU.

out needs to accelerate. Information on such market barriers and options for more binding roll out targets and targets that link the number of recharging and refuelling stations that are needed to the vehicle fleets that are likely to be in operation under initiatives such as the $CO_2$ standards, are considered in the Impact Assessment for AFID.

**By acting on the supply of ZEV, this initiative will contribute to address the market barriers related to the availability of ZEV in various market segments and to their affordability. This initiative will also provide clear signals for investments in zero-emission technologies, thereby addressing the risks for industry in the EU of losing its technological leadership**.

**The upcoming revision of the Alternative Fuels Infrastructure Directive will be a key instrument to address shortcomings with regards to recharging and refuelling infrastructure. It complements the investment signals on infrastructure provided for by the $CO_2$ emission standards which act on the supply of vehicles.**

***Market failures***

** Environmental externalities*

Even if the market was perfectly competitive and there was perfect information available to all agents, market forces would unlikely deliver the societal optimum in terms of $CO_2$ emissions. This is because vehicle manufacturers and purchasers do not directly experience this external environmental cost and therefore tend not to take it into account in their production and purchase decisions.

** Consumers undervaluing fuel savings*

Due to a lack of information and the challenge of making fully rational economic calculations, few consumers will consider the lifetime costs when purchasing a new car[47]. This is particularly the case for individual consumers. Users will tend to undervalue future cost savings in particular with regards to fuel consumption, as a result of which it may not appear attractive to pay more upfront for a more efficient vehicle[48]. This is also due to the uncertainty on the evolution of fuel and energy prices over the vehicle lifetime as well as regarding the period during which they intend to own and use the vehicle. As passenger cars generally have multiple owners over their lifetime, only a part of the fuel savings would be experienced by the initial purchaser.

** Split incentives*

Finally, a part of the cars and vans fleet is also affected by split incentives in the market, leading to a preference for purchasing less expensive vehicles over those with a more beneficial total cost of ownership. This is the case when the buyer of the vehicle is not bearing the fuel costs, for example in the case of rental cars. Depending on the fuel cost reimbursement policies and the purchase dynamics, this may apply for vans and for leased vehicles which have a share of around 30% of new registrations in the EU and of which most are company cars.

**The initiative on the $CO_2$ emission standards will help address the market failures described above. At the same time, pricing policies such as the possible emissions**

[47] Eurobarometer survey on climate change in 2019 shows that around one in ten citizens (12%) say that low fuel consumption was an important factor in their choice of purchasing a car, https://ec.europa.eu/clima/sites/clima/files/support/docs/report_2019_en.pdf

[48] David L. Greene PhD, 2018. https://ww2.arb.ca.gov/sites/default/files/2018-10/10-21-2018_Greene_UTenn-Consumer_Behavior_Modeling.pdf

**trading for buildings and road transport as well as the revision of the Energy Taxation Directive and the Eurovignette Directive could act on these failures. However road transport fuels are already subject to high level of taxation and very high carbon prices would be required to have an effective impact on these market failures. These effects are further analyzed in their respective impact assessment reports.**

### *2.2.3 Driver 3: Activity in road transport is increasing*

As shown in the Climate Target Plan, despite profound shifts in mobility being underway, such as shared mobility services and easier shifts between modes, and policies aimed at increasing the efficiency of the transport system, EU light-duty transport activity is expected to continue to grow (see Annex 7).

The COVID-19 crisis and the subsequent lockdowns have led to a decrease in road transport activity. However, the short to medium-term effects of the COVID-19 crisis may also lead to increases in the road transport activity, in particular on the private use of cars as health concerns have induced some people to avoid the use of public transport and increase the use of private cars.

**This initiative will not address this driver as $CO_2$ emission standards do not directly affect transport activity. This is addressed by policies targeting multimodal transport mobility as a service, low and zero emission zones for individuals or logistics, wider city planning initiatives including in the Renovation Wave and Bauhaus plans, and carbon pricing policies including the possible emissions trading for buildings and road transport.**

### *2.2.4 Driver 4: Insufficient reduction of fossil fuel used*

The EU-27 transport sector is currently relying very largely on fossil fuels as oil-derived fuels account for 93% of energy consumption in transport (with road transport depending on oil products of 94% of its energy use)[49]. After reaching its peak in 2007, oil consumption in transport (including international aviation and maritime) decreased by 12.2% during 2007-2013 (-2.1% per year). Since 2014, oil consumption has been following an upward trend at an average rate of 1.9% per year. As a consequence, the total EU oil import bill is estimated at EUR 227.5 billion in 2018[50].

The road transport fossil fuel supply in 2018 was dominated by diesel (59.8%), followed by petrol (23.3%). Without further intervention, oil products would still represent about 89 % of the EU transport sector needs in 2030 and 77% in 2050[51]. Different reasons explain this situation.

Despite the current $CO_2$ emission standards for vehicles, the vehicle stock share of internal combustion engines powered cars and vans using diesel, petrol or gas is today almost 98-99%, and it is projected to remain significant by 2030, more than 80% both for cars and vans.

Despite the current renewable energy policies, sustainable renewable and low-carbon fuels for transport are available in limited amounts, with the total renewable energy share in transport reaching 8.3% in 2018. Sustainable advanced biofuels are barely starting to be produced at scale, while power-to-liquid and power-to-gas fuels as well as clean hydrogen from renewable sources are available only at demonstration scale. As a consequence of high production costs,

[49] SWD(2020) 331 final
[50] SWD(2020) 951 final.
[51] Reference Scenario 2020

including for feedstocks, and lower technology and commercial maturity, available volumes of these fuels are limited, and prices are not competitive with the fossil-based fuels.

The shares of renewable and low carbon fuels are projected to remain limited in 2030.

The current fiscal framework for fuels often does not take into account $CO_2$ emissions and it thus tends to be ineffective to shift away from fossil fuels. In addition, lack of harmonisation across Member States is also likely to hamper the development of an internal market of alternatives to fossil fuels at sufficient scale. This constitutes an inefficient use of a potentially important instrument to internalise the climate change externality.

The lack of an efficient/strong carbon pricing, through fiscal policies or market-based mechanisms, also does not incentivise behavioural changes that could potentially reduce fossil fuel use.

**This impact assessment will look at how the $CO_2$ emission standards can address this driver, in particular in relation to the impacts on the deployment of zero emission vehicles and the use of electricity as fuels.**

**However, some of the underlying issues will also be tackled in other initiatives. The issue of promotion of renewable and low-carbon fuels will be looked at in the impact assessment for the Renewable Energy Directive. The issues of carbon pricing and taxation are assessed in the impact assessments for the revision of the EU ETS and the Energy Taxation Directive. Wider energy system integration and benefits of direct electrification for energy system efficiency will be pursued under Commission initiatives under the Energy System Integration Strategy.**

### 2.3 How will the problem evolve?

According to projections, with the $CO_2$ emission targets set out in Regulation (EU) 2019/631, there will be a significant emissions gap both in 2030 and in 2050 that will need to be closed, in order to ensure a sufficient contribution to the increased 2030 climate ambition, as well as by the objective of climate neutrality by 2050.

The baseline for this impact assessment is the Reference Scenario 2020, which models the existing 2030 climate and energy legislative framework, as further referred to and elaborated on in Section 5.1.

In the Reference Scenario 2020, without further policy action, the $CO_2$ emission standards currently set out in Regulation (EU) 2019/631 would remain applicable after 2030. As a consequence, the Reference Scenario 2020 shows that emissions from cars and vans in 2050 would only decrease by around 39% as compared to 2005, giving raise to the problem described in section 2.1.1. One of the main reasons is related to the limited penetration of zero-emission vehicles, which are necessary to ensure higher emissions reduction, as shown in the scenarios analysed in the Climate Target Plan.

Without further strengthening of the $CO_2$ emission standards, the shares of zero-emission cars and vans circulating on the roads in 2050 would remain limited to around 44% and 42% respectively. Even when considering a scenario with all the policies included in the MIX scenario except the strengthening of the $CO_2$ emission standards, the shares of zero-emission cars and vans on European roads in 2050 would be around 60% and 54% respectively, and emissions from cars and vans in 2050 would decrease by around 50% as compared to 2005. This is largely insufficient for reaching the climate neutrality objective.

As a result, the analysis of the evolution of the problem highlights the need to strengthen the $CO_2$ emission standards currently set out in Regulation (EU) 2019/631 despite the fact that this legislation came recently into force.

Full details are available in the publication related to the Reference Scenario. In addition, Section 6 presents the different impacts of the baseline scenario, as relevant.

# 3 WHY SHOULD THE EU ACT?

## 3.1 Legal basis

Title XX (Environment) of the Treaty on the Functioning of the European Union (TFEU), in particular Article 191 and Article 192, empowers the EU to act to ensure a high level of protection of the environment. Based on Article 192 of the TFEU, the EU has already adopted policies to address $CO_2$ emissions from cars and vans through Regulation (EC) 443/2009 and Regulation (EU) 510/2011, which were repealed and replaced by Regulation (EU) 2019/631, currently effective since 1 January 2020.

## 3.2 Subsidiarity: Necessity of EU action

Climate change is a transboundary problem, where coordinated EU action can supplement and reinforce national, regional and local action effectively. EU action is justified on the grounds of subsidiarity, in line with Article 191 of the Lisbon Treaty.

In light of the ambitious emission reduction target for 2030 in the perspective of the climate neutrality objective, stronger EU action is needed to ensure a sufficiently high contribution of the road transport sector standards. As underlined in the Climate Target Plan, Regulation (EU) 2019/631 therefore needs to be revisited and strengthened to ensure a clear pathway towards zero emissions mobility.

## 3.3 Subsidiarity: Added value of EU action

Although initiatives at the national, regional and local level can create synergies, alone they will not be sufficient. Lack of coordinated EU action via the strengthening of $CO_2$ emission standards would translate into a risk of market fragmentation due to the diversity of national schemes, differing ambition levels and design parameters. On their own, individual Member States would also represent too small a market to achieve the same level of results, therefore, an EU wide approach is needed to drive industry level changes and to create economies of scale.

Market fragmentation would potentially translate to competitive distortions, a risk of tailoring national legislation to suit local industry, and compliance costs (passed on to consumers) for both component suppliers and vehicle manufacturers. It would also weaken the incentive to design fuel efficient vehicles and deploy zero-emission vehicles to the overall EU market. Coordinated EU action therefore provides benefits for both manufacturers, component suppliers and consumers.

Furthermore, while national, regional or local fiscal incentives play a role to incentivise the market uptake of zero-emission vehicles, they are easily reversible, and therefore they do not provide the needed long-term market signal and predictability. Coordinated EU action through the strengthening of $CO_2$ emission standards could catalyse the transformation of the sector, and it would provide the entire automotive value chain with the necessary long-term,

stable market signal and regulatory certainty needed to make the large capital investments that are necessary to deploy zero-emission vehicles on the market.

## 4 OBJECTIVES

**General policy objective**

The general objectives of this initiative are to contribute to achieving climate neutrality by 2050 (i.e. achieve net zero GHG emissions by 2050) and to this end, in line with the 2030 Climate Target Plan, to contribute to reaching at least 55% net greenhouse gas emission reductions by 2030 compared to 1990 This articulation of targets and objectives requires a coherent strengthening of the policy architecture for climate, including the Regulation on $CO_2$ emission standards for cars and vans.

**Specific objectives**

1. Contribute to the 2030 at least -55% net GHG emissions target and to the climate neutrality objective by 2050 by reducing **$CO_2$ emissions** from cars and vans cost-effectively and thereby supporting Member States in meeting their target under the ESR, in case of a continued ESR scope.;
2. Provide benefits for **consumers and citizens** from wider deployment of zero-emission vehicles;
3. Stimulate **innovation in zero-emission technologies**, thus strengthening the **technological leadership** of the EU automotive value chain and stimulating employment.

The first specific objective concerns the contribution of cars and vans to the **increased overall climate ambition** for 2030 and 2050. With road transport causing 20% of EU GHG emissions in 2018, improving the $CO_2$ efficiency of new cars and vans is of key importance.

The majority of industry representatives, public authorities, and other stakeholders responding to the public consultation considered this objective important. More than half of responding citizens saw it as important or somewhat important (more information provided in Annex 2).

Considering that the effect of the $CO_2$ emission standards on the reduction of emissions from the running stock of vehicles is not immediate, and considering the dynamics of the fleet renewal, early action is important to ensure the achievement of the long term objective.

The second specific objective is related, in line with the European Green Deal, to **providing benefits to consumers** from a wider deployment of zero-emission vehicles. Policy action on $CO_2$ emission standards should aim at incentivizing the market supply of zero-emission vehicles, which provides (i) air quality benefits, in line also with the "zero pollution ambition" of the European Green Deal and the Commission's Communication on a Pathway to a Healthy Planet for All[52], and (ii) reduction of energy consumption, lowering energy bills, in line with the "just transition" objective of the European Green Deal. This aspect is specifically important in a context where policies on fuels could increase the energy prices for consumers and business. Providing benefits for the consumers is also essential to create buy-in for climate-related action.

These benefits for consumers and citizens were highlighted in the responses to the open public consultation on this initiative. Most responding public authorities, citizens and other stakeholders considered air pollution as an important or somewhat important co-benefit. Furthermore, the majority of all stakeholder categories considered that reducing the total cost

[52] COM(2021) 400 final

of ownership is an important objective. The European Consumer Organisation ('BEUC', which is an umbrella group for European consumer organisations) rated this objective as highly important.

The third specific objective relates to **innovation, technological leadership and employment**. This objective is strongly rooted in the European Green Deal as a new growth strategy, which aims at transforming the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy.

This objective was the one most supported by all stakeholder categories among respondents to the public consultation (80% of public authorities, 78% of industry respondents, 72% of other stakeholders and 69% citizens).

The Commission Communication "A New Industrial Strategy for Europe"[53] states the need for an industrial policy, fit for the ambitions of today and the realities of tomorrow. At the heart of this is the ability of Europe's industry to lead the twin transitions and drive its competitiveness. It cannot afford to simply adapt, it must become the accelerator and enabler of change and innovation. The Strategy also highlights that the EU must leverage the impact, the size and the integration of its single market to set global standards. By providing a common regulatory space and scale, the single market is the driver of competitiveness. This is particularly important for the transport sector, where the green transition offers great opportunities for European industry across the value chains to modernise, create high-quality jobs, develop new products and services, and strengthen competitiveness.

While the EU automotive sector has been successful in developing and manufacturing advanced internal combustion engine vehicle technologies and marketing them world-wide, it will need to adapt to the ongoing global transition towards zero- emission mobility and increasingly channel investments in zero emission technologies.

By providing a clear regulatory signal for industry to develop and invest in zero-emission vehicles, the objective is to foster innovation and thereby to maintain the technological leadership of the EU automotive value chain and stimulate employment in these new technologies.

The three specific objectives are all linked to the necessary increasing share of zero-emission vehicles on the EU market which will reduce $CO_2$ emissions from light-duty vehicles, provide benefits to consumers in terms of air quality (especially in urban areas) and energy savings, and strengthen the technological leadership of the EU automotive value chain. Additional co-benefits are expected to be the **increased energy efficiency and energy security** as the demand for imported oil will decrease.

[53] COM(2020) 102 final

# 5 WHAT ARE THE AVAILABLE POLICY OPTIONS?

This Section describes the options identified to address the problems listed in Section 3 and to achieve the objectives defined in Section 4. It sets out the rationale for their selection and design, taking into account the public consultation, additional stakeholder input as well as internal and external study reports.

The options explored reflect the outcome of the open public consultation and are grouped into the following categories:

(i) $CO_2$ emission targets for cars and vans (levels, timing, modalities);

(ii) specific incentives for zero- and low-emission vehicles (ZLEV);

(iii) a mechanism to take into account the potential contribution of renewable and low-carbon fuels for the purpose of target compliance assessment.

## 5.1 What is the baseline from which options are assessed?

The baseline for the assessment is built on the EU Reference Scenario 2020, which reflects the provisions laid down in the current Regulation (EU) 2019/631 and in particular the $CO_2$ emission targets set out therein[54], as summarised in **Table 2**.

**Table 2: EU fleet-wide target levels in the baseline scenario (TL_0), i.e. as set out under the current Regulation (EU) 2019/631 (2020 targets in g/km NEDC; 2025 and 2030 targets as % reduction compared to 2021 WLTP baseline)**

| | 2020 | 2025 | 2030 |
|---|---|---|---|
| **Cars** | 95 g/km | 15% | 37.5% |
| **Vans** | 147 g/km | 15% | 31% |

## 5.2 Description of the policy options

### *5.2.1 $CO_2$ emission targets for cars and vans*

5.2.1.1 Target levels (TL)

Since the specific WLTP emission target values for 2021 (in g/km) will only be determined in 2022, the new emission targets should be defined as a reduction percentage compared to the 2021 starting point defined in Annex I of the Regulation.

The options for the EU-wide fleet average target levels for cars and for vans set out in this Section are defining the target trajectory over the period 2025-2040 in five-year steps, without prejudging the levels of the targets applicable in the intermediate years. Options as regards these intermediate targets are set out in Section 5.2.1.2.

**Table 3** summarises the EU fleet-wide $CO_2$ emission target levels under the three options considered, reflecting Low, Medium (Med) and High emission reduction percentages. These target levels are consistent with the levels in the scenarios of the Climate Target Plan, and

[54] A detailed explanation on the transition from NEDC to WLTP based targets and on the definition of the 2021 WLTP baseline is given in Annex 5

they are embedded in the core policy scenarios described in Annex 4. Annex 9 provides a description of the main findings of the Climate Target Plan.

**Table 3: Target levels under the options considered (% reduction compared to 2021 starting point)**

| | 2025 | | 2030 | | 2035 | | 2040 | |
|---|---|---|---|---|---|---|---|---|
| | **Cars** | **Vans** | **Cars** | **Vans** | **Cars** | **Vans** | **Cars** | **Vans** |
| **TL_Low** | 15% | 15% | 40% | 35% | 60% | 55% | 80% | 80% |
| **TL_Med** | 15% | 15% | 50% | 40% | 70% | 70% | 100% | 100% |
| **TL_High** | 15% | 15% | 60% | 50% | 100% | 100% | 100% | 100% |

During the open public consultation, vehicle manufacturers and respondents representing the fossil fuel industry supported no or limited change in the current ambition level while public authorities and environmental NGOs called for the most ambitious levels, including an increase of the 2025 emission targets. The higher ambition option received certain support across stakeholder categories as part of the public consultation. For public authority, environmental and consumer organisation respondents, the preferred year for a 100% reduction target for both new cars and vans was 2035. Around 13 % of industry respondents and 10% of responding citizens also considered 2035 the date by when all new cars and vans should be zero-emission. Some environmental NGOs even call for more ambition. The European Consumer Organisation (BEUC) also supported the high ambition option. Some Member States already made announcements for the phase-out of combustion engines in the period between 2030 and 2040.

However, none of the options include a change to the current 2025 emission targets as there would be too little time left after the adoption of such new targets for manufacturers and automotive suppliers to prepare their implementation, thus creating too much investment uncertainty.

***Manufacturer specific target levels***

Starting from the EU fleet-wide targets set out in it, Regulation (EU) 2019/631 defines the specific emission targets for individual manufacturers using a limit value curve, based on the average mass of a manufacturer's new vehicle fleet in a given year.

During the stakeholder consultation, manufacturers supported maintaining the current regulatory approach while environmental NGOs called for removing the use of the limit value curve.

The current approach recognises that heavier vehicles require more energy for their propulsion. The Regulation foresees that the slope of the limit value curve will become lower over time as the EU-fleet wide targets become stricter. This means that the effect of the average vehicle mass on a manufacturer's target will diminish and the manufacturer specific targets will equalize over time. Furthermore, from 2025 onwards, the adjustment of the reference vehicle mass, which should ensure that the average of the manufacturer's specific targets does not deviate from the EU fleet-wide targets, will take place every two years instead of three-yearly as is currently the case. In this way, the limit value curve should better reflect trends in fleet mass.

It therefore does not appear necessary to look at options to change the methodological approach for the calculation of the manufacturers' specific targets.

The approach of setting fleet-wide $CO_2$ emission targets provides manufacturers with flexibility in their fleet composition. Compliance can be achieved by increasing the share of zero- and low-emission vehicles and/or by improving the average efficiency of the ICEV fleet. Some environmental NGOs have remarked that, as ZLEV shares increase, the fleet-wide targets may no longer require the ICEV fleet efficiency to improve and they recommended introducing a $CO_2$ emissions target for the ICEV fleet to prevent that its average emissions would increase over time.

However, it was acknowledged that the risk of such increase is limited as long as appropriate fleet-wide $CO_2$ targets are set, which reflect the market uptake of ZLEV. As the fleet-wide $CO_2$ targets become stricter over time, the share of ICEV in the fleet will shrink and the impact of these vehicles on the overall emissions will diminish.

Adding an ICEV fleet target to the Regulation would require an in-depth consideration of the appropriate reference level, of how it would apply across different manufacturers, which vehicles it should cover and its interaction with the overall $CO_2$ targets, with the provisions on pooling and on eco-innovation credits and with the ZLEV incentive mechanism. It would also require defining the level of fines to be imposed in case of non-compliance. An additional ICEV target would thus unduly add complication to the regulation for an uncertain added value.

In view of the above elements, the option of introducing an additional $CO_2$ emission target for ICEV is not taken forward.

#### 5.2.1.2 Timing of targets

Regulation (EU) 2019/631 sets out annual EU fleet-wide $CO_2$ targets. The stringency of these targets increases in five-year steps. The targets which start applying in 2020 remain applicable until 2024. As of 2025 the targets become stricter and stay at these levels until 2029. Finally, the stringency of the targets is further increased as of 2030, and manufacturers will have to continue to comply with them in the period post-2030.

In the past, manufacturers have anticipated the 2015 EU fleet-wide targets for cars and the 2017 targets for vans and those targets had even been met a few years ahead of the deadlines. However, in the last years, ahead of the stricter targets applying from 2020, while the EU average emissions remained significantly below the applicable target levels, less anticipation was observed. Since 2017 for cars, and since 2018 for vans, average EU fleet-wide emissions even increased on a year-to-year basis[55].

A way to ensure a steady decrease of emissions over time, would be to set stricter targets more frequently, for example annually or for an intermediate year. This option is supported by environmental NGOs which call more specifically for an interim target in 2027. Manufacturers supported the continuation of a 5-year steps approach.

The following options will be considered for defining the year(s) for which stricter targets are set. These options apply both for passenger cars and vans.

- Option TT 0: Target decreasing in 5-year steps

  New $CO_2$ targets start applying every 5 years

[55] https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission

- Option TT 1: Targets decreasing in less-than-5-year steps.

  New $CO_2$ targets start to apply annually or in some of the intermediate years. This could possibly be combined with some degree of flexibility as regards compliance by manufacturers, such as through a banking mechanism.

The majority of industry representatives responding to the public consultation stressed the need that targets should remain applicable for five years before being strenghtened, as in Option TT 0. This was supported in particular by automotive manufacturers and respondents representing the fossil fuel industry. Public authority respondents environmental organisations and the European Consumer Organisation (BEUC) largely supported strenghtening targets every year as in Option TT 1.

#### 5.2.1.3 Use of the revenues from excess emissions premiums

Excess emission premiums are imposed on manufacturers in accordance with Article 8 of Regulation (EU) 2019/631, if their average specific emissions exceed their specific emission targets in a given calendar year. The amounts of the premiums shall be considered as revenue for the EU general budget. Such revenue decreases the Member States' own contributions to the EU budget.

The co-legislators have requested the Commission in Article 15(5) of the Regulation to assess the possibility to assign the revenue to a specific fund or programme, notably "*with the objective to ensure a just transition towards a climate-neutral economy as referred to in Article 4.1 of the Paris Agreement, in particular to support re-skilling, up-skilling and other skills training and reallocation of workers in the automotive sector in all affected Member States and in particular in the regions and the communities most affected by the transition"*. Using the possible revenues for reskilling and upskilling objectives was specifically supported by manufacturers during the public consultation.

The following options will therefore be considered:

- Option REV 0: Change nothing: revenue from the excess emission premiums continues to be considered as revenue for the general budget of the Union
- Option REV 1: Assign revenues to a specific fund or programme
- Option REV 2: Consider the revenue as "own resources", within the meaning of Article 311 of the Treaty. Under this option the revenue would be considered reducing specifically the part of the own resources that are based on the gross national income of the Member States and would therefore have to be redistributed to ensure that the equity between Member States' contributions is maintained.

Public authorities and NGOs (including environmental and consumer organisations) responding to the public consultation were of the view that revenues from excess emission premiums should be allocated to a fund to support the just transition to a climate-neutral economy, in particular to support the automotive workers (REV 1). Most of industry respondents and citizens called for allocating them to funds serving other purposes, from supporting the decarbonisation efforts of the industry to climate mitigation efforts in general.

#### 5.2.1.4 Derogations for small volume manufacturers

Regulation (EU) 2019/631 acknowledges that $CO_2$ targets should be determined differently for smaller manufacturers as compared to larger ones, taking account of their more limited possibilities to reduce average $CO_2$ emissions of their vehicle fleet.

The evaluation study of the former Regulations[56] identified the small volume derogation option[57] as a potential weakness, although its negative impacts had been relatively small. As part of the public consultation, manufacturers indicated their preference for maintaining this derogation. An option setting a phase-out date beyond 2030 is discarded. With a later phase-out date, the difference in terms of stringency would increase even further between manufacturers benefitting or not from a derogation. As a result, the emission reduction efforts for small-volume manufacturers would become too severe to catch up and meet a non-derogated target and ultimately zero-emission cars also in this market segment.

Taking into account the above, the following options will be considered:

- Option SVM 0: maintain the 'small volume manufacturers' derogations
- Option SVM 1: Remove the possibility for small volume manufacturers to be granted a derogation target from 2030 on. The choice of the date allows concerned manufacturers enough time to programme and adapt to the new regulatory requirements. It is also consistent with the application date of the strenghtened targets under the options presented in Table 3

Around a third of respondents to the public consultation supported revising the provision on the 'small volume manufacturers' derogations. However, manufacturers were generally against revising this provision. Public authorities' and NGOs' opinions were rather mixed or neutral.

### *5.2.2 Incentive scheme for zero- and low-emission vehicles (ZLEV)*

#### 5.2.2.1 Context

Since 2009, the Regulation setting $CO_2$ emission performance standards for cars has included a mechanism, in addition to the $CO_2$ targets, aimed to incentivise the uptake of vehicles with zero or low emissions. In a first phase, the incentive took the form of "super-credits"[58]. In the current Regulation (EU) 2019/631, super-credits can be obtained by car manufacturers for the years 2020 to 2022[59]. From 2025 on, a new "bonus-only" incentive scheme will apply, covering both cars and vans and targeting zero- and low-emission vehicles (ZLEV). ZLEV are defined as vehicles with $CO_2$ emissions of not more than 50°g/km (WLTP).

This new scheme aimed to incentivise the uptake of ZLEV beyond a given level without undermining the $CO_2$ targets. It intends to facilitate a smooth transition towards zero-emission mobility and should provide a strong and credible signal for the development, deployment and marketing of such vehicles[60].

Regulation (EU) 2019/631 sets out benchmarks for the share of ZLEV in a manufacturer's fleet of new vehicles registered in a given year. If that ZLEV benchmark is exceeded, the specific $CO_2$ emission target (in g $CO_2$/km) of a manufacturer will be relaxed by up to 5%.

[56] Evaluation of Regulation 443/2009 and 510/2011 on the reduction of $CO_2$ emissions from light-duty vehicles (Ricardo-AEA and TEPR, 2015) https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf

[57] This derogation option applies for "small volume" manufacturers responsible for less than 10 000 new cars or 22 000 new vans registered per year

[58] The term "super-credits" refers to a system where vehicles with low $CO_2$ emissions (below 50 g/km) are counted multiple times when calculating the average specific emissions of the manufacturer concerned.

[59] The super-credit multiplier was 2 in 2020 and decreases to 1.66 in 2021 and 1.33 in 2022. The total amount of super-credits is limited to 7.5 g $CO_2$/km per manufacturer (or pool) over the whole period (2020-2022).

[60] Regulation (EU) 2019/631, Recitals 20-21

Accounting rules apply for calculating the ZLEV share of a manufacturer's fleet: the lower its emissions, the more a vehicle gets counted.

The "bonus-only" approach means that there are no direct consequences for a manufacturer not meeting the ZLEV benchmark level.

During the public consultation, manufacturers expressed the view that a ZLEV incentive scheme should be maintained in its current form up to 2030 and that it should focus on zero-emission vehicles only beyond 2030. They stressed the need to include low-emission vehicles in the incentive scheme until 2030 so as to further incentivise their contribution to the decarbonisation in a transitional period.

Environmental NGOs, on the other hand, are calling for removing the incentive scheme, as soon as the share of electric vehicles reaches a certain level. They argue that the benchmark is a temporary incentive to kick-start the EV market, and therefore it is no longer justifiable after a certain point. They also stress that benchmarks weaken the Regulation by allowing the manufacturers to get a bonus on the overall target. They also highlight that only zero emission technologies, which are future-proof, should be incentivised.

The main issues to be considered in this respect are: (i) the incentive type and (ii) the targeted vehicles and their accounting.

#### 5.2.2.2 Incentive type

The following options are considered as regards the ZLEV incentive types[61]:

- Option ZLEVT_no: no ZLEV incentive mechanismOption ZLEVT_B: bonus-only system

  This option maintains the "bonus-only" crediting system under Regulation (EU) 2019/631, with adjusted $CO_2$ targets and ZLEV benchmarks.

- Option ZLEVT_BM: bonus/malus system

  Same as option ZLEVT_B, except for the addition of a "malus" mechanism, which means that a manufacturer not meeting the ZLEV benchmark level would have to comply with a stricter specific $CO_2$ target.

- Option ZLEVT_M: ZLEV mandate

  Each manufacturer's new vehicle fleet would have to include at least a given share of ZLEV and manufacturers not meeting this mandate level would have to pay a penalty.

#### 5.2.2.3 Targeted vehicles

Under the options where a ZLEV incentive mechanism would be maintained, the types of vehicles to be targeted and the accounting rules need to be assessed, in particular in light of the objectives described in Chapter 4 to ensure a cost-effective $CO_2$ emission reduction, provide benefits for consumers and stimulate innovation in zero-emission technologies, as well as the recent developments on the deployment of ZLEV and the new options for the $CO_2$ target levels considered (Section 5.2.1.1).

[61] The same types have been considered in the impact assessment supporting the 2017 Commission Proposal for a Regulation setting $CO_2$ emission performance standards for cars and vans (SWD(2017)650 final of 8 November 2017).

The ZLEV incentivised by the complementary mechanism should be those that have the greatest potential contribution to reducing the $CO_2$ emissions of the new car and van fleet in real-world conditions. The types of vehicle most relevant in this respect are battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV), both having zero tailpipe $CO_2$ emissions. These vehicles will be key for the transition to zero-emission mobility.

In addition, it should be considered which plug-in hybrid electric vehicles (PHEV) should be further incentivised and to what extent.

In the current Regulation, the accounting of a ZLEV under the incentive scheme is based on its $CO_2$ emissions. In this way, the incentive is targeted towards vehicles having near-zero emissions and avoids over-incentivising PHEVs with a short electric range. For cars, two multipliers were introduced by the co-legislators to give a greater weight to PHEVs, and, up to 2030, to ZLEV registered in Member States with the lowest ZLEV uptake.

In view of the above, the following options will be considered as regards the type of vehicles to be covered by the incentive scheme and the accounting rules:

- Option ZLEVAC_0: change nothing
- Option ZLEVAC_1: only zero-emission vehicles are eligible
- Option ZLEVAC_2: ZLEV with emissions from 0 to 25 g $CO_2$/km are eligible, with a linear accounting according to their emission level.

### *5.2.3 Mechanism for renewable and low-carbon fuels accounting*

Under Regulation (EU) 2019/631, compliance of a manufacturer with its specific emission target is assessed against the tailpipe $CO_2$ emissions of its fleet as measured under the test cycle laid down in type approval legislation (WLTP). While fuels policy is an important aspect of road transport decarbonisation, so far, the EU legal instruments in place are regulating the GHG emissions of vehicles and transport fuels separately.

Some stakeholders, in particular fuel producers and some automotive and component manufacturers, expressed the view that compliance assessment under Regulation (EU) 2019/631 should take into account emission reductions due to the use of renewable and low-carbon fuels, which have lower life-cycle emissions.

This would contribute to one or a combination of the following objectives: (i) to provide fuels suppliers with additional incentives to invest in the development, production and marketing of renewable and low-carbon transport fuels; (ii) to provide vehicle manufacturers with additional options for complying with their specific $CO_2$ emission targets, and consequently avoiding possible inefficiencies.

During the public consultation, environmental NGOs have argued against the introduction of such a mechanism, thereby pointing at a possible increased complexity of the approach, with a risk of creating loopholes and double counting as well as delaying the introduction of zero-emission vehicles. Vehicle manufacturers indicated that the Commission should consider to increase the contribution of renewable and low-carbon fuels by an ambitious revision of the Renewable Energy Directive.

The following options will therefore be considered on this issue:

- Option FUEL0: change nothing
- Option FUEL1: application of “carbon correction” factors to the type-approved emissions of the vehicles, to reflect the carbon intensity and share of the eligible fuels.

- Option FUEL2: the introduction of a low-carbon fuels (LCF) crediting system

  Fuel suppliers have an obligation to market certain amounts of renewable and low-carbon fuels to comply with the transport fuel targets set in the Renewable Energy Directive. Additional volumes of such fuels put on the market would generate credits, reflecting their life-cycle GHG emissions savings. Vehicle manufacturers may, on a voluntary basis, purchase these LCF credits and use them to meet their specific emission targets. To avoid that the LCF credits create a disincentive for manufacturers to invest in zero-emission technologies, the maximum LCF credits contribution should be capped[62].

For both options FUEL1 and FUEL2 the focus should be on those fuels which need additional support to come to the market and have the greatest potential in sustainably reducing emissions in the light-duty vehicle segment without additional environmental effects.

[62] Options for such a possible crediting mechanism were outlined for example in the study "Crediting system for renewable fuels in EU emission standards for road transport" commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi) (Frontier Economics Ltd. and Flick Gocke Schaumburg, May 2020 (https://www.frontier-economics.com/media/3937/crediting-systems-for-renewable-fuels-in-eu-emission-standards-for-road-transport-en.pdf).

# 6 WHAT ARE THE ECONOMIC/EMPLOYMENT, ENVIRONMENTAL AND SOCIAL IMPACTS OF THE DIFFERENT POLICY OPTIONS AND WHO WILL BE AFFECTED?

## 6.1 Introduction

The quantification of the impacts of the options defined in Section 5 relies on a number of models, using as an input i.a. information on the costs and the $CO_2$ and energy reduction performance of technologies to be fitted in new vehicles.

The baseline used for the assessment is the Reference Scenario 2020 (REF), consistent with the other initiatives for the 'fit for 55 package'. Some options regarding specific design elements, in particular the ZLEV incentive system and issues related to fuels, complement the $CO_2$ emission targets for vehicles. Therefore it is considered more appropriate to assess their impacts within the context of a policy environment achieving $CO_2$ targets compatible with the overall 55% emission reduction objective rather than comparing with the Reference Scenario 2020. This policy context is mainly represented by the MIX policy scenario.

As explained in Section 1, the $CO_2$ emission standards interact with a number of other policies part of the 'Fit for 55%' package. In order to capture the impacts of the $CO_2$ emission standards in a policy context where these other policies are represented, the MIX policy scenario context is used to assess the three different levels of the $CO_2$ emission standards TL_Low, TL_Med and TL_High.

This means that the policies and drivers described in Annex 4 for the climate initiatives of the package are included in the analysis, and they are kept at the same level as in MIX policy scenario to ensure the comparability of the results. In particular, this ensures that the contribution of carbon pricing is duly taken into account, with the same carbon price under the three different levels of the $CO_2$ emission standards. Where relevant, the contribution of the $CO_2$ emission standards alone is also singled out in the analysis.

Detailed information on the methodological approach, on the key assumptions and on the MIX and core policy scenarios can be found in Annex 4, and some additional results of the analysis in Annex 8.

One of the main impacts of the $CO_2$ emission standards for vehicles is the change in the composition of the EU-wide fleet of new cars and vans, which is one of the main drivers for the other impacts described in this chapter. The impacts of the different target levels on the fleet composition are shown in **Table 4**. It shows that the implementation of more ambitious targets levels leads to higher penetration of zero emission vehicles (i.e. BEV and FCEV) in the fleet of new vehicles in particular year.

**Table 4: New cars and vans powertrain composition in 2030, 2035 and 2040 under different target levels (TL) options**

| | Cars | | | | Vans | | | |
|---|---|---|---|---|---|---|---|---|
| **2030** | ICEV* | PHEV | BEV | FCEV | ICEV* | PHEV | BEV | FCEV |
| TL_0 | 61,5% | 13,3% | 24,5% | 0,6% | 71,6% | 14,7% | 13,4% | 0,3% |
| TL_Low | 56,1% | 12,8% | 30,5% | 0,6% | 66,9% | 13,6% | 18,9% | 0,7% |
| TL_Med | 48,0% | 16,1% | 35,1% | 0,8% | 61,9% | 16,0% | 21,3% | 0,7% |
| TL_High | 39,4% | 14,3% | 45,3% | 1,0% | 51,3% | 13,3% | 34,7% | 0,7% |
| **2035** | | | | | | | | |
| TL_0 | 56,0% | 16,8% | 25,3% | 1,8% | 58,2% | 18,4% | 22,0% | 1,3% |
| TL_Low | 38,7% | 20,1% | 38,8% | 2,4% | 43,4% | 21,2% | 32,7% | 2,6% |
| TL_Med | 28,0% | 21,8% | 46,8% | 3,4% | 28,7% | 21,8% | 47,4% | 4,2% |
| TL_High | 0,0% | 0,0% | 90,2% | 9,8% | 0,0% | 0,0% | 94,2% | 5,8% |
| **2040** | | | | | | | | |
| TL_0 | 46,7% | 17,6% | 32,4% | 3,2% | 50,1% | 20,8% | 26,8% | 2,3% |
| TL_Low | 18,5% | 19,2% | 55,1% | 7,2% | 17,7% | 22,9% | 52,3% | 7,2% |
| TL_Med | 0,0% | 0,0% | 87,0% | 13,0% | 0,0% | 0,0% | 85,6% | 14,4% |
| TL_High | 0,0% | 0,0% | 89,9% | 10,1% | 0,0% | 0,0% | 93,0% | 7,0% |

* including HEV and gas fuelled vehicles

## 6.2 $CO_2$ emission targets for cars and vans

### *6.2.1 Target levels (TL)*

6.2.1.1 Economic impacts (including employment)

6.2.1.1.1 Introduction

Different types of economic impacts of the different TL options are considered.

(i) Net economic savings from societal and end-user perspectives (Sections 6.2.1.1.2 to 6.2.1.1.3)

These savings are calculated as the difference, between the policy options and the baseline, of the total costs, averaged over the EU-wide new vehicle fleet of cars and vans registered in 2030, 2035 or 2040. The total costs include the capital costs, the fuel or electricity costs, and the operation and maintenance (O&M) costs of the vehicles. For the societal perspective, they also include the external cost of $CO_2$ emissions[63]. The end-user perspective is presented for the first user (first 5 years after first registeration) and the second user (years 6-10).

(ii) Costs for automotive manufacturers (Section 6.2.1.1.4)

These costs are calculated as the difference, between the policy options and the baseline, of the manufacturing costs, averaged over the EU-wide new vehicle fleet of cars and vans registered in 2030, 2035, 2040.

(iii) Energy system impacts (Section 6.2.1.1.6)

[63] Based on "Handbook on the external costs of transport – Version 2019 – 1.1 (European Commission, DG MOVE) - https://op.europa.eu/en/publication-detail/-/publication/9781f65f-8448-11ea-bf12-01aa75ed71a1

In view of the links between the $CO_2$ standards for cars and vans and the energy system, impacts of the TL options on the latter have been analysed, also considering the links with the revision of the EU ETS as well as the Energy Efficiency and Renewable Energy Directives.

(iv) Investment in alternative fuels infrastructure (Section 6.2.1.1.7)

The investments needed for recharging and refuelling infrastructure have been analysed, to ensure consistency with the revision of the Alternative Fuels Infrastructure Directive.

(v) Macro-economic impacts, including employment (Section 6.2.1.1.8)

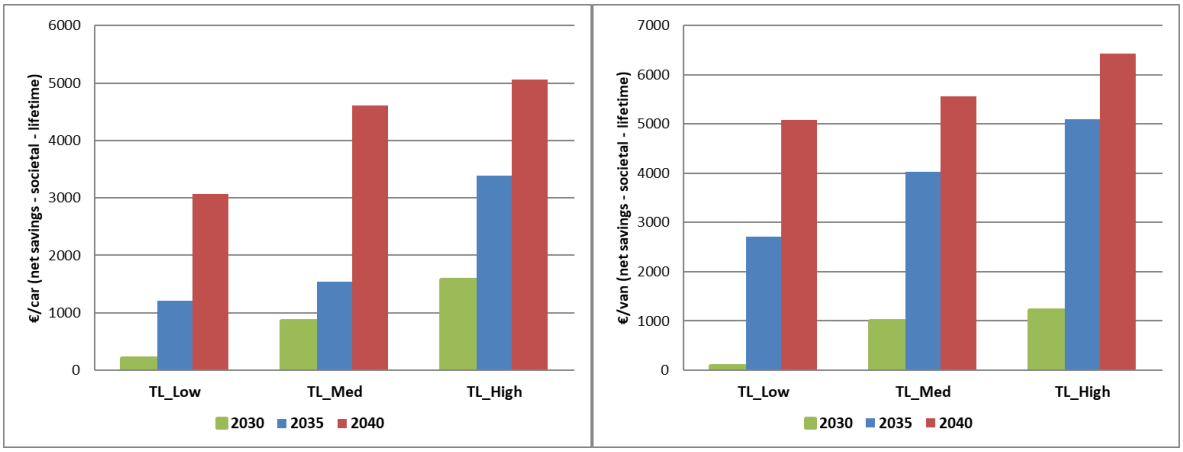
The below sections provide a summary of the main findings of the analysis.

6.2.1.1.2 Net economic savings over the vehicle lifetime from a societal perspective

**Figure 5** displays the effect of the $CO_2$ emission standards only, for the three target level (TL) options, on the average net savings over the vehicle lifetime from a societal perspective for a new vehicle registered in 2030, 2035 or 2040, in a MIX policy scenario context.

For both cars and vans, all three TL options lead to net savings. These savings increase with increasing target stringency.

**Figure 5: Average net savings over the vehicle lifetime from a societal perspective (EUR/vehicle) resulting from the $CO_2$ emission standards (in a MIX policy scenario context) (cars (l) and vans (r))**

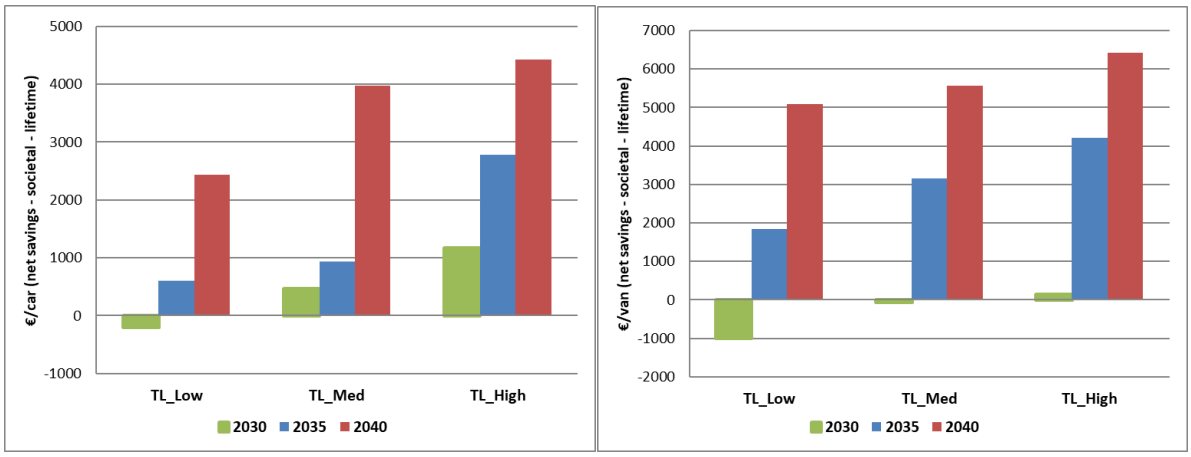



The $CO_2$ emission standards for cars and vans interact with other policies, which are part of the 'fit for 55 package' and which impact the average net economic savings. This concerns in particular (i) the strenghtening of the EU ETS and the possible emissions trading for buildings and road transport, which impact the fuels and electricity prices, as projected in the MIX policy scenario; (ii) the increased use of renewable fuels in road transport required under the Renewable Energy Directive, which also impacts the fuel prices; (iii) the preparation of stricter Euro 7 pollutant emission standards, which lead to additional capital costs for vehicles powered by internal combustion engines.

**Figure 6** shows the net savings over the vehicle lifetime from a societal perspective when the effects of those policies are taken into account, so that the costs considered also reflect the changes resulting from those policies. Two major effects contribute to the differences as compared to Figure 5: on the one hand a decrease in the energy savings due to higher electricity and fuel prices; on the other hand an increase in avoided $CO_2$ emissions due to the combination of policies.

This analysis shows that higher levels of the $CO_2$ targets for cars and vans result in higher societal benefits also when considering the combined effect of the $CO_2$ standards and the other policies as projected in the MIX scenario.

**Figure 6: Average net savings over the vehicle lifetime from a societal perspective (EUR/vehicle) resulting from the combination of policies (cars (l) and vans (r))**



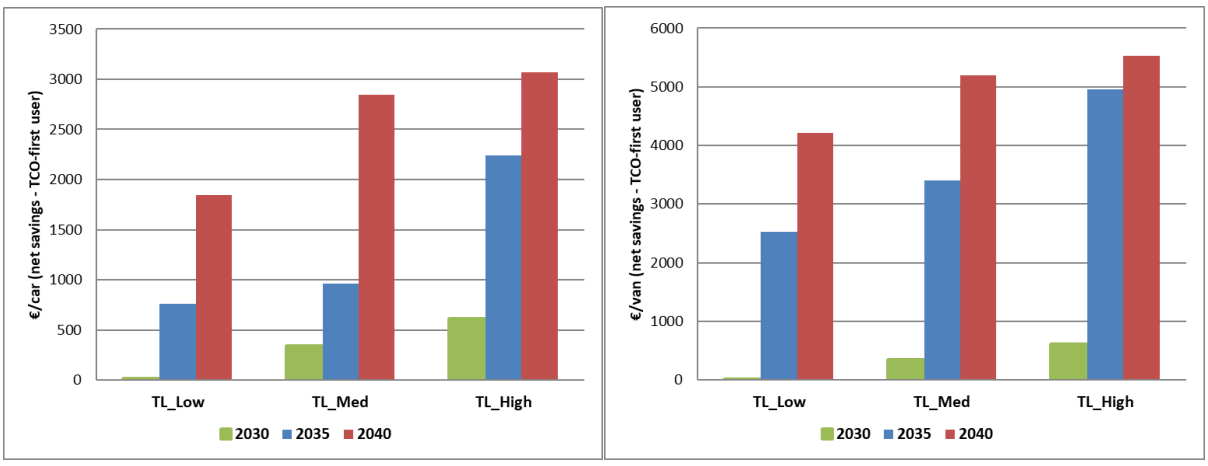

6.2.1.1.3 TCO-first user and TCO-second user

First user perspective

**Figure 7** shows the average net savings (EUR per vehicle) resulting from the $CO_2$ emission standards from a first end-user perspective considering the first five years of a vehicle's lifetime under the three TL options for a new vehicle registered in 2030, 2035 and 2040.

Overall, the factors determining the net savings are the same as under the societal perspective, apart from the $CO_2$ externalities. The trends show a positive effect of the $CO_2$ standards, with stricter targets delivering higher consumer benefits. This is explained mainly by the fact that the savings in the fuel expenditure during the use of the vehicles exceed the higher upfront capital costs of more efficient and zero- and low-emission vehicles.

**Figure 7: Average net economic savings from a TCO-first user (first 5 years) perspective (EUR/vehicle) resulting from the $CO_2$ emission standards (in a MIX policy scenario context) (cars (l) and vans (r))**

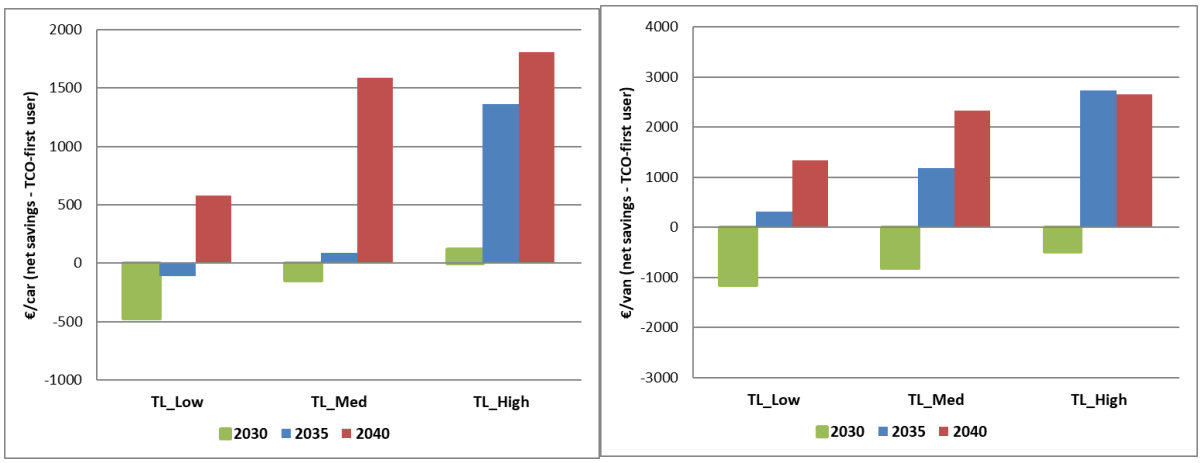


The effect of the interaction with the other policies of the 'fit for 55%' package, in particular the EU ETS and RED, is shown in

**Figure** 8. The policy interaction changes the outcome as compared to the case illustrated in **Figure 7**. The increase of fuel prices leads to a decrease of the fuel savings for consumers, up to the point that over the period of their vehicle use, overall losses can be experienced by the first users instead of savings.

However, the analysis shows that the $CO_2$ targets for cars and vans mitigate the effect of the higher fuel prices due to the other policies. Considered together with those policies, the strenghening of the $CO_2$ target levels leads to lower costs, except in the case of TL_Low option.

**Figure 8: Average net economic savings in TCO-first user (5 years) (EUR/vehicle) resulting from the combination of policies (cars (l) and vans (r))**




Second user perspective

The economic impacts of stricter $CO_2$ targets under the different TL options on buyers of second hand vehicles were also looked at. It is considered that second users on average purchase the vehicle after 5 years of use and resell it after 10 years.

The results of the analysis are similar as for the first-user (see Annex 8). Both for cars and vans, when considering the effect of the $CO_2$ standards only, net savings occur under all options considered from 2030 onwards. The net savings increase with the stringency of the targets.

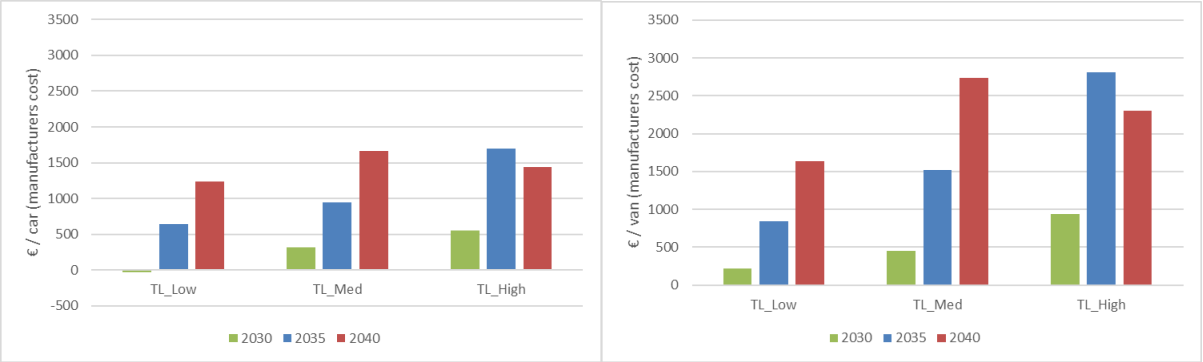
When considering the interaction with the other policies, stricter targets lead to net savings or to a reduction of the additional costs incurred.

#### 6.2.1.1.4 Costs for automotive manufacturers

The costs for automotive manufacturers depend on the costs of the technologies that they will deploy in the new vehicles fleet to meet the $CO_2$ targets. These costs, averaged over the EU-wide new cars and vans fleet, are shown in **Figure 9**.

In general, the costs for manufacturers increase with stricter $CO_2$ emission targets. The situation is slightly different in the year 2040. This is due to a different distribution in 2040, in the three target options, between battery electric and fuel cell electric vehicles, reflecting different technology penetrations over time for reaching the zero-emission targets.

**Figure 9: Average costs for automotive manufacturers resulting from the $CO_2$ emission standards (in a MIX policy scenario context) (cars (l) and vans (r))**




In general, for all economic sectors, the investment challenge of the transition was already recognised in the European Green Deal, which stated that "*Delivering additional reductions in emissions is a challenge. It will require massive public investment and increased efforts to direct private capital towards climate and environmental action, while avoiding lock-in into unsustainable practices. […] This upfront investment is also an opportunity to put Europe firmly on a new path of sustainable and inclusive growth. The European Green Deal will accelerate and underpin the transition needed in all sectors.*" The Impact Assessment of the Climate Target Plan analysed and quantified the investment challenge in section 6.4.1.3, with table 12 showing the quantitative increase in investments in all sectors and in all scenarios, with the power and residential sectors facing the biggest challenge.

Also the automotive sector is projected to face additional investments[64] as compared to the investments needed to comply with current $CO_2$ emission standards. These additional investments, which are necessary to meet the market demand of new vehicles and comply with the stricter $CO_2$ emission targets are shown in **Table 5** for the different target level options. Over the period 2021 to 2040, they are estimated at around 4.6 billion euros annually for the option TL_Low. The additional investments become almost 3 times higher for option TL_Med, and around 4 times higher for option TL_High. For TL_Low, TL_Med and TL_High the additional annual investments represent an increase of around 1%, 3% and 4% compared to the annual investments needed to comply with the current $CO_2$ emission standards.

**Table 5: Average annual additional investments over 2021-2030 and 2021-2040 for the different target level options**

| | Period 2021-2030 [billion €] | % | Period 2021-2040 [billion €] | % |
|---|---|---|---|---|
| TL_Low | 0.27 | 0.1% | 4.6 | 1% |
| TL_Med | 1.2 | 0.3% | 12 | 3% |
| TL_High | 2.6 | 0.6% | 19 | 4% |

[64] The estimation considers both direct manufacturing costs, including materials and labour, as well as indirect manufacturing costs, including R&D, warranty costs, depreciation and amortisation, maintenance and repair, general other overhead costs.

Meeting the different target levels options depends on the ability to mobilise these investments, which represent a limited increase as compared to the investments needed to comply with the current $CO_2$ emission standards levels.

Significant investments in zero-emission vehicles are already taking place or have been announced. Many automotive manufacturers are setting up plans to reach high to very-high market shares of zero-emission vehicles. (see details in Annex 8).

Key investments necessary for the deployment of zero-emission vehicles needed to meet the $CO_2$ emission standards are related to investments in batteries, the core zero-emission technology for cars and vans. The European Battery Alliance is contributing to large investments in batteries in the EU, including through the European Investment Bank and the state aid instrument for Important Projects of Common European Interest (IPCEI), and through support to research and innovation programmes.

Recent announcements by major players in the market also confirm investments in battery technologies[65]. A study[66] found that: (i) "the European battery industry produces all chemistries and will meet demand thanks to lead-based and Li-ion batteries, comprising more than 90% of the total European battery market by 2030"; (ii) "Europe will retain its strong position in 2030 and remain very competitive, but ongoing investment is needed to maintain/improve production and for R&D"; (iii) "current/projected capacity will just meet current/projected demand"; (iv) on Li-ion batteries, there is a "ten-fold future growth potential and Europe is ready to meet demand, although currently heavily reliant on imports".

In addition, experience shows that the automotive industry was able to mobilise significant investments to drastically reduce emissions from cars as a result of the application of the stricter 2020 target. According to preliminary data, the share of BEV and PHEV increased from 3% in 2019 to 11% in 2020.

The different elements presented above show the feasibility of the different target level options. It is important that automotive investments are matched by investments in the necessary recharging infrastructure, a key flanking measure to remove one of the demand-side market barriers to the uptake of zero-emission vehicles. The investment needs related to infrastructure are estimated in paragraph 6.2.1.1.7, covering both public and private charging points.

6.2.1.1.5 Innovation and competitiveness.

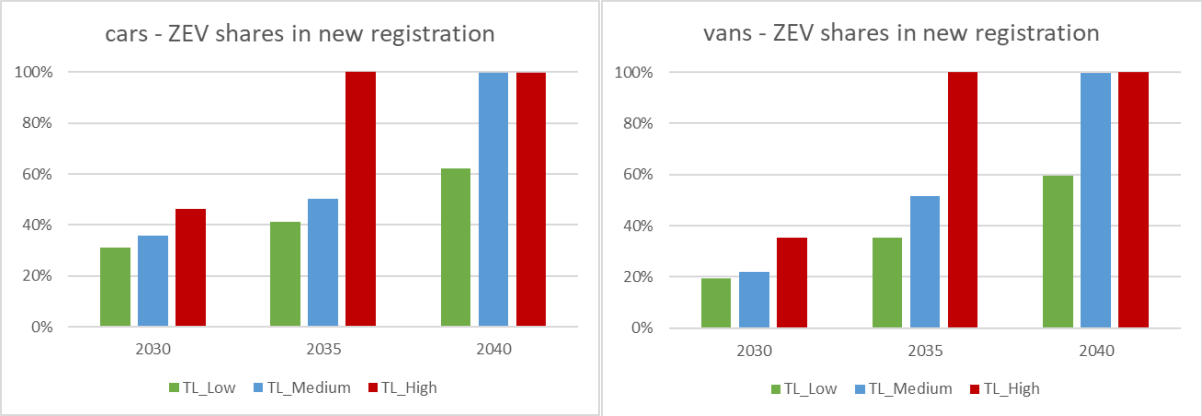
The different options considered for the target levels will have a positive impact on innovation. They are projected to incentivise the deployment of zero-emission technologies in the new vehicles fleet by requiring an increased supply of zero-emission vehicles to the market, which will spur innovation in the sector.

The projections on the penetration of zero-emission vehicles therefore serve as a quantitative proxy of the impacts on innovation. **Figure 10** presents the evolution of the projected penetration of zero-emission powertrains for new cars and vans over time, for the different options considered for the target levels.

**Figure 10: Projected shares of zero-emission vehicles in the cars and vans fleet resulting from the $CO_2$ emission standards**

[65] European Battery Alliance | Internal Market, Industry, Entrepreneurship and SMEs (europa.eu): https://ec.europa.eu/growth/industry/policy/european-battery-alliance_en

[66] The Rechargeable Battery Market and Main Trends 2011-2020 (eurobat.org)




While all options have a positive impact on the deployment of zero-emission technologies, TL_High leads to a faster deployment of these technologies towards the whole vehicle fleet becoming zero-emission. It therefore has a higher impact on innovation, with a steep increase between 2030 and 2035. Under the TL_Med options, the share of new zero-emission vehicles is projected to increase for cars to around 36%, 50% and 100% in 2030, 2035 and 2040 respectively, compared to around 6% in 2020. For vans, the share is projected to increase to around 22%, 52% and 100% in 2030, 2035 and 2040 respectively, compared to around 2% in 2020. Stimulating innovation in zero-emission technologies in the EU would also strengthen the technological leadership of the EU automotive value chain, as explained in Section 4.

In the global context, countries are stepping up their commitments to climate action. In particular, China recently pledged to achieve climate neutrality by 2060 and can be expected to continue to accelerate the deployment of zero-emission vehicles through regulatory action, also to tackle the serious air quality concerns in cities. The US has recently re-joined the Paris agreement and has announced ambitious action to reduce vehicle emissions, with California paving the way to a rapid transition towards zero-emission mobility through tightened legislation.

The US and China also represent the two biggest export markets for the EU automotive industry with 1 million and 460,000 cars exported in 2019 to the US and China respectively. This represents around 30% and 17% of EU export market value in these countries[67]. Stimulating innovation in zero-emission technologies is necessary in view of the importance of such markets, in light of the new climate commitments.

The International Energy Agency (IEA) foresees the electric light-duty vehicle stock to expand from about 10 million in 2020 to almost 140 million vehicles in 2030 (from less than 1% global stock share to 8% in 2030) according to the "Stated Policy Scenario". The stock would possibly increase even further to 220 million electric light-duty vehicles in 2030 (corresponding to an almost 15% stock share) in the "Sustainable Development Scenario"[68]. This indicates that, with the global demand for zero-emission vehicles increasing, further investment in innovation is key for European manufacturers to maintain and reinforce the EU automotive industry's competitiveness and market share on the global stage.

Stricter $CO_2$ emission standards provide certainty for the market deployment of EVs and a strong, long-term signal to automotive manufacturers to innovate. They can also drive

[67] Exports of passenger cars | ACEA - European Automobile Manufacturers' Association: https://www.acea.be/statistics/article/exports-of-passenger-cars

[68] https://www.iea.org/reports/global-ev-outlook-2021/prospects-for-electric-vehicle-deployment

innovation along the value chain, aiming at reducing the costs of production and securing availability of components..

If current $CO_2$ emission standards were to remain unchanged, manufacturers would be at risk of reduced competitiveness in other markets, as well as possibly lose market shares in Europe..

Drawing from the conclusions from GEAR 2030 on automotive competitiveness and sustainability[69], the evolution of the EU regulatory environment would influence the ability of automotive manufacturers to maintain and grow their future market shares both domestically and abroad.

European manufacturers are open to support current and even higher emission reduction targets under the condition that the required charging points and hydrogen stations are rolled out, as reported by the European Automobile Manufacturers' Association (ACEA)[70]. They are starting to shape up their future business strategies around zero-emission technologies, further underlining that their future competitiveness is linked to the development and marketing of these technologies.

Automotive manufacturers are announcing commitments to significantly increase their BEV and PHEV models in their portfolios over the next decade. This means that manufacturers link their future competitiveness to zero-emission vehicles, so that stricter $CO_2$ standards levels can be expected to better support their shift towards zero-emission vehicles.

Manufacturers are also bringing to Europe the innovation projects that will enable the deployment of zero-emission vehicles in the most competitive way. For example, investments in batteries production in Europe are surging, also thanks to joint efforts under the European Battery Alliance[71], with positive effects on industrial competitiveness even beyond the traditional automotive value chain. Therefore the industrial transformation that $CO_2$ emission standards can propel also boost new sectors and activities like electronics and software, and battery manufacturing.

The effect of $CO_2$ emission standards in the automotive industry can also be observed in how the market values fully electric and most innovative automotive manufacturers. Already in 2021, relatively new purely EV brands are regarded as innovation leaders. They are at the top of the global ranking of automakers by market capitalization, and in some cases they have a market capitalisation greater than competitors[72], despite these competitors being much larger in terms of sales numbers and total revenues[73]. This indicates that the market views these EV brands as attractive options for investors, representing relatively low risk investment strategies and positive expectations for these companies in the future. This constitutes a strong signal for manufacturers on what the market is considering valuable for the future and further underlines that the transformation towards zero-emission mobility is also beneficial for manufacturers in the medium- and long-term.

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[69] European Commission 2017. Report of the High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union (GEAR 2030): https://ec.europa.eu/growth/content/high-level-group-gear-2030-report-on-automotive-competitiveness-and-sustainability_en

[70] https://www.acea.be/press-releases/article/car-makers-open-to-higher-co2-targets-if-there-is-matching-infrastructure

[71] European Battery Alliance | Internal Market, Industry, Entrepreneurship and SMEs (europa.eu)

[72] https://companiesmarketcap.com/automakers/largest-automakers-by-market-cap/ and https://www.visualcapitalist.com/worlds-top-car-manufacturer-by-market-cap/

[73] https://www.investopedia.com/articles/company-insights/091516/most-profitable-auto-companies-2016-tm-gm.asp

Finally, demand side considerations also impose additional pressure on the market, where manufacturers must supply what is demanded. Some cities[74] show support for restriction zones to non-zero emission vehicles and some Member States[75] are announcing plans for all new cars to be zero-emission vehicles by certain dates[76]. Both these findings further underline that demand is increasing for zero-emission vehicles and that the automotive industry will remain competitive on the market as long as it is able to offer zero-emission solutions to satisfy the increasing demand.

In light of the above, stricter $CO_2$ target levels driving the development and supply of zero-emission technologies can be expected to have a positive impact on innovation and automotive industry's technological leadership and competitiveness.

#### 6.2.1.1.6 Energy system impacts

##### *6.2.1.1.6.1 Final energy demand and fuel mix*

**Figure 11** shows the impact of the different TL options on the final energy demand for passenger cars and vans over the period 2015-2050.

Under the baseline, demand was 189 Mtoe in 2015. It decreased significantly in 2020 due to the effect of the COVID-19 pandemic but is projected to increase again to 174 Mtoe in 2025. From then on, it is projected to decrease over time as vehicles meeting the $CO_2$ targets set in the current Regulation enter the fleet. In 2030, 2040 and 2050, demand under the baseline is respectively 11%, 28% and 38% lower than in 2025.

Under the different TL options, final energy demand decreases further and the effects of the more stringent $CO_2$ targets for cars and vans become more outspoken from 2035 on. While the stricter $CO_2$ emission targets in 2030 lead to a lower energy consumption already by 2030, their effect becomes stronger in the period post-2030 as a result of the fleet renewal. By 2040, demand is reduced by between 19%, 33% and 43% for the different TL levels, as compared to the baseline.

These results are built on the MIX scenario and therefore take into account the interaction with the other policies of the 'fit for 55% package' which have impacts on the energy system. This includes in particular: (i) the strenghtening of the EU ETS, and the emissions trading for buildings and road transport. They can both impact the energy consumption patterns due to carbon pricing on electricity, which becomes an important energy carrier for cars and vans, and on road transport fuels; (ii) the increased ambition on renewable energy and energy efficiency policies; (iii) policies to increase the efficiency of the transport sector[77].

It can be estimated that the vehicle $CO_2$ emission standards alone will contribute to the 2040 reductions of the final energy demand for cars and vans by 9, 24 and 36 percentage points for the three TL levels respectively. This contribution becomes more and more important over time in view of the delayed effect linked to the fleet renewal, as explained above. This will help contributing to the targets under the Energy Efficiency Directive.

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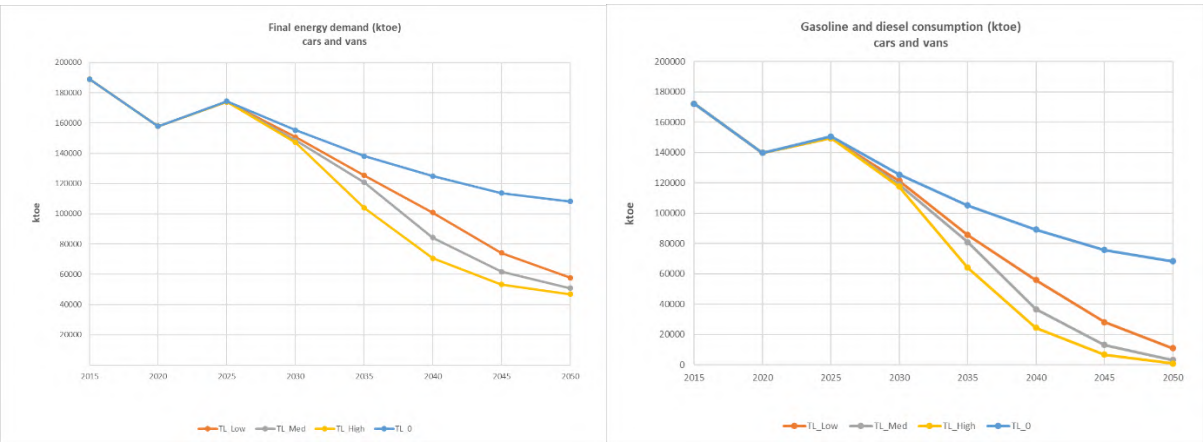
[74] Such as Paris, Madrid, Strasbourg, Athens, Rome, Amsterdam, Brussels, Berlin and Stuttgart.

[75] Such as Denmark, Ireland, the Netherlands, Slovenia, Sweden, France, and Spain.

[76] https://theicct.org/blog/staff/global-ice-phaseout-nov2020

[77] This includes support for multimodal mobility and intermodal freight transport; deployment of infrastructure for smart traffic management and transport digitalisation, as well as fostering of connected and automated mobility; initiatives to increase and better manage the capacity of railways, inland waterways, supported by the TEN-T infrastructure and CEF funding; measures to reduce noise and air pollution in urban areas. A complete description is provided in the SWD(2020) 331 accompanying the Sustainable and Smart Mobility Strategy Communication.

**Figure 11: Final energy demand (ktoe/year) and gasoline and diesel consumption (ktoe/year) for cars and vans under different TL options**



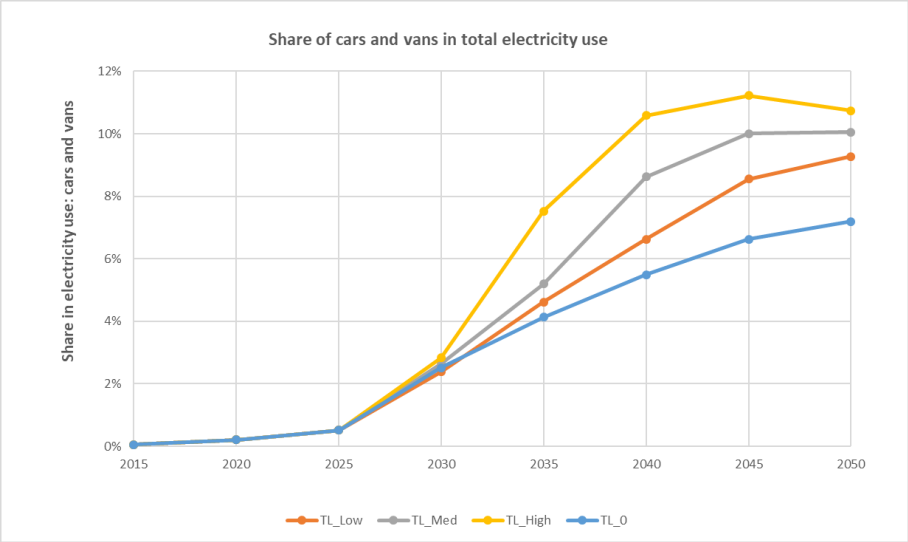

The $CO_2$ targets also have an impact on the demand per type of energy source for cars and vans. While diesel and gasoline remain the main fuels used in 2025 and 2030, there is a clear shift away from fossil fuels in the years thereafter. Over the period 2030 to 2050, the target level options TL_Low, TL_Med and TL_High would result in cumulative savings of diesel and gasoline with respect to the baseline of 685, 913 and 1100 Mtoe, respectively. This is equivalent to around 200-300 billion euros at current oil prices.

*6.2.1.1.6.2 Electricity consumption*

**Figure 12** shows the share of the total EU-27 electricity consumption used by cars and vans (together) in 2030, 2040 and 2050 for the three TL options. It illustrates that, even with the strictest targets considered, the share of electricity used by light-duty vehicles up to 2030 is not more than 2.8 percent of the total electricity consumption. From 2030 onwards, the effect of more electric vehicles coming to the market becomes more evident, in particular under the most ambitious option TL_High, where electricity consumption of cars and vans makes up around 11% of the total by 2040. Electrification of end-user sectors, including building, industry and transport is one of the three key concepts of the Energy System Integration Strategy[78], which also tackles the issues related to grid infrastructure.

[78] COM(2020) 299 final

**Figure 12: Electricity consumption by cars and vans as a percentage of total electricity consumption (EU-27) under different TL options**




6.2.1.1.7 Investment in alternative fuels infrastructure

As the $CO_2$ emission standards will incentivise increasing shares of electric and hydrogen powered cars and vans in the market, the related minimum refuelling and recharging infrastructure will have to be provided.

The revision of the Alternative Fuels Infrastructure Directive (AFID) aims at defining the framework necessary for the roll-out of publicly accessible infrastructure, a key barrier to the market uptake and customer acceptance of zero-emission vehicles and hence an indispensable corollary to the roll-out of zero-emission vehicle fleets. The review of the Energy Performance of Buildings Directive aims at strengthening the framework necessary for the roll-out of recharging infrastructure in buildings. The Connecting Europe Facility, Regional and Structural Funds, the Renovation Wave and InvestEU/ blends with EIB instruments could assist in funding.

In order to support the market uptake of the zero-emission vehicles projected in the scenarios assessed (see Section 6.1), it is estimated that investments in public and private recharging infrastructure will amount to around €4 bn per year over 2021-2040 in TL_Low, around €5 bn per year in TL_Med and around €6 bn in TL_High. Additional information on recharging infrastructure is provided in the Impact Assessment for the revision of the AFID, including on the sufficiency levels for infrastructure coverage underpinning the above-mentioned investments estimate.

6.2.1.1.8 Macro-economic impacts, including employment

*6.2.1.1.8.1 Introduction*

The E3ME and GEM-E3 models are used to assess macro-economic and sectoral economic impacts. In particular, these models are used to quantify the impacts of the different $CO_2$ targets for light-duty vehicles on the wider economy, i.e. GDP, sectoral output and employment.

An analysis of the macro-economic impacts, including on employment, of meeting the overall 55% emission reduction target by 2030 is presented in the Climate Target Plan (CTP), to take

into account the combined effect of different policies, including different levels of the $CO_2$ emission standards for vehicles[79]. The purpose of this analysis is to complement the CTP by focusing on the macroeconomic impacts of the $CO_2$ emission standards for cars and vans only. For this purpose, the MIX scenario context has been used both for the baseline and the policy scenarios. Different levels of $CO_2$ emission standards are also included, equivalent to TL_0 in baseline and TL_Low, TL_Med and TL_High in the policy scenarios.

*6.2.1.1.8.2 E3ME modelling results*

The E3ME model is used to assess macro-economic and sectoral economic impacts (see Annex 4 for a detailed description of the model and the main assumptions used for the analysis), in particular, to quantify the impacts of the different $CO_2$ targets for light-duty vehicles on the wider economy, i.e. GDP, sectoral output and employment.

**Table 6** shows the options for the target levels which were considered in the scenarios modelled by E3ME.

**Table 6: Scenarios modelled with E3ME for assessing the macro-economic impacts of the TL options**

| E3ME scenarios | $CO_2$ target levels option (cars and vans) |
|---|---|
| Baseline | TL0 |
| MIX55_LSTD | TL_Low |
| MIX55 | TL_Med |
| MIX55_HSTD | TL_High |

All the modelled scenarios estimate changes due to the new $CO_2$ target levels in order to isolate the macroeconomic effects of this specific policy. In all scenarios, government revenue neutrality from the associate reduction in fuel duty is imposed. The implementation of the new $CO_2$ targets reduces petrol and diesel consumption, which are commodities upon which taxes are levied in all Member States. The loss of fuel duty revenue due to lower petrol and diesel consumption is compensated, in all scenarios, by a proportional increase of VAT rates[80][81].

GDP and sectoral output

**Table 7** shows the projected GDP impact for the EU-27 for the three scenarios compared against the baseline.

[79] SWD(2020) 176 final

[80] As an example, in the scenario MIX55 modelled through E3ME, it is projected that fuel duty revenues in the EU-27 decrease by around 1,785 million euros in 2030, corresponding to a 2% decrease with respect to the baseline. The fuel duty revenue loss represents around 0.01% of the EU-27 GDP. To ensure revenue neutrality, VAT total revenues increase by around 0.08% in 2030. The loss in fuel duty revenues in 2035 and 2040 amounts to up to 0.03% and 0.07% of the EU-27 GDP.

[81] The choice of VAT compensation is functional in the model to ensure government revenue neutrality, and it does not imply specific policy choices. Alternative options in reality are possible and they would depend on specific Member States choices.

**Table 7: GDP impacts in the baseline (million euros in 2015 price) and percentage change from the baseline under the policy scenarios (E3ME results)**

| Scenario | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline (M€2015) | 14,704,321 | 15,689,067 | 16,925,347 |
| MIX55_LSTD | 0.00% | 0.06% | 0.28% |
| MIX55 | 0.01% | 0.13% | 0.45% |
| MIX55_HSTD | 0.02% | 0.26% | 0.65% |

The results show a positive impact, compared to the baseline, of the three policy scenarios on EU-27 GDP from 2030 onwards. It is projected that with stricter $CO_2$ targets for cars and vans increased consumer expenditure as well as increased infrastructure and vehicle technology investment would be triggered.

In these scenarios, stricter $CO_2$ emission standards lead to lower spending on fuel and higher disposable income for consumers. Despite VAT increases to offset the loss in fuel duty revenues, consumers overall benefit from higher disposable income. Together with a reduction in imports of petroleum products, this would result in an overall small positive impact on GDP, including through indirect effects, related to the increase of demand of goods and services in the EU.

At the sectoral level, there would be an expansion of electric vehicles supply chain, with a production increase in sectors such as metals and electrical and machinery equipment. This reflects the impact of increased demand for batteries, electricity infrastructure and electric motors.

The automotive sector would see a limited decrease in turnover due to the decreasing shares of internal combustion engines vehicles, while the electronic equipment sector would see an increase due to the additional demand for batteries.

This shows that the automotive value chain and its employment composition (see employment section below) are expected to change over time, with a shift from the production of components for internal combustion engines to the manufacturing and management of equipment for zero-emission powertrains.

While outside of the scope of the analysis of the impacts of different $CO_2$ emission standards levels, it should be noted that other trends, including shared mobility, connectivity and automation, and new business models, are likely to affect the automotive value chain, and its employment characteristics. While vehicle production is likely to remain the core competence of the automotive manufacturers, they have started to participate in new business models and to expand their suppliers pool to integrate new hardware, software and services.

Furthermore, the modelling results show that power and hydrogen supply sectors would increase production reflecting increased demand for electricity and hydrogen to power EVs, while the petroleum refining sector and petrol stations would see losses. Indirect effects are observed for the recreation and services sectors, which would benefit from higher demand from consumers. With stricter target levels, these effects would become slightly more pronounced.

**Table 8** shows the main impacts on the output within the most affected sectors for the different scenarios.

**Table 8: Impacts on the output within the most affected sectors (million euros in 2015 price) and percentage change from the baseline (E3ME results)**

| | Baseline | MIX55_LSTD | MIX55 | MIX55_HSTD |
|---|---|---|---|---|
| **2030** | | | | |
| Petroleum refining | 307,212 | -0.21% | -0.83% | -1.52% |
| Automotive | 940,332 | -0.08% | -0.19% | -0.37% |
| Electronics | 420,992 | 0.01% | 0.04% | 0.06% |
| Metals | 1,051,402 | 0.00% | 0.03% | 0.04% |
| Electrical equipment | 336,632 | 0.07% | 0.28% | 0.47% |
| Electricity, gas, water, etc | 1,152,642 | 0.04% | 0.14% | 0.27% |
| **2035** | | | | |
| Petroleum refining | 236,989 | -1.61% | -3.86% | -11.63% |
| Automotive | 978,138 | -0.20% | -0.72% | -1.93% |
| Electronics | 450,782 | 0.07% | 0.14% | 0.32% |
| Metals | 1,095,384 | 0.08% | 0.06% | 0.16% |
| Electrical equipment | 360,498 | 0.18% | 0.50% | 0.99% |
| Electricity, gas, water, etc | 1,216,738 | 0.27% | 0.63% | 1.64% |
| **2040** | | | | |
| Petroleum refining | 184,995 | -7.07% | -15.99% | -22.80% |
| Automotive | 1,019,037 | -0.19% | -1.77% | -3.46% |
| Electronics | 491,843 | 0.39% | 0.49% | 0.55% |
| Metals | 1,153,916 | 0.35% | 0.20% | 0.09% |
| Electrical equipment | 395,870 | 0.49% | 0.92% | 1.37% |
| Electricity, gas, water, etc | 1,327,498 | 0.89% | 1.84% | 3.04% |

Employment

As shown in **Table 9**, with stricter $CO_2$ target levels resulting in an increase in economic output, there is also an increase in the number of jobs across the EU-27 compared to the baseline, be it overall limited. The number of additional jobs also increases over time. The main drivers behind the GDP impacts also explain the employment impacts.

**Table 9: Total employment impacts (E3ME) in terms of number of jobs in the baseline (000s) and changes to the baseline (000s jobs) under the three policy scenarios**

| | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline | 201,047 | 198,282 | 195,316 |
| MIX55_LSTD | 4 | 76 | 350 |
| MIX55 | 24 | 129 | 477 |
| MIX55_HSTD | 39 | 297 | 588 |

At sectoral level, similar conclusions and considerations as for the impacts on the output can be drawn. The overall impacts are small. Positive impacts are mainly seen in the sectors

supplying to the automotive sector as well as in the power sector. Other sectors experience some positive second order effects, e.g. as a result of overall increased consumer expenditure.

In the different options assessed, the market uptake of battery and plug-in hybrid electric vehicles increases with respect to the baseline, while the conventional powertrains remain the majority of the fleet in 2030, but decrease thereafter, as shown in **Table 4**. This impacts the employment situation in the automotive sector.

In particular, as shown in **Table 10**, while the MIX55 scenario results in net 24,000 additional jobs economy-wide in 2030, it also results in 4,000 jobs losses in the automotive sector corresponding to 0.16% reduction compared to the baseline. Employment impacts are more pronounced in the long term. In 2040 there are net 477,000 additional jobs created economy-wide, while job losses in the automotive sectors increase by 36,000 jobs corresponding to 1.65% reduction compared to the baseline.

Job losses in the automotive sector reflect mainly the reduction in demand for internal combustion engine vehicles. However, as the automotive sector covers a variety of vehicles production activities, which would continue to operate for electric vehicles production, the losses are limited.

Jobs in electronics and electrical equipment increase as a result of the additional demand for batteries, and components for the electric engines. To fully reap the job opportunities offered by the transition towards zero-emission mobility, it is essential to stimulate investments in these areas and sub-sectors with growth potential.

The change in the automotive value chain described above is reflected in these changes in the employment distribution at sectoral level. Transitions of employment can occur at different levels: intra-company, within the automotive sector and also outside of the automotive sector. In this context, it remains key to ensure that adequate policies and programs are set-up for the reskilling of workers to facilitate the transitions.

At the EU level, beside the Just Transition Fund, the European Social Fund Plus (ESF+) is the main EU instrument to address this concern, with the aim to support Member States to achieve a skilled workforce ready for the green and digital transition[82].

With a total budget of 88 billion euros, the ESF+ contributes to financing the implementation of the principles from the European Pillar for Social Rights through actions in the area of employment, education and skills and social inclusion. It aims to, inter alia, achieve high employment levels, ensure social inclusion, contribute to poverty reduction, and grow a skilled and resilient workforce ready for the transition to a green and digital economy.

The ESF+ will in particular make a strong contribution to the green and digital transitions by driving investment in skilling opportunities so that workers can thrive in a climate-neutral, more digital and inclusive society.

The Industrial Strategy for Europe[83] also highlights the importance of increasing investment in skills and life-long learning with collective action of industry, Member States, social partners and other stakeholders through a new **'Pact for Skills'**[84]. The Pact helps to mobilise the private sector and other stakeholders to upskill and reskill Europe's workforce.

[82] https://ec.europa.eu/esf/main.jsp?catId=62&langId=en
[83] COM(2021) 350 final and COM(2020) 102 final
[84] https://ec.europa.eu/social/main.jsp?catId=1517&langId=en

The Pact also supports large-scale skills partnerships per ecosystem, some of which already put forward skilling commitments. The **Skills Roundtable** organized with the automotive sector provided a number of suggestions and principles for the automotive partnership, including:

- The need to address the fragmentation of skills initiatives in the EU and encourage closer co-operation between companies and educational institutes.
- A key first step is to map those initiatives and identify ways for cooperation between initiatives building on the DRIVES project[85].
- The Pact for skills must be inclusive to take account of the whole value chain (including SMEs) and workforce with the different levels of skills required
- Local and regional training centres and clusters can play an important role in identifying skill needs (especially for SMEs) and help in the delivering of training.
- The Pact should build on the work of DRIVES and related blueprints such as the ALBATTS[86] project.

It is needed to ensure that educational programmes provide future employees with a set of skills matching future demands, while creating an ecosystem where industry, education, and national and regional authorities are working together in targeting key areas and implementing relevant training, reskilling and upskilling in the automotive sector. It is crucial to ensure the transformation of the labour force in a particular area and in a way that reflects the possibilities of the region. National and local-level initiatives, such as cooperation between employers, trade unions and schools, collective bargaining frameworks, social security reforms and increased incentives for workers to relocate (to address missing skill-needs) can be important in tackling this challenge.

The further expansion of the value chain driven by other trends than the transition to zero-emission mobility is also likely to create new job opportunities in sectors traditionally not part of the automotive value chain, such as electronics, software and services.

**Table 10** also shows that jobs are also projected to decrease in the petroleum refining sector, by 1,000 in 2030 and 10,000 in 2040 as a consequence of the shift away from fossil fuels. However the electrification of road transport, increase employment in electricity sector.

**Table 10: Employment impacts, broken down by sector (E3ME model)**

| | **Baseline** | **MIX55_ LSTD** | **MIX55** | **MIX55_ HSTD** | **MIX55_ LSTD** | **MIX55** | **MIX55_ HSTD** |
|---|---|---|---|---|---|---|---|
| | **Number of jobs (000s)** | **Number of jobs (000s) change from baseline** | | | **% change from baseline** | | |
| **2030** | | | | | | | |
| Petroleum refining | 125 | 0 | -1 | -2 | -0.20% | -0.74% | -1.33% |
| Automotive | 2,312 | -1 | -4 | -7 | -0.06% | -0.16% | -0.30% |
| Electronics | 997 | 0 | 0 | 0 | 0.00% | 0.01% | 0.01% |
| Metals | 4,171 | 0 | 1 | 1 | 0.00% | 0.02% | 0.02% |
| Electrical equipment | 1,700 | 0 | 1 | 2 | 0.01% | 0.07% | 0.10% |
| Electricity, gas, | 2,450 | 0 | 2 | 4 | 0.02% | 0.08% | 0.16% |

[85] See www.project-drives.eu

[86] See www.project-albatts.eu

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| water | | | | | | | |
| ***Total*** | ***201,047*** | ***4*** | ***24*** | ***39*** | ***0.00%*** | ***0.01%*** | ***0.02%*** |
| **2035** | | | | | | | |
| Petroleum refining | 96 | -1 | -3 | -10 | -1.54% | -3.42% | -10.46% |
| Automotive | 2,245 | -3 | -13 | -39 | -0.14% | -0.59% | -1.75% |
| Electronics | 993 | 0 | 1 | 2 | 0.05% | 0.09% | 0.15% |
| Metals | 4,111 | 3 | 3 | 8 | 0.07% | 0.07% | 0.20% |
| Electrical equipment | 1,834 | 2 | 3 | 9 | 0.11% | 0.19% | 0.48% |
| Electricity, gas, water, etc | 2,355 | 5 | 9 | 21 | 0.19% | 0.38% | 0.90% |
| ***Total*** | ***198,282*** | ***76*** | ***129*** | ***297*** | ***0.04%*** | ***0.07%*** | ***0.15%*** |
| **2040** | | | | | | | |
| Petroleum refining | 74 | -5 | -10 | -14 | -6.13% | -13.42% | -18.51% |
| Automotive | 2,158 | -4 | -36 | -70 | -0.20% | -1.65% | -3.26% |
| Electronics | 990 | 3 | 4 | 5 | 0.30% | 0.37% | 0.49% |
| Metals | 4,038 | 13 | 11 | 10 | 0.31% | 0.26% | 0.26% |
| Electrical equipment | 2,010 | 9 | 10 | 11 | 0.45% | 0.51% | 0.53% |
| Electricity, gas, water, etc | 2,273 | 20 | 30 | 44 | 0.87% | 1.34% | 1.91% |
| ***Total*** | ***195,316*** | ***350*** | ***477*** | ***588*** | ***0.18%*** | ***0.24%*** | ***0.30%*** |

#### *6.2.1.1.8.3 GEM-E3 modelling results*

GEM-E3 is a general equilibrium model. It therefore assumes that the economy is in perfect equilibrium, with no spare capacity that could boost economic output. This has consequences when introducing policy changes, with GEM-E3 typically seeing crowding out effects of investments. A policy intervention to increase investments in a particular sector, for instance road transport, therefore limits capital availability for other sectors and redistributes labour.

The same scenarios as for the E3ME analysis were assessed.

The model was run using two variants: a "self-financing" variant where businesses and households use financial resources out of their disposable income to purchase the new vehicles; a "loan-based" variant where businesses and households receive a loan to purchase vehicle at an 11% interest rate and 10-year repayment period.

**Table 11** shows the GDP impact for the scenario MIX55, for the two financing schemes, in terms of percentage changes with respect to the baseline.

The loan-based variant presents a slightly positive effect. In this case, in the short term, the positive impacts are mostly driven by the possibility for firms and households to finance their purchases through loans, without crowding out other investments. This effect diminishes over time, in particular in the period post-2040, due to the pay-back of the loans. In the self-financing variant, the crowding out effect is dominant and there is a small negative impact. The additional upfront costs for vehicles reduce disposable income for other consumption purposes, thereby lowering spending of consumers on other goods and services.

**Table 11: GDP in the baseline (million euros) and percentage change from the baseline under scenario MIX55 comparing the self-financing and loan-based variants (GEM-E3 results)**

| | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline | 14,793,953 | 15,687,771 | 16,805,408 |
| MIX55 (self-financing) | -0.017% | -0.073% | -0.080% |
| MIX55 (loan-based) | 0.015% | 0.001% | 0.114% |

The impact on employment is presented in **Table 12**. In both variants the impact on employment is more positive than on GDP, indicating the change towards a more labour intensive economic structure[87]. In the loan-based scenario, the GDP growth is the main driver of increasing employment.

**Table 12: Employment impacts under the self-financing and loan-based scenarios (000s jobs in the baseline and % difference from the baseline under the MIX55 policy scenario) (GEM-E3 results)**

| | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline | 202,522 | 200,716 | 199,072 |
| MIX55 (self-financing) | 0.012% | -0.065% | -0.014% |
| MIX55 (loan-based) | 0.067% | 0.057% | 0.306% |

The changes in employment directly affect the disposable income of households. The shift towards electric and hydrogen fuel cell vehicles, the related higher use of electricity and hydrogen as well as changes in the use of other fuels (such as biofuels or synthetic fuels) affect employment in the EU through two main channels: i) labour intensity of vehicle production (including batteries), ii) labour intensity of energy production. The impact from the first channel greatly depends on where the batteries will be manufactured as these are significant components in terms of labour intensity. The second channel however will certainly have a positive impact on employment as imported fossil fuels will be partly substituted by other energy sources, a large share of which is domestically produced.

The GDP and employment impacts for the other scenarios, depending on the stringency of vehicle $CO_2$ emission standards, are similar. **Table 13** and **Table 14** present the GDP and employment impacts for all the scenarios assessed in the loan-based variant. In general, the positive impact tends to be slightly higher for the scenarios with stricter $CO_2$ targets, where higher expenditures for more efficient vehicles financed by loans lead to an increase of GDP. Post-2040, the repayment of loans decelerates the GDP growth rate.

**Table 13: GDP in the baseline (million euros) and percentage change from the baseline under the policy scenarios - loan-based variant (GEM-E3 results)**

| | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline | 14,793,953 | 15,687,771 | 16,805,408 |
| MIX55_LSTD | 0.006% | 0.0001% | 0.036% |
| MIX55 | 0.015% | 0.001% | 0.114% |
| MIX55_HSTD | 0.019% | 0.056% | 0.090% |

[87] The key mechanisms that drive the EU economy towards a more labour intensive structure are i) The expenditures that were leaking abroad for fossil fuel imports are now spent domestically stimulating demand for other goods and services, ii) The local content of biofuels and electricity production value chain is larger than that of imported oil.

**Table 14: Employment in the baseline (000s jobs) and percentage change from the baseline under the policy scenarios - loan-based variant (GEM-E3 results)**

| | 2030 | 2035 | 2040 |
|---|---|---|---|
| Baseline | 202,522 | 200,716 | 199,072 |
| MIX55_LSTD | 0.018% | 0.019% | 0.110% |
| MIX55 | 0.067% | 0.057% | 0.306% |
| MIX55_HSTD | 0.093% | 0.352% | 0.308% |

Vehicle manufacturing, electrical equipment manufacturing, fossil fuels production and power generation are the most impacted sectors. Annex 8 provides the sectoral results, which are driven by the switch between different vehicle technologies and fuels. Production and employment of the electric vehicles sector increases compared to baseline in all variants. Sectors producing the respective products and services for the operation and maintenance of these vehicles, such as electricity and batteries, increase their output and employment. For the sectors which supply fuels for road transport, the production is found to decrease, especially in the scenario with higher penetration of BEVs, displacing ICEVs and limiting the fuels use.

#### 6.2.1.2 Social impacts

The main element considered as regards social impacts is whether and to what extent the $CO_2$ targets affect different population groups differentiated according to their income. Therefore, building on the economic analysis presented in Section 6.2.1.1.3 and in particular the total costs of ownership for first and second users, the analysis looks at the impacts of the different $CO_2$ target level options on the welfare of consumers, taking into account the particular characteristics of different income groups. It also looks at the affordability of ZEV in the different income groups.

Consumers in the EU were segmented into five income groups (quintiles Q1-Q5, with Q5 having the highest income, based on Eurostat statistics[88]). As a consequence of their different annual income, these consumer groups face different situations as regards (i) the need for finance for the upfront cost to purchase a car; and (ii) the consideration given to the future operating expenditures. In particular, different income groups have different levels of own-financing possibilities and face different maximum quotas and interest rates for loans when access to finance is needed. In addition, they use different discount rates to calculate the present value of future loan payments, fuel and other operating costs[89].

The impacts on different income groups are analysed in terms of (i) affordability of vehicles, and (ii) 'subjective TCO'. The affordability reflects the variety of vehicle choice available to the consumer groups in view of their financial capacity[90]. The 'subjective TCO' is conceptually defined as the TCO in Section6.2.1.1.1, but taking into account also income-group specific parameters. The detailed methodological description, including specific quantitative assumptions, is provided in Annex 8.

[88] https://ec.europa.eu/eurostat/cache/metadata/en/ilc_esms.htm

[89] Higher discount rates are used for lower income quintiles, since they assign lower value to future costs/savings.

[90] For the analysis, a vehicle is thought to be affordable when a household has enough savings and annual income to be able to repay the loan for upfront capital costs in five years, provided that no more than 36% of annual income can be designated to the loan repayment.

Affordability

**Table 15** summarises the results on affordability for the baseline and the TL options in the years 2030, 2035 and 2040. It shows which car types (powertrains) and segments are not affordable in each of those cases for the affected income groups. The analysis did not indicate any affordability issues for third users, for income group Q3 as second user and for the income groups Q4 and Q5. Therefore, these categories are not included in the Table. The introduction of more stringent $CO_2$ targets does not change the situation compared to the baseline for Q1 as first and second users, since the same vehicles types are not affordable for them in the baseline and in the policy options.

For income group Q1 as second user and Q2, in general, higher TL options are associated with more restricted choices due to increased affordability issues for specific powertrain types. In most cases, these additional affordability restrictions are observed for large vehicles and for PHEV and/or FCEV powertrains.

In all scenarios, BEVs are affordable (except for larger segments), or become affordable (including for larger segments) with time. FCEVs continue being unaffordable, especially for larger segments. The TL_Low option does not change affordability compared to the baseline in 2030 and 2035; this effect is driven by the projected evolution of the costs of the technologies to reduce $CO_2$ and the extent to which these technologies are deployed into the new vehicles to meet the $CO_2$ targets. The $CO_2$ target levels in TL_Low do not require strong improvements of the efficiency of conventional engines. As a result, the affordability of the different powertrain types does not substantially change. Furthermore, in 2040, there is no difference in terms of affordability between TL_Med and TL_High options.

**Table 15: Overview of unaffordable car types (powertrains) and segments per income group under the baseline and TL options in 2030, 2035 and 2040[91]**

| | Q1 | | | Q2 | | | Q3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2030 | 2035 | 2040 | 2030 | 2035 | 2040 | 2030 | 2035 | 2040 |
| First user | | | | | | | | | |
| TL_0 | S, LM, UM, L | | | LM (PHEV, BEV), UM, L | | LM (PHEV, BEV, FCEV), UM, L | L | | |
| TL_Low | | | | | LM (CI+Hybrid, PHEV, BEV, FCEV), UM, L | | | | |
| TL_Med | | | | LM (CI+Hybrid, PHEV, BEV), UM, L | | | | UM (FCEV), L | |
| TL_High | | | | | LM, UM, L | | | | |
| Second user | | | | | | | | | |
| TL_0 | LM (PHEV), UM, L | LM (FCEV), UM, L | | L (BEV) | | | | | |
| TL_Low | | | | | | | | | |
| TL_Med | | | | | | | | | |
| TL_High | | | | | | L (FCEV) | | | |

*Legend*: S (Small), LM (Lower Medium), UM (Upper Medium), L (Large) *CI (Compression Ignition)*. *Note:* The table does not show segments (powertrains) with less than 1% share in sales.

Subjective TCO

It has been assessed how each of the three TL options affects subjective TCO for affordable options, as compared to the baseline[92]. For all TL options, absolute net savings are positively associated with income[93].

**Figure 13** shows the percentage changes of the ratio between subjective TCO (only accounting for the affordable vehicles option per income group) and average annual income within the income group for the different TL options, as compared to the baseline.

In all scenarios, lower income groups are projected to see higher savings relative to their annual income. The expected savings are also increasing with the level of ambition of the $CO_2$ emission standards and with time, for all income groups. Higher income groups are expected to benefit less from higher ambition scenarios and will see lower increases in saving with time, compared to lower income groups.

This result is driven by two main factors: (i) lower income groups are assumed to be 3rd or 2nd users, while higher income groups are 1st or 2nd users, which has an implication on the technology cost that each group faces (with or without depreciation). As a result, lower income groups can benefit from fuel cost savings without having to pay a high price to have access to these vehicles; (ii) even the same differences in technology costs would imply

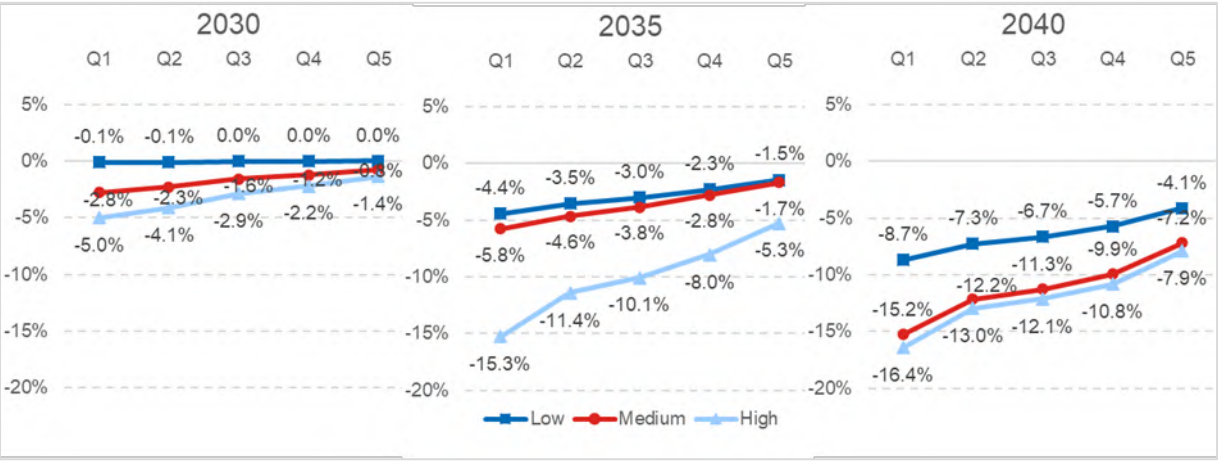
[91] When no particular powertrains are listed in parenthesis, this means that all powertrains are non-affordable. Segments which are not mentioned in the Table are affordable across all powertrains.

[92] All the analysis presented is executed in a MIX policy scenario context

[93] For example, in 2040, depending on the scenario, Q1 are expected to save 1,053-1,785 EUR over 5 year ownership period, Q2 – 1,443-1,858 EUR, Q3 – 1,811-3,014 EUR, Q4 – 2,049-3,609 EUR, Q5 – 2,370-4,287 EUR. Savings relative to income are higher for lower income groups, due to the differences in average annual income.

higher differences in savings across scenarios for lower income groups, when the savings are expressed in shares of annual income. It has to be however highlighted that the benefits for the lower income groups are delayed till they are able to access these more efficient vehicles in the second-hand market. Therefore, the faster these vehicles become available on the second-hand market, the faster the benefits for the lower income groups will materialise.

**Figure 13: Average "subjective" TCO changes (% of annual income) for income groups across TL options for a car newly purchased in 2030, 2035 and 2040**




Note: Negative values represent savings. Assumptions used to calculate the average TCO savings: all Q1 are 3rd users, 50% of Q2 are 3rd users and 50% are 2nd users, Q3 are all 2nd users, 50% of Q4 are 2nd users and 50% are 1st users, Q5 are all 1st users.

Infrastructure availability

In terms of non-monetary barriers, access to parking (and/or suitable on-street charging infrastructure in residential areas where off-street parking is not available) is expected to be a more important issue in the TL_High option, with higher levels of electrification. This will also have a higher impact on lower income households, as these are more likely to experience the restrictions compared to high income quintiles, explained by differences in housing across income groups.

In summary, the main results of the analysis show:

- For the higher income groups (Q3-Q4-Q5), there are no significant changes in the affordability issues with the 3 TL options.
- For the lowest income groups (Q1-Q2), there are some affordability restrictions for larger vehicles segments, mainly for PHEV and FCEV. However, these types of vehicles are generally not purchased by these income groups.
- BEV remain or become affordable with time for all the TL options except for the larger BEV for the lower income groups.
- From a TCO perspective for the affordable options, lower income groups are projected to see higher savings relative to their annual income. These relative savings increase with higher target levels.

The social impact analysis focuses on income groups defined at EU level since the $CO_2$ emission standards do not set specific targets and/or requirements at the Member States level. However the analysis provides useful insight on how consumers in different Member States may be affected.

The conclusions of the analysis are qualitatively valid for each Member State. In each Member State, lower income groups are expected to experience relatively more benefits than higher income groups, but are also more likely to face affordability issues.

Moreover, considering the distribution of impacts among Member States, consumers in Member States with average disposable income lower than the EU average are expected to experience higher TCO savings relative to their income than displayed in **Figure 13**. Conversely, consumers in Member States with average disposable income higher than the EU average are expected to experience lower TCO savings relative to their income than displayed in **Figure 13**.

#### 6.2.1.3 Environmental impacts

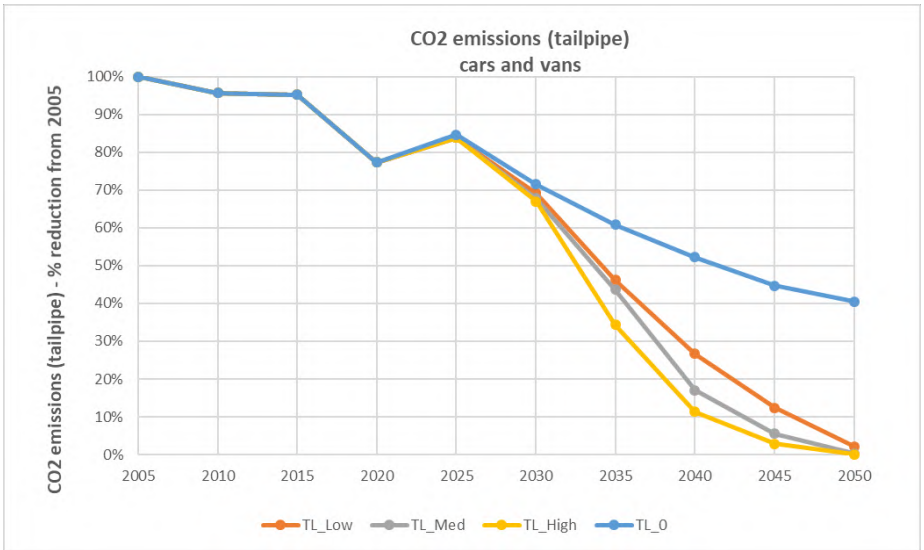
This section shows the environmental impacts, in terms of $CO_2$ and air pollutant emission reductions from cars and vans, up to 2050. While the stricter $CO_2$ emission targets in 2030 have an important impact already for emission reduction by 2030, this section also looks at the effects on emissions in the period post-2030. These effects will be stronger as a result of the increasing number of zero- and low-emission vehicles on the road through the fleet renewal.

##### 6.2.1.3.1 $CO_2$ emissions (tailpipe)

Figure 14 shows the evolution of the tailpipe $CO_2$ emissions of cars and vans in EU-27 between 2005 (100%) and 2050 under the baseline and the TL options. These results take into account both the $CO_2$ emission standards and the other policies reducing emissions in the MIX policy scenario. The drop of the $CO_2$ emissions in 2020 is driven by the decrease in road transport activity due to COVID-19 crisis. As a consequence $CO_2$ emissions in 2025 show an increase as compared to 2020, but they are on a decreasing trajectory as compared to 2015. This emission profile is notable in all the scenarios, since the COVID-19 effect is embedded in the Reference Scenario 2020.

The projected emission reductions in 2030 as compared to 2005 are 28% (baseline), 31% (TL_Low), 32% (TL_Medium) and 33% (TL_High). The effect of the stricter targets becomes more visible from 2035 on. In 2035, these reductions increase to 39% (baseline), 54% (TL_Low), 56% (TL_Medium) and 66% (TL_High) In 2040, these reductions further increase to 48% (baseline), 73% (TL_Low), 83% (TL_Medium) and 89% (TL_High). In the case of TL_Low, further post-2040 action would be needed to ensure tailpipe emissions decrease to almost zero by 2050 in line with climate neutrality.

**Figure 14: Tailpipe $CO_2$ emissions of cars and vans in EU-27 - % reduction compared to 2005**




Considering the emissions reduction in 2040 compared to 2005, the $CO_2$ emission standards alone are responsible for 37% of the additional emission reduction in the TL_Low option compared to the baseline. They contribute 54% in the TL_Med option and 61% in the TL_High option. This is shown in **Table 16**, with additional calculations for the periods 2005-2030 and 2005-2035.

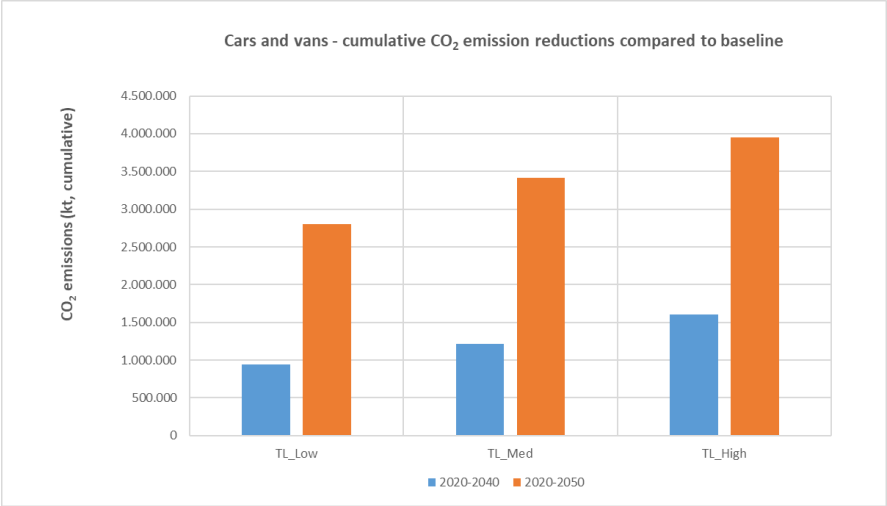
**Table 16: Contribution of the $CO_2$ emission standards to the $CO_2$ emissions reduction under the policy options compared to the baseline in various periods**

| | 2005-2030 | 2005-2035 | 2005-2040 |
|---|---|---|---|
| TL_Low | 9% | 17% | 37% |
| TL_Med | 42% | 30% | 54% |
| TL_High | 52% | 54% | 61% |

**Figure 15** below shows the reduction, compared to the baseline, of the cumulative $CO_2$ emissions from cars and vans over the periods 2020-2040 and 2020-2050 for the three TL options. These results take into account both the $CO_2$ emission standards and the other policies reducing emissions in the MIX policy scenario. Reductions increase with increasing stringency of the targets.

Cumulative emissions are reduced compared to the baseline by 11% (TL_Low), 15% (TL_Med), 19% (TL_High) in the period 2020-2040, and by 26% (TL_Low), 31% (TL_Med) and 36% (TL_High) in the period 2020-2050.

**Figure 15: Tailpipe $CO_2$ emissions of cars and vans for EU-27 - cumulative 2020-2040 and 2020-2050 emission reductions from the baseline (kt)**



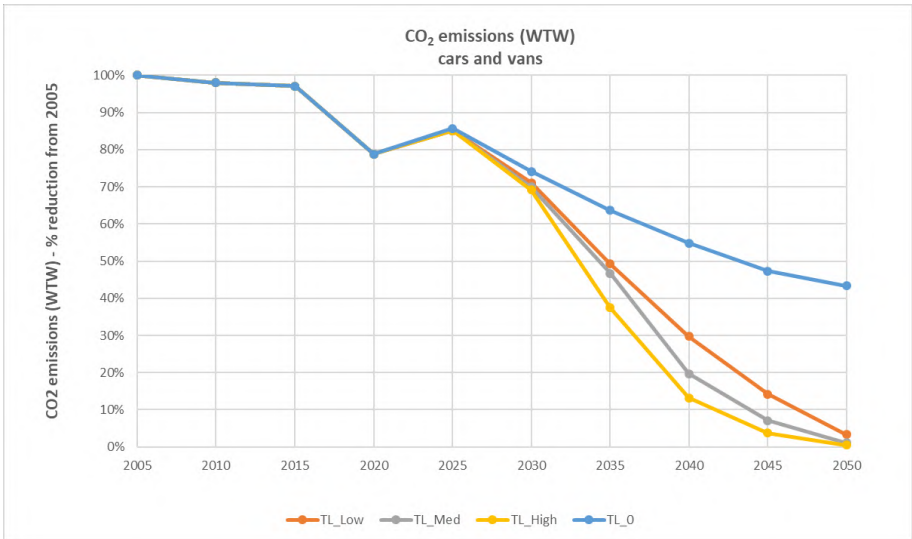

6.2.1.3.2 $CO_2$ emissions (WTW)

The trends for well-to-wheel (WTW) $CO_2$ emissions seen across the different TL options (see

**Figure** 16) are very similar to those for the tailpipe $CO_2$ emissions. Due to the upstream emissions (Well-To-Tank), the emission reductions observed are slightly lower.

Under the baseline, WTW $CO_2$ emissions reduce by 26% between 2005 and 2030. In 2040 and 2050, emissions are 45%, resp. 57% lower than in 2005. From 2035 onwards, significant additional reductions on top of the baseline are achieved under the TL options. In 2040, these range from 25 (TL_Low) to 42 (TL_High) percentage points. In 2050, the range is from 40 (TL_Low) to 43 (TL_High) percentage points. All the figures take into account the effect of the other policies in the MIX scenario which act on the upstream emissions, in particular the strengthened EU ETS, which strongly decrease the emissions from the power generation, emissions trading for buildings and road transport as well as the Renewable Energy Directive.

**Figure 16: Well-to-wheel (WTW) $CO_2$ emissions of cars and vans in EU-27 - % reduction compared to 2005**



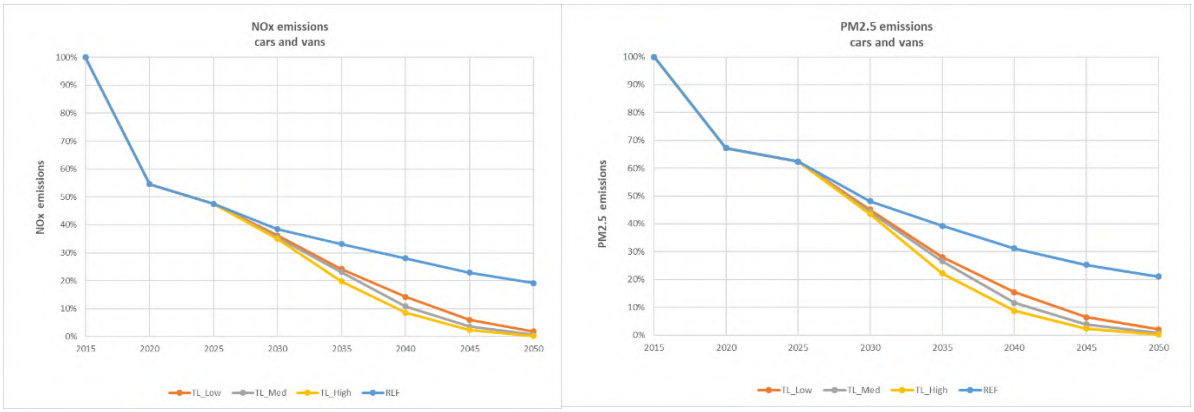
6.2.1.3.3 Air pollutant emissions

The changes in fuel consumption or mix triggered by stricter $CO_2$ targets will not only lead to lower $CO_2$ emissions, but also lower air pollutants emissions. These co-benefits have also been quantified and assessed for the baseline and the TL options.

The results are summarised in **Figure 17**. This covers the combined impacts of the $CO_2$ emission standards and stricter air pollutant emission standards, such as are expected to be proposed in the context of the Euro-7 emission legislation. The $CO_2$ emission standards contribute to reducing air pollutant emissions, since they drive the shift towards zero-emission vehicles, which have no pollutant tailpipe emissions.

The cumulative cost of the avoided pollutants compared to the baseline in the period 2030 to 2040 amounts to around 42, 49 and 59 billion euros, respectively for the three target levels considered. The estimation is based on the methodology of the 2019 Handbook on the external costs of transport[94], and it includes health effects, crop losses, material and building damage as well as biodiversity loss.

**Figure 17: $NO_x$ and PM2.5 emissions of cars and vans in EU-27 (% reduction compared to 2015)**




## *6.2.2 Timing of the targets (TT)*

*Economic impacts*

The current five-yearly target strengthening (option TT0) takes into account the time needed for manufacturers to develop and market new models, equipped with additional $CO_2$ reducing technologies, or platforms with novel powertrains. It thus acknowledges the typical investment cycles of the industry.

Option TT1, especially in the case of annually tightened targets, makes it more difficult for manufacturers to deal with year-to-year market fluctuations and to manage the introduction of new or upgraded models and technologies in the fleet. This is therefore likely to increase compliance costs for manufacturers. At the same time, economic savings for consumers or society are likely to increase.

[94] https://op.europa.eu/en/publication-detail/-/publication/9781f65f-8448-11ea-bf12-01aa75ed71a1

In particular under a system of annually tightened targets, allowing the banking of credits obtained from overachieving the targets in a given year for use in following years would offer manufacturers greater flexibility and could increase the overall cost-effectiveness of the policy. It would reward early movers and help to alleviate efforts at a later stage, which may be generally more expensive. It would also allow for dealing with unexpected annual fluctuations in a manufacturer's fleet.

Compared to optin TT0, option TT1 would speed up the market introduction of ZLEV, which would have a positive impact on the technology cost reduction.

*Environmental impacts*

Option TT1 would ensure that $CO_2$ emission reductions either follow an annual path or would have to be achieved within 2-3 years from the previous binding target. In practice, also a five-yearly tightening of the targets (option TT0) may create some anticipation by manufacturers, in particular where a significant improvement of the average performance is required over those years. Nevertheless, the absence of more ambitious intermediate $CO_2$ targets would delay the introduction of $CO_2$ reducing technologies with high manufacturing costs.

Option TT1 would therefore provide greater certainty than option TT0 that a gradual $CO_2$ emission reduction will be effectively delivered. This will lead to lower $CO_2$ and air pollutant emissions in the intermediate period and beyond.

In a worst case scenario, where manufactures do not reduce the average specific emissions of their fleet in the period between 2030 and 2035, the $CO_2$ emissions (tailpipe) from cars and vans in 2035 would be 5% higher. This would also mean an increase by 5% of the cumulative $CO_2$ emissions from cars and vans over that period, equivalent to around 57 million tons $CO_2$. This scenario is however unlikely as it does not take into account any anticipation by manufacturers during that period. While the experience with the 2020 target shows that this anticipation was limited, with stricter targets and a clear signal for the longer term manufacturers are less likely to postpone improvements of their fleet emissions. The projected developments of the infrastructure for zero-emission vehicles, driven by the revision of the AFID, will also create better conditions for target anticipation.

In case banking of credits would be allowed to mitigate the effect of annually tightening targets, their accumulation and carry-over could undermine the effectiveness of the targets. To avoid such negative impacts, the level of credits banked could be capped and credits could be set to expire after a fixed time limit. In addition, there could be rules on the maximum carry over from one compliance period to another.

*Social impacts*

Under option TT1, consumers would benefit from energy cost savings earlier on than under option TT0.

*Administrative burden*

Under option TT1, administrative costs and complexity would increase in case of banking as the emissions monitoring system would need to keep track of the credits used. In case the composition of a pool changes during a banking period, it would be necessary to establish the correct reallocation of the credits banked as a pool to each manufacturer in the pool.

### *6.2.3 Use of the revenues from excess emissions premiums*

Excess emission premiums are imposed on manufacturers if their average specific emissions exceed their targets in a given calendar year. Until 2019, the revenues from the excess emission premiums have been limited, and did not exceed 3 million euros in any given year.

However, with the increasing stringency of the EU fleet wide targets, it is not excluded that these revenues may increase significantly in the years to come. Even if more significant amounts would become available, they will, however, still be highly variable and difficult to predict over time.

#### 6.2.3.1 Option REV 1: Assigning the revenue to a specific fund or programme

The possibility of assigning the revenue has been evaluated for the Just Transition Fund and the Innovation Fund.

The objective of the Just Transition Fund (JTF) to support the transition process towards the EU's 2030 target for energy and climate and a climate-neutral EU economy by 2050 is consistent with the overall objective of re-skilling and up-skilling of workers as expressed in the review Article of Regulation (EU) 2019/631.While the JTF does not foresee any means of channelling support directly to the automotive sector, it is not excluded that the sector could benefit indirectly, inter alia through re-skilling and up-skilling of workers, if such support is in line with the aims of the Member States' territorial just transition plans as approved by the Commission.

The Innovation Fund pursues objectives that are formally consistent with those of Regulation (EU) 2019/631. However, in its current set-up, as defined in the EU ETS Directive, it would not be possible to target the objective of re-skilling and up-skilling referred to in the review Article of Regulation (EU) 2019/631, nor to ring-fence any revenue from the premiums specifically to the automotive sector. Assigning the revenue to the Innovation Fund is therefore conditional on (i) the revision of the EU ETS Directive, and on how the automotive sector may be addressed, at least indirectly, by support from the Fund, and (ii) on the addition in the Directive of the relevant provisions on the receipt and distribution of the assigned revenue. It would also be necessary to revise the implementing legislation on the operation of the Innovation Fund as well as on the management of the revenue of the Fund by the EIB.

*Environmental impacts*

There are no direct environmental impacts. Where additional spending possibilities are created, there may, however, be some indirect beneficial impacts, by channelling the amounts available to climate related expenditure.

*Economic impacts*

Assigning the revenue to a specific fund or programme may in principle lead to increased spending possibilities. The overall impact of that revenue may, however, be limited, considering that the $CO_2$ emission performance standards provides a framework for manufacturers to meet their specific emission targets. It does not aim at raising revenues.

Based on the current set up of the two Funds, it should also be noted that support could not be directly addressed to the automotive sector.

*Social Impact*

While the possibility is foreseen under the JTF to specifically support the up-skilling and reskilling, including training, of affected workers, it is likely that the social impact of assigning the revenue from the premiums to either of the two funds will have a limited social impact, considering that the amounts available may be quite small.

*Administrative burden*

Assigning the revenue will increase the administrative burden.

Due to the variability and unpredictability of the revenue, mechanisms will be needed to ensure that before being assigned, the amounts reach a level that would at least exceed the cost associated to the additional administrative burden resulting from the assignment and the need to distribute the additional resources.

This may be achieved by either allowing the revenues to accumulate over a longer period, or provide for a threshold over which the revenue would be assigned (if below the threshold, the premiums would be considered as revenue for the general budget).

In the case of the JTF, the additional resources resulting from the assigned revenue will be distributed among Member States in accordance with the distribution mechanisms foreseen in the JTF Regulation. Member States will, in order to include those additional resources, have to amend their spending programmes and those amendments will subsequently have to be approved by Commission Decisions. While excess emission premiums may be imposed annually, it would lead to excessive administrative burden if this would result in the need to annually revise and approve Member States' spending programmes.

In the case of the Innovation Fund, the revenue from the premiums could only be assigned once the amount is certain and can be included in the relevant financing decision preceding the call for projects. In order to ensure the certainty of the amounts, the premiums would have to be accumulated and this would require that the agreement with the EIB on the management of the revenue of the Innovation Fund would have to be renegotiated, including the fees charged by EIB to cover the additional costs.

#### 6.2.3.2 Option REV 2: Consider the revenue from the excess emission premiums as an "own resource"

The EU budget is financed primarily by own resources. These are defined in Council Decision (EU, Euratom) 2020/2053 and do not currently include revenue from financial penalties such as that from excess emission premiums.

As mentioned in Recital (8) of that Decision, work should, however, continue, in the course of the multiannual financial framework for the period 2021-2027, towards the introduction of other own resources. A pre-condition for this option to be considered, is that the revenue may be defined as an "own resource" under that Decision. However, the inter-institutional agreement of 16 December 2020 states that the Commission should, in its proposal for defining additional own resources, give priority to revenue from the emissions trading system, the carbon border adjustment mechanism and a digital levy.

*Environmental impact*

There are no specific environmental impacts.

*Economic impact*

The objective of considering the revenue from the premiums as an "own resource" would be that this revenue can be considered additional to other own resources. As compared to the current approach, where the premiums are considered revenue for the general budget, this could in principle lead to increased spending possibilities.

It should, however, be noted that this option would not allow targeting the automotive sector any more than the current approach.

*Social impact*

There are no specific social impacts resulting from this option.

*Administrative burden*

It is expected that the administrative burden would increase as compared to BAU.

Own resources consist in principle of contributions from the Member States. Should the revenue from the premiums be considered as own resources, they would first have to be distributed among Member States and would as such reduce the Member States' contributions from other sources. This distribution would lead to additional administrative burden and is likely to be disproportionate considering the potentially limited and uncertain amounts that could be made available through this source of revenue.

### *6.2.4 Derogations for small volume manufacturers*

Small volume derogations are available to manufacturers responsible for between 1 000 and 10 000 new cars or 22 000 new vans registered in a calendar year[95]. In 2019, such derogations were granted to 12 car manufacturers and two van manufacturers[96].

Under option SVM 1 the possibility for small volume manufacturers (SVMs) to be granted a derogation target would be removed from 2030 onwards. This would make all small volume manufacturers subject to a specific emission target based on the EU-wide fleet target.

*Environmental impacts*

With the applicable targets, the environmental benefits of removing the small volume derogation would be rather limited. However, as the EU fleet-wide targets get stricter and other manufacturers will have to reduce their emissions at a faster pace, the positive impact of this option will increase. Therefore, the environmental impacts of removing the derogation would most likely be slightly positive.

*Economic impacts*

Removing the small volume derogation would increase the cost of compliance for SVMs. However, SVMs are not a homogenous group in terms of their portfolio: they currently include specialist car manufacturers (e.g. of sports and luxury cars), parts of large international groups with limited sales in the EU, as well as recent market entrants and companies competing against the established mass-market manufacturers. In the case of vans, there are very few SVMs and differences between them are not as significant.

For those SVMs that are effectively large manufacturers with low levels of registrations in the EU, the implications of the transition would be no different from those experienced by the large volume manufacturers. As a result, a derogation does not seem justified anymore. .

For independent SVMs, the capacity to bear the additional cost will differ depending on their type of portfolio (market segment, price/margin of their vehicles), the number of vehicles they put on the EU market and their global scale. Many SVMs operate in the sports and luxury segments, which means that their vehicle prices tend to be higher than the market average, and the possibility to pass-on the costs of additional $CO_2$ emissions technologies to consumers is also higher. For the most succesful amongst them, this also translates into higher than average profit margins per vehicle[97]. The electrification efforts required to meet the future

[95] Manufacturers with fewer than 1,000 cars or vans registered per year would still be exempted from meeting a specific $CO_2$ emission target.

[96] Cars: 12 SVMs with a total of 25 844 vehicles registered (0.2% of EU fleet): Alpina (693 cars), Aston Martin, Bentley, DR Automobiles, DR Motor Company, Ferrari, General Motors, Lamborghini, Lotus (717 cars), Mahindra, Maserati, McLaren. Noble was granted a derogation target, but no new cars have been registered in 2019.
Vans: 2 SVMs with a total of 4 970 vehicles registered (0.3% of EU fleet): Piaggio, Ssangyong.

[97] https://www.autocar.co.uk/car-news/industry/inside-industry-why-scale-critical-mainstream-car-makers

targets might bring specific economic challenges for such independent manufacturers to develop and integrate electrified powertrains.

Without derogation targets, the possibility to pool with other manufacturers may allow some mitigation of the compliance costs. Also, as targets will become stricter over time, it is clear that emission reduction efforts will have to be made by all SVMs, also if they join a pool. Providing a date for the phasing-out of the small volume derogations should therefore provide planning certainty, help remove market distorting effects and ensure a more level playing field among these manufacturers.

*Administrative burden*

Removing the SVM derogation would simplify the implementation of the Regulation by avoiding the need for manufacturers to prepare and for the Commission to assess derogation applications. This would slightly lower the overall administrative costs of the Regulation. This effect may be partially balanced in case this option would lead to more pooling.

*Social impacts*

The social impacts of removing the SVM derogation are expected to be very small, taking into account the limited number and size of the manufacturers concerned.

## 6.3 Incentive scheme for zero- and low-emission vehicles (ZLEV)

### *6.3.1 Introduction and methodological considerations*

#### 6.3.1.1 Combined options for the ZLEV incentive type and scope

Based on the elements for possible options set out in Chapter 5 regarding the ZLEV incentive type (options ZLEVT) and the vehicles it would cover (options ZLEVAC), a large number of combinations of options could potentially be defined. For practical reasons it was decided to select three combinations to analyse the impacts, as shown in **Table 17**:

- ZLEV_Low is a bonus-only crediting system covering zero- and low-emission vehicles with emissions up to 25 g/km and linear accounting (vehicles emitting 25 g/km are counted as zero vehicles; ZEV are counted as one vehicle)
- ZLEV_Med is a two-way crediting system covering only ZEV;
- ZLEV_High defines a mandatory share of ZEV to be met by each manufacturer.

These combinations are considered representative for a range of ambition levels (low-medium-high) as regards the type and scope of the incentive mechanism. Their combined assessment therefore provides a good picture of the projected impacts across the full spectrum of possible ZLEV options.

The ZLEV share of the fleet from 2035 onwards is projected to be very high under all TL options considered (see Section 6.1), driven solely by the stringency of the $CO_2$ emission targets. In these cases, no additional specific incentive for ZLEV would be necessary. Therefore the options for the ZLEV incentive mechanism will only be considered in relation to the $CO_2$ emission target for 2030.

The baseline for this assessment will be the ZLEVT_no option (same $CO_2$ targets, but no additional ZLEV incentive).

**Table 17: Combined options for the type of ZLEV incentive and its scope (vehicles covered) – cars and vans**

| Combined option | Incentive type (ZLEVT) | Vehicles covered (ZLEVAC) |
|---|---|---|
| ZLEV_Low | ZLEVT_B: bonus only | ZLEVAC_2: ZLEV < 25 g/km |
| ZLEV_Med | ZLEVT_BM: bonus/malus | ZLEVAC_1: ZEV |
| ZLEV_High | ZLEVT_M: mandate | ZLEVAC_1: ZEV |

The crediting systems under options ZLEV_Low and ZLEV_Med would leave flexibility to manufacturers as to their fleet share of ZLEV, under the constraint that their $CO_2$ target is met. This means that the ZLEV benchmark may be over- or underachieved by individual manufacturers or pools, which in turn may affect their $CO_2$ target. To preserve the environmental integrity and limit the impacts on the $CO_2$ target, the changes to the target level are limited to +/- 5%[98].

As explained in the next sections, the impacts of these options will depend on the ZLEV share of different manufacturers and how it compares with the benchmarks set.

As it is not possible to project strategic decisions of individual manufacturers, several sets of scenarios are analysed to assess these options, representing different possible strategies and outcomes.

In order to ensure that the ZLEV incentive mechanism effectively provides an additional signal to increase the ZLEV market uptake, the ZLEV benchmark or mandate should be set higher than what would be otherwise projected. In the case of a bonus-only crediting system, too low benchmarks even bear a high risk of undermining the $CO_2$ targets without triggering an additional ZLEV uptake.

For the quantitative assessment, the $CO_2$ targets defined under option TL_Med were considered and the ZLEV benchmark/mandate levels in 2030 have been set at 45% for cars and 35% for vans, which is around 10% higher than the actual shares projected in the new vehicle fleet under this option when no ZLEV incentive would be in place.

#### 6.3.1.2 General considerations regarding the incentive mechanism

When assessing the impacts of the ZLEV incentive, it needs to be considered how it delivers on its intended purpose, without creating unwanted side effects. The main aim of the mechanism should be to help overcome barriers hampering the uptake of ZLEV, by incentivizing manufacturers to preferentially put ZLEV on the market, reaching at least the ZLEV shares that would be required to meet the $CO_2$ targets. At the same time, it should be avoided that the incentive mechanism undermines the effectiveness of the standards or leads to much higher costs for manufacturers or consumers.

The analysis will therefore aim at understanding:

- whether the mechanism would indeed incentivise manufacturers to increase their share of ZLEV as compared to the ZLEV_no option;

- the environmental and economic effects of manufacturers meeting, under- or overachieving the ZLEV mandate or benchmark levels.

[98] A 5% cap is already applied in the current Regulation

### *6.3.2 Economic impacts*

For the assessment of the economic impacts of the ZLEV incentive options, the TCO of the different options have been calculated.

For passengers cars, the TCO results show that no significant difference is experienced by either the first-user or the second user, between the ZLEV_no option and ZLEV_Low and ZLEV_med options in scenarios with ZLEV/ZEV shares that are equivalent to the benchmark levels (i.e. without triggering the bonus/malus), as well as in a ZLEV_High option.

The absolute differences in TCO over five years are in the order of 15 euro/vehicle for the first user and 20 to 50 euro/vehicle for the second user (in this last case, the TCO of the ZLEV_no option is always higher).

In all these scenarios the incentive mechanism determines change in the fleet composition that impacts the capital cost and the operating cost component of the TCO. In particular an increase penetration of zero-emission vehicles is combined with a decrease in the efficiency of conventional vehicles (including due to shifts of conventional vehicles towards larger segments). This leads to a decrease in the average capital costs, but also a decrease in the fuel savings.

Different results are shown in a scenario where in a bonus/malus system, the malus is triggered, i.e. manufacturers ZEV share remain below the benchmark levels set and their $CO_2$ emission target is therefore made stricter. Because of the impact on the $CO_2$ target level and the possible consequent additional difficulties for the manufacturers, this scenario has been specifically analysed. In this case, the conventional engines need to become more efficient, while the share of ZEV is still higher than in ZLEV_no (even if, they are lower than the benchmark). This determines overall a more beneficial TCO, with first and second user TCO benefits increasing by about 190 euro/car, related to a slightly more ambitious $CO_2$ target (up to 5%) as compared to ZLEV_no.

For vans, different dynamics are observed. In the ZLEV_Low and ZLEV_Med option, scenarios with ZLEV/ZEV shares equivalent to the benchmark levels (i.e. without triggering the bonus/malus), the TCO for the first user show net costs, with differences as compared to ZLEV_no of around 340 euro/vehicle. The TCO for the second user shows a deterioration of the savings of around 190 euro/van, compared to the around 370 euro/van TCO benefit of the ZLEV_no option. Both effects are related to the decrease of the fuel cost savings linked to less efficient conventional vehicles in the fleet.

In the case of the triggering of a malus in the ZLEV_Med for vans, the same conclusions can be drawn up as for cars.

In summary, the scenarios analysed for the different options show that:

- The TCOs for cars do not significantly change in case of mandates, or benchmark based incentive types when the benchmark levels are met.
- The TCOs for vans deteriorate in case of mandates, or benchmark based incentive types when the benchmark levels are met
- In case of benchmark-based system where the malus is triggered, the TCO show higher savings as compared to the option without incentive, both for cars and vans. The comparison is however biased by the fact that a different $CO_2$ target level applies.

Besides this analysis on the TCOs and from the perspective of the automotive manufacturers, a binding ZEV mandate or a bonus/malus system reduce significantly the flexibility for manufacturers to meet their $CO_2$ emission targets. Under these options manufacturers would be required to put on the market a predetermined share of zero-emission vehicles to avoid

fines or having to meet stricter $CO_2$ emission targets with further improvement of conventional technologies. These options may therefore lead to the targets not being met in the most cost-efficient way. A bonus-only system would not lead to changes in the impacts for automotive manufacturers, as it would not impose additional requirements to the manufacturers, who are able to decide to meet the benchmark levels or not, depending on their specific circumstances.

*Administrative burden*

The different options considered as regards the ZLEV incentives would not create significant additional administrative costs.

In case of a binding mandate (ZLEV_High), an additional compliance assessment regime would need to be established and, in case of non-compliance, fines would have to be imposed and collected.

### *6.3.3 Social Impacts*

All of the scenarios analysed for the different options for the ZLEV incentive show the same impacts in terms of the affordability of the different powertrains and vehicle segments among the five income groups. Furthermore, they lead to the same quantitative results as for option TL_M, see section 6.2.1.2.

### *6.3.4 Environmental impacts*

The modelling of the different options for the ZLEV incentives revealed only limited variations in the overall tailpipe $CO_2$ emission levels of the vehicle fleet. Even though the fleet composition has an effect due to the differences between vehicle segments and powertrain types in the gap between test and real-word $CO_2$ emissions, the total tailpipe emissions are mainly determined by the EU-wide fleet $CO_2$ target.

Therefore, tailpipe $CO_2$ emissions will be slightly lower in case of ZLEV_Med leading to a full application of the "malus" and slightly higher in case of a full "bonus". A result, the full "bonus" scenario may risk undermining the environmental effectiveness.

Emission reductions of $NO_x$ and PM2.5 over the period 2030-2040 show limited variation among the different options considered.

<u>Interaction between the ZLEV incentive and the $CO_2$ target level: impact on conventional vehicles</u>

The introduction of a ZLEV incentive mechanisms aims to increase the market uptake of ZLEV. A higher ZLEV share in a manufacturer's fleet also means that a given fleet-wide $CO_2$ target could be met while the other vehicles in the fleet become less efficient.

In both the ZLEV_Low and ZLEV_Med options, scenarios with Z(L)EV shares equivalent to the benchmark levels (i.e. without triggering the bonus/malus) showed that conventional vehicles in 2030 could potentially have 2% to 6% higher WLTP $CO_2$ emissions compared to a situation where no ZLEV incentive would apply. The same happens in the ZLEV_High option. More specifically, in the ZLEV_Med scenario analysed, emissions of diesel cars were found to increase up to 17% as the $CO_2$ target gets weakened. In this case, also a potential deterioration of the average emissions of those vehicles compared to 2020 could be observed, in the order of 1%-7%.

## 6.4 Mechanism for renewable and low-carbon fuels accounting

### *6.4.1 Economic impacts*

#### 6.4.1.1 Option FUEL1 (application of "carbon correction" factors)

Under this option, "carbon correction" factors would be applied to the type-approved $CO_2$ emissions of the vehicles, to reflect the carbon intensity and share of renewable and low-carbon fuels used by cars and vans.

This would lower the average specific emissions of a manufacturer's vehicle fleet. Therefore, in order to comply with its specific emission target, a manufacturer would need to implement less technologies to reduce the tailpipe $CO_2$ emissions of its vehicles put on the market and this would reduce the compliance costs for manufacturers.

The analysis carried out in the context of the MIX policy scenario and with the medium target levels (TL_M) shows that the technology costs for manufacturers would be reduced, as if the $CO_2$ emission standard to be met was around 6 percentage points less stringent than in TL_M in 2030.

The average net savings (EUR per vehicle) from a societal perspective and from the user's TCO perspective are less favourable under the option FUEL1 compared to the MIX scenario due to the lower uptake of ZEV. This is consistent with the analysis provided under section 6.2.1.1.3 as this option is equivalent to setting less ambitious $CO_2$ target levels.

#### 6.4.1.2 Option FUEL2 (low-carbon fuels (LCF) crediting system)

Under this option, an individual manufacturer would have the possibility of obtaining credits for determining its average specific $CO_2$ emissions and meeting its specific targets if additional quantities of LCF were used in road transport. Such credits would have to be obtained from fuel suppliers marketing quantities of LCF which are higher than those required to comply with their obligations from the implementation of the Renewable Energy Directive (RED) in the Member States and their obligations under the Refuel Aviation and Maritime. This option could trigger additional investments in LCF.

In the economic analysis of this option, a comparison is made between (i) the costs for an additional newly registered battery electric vehicle (BEV) to meet the $CO_2$ target as compared to an ICEV and (ii) the costs for the amount of $CO_2$ saved from LCF quantities that achieve the same effect for meeting the $CO_2$ emission standards as the additional BEV. This allows a comparison of a target achievement strategy without the crediting scheme of $CO_2$ emission savings from LCF (current design of the legislation) and by purchasing additional amounts of LCF credits for target compliance.

The cost analysis is limited to advanced biofuels (defined by Annex IX part A of RED) and Renewable Fuels of Non-Biological Origin (RFNBO) and newly registered cars and vans in 2030 and 2035. Different cost paths for the LCF are used for the calculations in order to illustrate different possible developments (see Annex 8).

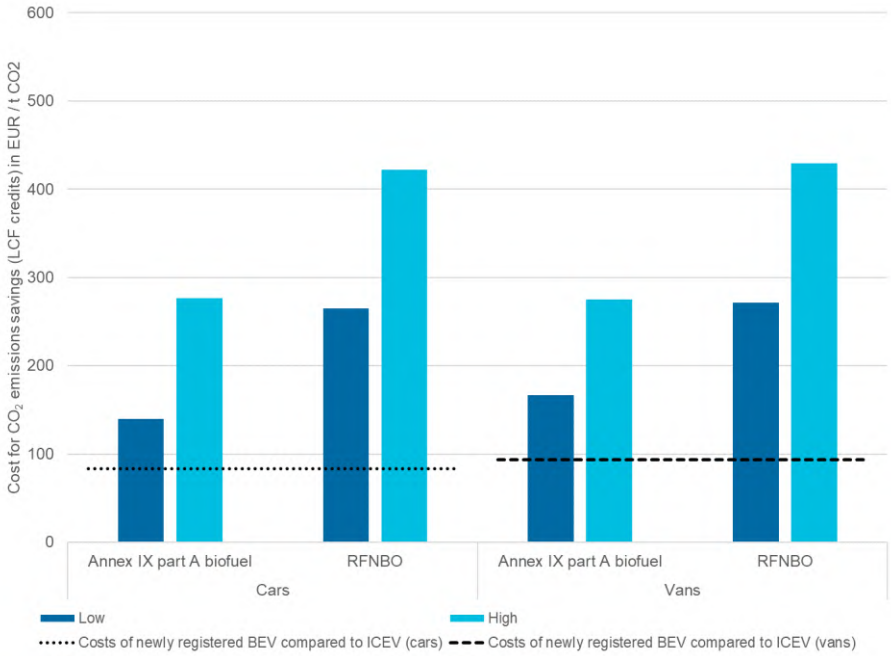
From a manufacturer's perspective, the analysis carried out shows that the costs for a manufacturer of purchasing LCF credits are significantly higher than complying with its targets through an additional BEV.

**Figure 18** shows the cost results, averaged over the EU-wide new vehicle fleet of petrol and diesel cars and vans registered in 2030. The same trends are observed for 2035 and 2040. In this case, crediting $CO_2$ reductions from advanced biofuels leads to higher compliance costs

for manufacturers as compared to those required for achieving target compliance by an additional BEV. This is observed both in case of a low and high cost assumption for different types of advanced biofuels and RFNBOs.

Moreover, it has to be considered that the advanced biofuels with lower production costs, substitute for gasoline, will likely not be available in very large quantities in 2030 and 2035 in addition to the quantities needed under the requirements of RED and for $CO_2$ reduction in aviation and the maritime sector. The likelihood that a manufacturer can use such advanced biofuels with very low production costs to meet its $CO_2$ target is low for these reasons.

**Figure 18: Costs (averaged over the EU-wide new vehicle fleet of petrol and diesel cars and vans) for $CO_2$ emission savings [EUR/t$CO_2$] for a manufacturer under a Low Carbon Fuels compliance strategy in 2030**

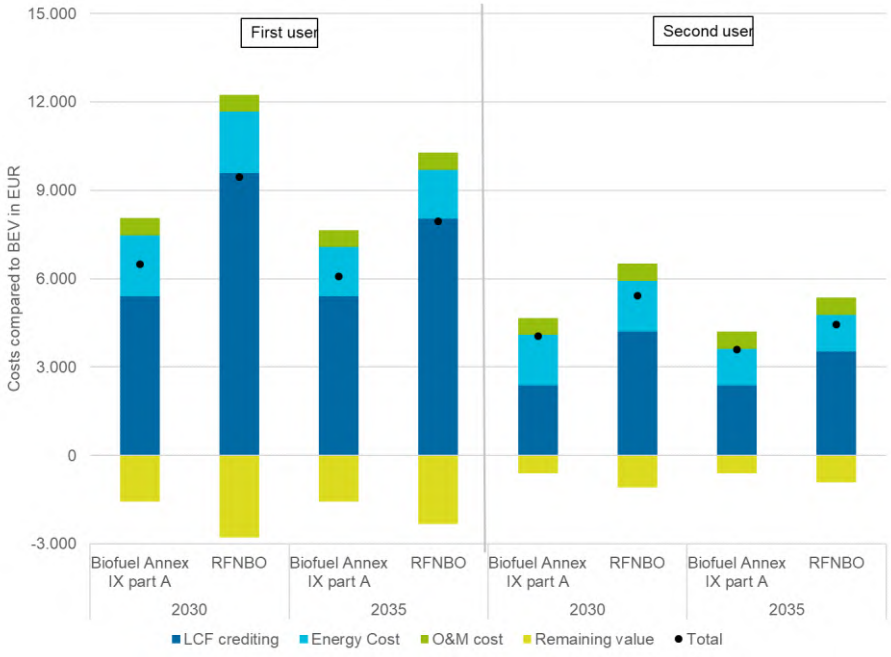



For the costs for end-users and for the calculation of societal costs, in addition to the costs of purchasing the vehicles, the operational costs of the vehicles during the use are a key element when comparing the costs of the two different target compliance options with each other.

Cost advantages arise for BEV due to their energy efficiency advantages. The analysis shows that the additional purchase costs for BEV are also lower than the costs required for LCF credits. For this reason, all calculations for the total costs for end users (both first and second users) and for societal costs show a clear cost advantage for the use of a BEV compared to $CO_2$ emission reduction via LCF credits, even considering increased electricity prices as a result of the EU ETS and policies acting on the power sector, as in the MIX policy scenario.

As an example, **Figure 19** displays for cars the significant additional costs for a first or a second user in case of a manufacturer would chose to comply with its 2030 or 2035 target by purchasing LCF credits rather than by an additional BEV. The same trends are observed from a societal perspective as well as for vans.

**Figure 19: Average costs (EUR) as TCO-first user and TCO-second user of a Low Carbon Fuels compliance strategy compared to a BEV compliance strategy**




### *6.4.2 Environmental impact*

In the FUEL1 and FUEL2 options, the compliance of vehicles manufacturers with their $CO_2$ emission targets take into account the share of renewable and low-carbon fuels. As a result, the compliance of vehicles manufacturers with their targets requires less efforts to decrease their fleet $CO_2$ emissions per kilometre as compared to the FUEL0 option (no accounting for the renewable and low-carbon fuel contribution).

The results described below are all from specific PRIMES simulations. They refer to the MIX scenario policy context, where the $CO_2$ emission standards for vehicles are set at the level of the TL_M option with de-facto the FUEL0 option. The share of renewable and low-carbon fuels in road in the FUEL0 scenario is around 9% in 2030, driven by the increased ambition of the Renewable Energy Directive to mainstream renewable energy in transport.

In the FUEL1 option, the average WLTP $CO_2$ emissions[99] of the vehicle fleet increase by around 6% in 2030 compared to FUEL0, considering the actual lifecycle emission savings of renewable and low-carbon fuels relative to the fossil fuels comparator.

FUEL1 option leads to a higher uptake of ICEV in 2030 as compared to FUEL0, while the share of ZEV in the new registration of 2030 decreases by around 3 percentage points both for cars and for vans.

As a result of the combination of the effects described above, the reduction of $CO_2$ tailpipe emissions from cars and vans in FUEL1 during the period 2005-2030 slightly decreases compared to FUEL0, by around 1 percentage point.

While the FUEL1 option does not lead to an increase of the renewable and low carbon fuels share as compared to the MIX scenario, the FUEL2 option acts as an incentive for the fuel

[99] i.e. $CO_2$ emissions measured under the WLTP test cycle procedure which uses reference fuels

industry to produce and market additional quantities which would create credits for the automotive manufacturers compliance with the $CO_2$ emission standards.

In order for the FUEL2 option to create incentives for increased uptake of renewable and low carbon fuels, its scope needs to be limited to advanced biofuels from feedstocks listed in Part A of Annex IX of RED (thereinafter 'PartA biofuels') and to RFNBO, to ensure a consistent approach with the RED framework. The RED also limits the contribution of other types of biofuels, in particular food-based biofuels and biofuels from feedstocks listed in Part B of Annex IX, to minimise undesired impacts, including ILUC and system gaming/frauds.

The assessment of option FUEL2 is therefore limited to the impacts of credits for specific renewable and low-carbon fuels. In addition, in order to prevent disincentives for the automotive manufacturers to invest in vehicles zero-emission technologies, the overall contribution of the fuels credits to the manufacturers' compliance with the $CO_2$ emission standards is capped at 5%.

The overall biofuels consumption is approximately 19 Mtoe in 2030 in the FUEL0 scenario, out of which around 5 Mtoe of PartA biofuels. In the FUEL2 option, in case the 5% cap is met, an additional 5.3 Mtoe of PartA biofuels is consumed by cars and vans. This represents a doubling of the use of PartA biofuels in road in 2030 relative to FUEL0.

The same effect as in FUEL1 option is observed concerning the average WLTP $CO_2$ emissions of the vehicles fleet, which increase by around 5% in 2030 compared to FUEL0, considering the actual lifecycle emission savings of the additional renewable and low-carbon fuels in the scope of the option relative to the fossil comparator. The shares of ICEV registered in 2030 increases in FUEL2 compared to FUEL0, while the share of ZEV reduces by around 3 percentage points.

The additional quantities of PartA biofuels slightly overbalance the increase in the WLTP $CO_2$ emissions of new vehicles. As a result, the reduction of $CO_2$ tailpipe emissions in 2005-2030 from cars and vans, amounting to around 30% in FUEL0, increases by around 1 percentage point in FUEL1 under the most extreme case in which the additional PartA biofuels are enough to meet the cap.

However, the additional quantities of PartA biofuels in 2030 under the FUEL2 option lead to an increase in the overall gasoline and diesel blended fuel prices. This effect is driven by the need to use more expensive feedstocks, with an overall increase of around 20% of the costs of the additional PartA biofuels, due to competition with other transport modes, in particular aviation and maritime, for which specific targets are set under the MIX policy context.

In both FUEL1 and FUEL2 options, the incentives are not strong enough to incentivise the market uptake of RFNBO and/or other e-fuels for cars and vans by 2030. This is due to constraints related to technological developments, maturity, costs, as well as the need to ensure additionality compared to the targets set under RED II and the aviation and maritime fuels Initiatives, in the case of option FUEL2.

Should the market behave differently than what is projected under these scenarios and should RFNBO and/or e-fuels come to the road market by 2030, this could lead to negative impacts in terms of overall energy savings. The electricity requirement for the production and downstream transportation and distribution of different types of e-fuels has been estimated to be from around 1.6-1.8 times higher for compressed gaseous hydrogen and between 2.2 to 6.7 times higher for liquid e-fuels, when compared to the direct use of electricity[100], depending on

[100] See https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

the specific fuel type. When considering not only the fuels production phase, but also the vehicle powertrain efficiency / losses when the fuels is used, the total efficiency declines even more. According to literature[101], the overall efficiency of electricity use for battery electric cars is 69%, while it deteriorates to around to 26% for hydrogen fuel cells vehicles, and to 13% for internal combustion engines powered with e-fuels.

Concerning pollutants emissions, literature sources show that, compared with fossil fuels, the use of biofuels and/or e-fuels does not provide benefits in terms of $NO_x$ and PM emissions[102]. Therefore under both options FUEL1 and FUEL2 leading to reduced penetration of ZEV, a slight increase of pollutant emissions can be expected compared to FUEL0.

### *6.4.3 Social impact*

Introducing the option FUEL1 would lead to social impacts equivalent to a lower level of ambition of the target levels. These impacts are described under section 6.2.1.2. Consumers would not experience the fuel savings from the use of more efficient and zero-and low-emission vehicles, since the manufacturers would need less of these vehicles to meet their $CO_2$ emission targets.

As regards the option FUEL2, the increase in the total costs for end users described under the economic impact will affect consequently all the different income groups.

### *6.4.4 Administrative burden*

Option FUEL1 would not lead to additional administrative burden.

The implementation of the LCF credits option (FUEL2) would significantly increase the administrative burden and complexity of the compliance system. This concerns in particular the following main issues:

(i) setting up of a new crediting, monitoring and reporting system for the credits generated by fuel suppliers in case of exceedance of their targets under the Renewable Energy Directive and Refuel aviation and maritime proposals and to allow manufacturers to purchase these credits.

(ii) additional checks at the stage of issuing the credits and checking of manufacturers compliance with their annual specific target in order to ensure full additionality of the system. Assessing compliance by vehicle manufacturers would therefore require involvement of the national authorities responsible for the implementation of the Renewable Energy Directive.

(ii) addressing the complexity of different timing in the reporting cycles as the compliance cycle for vehicle manufacturers is annual while the reporting under the Renewable Energy Directive is biannual.

## 6.5 Coherence and interaction with other policies in the "Fit for 55%" package

The Climate Target Plan highlights how achieving at least 55% greenhouse gas emissions reductions will require actions in all sectors. For road transport, the Climate Target Plan concluded that a basket of policy measures is necessary, and that *"in parallel to applying emissions trading to road transport at the level of the fuel supplier and road pricing in line*

[101] https://www.agora-verkehrswende.de/en/publications/the-future-cost-of-electricity-based-synthetic-fuels/
[102] https://www.concawe.eu/wp-content/uploads/2020-01-2147.pdf (Figures 9-13)

*with the ongoing revision of the Eurovignette Directive, only stringent $CO_2$ emissions performance standards ensure the supply of modern and innovative clean vehicles"*.

This conclusion is underpinned by the analysis in the Climate Target Plan Impact Assessment. In all scenarios reaching the 2030 at least 55% target and climate neutrality by 2050, the stringency of the $CO_2$ standards for cars and vans increases as compared to the current legislation. The same conclusion is presented in the 'Sustainable and Smart Mobility Strategy', based on the analysis in its accompanying Staff Working Document.

### *6.5.1 Coherence and interaction with emissions trading for buildings and road transport*

The 'Fit for 55' core scenarios confirm that, considering the effectiveness of the $CO_2$ emission standards at providing consumers with technology choice and lowering emissions in the transport sector, and the more limited responsiveness of this sector to carbon pricing alone, an increase in the ambition for the $CO_2$ emission standards is necessary for road transport to contribute to the -55% target.

In the MIX scenario, an increase in the stringency of the $CO_2$ emission standards and emissions trading for buildings and road transport complement each other to deliver emission reductions in road transport. The MIX scenario, where policies address market failures in a targeted manner and provide investor/consumer certainty while pushing for uptake of innovative technologies, is considered a balanced policy approach, limiting the risk of (i) a too high carbon price with related increase in energy prices for all consumers; (ii) higher costs for economic operators due to only regulatory measures.

The $CO_2$ emission standards address the supply of more fuel-efficient and zero-emission vehicles, setting requirements on vehicle manufacturers with regard to their new vehicle fleets. Emissions trading for buildings and road transport concerns the fuel use in the entire vehicle stock (existing and new vehicles). It could increase the demand for more fuel-efficient vehicles, facilitating the fulfilment of the $CO_2$ targets of the vehicle manufacturers.

While an emission trading system sets a cap to the overall emissions, the $CO_2$ emission standards are necessary to ensure that efficient and zero-emission vehicles, a key instrument to achieve the cap, are supplied to the market, thereby allowing the emission trading to function. This increases in importance under the option to create a separate emission trading for the new sectors, in which the relative role of the car sector to comply with the cap is bigger.

Furthermore, the $CO_2$ emission standards provide for an essential tool to keep road transport emissions below the cap for the new sectors. Emissions trading for buildings and road transport will require to set a cap for those sectors. The cap and the Linear Reduction Factor (LRF) for the separate emissions trading would be set in line with cost effective emission reductions resulting from a mix of carbon pricing and other policies in the sectors concerned. The $CO_2$ emission standards are one of these policies and are a strong driver for emission reductions over time. As a result, increasing the level of the $CO_2$ emission standards will contribute to increasing emission reductions and thus lower the carbon price required to achieve a given cap. Vice-versa, less stringent $CO_2$ emission standards will contribute to increase the carbon price to achieve a given cap. The draft Impact Assessment for the ETS also highlights the continued need for $CO_2$ emission standards.

### *6.5.2 Coherence and interactions with ESR, EED, RED, ETS and AFID*

By ensuring a reduction of road transport emissions, the $CO_2$ emission standards notably support Member States in meeting their targets under the Effort Sharing Regulation.

Since the standards incentivise the increase in efficiency and the electrification of vehicles, they contribute to the Energy Efficiency Directive objective.

Complementarities exist with the Renewable Energy Directive. By providing a route to using renewable energy in transport, the $CO_2$ emission standards will contribute to the Renewable Energy Directive objective. Both instruments deliver reduction of emissions, the $CO_2$ emission standards by supplying new zero-emission vehicles to the market, the Renewable Energy Directive (RED) by incentivising the uptake of renewable and low carbon fuels for the combustion engine vehicles in the stock.

In addition, the revision of RED will work in synergy with the $CO_2$ emission standards for vehicles. The $CO_2$ emission standards will increase the electrification of road transport through the supply of zero-emission vehicles while the RED will additionally act on the energy supply side by introducing a credit mechanism incentivising the participation of electricity providers to the necessary roll-out of publically available recharging infrastructure.

There are also important synergies between the $CO_2$ emission standards and a strengthened ETS and the Renewable Energy Directive. The ETS and Renewable Energy Directive will drive decarbonisation of the power generation, so that zero-emission vehicles, incentivised by the $CO_2$ emission standards, are progressively powered by low or renewable energy sources thus achieving decarbonisation of full well-to-wheel emissions.

Finally, while the $CO_2$ emission standards ensure the supply of zero-emission vehicles, the Alternative Fuels Infrastructure Directive (AFID), which incentivises the rollout of recharging and refuelling infrastructure, is a necessary complementary instrument to address the market barrier on the deployment of infrastructure. This in turn is also incentivised by the ESR, which incentivises Member States to take action in their road transport sectors.

## 7 COMPARISON OF OPTIONS

The options are compared against the following criteria:

- Effectiveness: the extent to which the different options would achieve the objectives set out in Section 4
- Efficiency: the extent to which the objectives can be achieved for a given level of resource/at least cost;
- Coherence of each option with the increased 2030 ambition level, the 2050 climate neutrality objective and the consistency with the overall 'fit for 55%' package;
- Proportionality, in terms of administrative costs and complexity.

**Table 18** summarizes the assessment of each option against the criteria of **effectiveness, efficiency, coherence and proportionality,** following the categories of issues considered in the previous Sections.

**Table 18: Summary of key impacts expected**

| ××  | × | 0 | ✓ | ✓✓ |
|---|---|---|---|---|
| Strongly negative | Weakly negative | Neutral | Weakly positive | Strongly positive |

| *Options considered* | *Effectiveness* | *Efficiency* | *Coherence* | *Proportionality – added value* |
|---|---|---|---|---|
| ***1. $CO_2$ EMISSION TARGETS (cars and vans)*** | | | | |
| ***1.1 Target Levels*** | | | | |
| TL_0 | ***0*** | ***0*** | ***0*** | ***0*** |
| TL_Low | ✓ | ✓ | ✓ | ✓ |
| TL_Medium | ✓✓ | ✓✓ | ✓✓ | ✓ |
| TL_High | ✓✓ | ✓✓ | ✓✓ | ✓ |
| ***1.2 Timing of targets*** | | | | |
| TT 0 | ***0*** | ***0*** | ***0*** | ***0*** |
| TT 1 | ✓ | × | ***0*** | ×× |
| ***1.3 Use of revenues from excess emissions premiums*** | | | | |
| REV 0 | ***0*** | ***0*** | ***0*** | ***0*** |
| REV 1 | ***0*** | × | ***0*** | × |
| REV 2 | ***0*** | × | ***0*** | × |
| ***1.4 Derogations for small volume manufacturers*** | | | | |
| SVM 0 | ***0*** | ***0*** | ***0*** | ***0*** |
| SVM 1 | ✓ | ***0*** | ✓✓ | ***0*** |
| ***2. INCENTIVE SCHEME FOR ZERO- AND LOW-EMISSION VEHICLES (cars and vans)*** | | | | |
| ZLEVT_no | ***0*** | ***0*** | ***0*** | ***0*** |
| ZLEV_Low | ×× | ***0*** | ***0*** | ***0*** |
| ZLEV_Med | ***0*** | × | ***0*** | ×× |
| ZLEV_High | ✓ | × | ***0*** | ×× |
| ***3. MECHANISM FOR RENEWABLE AND LOW-CARBON FUELS ACCOUNTING (cars and vans)*** | | | | |
| FUEL0 | ***0*** | ***0*** | ***0*** | ***0*** |
| FUEL1 | ×× | ×× | ×× | × |
| FUEL2 | × | ×× | ×× | ×× |

## 7.1 $CO_2$ emission targets for cars and vans

### *7.1.1 $CO_2$ emission target levels*

The options considered cover a range of target level trajectories up to 2040. As described in Section 6 of this IA, the stricter the target levels set for cars and vans, the higher their **effectiveness** in achieving the specific objectives of reducing $CO_2$ emissions and providing air quality benefits to consumers. TL_Low is the least effective option as it would lead to less $CO_2$ emission reduction, less air quality benefits to consumers and less supply of zero-emission vehicles.

Stricter targets should also lead to an increase in the market uptake of ZEV[103], and thereby increase the effectiveness of the policy to stimulate innovation in zero-emission technologies. This will in turn also provide a stronger signal stimulating investments in recharging and refuelling infrastructure. To the extent that such accelerated uptake of ZEV would yield economies of scale, this could further bring down vehicle costs and make ZEV more attractive/affordable for consumers. With stricter targets, it is expected that manufacturers would bring on the market more ZEV models at lower prices in order to attract customers and avoid losing market share.

In terms of **efficiency**, the three TL options considered deliver benefits over the lifetime of a vehicle from a societal perspective. These savings increase with increasing target stringency. This is the case when considering the effect of the $CO_2$ standards separately, as well as when considering the combined effect of the $CO_2$ standards and the other policies as projected in the MIX scenario.

From a first and second end-user perspective, the $CO_2$ standards have a positive effect on the total cost of ownership, with higher targets delivering higher benefits. Savings in the fuel expenditure during the use of the vehicles outweigh the possible higher upfront costs of more efficient vehicles. Among the options considered, TL_Low provides less economic savings from a societal and end-users perspective.

However, up to 2035, costs for the manufacturers increase with stricter $CO_2$ targets, making the option with the highest target level score less positively on this point.

As regards the social impacts, lower income groups are projected to see higher savings relative to their annual income from a total cost of ownership perspective and this effect becomes more outspoken with higher target levels, while there is little impact on the affordability of different vehicle types. BEV remain or become affordable with time for all the TL options except for the larger BEV for the lower income groups.

As regards the macro-economic impacts, the results show a small positive impact for the policy scenarios compared to the baseline in terms of EU-27 GDP. It is projected that higher $CO_2$ targets trigger increased consumer expenditure as well as increased infrastructure investment. This combined impact, as well as a reduction in imports of petroleum products, would result in an overall positive impact on GDP and reduce the import dependency of the EU economy.

On the one hand, at the sectoral level, there would be an increase in the electric vehicles supply chain, with a production increase in sectors such as metals and electrical and

[103] For instance, the share of zero-emission cars in the new fleet in 2030 ranges from 25% in the baseline to between 30% and 45% in the three target levels options. In 2035, all new cars are ZEV under TL_High, around 55% under TL_Med and 40% under TL_Low.

machinery equipment. This reflects the impact of increased demand for batteries, electricity infrastructure and electric motors.

On the other hand, the automotive sector itself would see a decrease in turnover due to the decreasing use of combustion engines in cars. Similarly, the power and hydrogen supply sectors would increase production reflecting increased demand for electricity and hydrogen to power electric vehicles, while the petroleum refining sector would see a lower production. With more stringent target levels, these effects would become slightly more pronounced.

With more ambitious $CO_2$ target levels resulting in an increase in economic output, there is also a marginal increase in the number of jobs across the EU-27 compared to the baseline. The number of additional jobs also increases slightly over time. The main drivers behind the GDP impacts also explain the employment impacts. Additional enabling measures for EU investments into battery production, such as the European Battery Alliance, would amplify the positive employment effects.

Shifts in sectoral economic activity will also affect the skills and qualifications required in the automotive sector. Re-skilling and up-skilling of workers will be necessary.

In terms of **coherence**, higher targets would contribute more to the overall 55% emission reduction by 2030 and to supporting Member States in meeting their target under the Effort Sharing Regulation (ESR), in case of a continued ESR scope, as well as to achieving the 2050 climate neutrality objective. Conversely, ESR also incentivises Member States to develop the recharging and refuelling infrastructure for zero-emission vehicles, thus facilitating compliance of the automotive manufacturers with their targets. Higher $CO_2$ targets would also contribute more to the achievement of the energy efficiency objectives.

The CTP has shown that a set of policy instruments is needed to achieve the increased climate target. The 'Fit for 55' core scenarios (see joint methodological paper) build on the CTP and analyse the interplay among the different instruments, in particular the intensity of carbon pricing and regulatory measures, to reach the -55% climate target.

The $CO_2$ emission standards for vehicles are a key regulatory measure driving the results of the core scenarios in road transport. The ambition levels TL_Low, TL_Med and TL_High are embedded into the core scenarios, which therefore provide an assessment of the coherence and interplay of the $CO_2$ emission standards with the other instruments.

The 'Fit for 55' core scenarios show that, considering the effectiveness of the $CO_2$ emission standards at lowering emissions in the transport sector, and the limited responsiveness of this sector to carbon price, an increase in the ambition for the $CO_2$ emission standards is necessary to ensure a sufficient reduction of emissions in road transport to contribute to the -55% target.

The core scenarios also show that in general a combination of carbon pricing and regulatory measures limits the risk of (i) a too high carbon price with related increase in energy prices for all consumers; (ii) high costs for economic operators due to only regulatory measures.

In addition, there are clear complementarities between $CO_2$ emission standards and carbon pricing through an extension of emission trading to road transport fuels. The $CO_2$ emission standards address the supply on the market of more fuel efficient vehicles and set requirements on vehicle manufacturers with regards to their fleets of new vehicles. This will ensure a significant increase in the supply of new zero-emission vehicles over time. The ETS coverage concerns the fuel use in the entire vehicle stock and captures real-life emissions. It could increase the demand for more fuel-efficient vehicles, facilitating the fulfilment of the $CO_2$ efficiency objectives of the vehicle manufacturers. It could address possible rebound

effects, whereby customers drive more as their vehicles become more efficient due to lower usage costs[104].

The MIX scenario**,** where policies address market failures in a targeted manner and provide investor/consumer certainty while pushing for uptake of innovative technologies, is therefore considered a balanced policy approach. In the MIX scenario, both carbon pricing and $CO_2$ emission standards are aligned to trigger investments in clean technologies and infrastructure.

In case the $CO_2$ emission standards were to be set at the level of TL_Low option in combination with emissions trading for buildings and road transport, the carbon prices would need to increase to ensure a contribution of road transport compatible with the overall 55% objective, leading to higher energy costs for consumers and transport operators, as shown in MIX-CP scenario. Conversely, the TL_High option, as shown in REG, could potentially result in a sufficient contribution of road transport to the -55% target, together with increase ambition in other regulatory policies (RED and EED in particular), even in absence of carbon pricing. The TL_High option can also contribute to limit the risks of excessively increasing carbon prices in the new emissions trading and their possible impacts on vulnerable consumers. The carbon prices in the new emissions trading depend on different policies, not only the $CO_2$ emission standards for cars and vans. Annex 4, in particular in Tables 25 and 26, provides detailed information on the levels of carbon prices and the levels of regulatory measures, including the $CO_2$ emission standards for cars and vans, in the different core policy scenarios.

The $CO_2$ emission standards are also a complementary measure to the RED. The RED incentivises the uptake of renewable and low carbon fuels for the combustion engine vehicles in the stock. It therefore complements the $CO_2$ emission standards, which drive the supply of more efficient vehicles, by acting on the fuels supply side. In addition the RED contributes to the decarbonisation of the power generation, so that zero-emission vehicles incentivised by the $CO_2$ emission standards are progressively powered by renewable energy sources.

As the $CO_2$ emission standards will incentivise increasing shares of electric and hydrogen powered cars and vans in the market, the related refuelling and recharging infrastructure will have to be provided. With this respect, the ambition level of the $CO_2$ emission standards drives the needs of the revision of the Alternative Fuels Infrastructure Directive, also part of the 'Fit for 55%' package.

In terms of **proportionality**, no major differences could be identified between the options.

### *7.1.2 Timing of targets*

The option of setting targets decreasing in less-than-5-year steps (TT1) would provide greater certainty that a gradual $CO_2$ emission reduction will be effectively delivered. It therefore scores more positively in terms of **effectiveness** than the baseline (TT0).

However, option TT1 would leave manufacturers with much less flexibility to deal with year-to-year market fluctuations and to manage the introduction of new or upgraded models and technologies in the fleet. In terms of **efficiency**, it is scored slightly negative as this option is likely to increase compliance costs for manufacturers. At the same time, economic savings for consumers and society are likely to increase.

[104] CE Delft, Analysis of the options to include transport and the built environment in the EU ETS (2014), p. 60. ICF et al. (2020): Possible extension of the EU Emissions Trading System (ETS) to cover emissions from the use of fossil fuels in particular in the road transport and the buildings sector, under DG CLIMA Framework Contract

Allowing the banking of credits obtained from overachieving the targets in a given year for use in following years could offer manufacturers greater flexibility, but would significantly increase the administrative costs and complexity, making this option score lower in terms of **proportionality**.

In terms of **coherence**, no major differences could be identified between the options.

### *7.1.3 Use of revenues from excess emissions premiums*

The options of assigning the revenue from excess emissions premiums collected under the Regulation to a specific fund or programme (REV_1) or as own resource (REV_2) should be considered in the context of supporting the transition towards a climate-neutral economy as well as the (re-)skilling and reallocation of automotive workers. They are therefore considered in the context of the first and third specific objective of this initiative.

It cannot be anticipated whether or how much manufacturers will exceed their targets. This means that the revenue from the excess emissions premiums will be uncertain and most likely very limited. Overall, this creates some doubts over the **effectiveness** of the two options.

The Just Transition Fund (JTF) option could be effective in contributing to the transition in this sector, but this requires that the support fits within the aims of the Member State plans approved by the Commission. Assigning the revenue to the Innovation Fund would be conditional on a series of amendments to the EU ETS and its implementing legislation. In both cases, the automotive sector could not benefit directly from the revenue.

In addition, these options would increase the administrative burden as mechanisms will need to be put into place in order to make it operational under these Funds, e.g. to distribute the additional resources. It is therefore uncertain at this stage whether the additional burden would outweigh the benefits achieved, making this option scores lower than the baseline in terms of **efficiency** and **proportionality**.

The option of allocating the revenue from the premiums to the EU budget as an "own resource" would not allow targeting the automotive sector and would thus not be more effective than the current approach. In addition, also this option could disproportionately increase the administrative burden due to the legal architecture of the management of the own resources.

In terms of **coherence**, no major differences could be identified between the options.

### *7.1.4 Derogations for small volume manufacturers*

Removing from 2030 onwards the possibility for manufacturers to be granted a "small volume" derogation would improve the **effectiveness** and coherence of the legislation. It would help to better achieve the specific policy objectives by signalling also to those manufacturers the need to start introducing zero-emission vehicles in their fleet.

**Coherence** would be improved by removing a possible market distorting element in the current Regulation which allows some global players to benefit from a competitive advantage because of limited sales on the EU market. It may also be perceived as unduly protecting small volume manufacturers of conventional vehicles against competitors focusing on zero-emission vehicles, in particular in the longer term.

Removing the derogation regime would increase the regulatory burden and the costs on some small manufacturers, but this is mitigated by providing time until 2030 for these manufacturers to adapt and pursue new compliance strategies for the next decade. At the same time, this option would avoid maintaining a competitive disadvantage for manufacturers not

belonging to the "small volume" category. In view of this, the option is not considered to create **proportionality** issues and scores neutral on the **efficiency** criteria.

### 7.2 Incentive scheme for zero- and low-emission vehicles

The assessment of the different options regarding the ZLEV incentive mechanism shows only limited variations in the overall tailpipe $CO_2$ emissions of cars and vans in the period 2030 to 2050.

The "bonus-only" option (ZLEV_Low) scores lowest in terms of environmental **effectiveness**, as it may risk undermining the environmental effectiveness, albeit that the effect is limited by the 5% cap. Compared to the no incentive option, tailpipe $CO_2$ emissions under the "bonus-malus" option (ZLEV_Med) will be slightly lower when this would lead to a full application of the "malus" and slightly higher in case of a full "bonus". As a possible side-effect, the average emissions of internal combustion engine vehicles could increase in the three options considered in case of an increased ZLEV market uptake. And

In terms of **efficiency**, little difference in impacts could be observed under the scenarios considered for these options: total costs of ownership for end-users do not significantly change compared to the ZLEVT_no option. However a binding ZEV mandate or a bonus/malus system reduce significantly the flexibility for manufacturers to meet their $CO_2$ emission targets. A bonus only system would not change the impacts as it would not impose additional requirements to the manufacturers, who are able to decide to meet or not the benchmark levels, depending on their specific circumstances.

A binding ZEV mandate (ZLEV_High) or a bonus/malus system (ZLEV_Med) reduce significantly the flexibility for manufacturers to meet their $CO_2$ emission targets. In particular the latter could lead to a disproportionate impact for manufacturers not meeting the ZLEV benchmark as this would cause their $CO_2$ target to be strengthened, leaving them with few or no compliance options. These two options therefore score low in terms of **proportionality**.

In terms of **coherence**, no major implications of either of the options could be identified.

### 7.3 Mechanism for renewable and low-carbon fuels accounting

The option FUEL1, i.e. the application of "carbon correction" factors to the type-approved $CO_2$ emissions of the vehicles to reflect the carbon intensity and share of renewable and low-carbon fuels used by cars and vans, scores lowest in terms of **effectiveness**. For a given $CO_2$ target level, it would yield lower $CO_2$ emission reductions for cars and vans than the 'no fuels accounting' option. Compared to the baseline, it also scores negatively with regards to air pollution and to innovation in zero-emission technologies.

This option scores also lower than the 'no fuels accounting' option in terms of economic savings, both from a societal perspective and from the user's TCO perspective. It would also reduce the planning certainty for automotive manufacturers and their suppliers, unless the carbon correction factor would be set in advance to a predefined value. It therefore scores negatively on the **efficiency** criteria.

In terms of **coherence**, it scores lower as it leads to double counting of the contribution of renewable and low-carbon fuels under the RED and under the $CO_2$ emission standards.

In terms of **proportionality**, option FUEL1 scores slightly negative compared to the baseline as it adds some degree of complexity through the application of "carbon correction" factors.

As regards option FUEL2, i.e. the introduction of a low-carbon fuels (LCF) crediting system, the following assessment can be made in terms of **effectiveness**. This option would be

comparable to the 'no fuels accounting' option with regards to the $CO_2$ emission objective. A slight reduction of $CO_2$ tailpipe emissions reduction could be seen in an extreme case of a doubling of the amount of advanced biofuels used in the vehicles fleet. However, this would lead to negative impacts in terms of overall energy savings with regards to the production and use of RFNBO and e-fuels for the road transport sector. It would also increase air pollutant emissions as well as in the overall gasoline and diesel blended fuel prices. The LCF option would also be less effective in stimulating innovation in zero-emission vehicles. It therefore scores negatively on effectiveness compared to the baseline.

The FUEL2 option also scores lower in terms of **efficiency** as the analysis shows that the costs for a manufacturer to comply with its $CO_2$ target by purchasing LCF credits are significantly higher than by adding a BEV to its fleet. It would also reduce the planning certainty for automotive manufacturers and their suppliers. The total costs of ownership for first and second users and the societal costs over a vehicle's lifetime are also higher under the LCF crediting system.

In terms of **coherence**, implementation of the FUEL2 option also scores lower than the 'no fuels accounting' option as it risks incentivising the use of these fuels in road transport, lowering their availability for other transport modes where less or no alternative exist. This is not coherent with the need to reduce economy-wide emissions as explained in the conclusions of the Climate Target Plan. In view of the significant energy requirements for the production of RFNBO and e-fuels and of the low efficiency of their use in vehicles, this option also lacks coherence with the energy-efficiency-first principle underlined in the EU Strategy for Energy System Integration. Furthermore this option would risk creating an incentive for the further use of woody biomass-based products as biofuels, instead of using it for valuable resources for circular bio-based materials and products. It would therefore not be coherent with the approach taken in the LULUCF Regulation.

Finally, the FUEL2 option would also significantly increase the administrative burden and complexity of the compliance system. It therefore scores the lowest in terms of **proportionality**.

# 8 PREFERRED OPTION

When proposing its updated 2030 greenhouse gas emissions reduction of at least 55%[105], the European Commission also described the actions across all sectors of the economy that would complement national efforts to achieve the increased ambition. A number of impact assessments have been prepared to support the envisaged revisions of key legislative instruments.

Against this background, this impact assessment has analysed the various options through which a revision of $CO_2$ emission standards for cars and vans could effectively and efficiently contribute to the delivery of the updated target as part of a wider "Fit for 55" policy package.

*Methodological approach*

Drawing conclusions about preferred options from this analysis requires tackling two methodological issues.

First, as often the case in impact assessment analysis, ranking options may not be straightforward as it may not be possible to compare options through a single metric and no option may clearly dominate the others across relevant criteria. Ranking then requires an implicit weighting of the different criteria that can only be justifiably established at the political level. In such cases, an impact assessment should wean out as many inferior options as possible while transparently provide the information required for political decision-making.

Secondly, the "Fit for 55" package involves a high number of interlinked initiatives underpinned by individual impact assessments. Therefore, there is a need to ensure coherence between the preferred options of various impact assessments.

*Policy interactions*

Given the complex interdependence across policy tools and the interplay with the methodological issue outlined above, no simultaneous determination of a preferred policy package is thus possible. A sequential approach was therefore necessary.

First, the common economic assessment[106,107] underpinning the "Communication on Stepping up Europe's 2030 climate ambition" looked at the feasibility of achieving a higher climate target and provided insights into the efforts that individual sectors would have to make. It could not, however, discuss precise sectoral ambitions or detailed policy tools. Rather, it looked at a range of possible pathways/scenarios to explore the delivery of the increased climate ambition. It noted particular benefits in deploying a broad mix of policy instruments, including strengthened carbon pricing, increased regulatory policy ambition and the identification of the investments to step up the climate ambition.

An update of the pathway/scenario focusing on a combination of carbon pricing and medium intensification of regulatory measures in all sectors of the economy, while also reflecting the COVID-19 pandemic and the National Energy and Climate Plans, confirmed these findings.

Taking this pathway and the Communication on Stepping up Europe's 2030 climate ambition as central reference, individual impact assessments for all "Fit for 55" initiatives were then developed with a view to provide the required evidence base for the final step of detailing an effective, efficient and coherent "Fit for 55" package.

[105] Communication on Stepping up Europe's 2030 climate ambition - COM(2020)562
[106] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020SC0176
[107] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0331

At the aggregate level, these impact assessments provide considerable reassurances about the policy indications adopted by the Commission in the Communication on Stepping up Europe's 2030 climate ambition. This concerns notably a stronger and more comprehensive role of carbon pricing, energy efficiency and renewable energy policies, land sector, instruments supporting sustainable mobility and transport. These would be complemented by a carbon border adjustment mechanism and phasing out free allowances. This would allow to continue to address the risk of carbon leakage in an efficient manner. It would also preserve the full scope of the Effort Sharing Regulation for achieving the increased climate target.

Various elements of the analyses also suggest that parts of the revenues of a strengthened and extended ETS should be used to counter any undesirable distributional impacts such a package would entail (between and within Member States). While the best way to do this is still to be determined, this would seem a superior alternative to foregoing the relevant measures altogether or simply disregarding the uneven nature of their distributional impacts. Under both these alternatives, the eventual success of any package proposed would be at risk.

*Preferred policy options*

Preliminarily assuming this fact and the analysis above as the framework for the aggregate "Fit for 55" package, the specific analysis carried out in this impact assessment comes to the main following conclusions and would suggest the following preferred policy options for the revision of the $CO_2$ emission standards for cars and vans.

**1) $CO_2$ emission targets for cars and vans**

In order to contribute to the overall 2030 increased ambition level and the 2050 climate neutrality objective, the preferred option is to significantly strenghten the $CO_2$ targets for cars and vans as of 2030. This will provide for the necessary steer to accelerate the supply to the market of zero-emission vehicles, bring benefits for vehicle users as well as stimulate innovation and technological leadership, while limiting the costs increase for manufacturers.

It is also preferable to maintain the regulatory approach of setting targets decreasing in 5-year steps in order to provide for sufficient flexibility for manufacturers to manage this transition.

The possible revenues from excess emissions premiums would remain part of the general EU budget. The other options considered would significantly increase the administrative burden while not directly benefitting the automotive sector in its transition.

The possibility for small volume manufacturers to be granted a derogation target would be removed from 2030 onwards, thereby improving the effectiveness and coherence of the legislation.

**2) Incentive scheme for zero- and low-emission vehicles (ZLEV)**

It is preferable to remove as of 2030 the incentive scheme for zero- and low-emission vehicles (ZLEV). Such a scheme is not necessary in combination with the stricter $CO_2$ targets, as those will require manufacturers to deploy significantly more zero-emision vehicles. This would also simplify the legislation. It would avoid the risk of undermining its effectiveness in case of a bonus-only system or the risk of creating disproportionate impacts in case of a binding mandate or a bonus/malus system which would reduce significantly the flexibility for manufacturers to meet their $CO_2$ emission targets.

**3) Mechanism for renewable and low-carbon fuels accounting**

The preferred option is not to include an accounting mechanism for renewable and low-carbon fuels to assess manufacturers compliance with the $CO_2$ emission standards. Such a mechanism would undermine the effectiveness and efficiency of the legislation while

increasing the administrative burden and complexity. Promoting the use of renewable and low-carbon fuels will be done through the revision of the fuels related legislation (RED II, emissions trading for buildings and road transport and Energy Taxation Directive).

Overall, the above elements would strengthen the $CO_2$ emission standards for cars and vans and help ensure that road transport makes the necessary contribution towards the more ambitious GHG target of at least -55% by 2030 as defined in the Climate Target Plan. At the same time, it would be complementary to and fully consistent with the other legislative initiatives that contribute to the same objective, in particular the revision of the ESR, the strengthening of ETS and emissions trading for buildings and road transport, the revision of the RED II and the EED.

**REFIT (simplification and improved efficiency)**

Compared to the current Regulation, the abovementioned preferred policy options are not expected to increase the administrative costs caused by the legislation. In addition, they are not increasing the complexity of the legal framework.

Under the preferred options, two of the existing provisions, i.e. the ZLEV “bonus” incentive mechanism and the 'small volume' derogation, would be removed from 2030 onwards, which will contribute to the simplification of the legislation. At the same time, the regulatory system will continue to provide for flexibilities intended to lower the compliance cost for manufacturers.

No changes in the compliance monitoring regime or in the level of the excess emissions premium are foreseen. The preferred options will therefore neither increase administrative costs for manufacturers and competent national authorities nor enforcement costs for the Commission.

# 9 HOW WOULD IMPACTS BE MONITORED AND EVALUATED?

The actual impacts of the legislation will continue to be monitored and evaluated against a set of indicators tailored to the specific policy objectives. A mid-term review of the legislation would allow the Commission to assess the effectiveness of the legislation and, where appropriate, propose changes.

A well-established system is in place for monitoring the impacts of the legislation. Member States annually report data for all newly registered cars and vans to the Commission. In addition to the type-approved $CO_2$ emission and mass values, a number of other relevant data entries are monitored, including fuel type and $CO_2$ emission savings from eco-innovations. Manufacturers have the opportunity to notify errors in this provisional data.

The Commission, supported by the European Environment Agency (EEA), publishes every year the final monitoring data of the preceding calendar year including the manufacturer specific performance against the $CO_2$ targets. The legislation will continue to rely on this well-established monitoring and compliance framework.

## 9.1 Indicators

For the specific policy objectives the following core monitoring indicators have been identified:

- Contribute to the 2030 at least -55% GHG emissions target and to the climate neutrality objective by 2050 by reducing **$CO_2$ emissions** from cars and vans cost-effectively:
    - The EU fleet average $CO_2$ emissions measured at type approval will be monitored annually on the basis of the monitoring data against the target level set in the legislation;
    - The gap between the type-approved $CO_2$ emissions data and real-world $CO_2$ emissions data will be monitored through the collection and publication of real-world fuel consumption data as well as reporting of deviations from the type approved $CO_2$ emissions and corrections to the $CO_2$ emissions data as initially reported by Member States and corrected by manufacturers.
    - Cars and vans GHG emissions will be monitored through Member States' annual GHG emissions inventories;
    - The costs and effectiveness of technologies used in the vehicles to reduce emissions will be monitored on the basis of data to be collected from manufacturers, suppliers and experts.
- Provide benefits for **consumers** from wider deployment of zero-emission vehicles:
    - The number and share of newly registered zero- and low-emission vehicles will be monitored through the annual monitoring data submitted by Member States;
    - Developments in energy cost savings will be monitored through the EU-wide fleet average emissions as well as the collection of real world fuel and energy consumption data.
    - Air quality benefits will be monitored through Member States' annual pollutant emissions inventories and air quality monitoring data.
- Stimulate **innovation in zero-emission technologies**, thus strengthening the **technological leadership** of the EU automotive value chain and stimulating employment:

- The level of innovation will be measured in terms of new patents by European automotive manufacturers related to zero--emission technologies through publicly available patents databases.
- The level of employment will be monitored on the basis of publicly available Eurostat statistics on sectoral employment data for the EU.

The methodology for an evaluation of the legislation will put particular emphasis in ensuring that causality between the observed outcomes, based on the above indicators, and the legislation can be established. In this context, methodological elements will include the establishment of a robust baseline/counterfactual scenario and the use of regression analysis/empirical research.

## 9.2 Operational objectives

Based on the policy options, the following operational objectives have been identified:

| **Operational objectives** | **Indicators** |
|---|---|
| Reach a specific $CO_2$ emissions target level by the target year(s) | Compliance of manufacturers with their specific emissions target in the target year(s) |
| Achieve a certain level of deployment of zero-emission vehicles in a specific year | Share of zero-emission vehicles in that year |
| Increase technological innovation | Number of new patents registered by European manufacturers related to fuel-efficient technologies and zero/low-emission vehicles |