Centrum für Europäische Politik
FREIBURG | BERLIN

cepStudy

21 January 2025

Towards Decarbonised Road Transport Driven by a Globally Competitive EU Automotive Industry

Further Development of a Resilient EU Regulatory Framework to Safeguard the Transformation

Dr. Martin Menner, Dr. Götz Reichert, Prof. Dr. Jan S. Voßwinkel and Dr. André Wolf

This study was commissioned by the Association des Constructeurs Européens d'Automobiles (ACEA).

Content

Figures

Tables

Glossary

GHG

Greenhouse Gases – like e.g. carbon dioxide (CO_2) methane (CH_4) and nitrous oxide (N_2O).

HDV

Heavy Duty Vehicle – Lorries, Coaches and Buses

Internal Combustion Engine (ICE)

A heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber inside the engine, e.g. Otto engine, Diesel engine or Wankel engine.

Internal Combustion Engine Vehicle (ICEV)

Vehicle powered by an ICE.

Battery Electric Vehicle (BEV)

Vehicle with electric propulsion powered by batteries.

Hybrid Electric Vehicle (HEV)

Vehicle combining electric propulsion and an ICE where the battery cannot be charged by the electric grid.

Plug-In-Hybrid Electric Vehicle (PHEV)

Vehicle combining electric propulsion and an ICE where the battery can be charged by the electric grid.

Extended Range Electric Vehicle (EREV)

BEV with an extended range thanks to an electricity-generating ICE.

Fuel-Cell Electric Vehicle (FCEV)

Vehicle with electric propulsion powered by fuel cells.

(Rechargeable) Electric Vehicles (EV)

BEV or PHEV.

Zero-Emission Vehicle (ZEV)

BEV or FCEV.

Hydrogen-Combustion Vehicle (H2ICEV)

Vehicle powered by combustion of hydrogen

TCO

Total Cost of Ownership of a vehicle.

E-Fuels

Synthetic fuels from renewable hydrogen and captured CO_2, e.g. e-methane, e-methanol, e-gasoline or e-diesel.

EU-ETS 1

EU Emission Trading System for Energy, Industry, Aviation and Maritime Transport.

EU-ETS 2

EU Emission Trading System for Road Transport and Buildings.

Executive Summary

The European Union wants to reduce its greenhouse gas (GHG) emissions to net zero until 2050 (climate neutrality) and by 55% until 2030 compared to 1990. In this respect, road transport is a key sector since it is still a major source of CO_2 emissions.

The **European automotive industry** is essential for the **decarbonisation of road transport** as well as for the **prosperity and innovative strength** of the European economy. It is undergoing a transition towards e-mobility and zero-emission vehicles (ZEVs), with a growing number of new models being launched on the market. **To ensure that CO_2 emission standards for their new vehicle fleets are met**, manufacturers must be **competitive** and be supported by **demand incentives**, such as a sufficient recharging infrastructure, effective CO_2 prices and low electricity costs.

This study examines **whether the current EU regulatory framework is capable of promoting the transition to decarbonised road transport, in the EU and globally, while maintaining the global competitiveness of the EU automotive industry**.

Key Results:

Climate-Neutral Road Transport in the EU

The **EU Emissions Trading System (EU-ETS 2)** caps CO_2 emissions and **guarantees that decarbonisation goals in road transport are reached**. With this safeguard in place, to allow for a more **market-driven transition**, the EU can provide **more technology openness by introducing flexibilities within CO_2 emission standards that enable automakers to adapt to changing conditions.**

- To achieve this, **CO_2 emission standards** should be further developed by introducing **flexibility options**. These could for all vehicle types encompass, e.g., a phase-in, or conditionality of targets on the actual provision of necessary enabling conditions like recharging and refuelling infrastructure, and – regarding cars and vans – a banking/borrowing scheme, a postponement of the tightening of limit values or their reduction.
- EU policy should also **guarantee the necessary enabling conditions** – effective carbon pricing, sufficient recharging and refuelling infrastructure, as well as secure access to affordable raw materials and energy.

Globally Competitive EU Automotive Industry

The ***de facto* ban of** Internal Combustion Engine Vehicles **(ICEVs) for cars and vans and the missing perspective for HDVs running on biofuels or e-fuels risk a shut-down of** those **parts of the EU automotive industry** – suppliers, final production, research and development – dedicated to production and improvement of ICEVs and hybrids, just to see global competitors take over and EU industry losing its competitive advantage. Related losses of jobs and value added would severely impair societal acceptance of EU climate policy.

- Therefore, manufacturers should **be granted technology openness in the long term** to maintain a **strong home market for efficient ICEVs and hybrids** that can run on **climate-neutral fuels** and be **sold in other world regions** likely to demand such vehicles for decades to come. Options for this are a special type approval for these vehicles and banning only pure conventional ICEVs as is done in China and some US states that still allow hybrids beyond 2035.

Taking Stock

The EU aims to decarbonise road transport mainly through **electrification**. The key strategy is to manage the transition to zero emission vehicles (ZEV) by strict CO_2 emission standards for new road vehicles and to encourage the sale of battery electric cars and vans (BEV) as well as zero- and low emission lorries and buses (ZLEV). Since the adoption of the EU decarbonisation strategy, inconsistencies and risk for its implementation have already become visible. The geopolitical situation has changed considerably. Other countries with big automotive markets have adopted new policies.

(A) Following **risks to the decarbonisation targets** for EU road transport and the **competitiveness of the EU automotive industry** in the **EU internal market** are identified (Section 2.1.2):

- As long as potential users of battery electric vehicles (BEVs) do not experience them as a better technology than internal combustion engine vehicles (ICEVs) in terms of total cost of ownership (TCO), range, and convenience of charging, the transition will not be a self-propelling process and risks to fail due to lack of demand. This risk has already materialised as BEV sales have slumped recently, foremost in Germany – the biggest car market in the EU – due to the abolishment of purchase subsidies. A potential failure of the future EU Emissions Trading System for road transport and buildings (EU-ETS 2) to deliver a sufficiently high carbon price in road transport could lead to a persistent TCO disadvantage for BEVs. In contrast, with high fuel or carbon prices an allegedly widespread, mainly non-electric and therefore inefficient use of plug-in hybrids (PHEVs) – that had led to an early end of German subsidies for their purchase – can demonstrably be largely avoided. If the roll-out of an adequate recharging infrastructure keeps lacking behind prospective BEV sales in the EU, the adoption of BEVs will remain limited. For lorries and buses (HDVs), the infrastructure policy is not proactive enough.
- The strategic focus on BEVs increases the EU's import dependencies on raw material markets characterised by high supply concentration and geopolitical uncertainty. High costs and supply risks of batteries and critical raw materials can result in a competitive disadvantage of the EU automotive industry compared to BEV imports from international competitors like China.

For a successful transformation and decarbonisation of EU road transport and to "avoid the radical displacement of production away from the EU's automotive sector" (see Draghi Report, p. 152), it is **crucial that EU legislation provides sufficient flexibility and technology openness to adapt to volatile circumstances.** It must also provide **the necessary enabling conditions for all technologies needed for the transformation**. This includes reliably increasing carbon prices through a socially and politically safeguarded EU-ETS 2 without price caps, a sufficient charging and refuelling infrastructure, a higher contribution of alternative fuels to road transport decarbonisation, and the reduction of supply and price risks on global markets for critical raw materials.

(B) EU legislation also affects the **competitiveness of EU automotive production on the global market** since it differs substantially from rules applying to competitors in other regions (Section 2.2.1):

- Many countries with considerable demand and/or automotive industries pursue medium- and long-term "multi-technology strategies", reflected in their CO_2 emissions legislation. Many countries provide for more time for the transformation to zero emissions vehicles.
- Risks to the EU's electrification strategy could arise from rising raw material costs for batteries if demand picks up. As a large proportion of BEV sales depends on state incentives, sales usually slow down when purchase subsidies are reduced – like recently in China and Germany.

It is likely that imposing a **pure-electric strategy for cars and vans and an electric-centred strategy for HDVs** in their home market **would strip EU manufacturers of potential demand from loyal customers for climate-friendly vehicles** that might have strong demand also on global markets:

Vehicles with ICE powertrains are cheaper to buy and are likely to remain so. Nearly 4 billion people live in countries with inadequate electrical infrastructure for BEVs. For many developing countries, a plausible decarbonisation strategy for road transport is to opt partly for efficient ICEVs and hybrids that run on domestically produced biofuels or e-fuels in countries with abundant wind and/or solar radiation – inducing a continued demand for efficient HEVs suitable for clean fuels.

For the success of EU automotive production in Europe in **global markets**, **technology openness must be granted beyond 2035** also in its **home market** – thereby helping to "maintain the European production base with current technological advantages as long as international markets show demand" (see Draghi Report, p. 152).

To shift the TCO in favour of EVs and ZEVs and **grant** the European automotive industry **flexibility and technological openness** in the EU internal market and for global markets **without jeopardising the EU climate targets**, it is crucial to politically **safeguard the EU-ETS 2 and its binding cap**.

The Way Forward

Proposals for the Further Development of EU Legislation

In order **to enable a self-propelling, market-driven transition** to a decarbonised and competitive EU automotive industry, following **routes for further development of the EU legislation** are proposed:

(1) For **cars and vans**, EU legislation should provide for **technological openness**. With CO_2 emissions capped by the EU-ETS 2, the EU can and should grant **more flexibilities within the CO_2 emission standards** in order to enable a market-driven transition, to respect technology diffusion patterns and to avoid putting EU carmakers potentially in a situation where legally binding targets would be unattainable for them due to factors beyond their control such as lacking demand due to insufficient enabling conditions (Section 2.1.1.12). A higher contribution of alternative fuels is also crucial for the decarbonisation of road transport. A home market for PHEVs, other hybrids or ICEVs using alternative fuels should still be permitted beyond 2035 (Section 3.2.2.2).

(2) For **HDVs**, the already higher degree of technology openness should still increase by similar **flexibilities** and perspectives. HDVs running on biofuels should also be supported (Section 3.2.2.2).

(3) EU legislation should ensure that the roll-out of **infrastructure for charging and refuelling** of all relevant alternative fuels anticipates and serves the needs (Section 3.2.1.3).

(4) In order to allow carbon pricing to shift TCO in favour of ZEVs, the **EU-ETS 2** should be politically safeguarded by full redistribution of ETS revenues by a **climate dividend** and hardship provisions. **Energy taxes** should be based mainly on GHG emissions (Section 3.2.1.1).

(5) **Supply and price risks on global markets for critical raw materials** should be managed by a smart diversification strategy, stable resource partnerships and a thriving domestic recycling economy (Section 3.2.2.4).

(6) The **EU's innovation capacity for mobility technologies** should be maintained through targeted R&D support and removal of barriers to their commercialisation (Section 3.2.3.1).

Options to Enable More Technology Openness

For **cars and vans**, to **increase substantially the level of technology openness** that would help in the transition in the EU and open up a future for ICEVs and hybrids produced in the EU for export markets (see Route 1), the following – partly complementary, partly alternative – **options** could be considered:

1. The EU could **modify the paths for percentage reductions of CO_2 tailpipe emissions** of new vehicles in the **CO_2 emission standards** and provide some relief to the EU automotive industry:

(A1) **Postponement** of the 100% reduction target for fleet emissions of **cars and vans** to 2040 and establishment of lowered targets before

This would maintain technological openness for a few years longer, allowing for a market-driven transition and ensuring that enabling conditions can be advanced at a more realistic pace until 2040. With an average life of about 12 years, most cars will be ZLEV by 2050.

(B1) **Relaxed targets**: Relaxing the CO_2 emissions reduction targets for 2035 and before

Relaxing the EU fleet-wide CO_2 emission target in 2035 to less than 100% would remove the factual ICE ban for newly registered cars and vans in the EU and ensure technology openness beyond 2035. It should be accompanied by relaxed earlier targets to enable a more market-driven transition. The remaining emissions would then have to be reduced via the EU-ETS 2.

(C) **Carbon Correction Factor**: Relaxed reduction targets dependent on alternative fuels supply

The EU fleet-wide CO_2 emission target could be relaxed each year to the extent that sales of alternative fuels have increased and thereby have brought about additional decarbonisation.

(D) **Conditional relaxation of reduction target** when enabling conditions are not fulfilled

This option links the obligations of carmakers to the implementation progress of enabling conditions: If an assessment of the progress made on prerequisites for target feasibility, such as the infrastructure for charging and refuelling, shows that progress has been insufficient, the targets for car manufacturers will be reduced accordingly.

(E) **Postponement and subsequent freezing** of 2025 CO_2 emission targets

This option abandons the path to ever stricter CO_2 emission standards and maintains the postponed 2025 target values perpetually. Demand for efficient low emission vehicles will be generated by carbon prices in the EU-ETS 2 as TCO will change in their favour. Overall, it is guaranteed that road transport CO_2 emissions will be reduced to zero by the decreasing cap on allowances of the EU ETS 2.

2. If the EU does not want to modify target values in CO_2 emission standards, there are **options to establish more flexibility** for carmakers to comply with their specific CO_2 emission targets:

(F) **Phase-in:** During a transition phase, only a fraction of the fleet, e.g. 90%, is used to determine the average fleet emissions.

This does not imply weakening the decarbonisation objective, as all emissions are capped through the EU-ETS 2. The original reduction target remains unchanged in principle, as does the commitment to market ZEVs. Carmakers will be given some flexibility for the transition.

(G) **Banking and Borrowing:** Allow to carry forward and backward excess CO_2 reductions

In contrast to HDVs, for cars and vans there is no provision to carry forward excess CO_2 reductions by means of “emission credits” (“banking”) and to compensate for shortfalls by incurring “emission debts” (“borrowing”). Banking and borrowing can reduce the inefficiency of rigid CO_2 emission targets by giving individual manufacturers more flexibility to adapt to changing circumstances. This option should be already available for the 2025 targets.

3. Beyond the flexibilities in the transition, there are options to secure a strong home-market for **efficient ICEVs and hybrids suitable for the use of climate-neutral fuels** beyond 2035:

(H) **Type Approval** for vehicles running exclusively on alternative fuels

This option would serve the purpose of providing a home-market for ICEVs and hybrids running on alternative fuels including advanced biofuels.

(I1) **Hybrid Exemption** from ICE ban by banning only pure ICEVs by 2035

The factual ICE ban could be substituted with an explicit sales ban on pure ICEVs by 2035. Sales of PHEVs and specific types of hybrids suitable for alternative fuels would still be permitted in the EU – as they are also in China and in the US states following California’s rules.

For **HDVs**, the **options (C), (D), (E), (F) and (H) may also apply,** as well as following **modified options**:

(A2) **Postponement** of the 90% reduction target for fleet emissions of **HDVs** to 2045 and establishment of lowered targets before. Postponement of pure-electric quotas for urban buses.

(B2) **Lower target**: Relaxed emissions target for 2040 and lower targets before

(I2) Permission to **register hybrids beyond 2040**

It is essential to note that **neither of the described flexibility options would jeopardise the overall EU climate targets** since the **decreasing allowance cap** of the **EU-ETS 2 will effectively and safely bring about** the corresponding **CO_2 emission reductions**.

1 At Stake: A Decarbonised, Globally Competitive and Resilient EU Automotive Industry

With the European Climate Law[1], the European Union (EU) has committed itself to reducing its greenhouse gas (GHG) emissions to net zero until 2050 (**climate neutrality**) and by 55% until 2030 compared to 1990 levels (EU 2030 climate target). With regard to an interim target for 2040, the outgoing European Commission[2] as well as Ursula von der Leyen in her Political Guidelines for the next European Commission 2024-2029[3] have already recommended a GHG emissions reduction of 90% compared to 1990. Such a target would require further ambitious climate actions across all sectors of the economy for the period after 2030[4] which will be decided upon by the EU legislators in the near future. To achieve the already established ambitious **climate targets**, the EU has enacted extensive regulatory projects within the framework of the **European Green Deal**, most notably the **"Fit for 55" legislative package** of 2021[5]. A critical area for achieving the EU climate targets is **road transport**, which contributes significantly to GHG emissions (approx. 24% of total GHG emissions of the EU in 2022).[6] This includes, e.g., market-based instruments such as the introduction of emissions trading for transport and buildings, and specific obligations for the automotive industry in the form of rigid CO_2 emissions standards of new road vehicles, differentiated according to passenger cars and light commercial vehicles (vans) as well as heavy duty vehicles (HDVs: lorries and busses).

The EU aims to decarbonise[7] road transport by promoting cleaner fuels, electrification and sustainable mobility solutions. **Key strategies for the decarbonisation of motorised road transport** include:

- managing the transition to predominantly electric vehicles (EV) by strict CO_2 emission standards especially for new road vehicle fleets, and by encouraging the sale of electric cars, vans, lorries and buses in order to ultimately end tailpipe CO_2 emissions and the dependence on fossil fuels;
- investing in infrastructure by developing charging networks and supporting EV infrastructure.[8]

The **global impact** of these efforts extends beyond the EU, as (a) cleaner road transport contributes to a more sustainable planet, (b) advancements in vehicle technology can spread through exports benefitting customers all over the world, and (c) successful policies in the EU can inspire other countries to implement similar strategies for decarbonising their road transport.

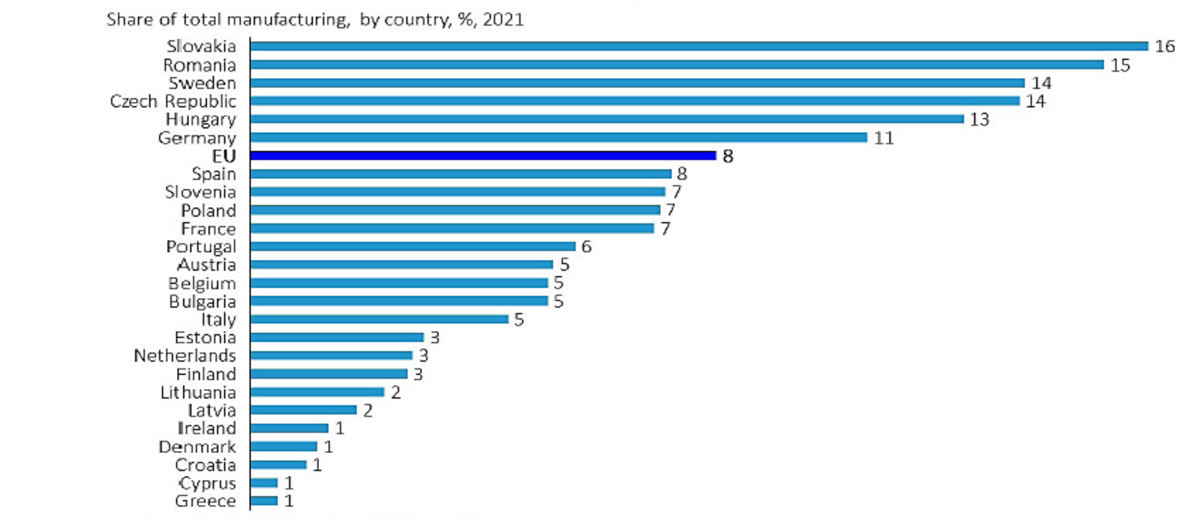
The transformation pursued by these EU climate policies can only be successful if it gains wide **societal acceptance** by being **environmentally effective**, **socially just** and by **preserving the prosperity and innovative strength of European economy**. As the recent **report on "The Future of European**

---

1 Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality ("European Climate Law"); see Menner, M. / Reichert, G. (2020), European Climate Law, cepPolicyBrief 03/2020.
2 European Commission (2024), Communication COM(2024) 63, Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society.
3 Ursula von der Leyen (2024), Europe's Choice – Political Guidelines for the Next European Commission 2024-2029, p. 8.
4 See, e.g., European Scientific Advisory Board for Climate Change – ESABCC (2023), Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030-2050.
5 European Commission (2023), Press Release of 9 October 2023, Commission welcomes completion of key 'Fit for 55' legislation, putting EU on track to exceed 2030 targets.
6 Eurostat (2024). Greenhouse gas emissions by source sector.
7 We use the term "decarbonise" in the broad sense of GHG emission reduction, allowing for emissions of previously captured CO_2.
8 European Commission (2020), Communication COM(2020) 789, Sustainable and Smart Mobility Strategy – putting European transport on track for the future; see Menner, M. / Reichert, G. (2021), Sustainable Mobility, cepPolicyBrief 09/2021.

Competitiveness" by Mario Draghi published in September 2024 (**Draghi Report**) states, "the 'European Green Deal' was premised on the creation of new green jobs, so its political sustainability could be endangered if decarbonisation leads instead to de-industrialisation in Europe – including of industries that can support the green transition".[9] In this respect, the stakes are particularly high for the European automotive industry which is a central cornerstone of industrial value chains in Europe. In many Member States of the EU the share of the automotive industry in total manufacturing is substantial – as illustrated in the following figure taken from the Draghi Report. [10]

Fig. 1: The Relevance of the Automotive Industry by EU Member State



Source: European Commission, 2024. Based on Eurostat, 2024.

The **far-reaching impact and relevance of the EU automotive industry** is particularly evident in its **employment effects**. According to industry estimates, about 2.4 million people were employed in the production of motor vehicles and its parts in the EU27 in 2021. When accounting for indirect job effects in upstream industries, trade, transport and manufacturing, the total employment contribution adds up to 12.9 million jobs, about 6.8% of total EU employment.[11] This relevance is also reflected in **trade** figures. In 2022, the EU automotive industry exported motor vehicles with a total value of EUR 171 billion to third countries, accounting for 7% of total EU merch.[12] Moreover, the sector is a key driver of **industrial innovation**. In 2021, it invested more than EUR 59 billion in Research and Development (R&D), almost a third of total R&D investments by European industries.[13]

Overall, the EU automotive industry has proven to be very competitive in the past. In general terms, **competitiveness** can be understood as the continued ability to make profits by meeting customer needs in a competitive global environment and in compliance with the relevant regulatory framework.[14]

9 Draghi, M. (2024), The Future of European Competitiveness – Part A | A competitiveness strategy for Europe (henceforth: Draghi Report – Part A), p. 33.
10 Draghi, M. (2024), The Future of European Competitiveness. Part B | In-depth analysis and recommendations (henceforth: Draghi Report – Part B), Figure 1, p. 141.
11 ACEA (2023), Automotive sector: Direct and indirect employment in the EU.
12 Eurostat (2024), Eurostat Database, EU trade since 1988 by HS2-4-6 and CN8.
13 ACEA (2023), R&D shares of industrial sectors in the European Union.
14 Definition based on Chikán, Attila, Erzsébet Czakó, Bence Kiss-Dobronyi, und Dávid Losonci. „Firm Competitiveness: A General Model and a Manufacturing Application". International Journal of Production Economics 243: 1-13. https://doi.org/10.1016/j.ijpe.2021.108316.

However, the ambitious **EU climate policy poses a challenge** to the established business model of the European automotive industry if the necessary **enabling conditions needed for the transformation** – e.g., a sufficient recharging and refuelling infrastructure, reliably increasing carbon prices, a higher contribution of alternative fuels to road transport decarbonisation, and the reduction of supply and price risks on global markets for critical raw materials – are not in place.

The EU recognises in principle that a thriving and globally competitive automotive industry is also essential for overall economic growth, innovation, and job creation in the EU. In this respect, the European Commission sees in the transformation of road transport towards climate neutrality "great opportunities" for the European industry "to modernise, create high-quality jobs, develop new products and services, strengthen competitiveness and pursue global leadership as other markets are moving fast towards zero-emission mobility".[15]

To foster global competitiveness and resilience of the EU automotive industry, the EU focuses on:

- supporting research and innovation (R&I) in batteries and fuel cells[16];
- investing in skilled labour and fostering a workforce capable of driving innovation[17];
- reducing strategic dependencies on key technologies, securing access to third country markets[18].

However, it is increasingly becoming apparent that the ongoing transformation of the EU automotive industry with its own ambitious decarbonisation goals is facing serious challenges especially with regard to its competitiveness. In this respect, the **Draghi Report** is ringing the alarm bells. It finds that the "**EU's position in the [global automotive] sector already shows signs of eroding competitiveness**"[19], and concludes that "[if the EU is not able to rapidly adjust to this new competitive environment, the automotive sector may lose ground at an even faster pace. According to some industry experts, even more than 10% of local EU production may be displaced in the following five years."[20]

There are signs that political decision-makers are increasingly becoming aware of the critical situation and bleak outlook for the European economy in general and the automotive industry in particular. In her **Political Guidelines for the next European Commission 2024-2029**[21] of 18 July 2024, **Ursula von der Leyen** put a **triad of criteria** for a ***decarbonised*, *competitive* and *resilient* European economy** at the centre of her proposal for a **"Clean Industrial Plan"**. While she stressed that the EU "must and will stay the course on the goals set out in the European Green Deal", she also highlighted the "equally urgent **need to decarbonise and industrialise our economy at the same time**."[22] She admitted that "there are still **too many structural brakes on our competitiveness**. Our companies operate in a turbulent world, with more unfair competition, higher energy prices, skills and labour shortages…".[23]

[15] European Commission (2020), Communication COM(2020) 789, Sustainable and Smart Mobility Strategy – putting European transport on track for the future, p. 1.
[16] Id.
[17] European Commission (2020), Commission presents European Skills Agenda for sustainable competitiveness, social fairness and resilience.
[18] European Commission (2022), Staff Working Document SWD (2022) 16, For a resilient, innovative, sustainable and digital mobility ecosystem.
[19] Draghi Report – Part B, pp. 144 et seq.
[20] Id., p. 151.
[21] Ursula von der Leyen (2024), Europe's Choice – Political Guidelines for the Next European Commission 2024-2029.
[22] Id., p. 8.
[23] Id., p. 6.

To overcome these obstacles, the EU needs “a new Clean Industrial Deal for competitive industries and quality jobs. […] Our full focus will be on supporting and creating the **right conditions for companies to reach our common goals**.”[24] This means, *inter alia*, “simplifying, investing and ensuring access to cheap, sustainable and secure energy supplies and raw materials.” In this respect, the EU must make its economy “**more resilient** and less dependent.”[25]

A thriving and globally competitive European automotive industry is essential for overall economic growth, innovation, and job creation in the EU. It is currently undergoing a fundamental transition to e-mobility and zero-emission vehicles (ZEVs), with its own ambitious decarbonisation goals a growing number of new models being launched on the market every year.

To ensure that CO_2 emission standards for their new vehicle fleets and their own decarbonisation goals **are met**, manufacturers must be **competitive** and have adequate **enabling conditions for the transformation** in place – such as sufficient recharging and refuelling infrastructure, upgraded electricity grids, effective CO_2 prices and low electricity and raw material costs.

However, in terms of both its competitiveness and these enabling conditions for the transformation, the **automotive industry is dependent on other economic players** – like electricity and fuel suppliers – and ultimately on the appropriateness of of the overall EU legislation.

Given the EU automotive industry’s significance for the entire European economy and the serious challenges its transformation is faced with, it is indeed necessary at this very point in time to analyse the effectiveness and consistency of the multi-faceted regulatory approach set forth especially in the “Fit for 55” legislative framework. Especially in respect of the upcoming reviews of essential elements of this legislation, this study aims to make a scientific contribution to the ongoing discussions.

Due to the industry’s global outreach, such an investigation cannot be limited to the domestic environment of the EU internal market, but must consider the **role of global markets and framework conditions**. This is especially true given the unpredictable way in which these conditions have changed in recent years, especially since the start of the war in Ukraine.

From a societal perspective, the benchmark of any investigation must be an environmentally effective and also an efficient, cost-minimising – and therefore socially acceptable and competitiveness preserving – adaptation path towards climate neutrality.

Therefore, this study conducts such an analysis, focusing on the **adequacy of EU rules in the context of changing global framework conditions**. Its main message is that, in order to contribute to a both effective and also cost-minimising path towards climate neutrality, **the European automotive sector of the future must indeed at the same time be decarbonised, globally competitive and resilient**. If one of these interdependent and mutually reinforcing criteria is not fulfilled, the entire transformation is at stake.

[24] Id., p. 8.
[25] Id., p. 9.

2 At the Test Bench: Does the EU Regulatory Framework Measure Up to the Challenges?

2.1 At Home: Risks to Decarbonisation and Competitiveness in the EU

The EU climate policies of the European Green Deal and its Fit-for-55 legislation are mainly targeted to the GHG emissions attributable to the EU by either production in the EU internal market or to imports into the EU. As part of this decarbonisation agenda, the EU wants to ensure a level playing field within the EU internal market between domestic producers and producers of goods imported to the EU. A considerable number of EU legal acts aim to address different factors necessary for the decarbonisation of the road transport sector.

2.1.1 Status Quo of EU Regulatory Framework

The main building blocks of the overall architecture of EU climate policy with relevance for the European automotive industry are the EU Emissions Trading Directive [EU-ETS, 2003/87/EC][26] and the Effort Sharing Regulation [ESR, (EU) 2018/842][27]. Under **EU-ETS Directive**, the EU aims to reduce its GHG emissions caused by energy generation, energy-intensive industries, aviation and maritime transport by 62% by 2030 compared to 2005 through its established emission trading system (**EU-ETS 1**). As of 2027, the new emissions trading system for fuel combustion in road transport, buildings and additional sectors (**EU-ETS 2**) is designed to price GHG emissions to contribute to 42% emission reductions by 2030 compared to 2005. The **Effort Sharing Regulation** not only sets an EU-wide emission reduction target of 40% by 2030 compared to 2005 for domestic transport, buildings, agriculture, waste and small industries, but also legally binding reduction targets for each EU Member State, ranging from 10% for Bulgaria to 50% for Germany.

These core targets and provisions are **complemented by various specific legal acts** which pursue different approaches and regulate, for example, the promotion of **renewable energy**[28] and **energy efficiency** in different sectors[29]. In particular, **sector-specific provisions** such as CO_2 emission standards for new passenger cars and light commercial vehicles (vans) as well as for heavy-duty vehicles (HDVs: lorries and buses) have been set.

In this very context, the Draghi Report criticises that "the technological neutrality principle, which has been a guiding principle of EU legislation, has not always been applied in the automotive sector."[30] At least with regard to the legal requirements for cars and vans, the EU's overall approach in essence strives for a factual ban of new vehicles with an internal combustion engine (ICE)[31] and the transition to a new fleet of battery electric vehicles (BEVs) and – to a small extent – to electric vehicles powered

26 Directive (EU) 2023/959 amending Directive 2003/87/EC establishing a system for GHG emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union GHG emission trading system; Regulation (EU) 2023/957 amending Regulation (EU) 2015/757 in order to provide for the inclusion of maritime transport activities in the EU Emissions Trading System and for the monitoring, reporting and verification of emissions of additional GHG and emissions from additional ship types.

27 Regulation (EU) 2023/857 amending Regulation (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999.

28 Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

29 Directive (EU) 2023/1791 on energy efficiency and amending Regulation (EU) 2023/955 (recast).

30 Draghi Report – Part B, p. 146.

31 Draghi Report – Part B, p. 146 et seq.

by fuel cells (FCEVs). Despite claims that the CO_2 emissions standards for **cars and vans** are "technology neutral"[32], they in essence represent a *de facto* "**pure-electric strategy**".[33]

The strategy for **HDVs** is more flexible –it explicitly counts H_2 combustion engine vehicles as ZEVs and leaves some room for ICEVs due to the mere 90% reduction target in 2040. Nonetheless, the vast majority of HDVs will likely turn out to be electric to fulfil the ambitious final reduction targets since HDVs running on biofuels do not count towards the reduction target and green H_2 might result to be expansive and scarce in the medium term. Hence, it might be considered as an **"electric-centred" strategy**.

2.1.1.1 CO_2 Emissions Standards for Cars and Vans

In order to contribute to achieving the **EU's climate target of reducing its GHG emissions**, as laid down in the Effort Sharing Regulation (EU) 2018/842[34], and the objectives of the Paris Agreement, Regulation (EU) 2019/631[35] established **CO_2 emissions requirements for new passenger cars and for new light commercial vehicles (vans)** from 2020 onwards.[36] In the context of the European Green Deal and the Fit for 55 reforms of the EU's energy and climate acquis, Regulation (EU) 2019/631 was amended in 2023[37] especially by tightening the CO_2 emission standards for new passenger cars and vans applying from 2030 and setting a 100% emission reduction target for both of them from 2035 onwards in order to make a contribution to the EU's climate targets of reaching at least 55% net GHG emission reductions by 2030 compared to 1990 as well as climate neutrality by 2050, in line with the "European Climate Law"[38]. In addition to contributing to the achievement of the **EU climate targets**, the 2023 amendments were also justified by the EU legislators with the expectation that more ambitious CO_2 emission standards for passenger cars and vans would "accelerate the **uptake of zero-emission vehicles (ZEVs)**, increase their affordability and also accelerate the decarbonisation of the second-hand market in all segments, with greater benefits for low- and middle-income consumers"[39], e.g. "in terms of air quality, strengthening energy security and efficiency, and the associated energy savings"[40]. Furthermore, the EU legislators emphasised that the tightened CO_2 emissions reduction requirements should also ensure "that **innovation in the automotive value chain** can be maintained"[41]. Within the

---

32 Regulation (EU) 2023/851, recital 10.

33 European Commission (2021), SWD(2021) 613 Impact Assessment Part 1 Accompanying the Proposal for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, Table 4, p. 34. See below Section 3.2.2.2.

34 Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.

35 Regulation (EU) 2019/631 setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles; European Commission (2021), Proposal COM(2021) 556 for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition; see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.

36 Regulation (EU) 2019/631, Art. 1(1).

37 Regulation (EU) 2023/851 amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition; European Commission (2021), Proposal COM(2021) 551 for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition; see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.

38 Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality ("European Climate Law"); see Menner, M. / Reichert, G. (2020), European Climate Law, cepPolicyBrief 03/2020.

39 Regulation (EU) 2023/851, recital 7.

40 Regulation (EU) 2023/851, recital 10.

41 Regulation (EU) 2023/851, recital 10.

global context, the EU automotive value chain "must be a **leading actor in the ongoing transition towards zero-emission mobility**"[42]. Therefore, the new CO_2 emissions reduction targets from 2030 onwards were set at a level in order to "deliver a strong signal to accelerate the uptake of zero-emission vehicles" on the EU internal market and "to stimulate innovation in zero-emission technologies in a cost-efficient way".[43]

Regulation (EU) 2023/851, which amended Regulation (EU) 2019/631, claims in its recitals[44] that the "strengthened CO_2 emissions reduction standards are **technology neutral** in reaching the fleet-wide targets that they set." Accordingly, "**[d]ifferent technologies are and remain available to reach the zero-emission fleet-wide target**. Zero-emission vehicles currently include battery electric vehicles, fuel-cell and other hydrogen (H_2) powered vehicles, and technological innovations are continuing. Zero- and low-emission vehicles, which also include well performing plug-in hybrid electric vehicles, can continue to play a role in the transition pathway."

Following an intensive discussion on the future role of e-fuels and a last-minute intervention of the German Transportation Minister Volker Wissing[45], a legally non-binding recital was included the final text of Regulation (EU) 2023/851, stating that "the Commission will make a proposal for registering after 2035 vehicles running exclusively on climate-neutral fuels in conformity with Union law, outside the scope of the fleet standards, and in conformity with the Union's climate neutrality objective".[46] In this respect, Ursula von der Leyen in her Political Guidelines for the next European Commission 2024-2029 of 18 July 2024[47] as well as in her Mission Letter of 17 September 2024 to Wopke Hoekstra, Commissioner-designate for EU climate policy, announced that to reach "the 2035 climate neutrality for cars [… requires] a technology-neutral approach, in which e-fuels have a role to play through a targeted amendment of the regulation setting CO_2 emission performance standards for cars and vans planned, as part of the foreseen review".[48]

From 2020, Regulation (EU) 2019/631 sets the **EU fleet-wide targets**[49] of 95 g CO_2/km for the average emissions of new passenger cars and of 147 g CO_2/km for the average emissions of vans registered in the EU[50], based on the emission test procedure NEDC (New European Driving Cycle). The new EU fleet wide targets that will apply from 2025, which are based on the WLTP (Worldwide Harmonized Light Vehicles Test Procedure), are set for cars for the period 2025-2029 at 93.6 g CO_2/km (15% CO_2 emission reduction compared to 2021) and for 2030-2034 at 49.5 g CO_2/km (55% reduction).

For vans the targets are set for 2025-2029 a 153.9 g CO_2/km (15% reduction) and for 2030-2034 at 90.6 g CO_2/km (50% reduction).[51]

---

42 Regulation (EU) 2023/851, recital 10.
43 Regulation (EU) 2023/851, recital 12.
44 Regulation (EU) 2023/851, recital 10.
45 See, e.g., Posaner, J. (2023, Brussels and Berlin strike deal on 2035 combustion-engine ban, Politico of 25 March 2023,
46 Regulation (EU) 2023/851, recital 11.
47 Ursula von der Leyen (2024), Europe's Choice – Political Guidelines for the Next European Commission 2024-2029, p. 9.
48 Ursula von der Leyen (2024), Mission Letter to Wopke Hoekstra, Commissioner-designate for Climate, Net Zero and Clean Growth, p. 6.
49 Regulation (EU) 2019/631, Art. 3(1)(k): "EU fleet-wide target" means the average CO_2 emissions of all new passenger cars or vans to be achieved in a given period.
50 Regulation (EU) 2019/631, Art. 1(2).
51 Regulation (EU) 2019/631, Art. 1(4)-(5) in conjunction with Commission Implementing Decision (EU) 2023/1623.

From **2035** onwards**, the EU fleet-wide CO_2 emission target for both cars and vans** is set at a **100% reduction of CO_2 emissions**.[52]

The **annual specific CO_2 emission targets for each manufacturer**[53] for the years 2021-2024[54] and 2025 onwards[55] are based on these EU fleet-wide targets, the average mass of the manufacturer's registered new vehicles and the WLTP. Different manufacturers can act jointly to meet their emissions target by **pooling**.[56]

To incentivise the uptake of zero and low emission vehicles (ZLEVs)[57] with emissions between 0 and 50 g CO_2/km, for car and van manufacturers a ZLEV crediting system will apply in the period 2025-2029. This **ZLEV incentive mechanism** will alleviate a manufacturer's specific CO_2 emission target if its share of new ZLEV registered in a given year exceeds the benchmarks of 25% for cars and 17% for vans.[58] Accordingly, one percentage point exceedance of the ZLEV benchmark will increase the manufacturer's CO_2 target by one percent. However, the alleviation of the emission target will be capped at maximum 5%.

To promote the development of new and advanced technologies reducing CO_2 emissions, manufacturers may obtain **emission credits** for cars and vans which are equipped with innovative technologies (**eco-innovations**) whose full CO_2 savings are impossible to demonstrate during their type-approval.[59] The manufacturer must demonstrate these savings based on independently verified data. The maximum emission credits for these eco-innovations per manufacturer are 7 g CO_2/km per year until 2024, 6 g CO_2/km from 2025 to 2029, and 4 g CO_2/km from 2030 to 2034. As of 2025, the efficiency improvements for air conditioning systems will become eligible as eco-innovations.

If the average CO_2 emissions of a manufacturer's fleet exceeds its specific emission target in a given year, the manufacturer must pay for each of its new vehicles registered in that year an **excess CO_2 emissions premium** of EUR 95 per g/km.[60]

Regulation (EU) 2019/631 itself explicitly obliges the European Commission to **review in 2026** "the effectiveness and impact of this Regulation" and report its results to the European Parliament and to the Council.[61] In particular, the European Commission must assess "progress made under this Regulation towards achieving the reduction targets […], taking into account the technological developments, including as regards plug-in hybrid technologies, and the importance of an economically viable and socially fair transition towards zero-emission mobility." Based on that assessment, the European Commission must assess "the need to review the targets" and also "the impacts of establishing minimum energy efficiency thresholds for new zero-emission passenger cars and light commercial vehicles". If

52 Regulation (EU) 2019/631, Art. 1(5a).
53 Regulation (EU) 2019/631, Art. 4 and Art. 3(1)(a): "Average specific emissions of CO_2" means, in relation to a manufacturer, the average of the specific emissions of CO_2 of all new passenger cars or of all new vans of which it is the manufacturer.
54 Regulation (EU) 2019/631, Annex I, parts A and B, point 4, using the values set out in Commission Implementing Decision (EU) 2022/2087, Annex II.
55 Regulation (EU) 2019/631, Annex I, parts A and B, point 6, using the values set out in Commission Implementing Decision (EU) 2023/1623, Annex II.
56 Regulation (EU) 2019/631, Art. 6.
57 Regulation (EU) 2019/631, Art. 3(1)(m): "Zero- and low-emission vehicle" means a passenger car or a van with tailpipe emissions from zero up to 50 g CO_2/km, as determined in accordance with Regulation (EU) 2017/1151.
58 Regulation (EU) 2019/631, Art. 1(6) in conjunction with Annex I, Parts A and B, points 6.3.
59 Regulation (EU) 2019/631, Art. 11.
60 Regulation (EU) 2019/631, Art. 8.
61 Regulation (EU) 2019/631, Art. 15(1).

the European Commission arrives at the conclusion that changes should be made, its report "shall, where appropriate, be accompanied by a proposal to amend" Regulation (EU) 2019/631.

2.1.1.2 CO_2 Emissions Standards for Lorries and Buses

The EU legislators also amended **Regulation (EU) 2019/1242** setting tighter **CO_2 emissions standards for new heavy-duty vehicles (HDVs: lorries and buses).**[62] These are intended to make a contribution to achieving the EU 2030 climate target and climate neutrality by 2050 by increasing the share of zero-emission vehicles in the HDV fleet, while ensuring that innovation in and the competitiveness of the sector are preserved and enhanced.[63] The scope of the existing Regulation is expanded to make almost all new HDVs with certified CO_2 emissions – including smaller lorries, urban buses, coaches and trailers – subject to emission reduction targets.[64]

Accordingly, CO_2 emissions from **lorries and buses** will have to be reduced – compared to the average CO_2 emissions of the reporting period of 2019 – in the period 2025-2029 by 15%, in the period 2030-2034 by 45%, in the period 2035-2039 by 65% and in the periods 2040 onwards by 90%.[65] Manufacturers of **urban buses** must ensure in their fleet of new vehicles a minimum share of zero-emission urban buses of 90% by 2030 and of 100% by 2035.[66]

The **average specific CO_2 emissions**[67] of each manufacturer in each reporting period are determined for the preceding reporting period based on the data reported for the manufacturer's new HDVs registered in the preceding reporting period, a zero- and low-emission factor[68] and in the reporting period 2030-2034, new zero-emission vocational vehicles.[69] To incentivise the uptake of **zero-**[70] **and low-emission**[71] **HDVs**, until 2029 the **zero- and low-emission factor** can reduce the average specific CO_2 emissions of a manufacturer by a maximum of 3%.[72] The zero- and low-emission factor shall take into account the number and the CO_2 emissions of all zero- and low-emission lorries in the manufacturer's fleet.[73] For the reporting periods 2025-2029, the zero- and low-emission factor shall be determined on

[62] Regulation (EU) 2024/1610 amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, amending Regulation (EU) 2018/858 and repealing Regulation (EU) 2018/956; European Commission (2023), Proposal COM(2023) 88 for a Regulation amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations; see Menner, M. / Reichert, G. (2023), CO_2 Emission Targets for Lorries, Vans and Buses, cepPolicyBrief 13/2023.

[63] Regulation (EU) 2019/1242, Article 1. See also, e.g. Council of the EU, Press Release of 13 May 2024, Heavy-duty vehicles: Council signs off on stricter CO_2 emission standards; European Parliament, Press Release of 10 April 2024, MEPs adopt stricter CO_2 emissions targets for trucks and buses.

[64] Regulation (EU) 2019/1242, Art. 2.

[65] Regulation (EU) 2019/1242, Art. 3a.

[66] Regulation (EU) 2019/1242, Art. 3d.

[67] Regulation (EU) 2019/1242, Art. 3(4): "average specific CO_2 emissions" means the average of the specific CO_2 emissions of a manufacturer's new HDVs in a given reporting period.

[68] Regulation (EU) 2019/1242, Art. 5.

[69] Regulation (EU) 2019/1242, Art. 4.

[70] Regulation (EU) 2019/1242, Art. 3(11): "zero-emission heavy-duty vehicle" means (a) a heavy-duty motor vehicle without an internal combustion engine, or with an internal combustion engine that emits not more than 3 g CO_2/(tkm) or 1 g CO_2/(pkm); (b) a heavy-duty motor vehicle without an internal combustion engine, or with an internal combustion engine that emits not more than 1 g/kWh of CO_2 or not more than 1 g/km of CO_2; (c) a trailer equipped with a device that actively supports its propulsion, and that has no internal combustion engine or has an internal combustion engine that emits less than 1 g CO_2/kWh.

[71] Regulation (EU) 2019/1242, Art. 3(12): "low-emission heavy-duty vehicle" means an HDV, other than a zero-emission HDV, with specific CO_2 emissions of less than half of the reference CO_2 emissions of all vehicles in the vehicle sub-group to which the HDV belongs.

[72] Regulation (EU) 2019/1242, Art. 5(4).

[73] Regulation (EU) 2019/1242, Art. 5(1).

the basis of a 2% benchmark.[74] As of 2025 onwards, the European Commission determines for each manufacturer a **specific CO_2 emissions target** for the preceding reporting period.[75] For the purpose of calculating the average specific CO_2 emissions of manufacturers, individual heavy-duty vehicles may be transferred between manufacturers.[76] For the purpose of determining a manufacturer's compliance with its specific CO_2 emissions targets in the reporting periods between 2025 and 2039, its **emission credits** or **emission debts** will be taken into account.[77] These correspond to the number of new HDVs of the manufacturer in a reporting period, multiplied by (a) the difference between the CO_2 emissions reduction trajectory[78] and the average specific CO_2 emissions of that manufacturer, if that difference is positive (**"emission credits"**; "banking"); or (b) the difference between the average specific CO_2 emissions and the specific CO_2 emissions target of that manufacturer, if that difference is positive (**"emission debts"**; "borrowing"). Emission credits and emission debts acquired in the reporting periods between 2025 and 2039 will be carried over from one reporting period to the next. However, any remaining emission debts shall be cleared in the reporting periods of the years 2029, 2034 and 2039. Emission credits shall be taken into account for the purpose of determining the manufacturer's compliance with its specific CO_2 emissions target only in any of the reporting periods of the seven years that follow the reporting period during which they have been acquired.[79] In case a manufacturer is found to be in **non-compliance** by having excess CO_2 emissions in a given reporting period from 2025 onwards, the European Commission will impose an **excess CO_2 emissions premium**, calculated according to the following formula: excess CO_2 emissions × 4.250 EUR/gCO_2/tkm.[80]

2.1.1.3 Euro-7 Norms for Emissions of Cars, Vans, Lorries and Buses

In April 2024, the EU legislators adopted the **Regulation (EU) 2024/1257 on type-approval of motor vehicles with respect to their emissions and battery durability (Euro 7)**.[81] For the first time, the new Euro 7 Regulation covers cars, vans and heavy-duty vehicles – lorries and buses – in one single legal act.[82] It establishes rules for the exhaust emissions of air pollutants by road vehicles, but also for other types of emissions such as tyre abrasion and brake particle emissions.[83] It also introduces requirements for battery durability.[84] For **cars and vans**, the Euro 7 Regulation keeps the existing Euro 6 exhaust emission limits – also in view of the positive effect of the expected uptake of EVs with no exhaust emissions on air quality[85] – but introduces stricter requirements for solid particles. Accordingly, the number of exhaust particles will be measured at the level of PN_{10} instead of PN_{23}. For **lorries and buses**, the regulation imposes more stringent limits for exhaust emissions measured in laboratories (e.g. NO_X limit of 200mg/kWh) and in real driving conditions (e.g. NO_X limit of 260 mg/kWh), while maintaining the current Euro VI testing conditions. In addition, Euro 7 introduces new strict **limits for particle**

74 Regulation (EU) 2019/1242, Art. 5(3) in conjunction with Annex I, point 2.3.2.
75 Regulation (EU) 2019/1242, Art. 6 in conjunction with Annex I, point 4.1.
76 Regulation (EU) 2019/1242, Art. 6a in conjunction with Article 4 and Annex I, point 2.2.
77 Regulation (EU) 2019/1242, Art. 7 in conjunction with Annex I, point 5.
78 Regulation (EU) 2019/1242, Art. 7(2).
79 Regulation (EU) 2019/1242, Art. 7(1).
80 Regulation (EU) 2019/1242, Art. 8.
81 Regulation (EU) 2024/1257 on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7); European Commission (2022), Proposal COM(2022) 586 for a Regulation on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability (Euro 7); see Menner, M. / Reichert, G. (2023), Euro 7 Emission Standards for Motor Vehicles, cepPolicyBrief 05/2023.
82 Regulation (EU) 2024/1257, Art. 2.
83 Regulation (EU) 2024/1257, Annex I.
84 Regulation (EU) 2024/1257, Annex II.
85 See Menner, M. / Reichert, G. (2023), Euro 7 Emission Standards for Motor Vehicles, cepPolicyBrief 05/2023.

emissions produced when braking. Accordingly, its sets brake particles emissions limits (PM_{10}) for cars and vans (3mg/km for pure electric vehicles; 7mg/km for most internal combustion engine ICE, hybrid electric and fuel cell vehicles and 11mg/km for large ICE vans).

2.1.1.4 Promotion of Renewable Energy (RED III)

As part of the Fit for 55 reforms of the EU's energy and climate acquis, **Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources** was amended in 2023 (**RED III**).[86] It regulates the promotion of energy from renewable sources across the different sectors. To this end, RED III sets a binding target for the share of renewable energy in the EU's overall final energy consumption of 42.5% by 2030, with an additional 2.5% indicative top-up for achieving a target of 45%.[87] RED III includes, *inter alia*, rules on financial support for electricity from renewable sources, on accelerated permit procedures for renewable energy projects, and on **flexibility provided by electric vehicles and batteries to the energy system** by feeding renewable electricity into the grid when needed[88].

Furthermore, RED III sets rules for the use of renewables in the electricity, industrial, heating and cooling, and in the transport sector. For the **transport sector**, Member States must set an **obligation on fuel suppliers** to ensure that the **amount of renewable fuels and renewable electricity supplied to the transport sector** leads to either a **share of renewable energy within the final consumption of energy in the transport sector of at least 29% by 2030**, or to a **reduction of GHG intensity of at least 14.5% by 2030**, compared to specific baseline[89] and in accordance with an indicative trajectory set by the Member State.[90] Accordingly, feedstocks are divided into two categories: Feedstocks listed in Part A of Annex IX Directive (EU) 2018/2001 ("advanced biofuels") can contribute unlimitedly to the fulfilment of the obligation of fuel suppliers, whereas the share of biofuels and biogas produced from the feedstock listed in Part B of Annex IX ("mature biofuels") in the energy content of fuels and electricity supplied to the transport sector is limited to 1.7%.[91] Intermediate crops, such as catch crops and cover crops, as well as crops grown on severely degraded land, except food and feed crops, belong to advanced biofuels only when destined for aviation fuels.[92] The contribution of crop-based biofuels is capped at the 2020 Member State levels, with a maximum share of 7% of the final consumption of energy in transport.[93]

In addition, Member States must set an **obligation on fuel suppliers** to ensure that the **combined share of advanced biofuels and biogas** produced from the feedstock listed in Part A of Annex IX[94] and of **renewable fuels of non-biological origin (RFNBO)** in the energy supplied to the transport sector is **at least 1% in 2025 and 5.5% in 2030**, of which a share of at least 1 percentage point is from RFNBO in

---

[86] Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (recast); European Commission (2021), Proposal COM(2021) 557 for a Directive amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652; Schwind, S. / Reichert, G. (2022), Fit for 55: Renewable Energies, cepPolicyBrief 01/2022.

[87] Directive (EU) 2018/2001, Art. 3(1).

[88] Directive (EU) 2018/2001, Art. 20a.

[89] Directive (EU) 2018/2001, Art. 27(1)(b).

[90] Directive (EU) 2018/2001, Art. 25(1)(a).

[91] Directive (EU) 2018/2001, Art. 27(1)(c)(iv) in conjunction with Annex IX. European Court of Auditors (2023), Special Report 29/2023: The EU's support for sustainable biofuels in transport.

[92] Directive (EU) 2018/2001, Annex IX.

[93] Directive (EU) 2018/2001, Art. 26(1).

[94] Directive (EU) 2018/2001, Annex IX, Part A.

2030.[95] “RFNBO” encompass renewable liquid and gaseous fuels of non-biological origin[96], meaning that these fuels are produced from renewable energy sources other than biomass. Therefore, **renewable hydrogen** produced by feeding renewables-based electricity into an electrolyser is an RFNBO. At the same time **e-fuels** – e.g. **synthetic ammonia, e-methane, e-methanol, e-gasoline, e-diesel or e-kerosene** – are considered RFNBOs when **produced from renewable hydrogen**.

Overall, RED III leaves considerable leeway to the Member States for the design of specific measures for the implementation, e.g., of the obligations on fuel suppliers regarding the amount of renewable fuels and renewable electricity as well as the share of advanced biofuels, biogas and RFNBO in the energy supplied to the transport sector. **Furthermore, no obligations are set in this respect beyond 2030.** Consequently, it would then be up to the EU-ETS 2 to provide incentives for further reductions in the GHG content of fuels, provided that its price signal is strong enough (see below Section 2.1.1.8).

2.1.1.5 Alternative Fuels Infrastructure Regulation (AFIR)

As part of the Fit for 55 reforms of the EU’s energy and climate acquis, the EU enacted the new **Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure (AFIR)** which repeals Directive 2014/94/EU and is applicable as of 13 April 2024[97]. To achieve the EU’s climate targets, AFIR establishes mandatory national targets with the objective of deploying sufficient publicly accessible infrastructure for alternative fuels – especially electricity and H_2 – to support the uptake of alternative fuel vehicles across all transport modes (road vehicles, trains, vessels and stationary aircraft).[98]

With regards to the **recharging infrastructure for electric cars and vans (light-duty vehicles)**, the EU Member States must ensure that publicly accessible recharging stations are set up in proportion to the number of registered vehicles and that they provide sufficient power output for those vehicles. To that end, Member States must ensure that starting from 2024 for each light-duty battery electric vehicle registered in their territory, a total power output of at least 1.3 kilowatts (kW) and for each light-duty plug-in hybrid vehicle registered in their territory, a total power output of at least 0.80 kW is provided through publicly accessible recharging stations.[99]

Furthermore, the Member States must ensure a minimum coverage of publicly accessible recharging points dedicated to light-duty electric vehicles on the road network of the trans-European transport network (TEN-T) in their territory. To that end, they must achieve the following national targets:[100]

- By the end of 2025, one recharging pool with a power output of at least 400 kW (including at least one 150 kW recharging point) at least every 60 kilometres (km) on the TEN-T core network in each direction of travel; by the end of 2027, each pool must provide a power output of 600 kW and include at least two 150 kW recharging points.

---

95 Directive (EU) 2018/2001, Art. 25(1)(b).
96 Directive (EU) 2018/2001, Art. 2(36).
97 Directive 2014/94/EU on the deployment of alternative fuels infrastructure; European Commission (2021); European Commission (2021), Proposal COM(2021) 559 for a Regulation on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU; see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.
98 Regulation (EU) 2023/1804, Art. 1(1).
99 Regulation (EU) 2023/1804, Art. 3(1).
100 Regulation (EU) 2023/1804, Art. 3(4).

- By the end of 2027, on at least half of the TEN-T comprehensive network, each recharging pool must provide a power output of at least 300 kW and include at least one 150 kW recharging point, and over the entire length by the end of 2030.
- By the end of 2035, each recharging pool must offer at least 600 kW and include at least two 150 kW recharging points.

With regards to the **recharging infrastructure for HDVs**, Member States must ensure a minimum coverage of recharging points:[101]

- By the end of 2025, recharging pools must be installed along at least 15% of the TEN-T road network with a power output of at least 1400 kW and include at least one recharging point with a power output of at least 350 kW.
- By the end of 2027, recharging pools must be deployed on at least half of the TEN-T road network with a power output of at least 1400 kW (2800 kW along the core network), including at least one recharging point (two for the core network) of at least 350 kW.
- By the end of 2030, the power output must increase to at least 1500 kW on the TEN-T comprehensive network (100 km apart) and 3600 kW (60 km apart) on the TEN-T core network.
- By the end of 2027, each "safe and secure parking area" must be equipped with at least two publicly accessible recharging stations (rising to four charging stations by the end of 2030) that provide an individual power output of at least 100 kW.
- By the end of 2025, each urban node must have publicly accessible recharging points dedicated to HDVs with an aggregated power output of at least 900 kW (rising to 1800 kW by the end of 2030).

By the end of 2030, Member States must ensure that publicly accessible **hydrogen refuelling stations for road vehicles** with a total capacity of at least 1 tonne per day are deployed at least every 200 km along the TEN-T core network. At least one refuelling station must be deployed in each urban node.[102]

Until the end of 2024, Member States must ensure that an appropriate number of publicly accessible **refuelling points for liquefied methane for road transport** are set up, at least along the TEN-T core network, where there is demand, unless the costs are disproportionate to the benefits.[103]

2.1.1.6 Emissions Trading for Energy, Industry, Aviation, Maritime (EU-ETS 1)

Since 2005, the central cornerstone of the EU climate policy for the avoidance and reduction of GHG emissions has been the **EU Emissions Trading System (EU-ETS 1)**.[104] The EU-ETS 1 follows a **"cap and trade"** approach. It sets a cap on the maximum allowable GHG emissions from the sectors covered – energy production, energy-intensive industries, flights within the EU, maritime transport – by limiting

[101] Regulation (EU) 2023/1804, Art. 4(1).
[102] Regulation (EU) 2023/1804, Art. 6.
[103] Regulation (EU) 2023/1804, Art. 8.
[104] Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union. European Commission (2021), Proposal COM(2021) 551 for a Directive amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757; see Menner, M. / Reichert, G. (2022), Fit for 55: EU-Emission Trading Scheme (EU ETS I) for Industry and Energy, cepPolicyBrief 05/2022.

the amount of EU-ETS I emission allowances and lowering them annually by a linear reduction factor – 2024-2027: 4.3%, 2028 onwards: 4.4% – so that total GHG emissions are reduced gradually. EU-ETS I emission allowances are tradeable. In this way, the most cost-efficient GHG avoidance options are automatically identified by the market, thus reducing GHG emissions at the lowest cost. In the context of the "Fit for 55" reforms, the EU increased the EU-wide target for reducing GHG emission in sectors covered by the EU-ETS 1 in the period 2021-2030 by 62% compared to 2005 levels.

2.1.1.7 Carbon Border Adjustment Mechanism (CBAM)

As part of the "Fit for 55" reform of the EU-ETS 1, a **Carbon Border Adjustment Mechanism (CBAM)**[105] was introduced to tackle the problem of **carbon leakage**. The CBAM aims to ensure that the EU's efforts to reduce GHGs are not undermined, either by shifting production and the associated GHG emissions to third countries with less stringent climate protection requirements (carbon leakage) or by importing more carbon-intensive goods into the EU. In order to create a **"level playing field" in international competition** and thus prevent carbon leakage, the CBAM is intended to make the import of certain carbon-intensive goods containing embedded GHG emissions – cement, electricity, fertilisers, iron and steel, aluminium and hydrogen – from third countries with no or less ambitious climate protection requirements or corresponding CO_2 costs more expensive. The amount of the CBAM levy should correspond to the carbon price of EU-ETS 1 allowances. At the same time, existing measures to lower the risk of carbon leakage, namely the free allocation of allowances in EU-ETS 1, will be gradually phased out. Already, it has become apparent that the CBAM's implementation, which has already experienced a rocky start[106], raises numerous technical questions.[107]

2.1.1.8 Emissions Trading for Road Transport and Buildings (EU-ETS 2)

As part of the "Fit for 55" reform of the EU-ETS Directive, the EU established, as from 2027 or 2028, a **new separate emissions trading system (EU-ETS 2)**[108] to incentivise the reduction of GHG emissions from **fuels combusted in the road transport and buildings sectors**. Like the EU-ETS 1, the EU-ETS 2 is a cap-and-trade system. Unlike the EU-ETS 1, however, the EU-ETS 2 requires not the end consumers of fuels to hold emission allowances, but any natural or legal person liable to pay excise duties on energy, such as tax warehouses and fuel suppliers (**"upstream" emissions trading**).[109] Such regulated entities covered by the EU-ETS 2 must surrender allowances for their verified GHG emissions corresponding to the quantities of fuels they have released for consumption.[110] The allowances in EU-ETS 2 will not be fungible with allowances traded in the existing EU-ETS 1 and will be placed on the market only by auctioning, without any free allocation.[111]

[105] Regulation (EU) 2023/956 establishing a carbon border adjustment mechanism; European Commission (2021), Proposal COM(2021) 564 for a Regulation establishing a carbon border adjustment mechanism; see Menner, M. / Reichert, G. (2022), Fit for 55: EU-Emission Trading Scheme (EU ETS I) for Industry and Energy, cepPolicyBrief 05/2022; see also Jousseaume, M. / Menner, M. / Reichert, G. (2022), CBAM: Damaging to Climate Protection and EU Export Industries, cepStudy of 13 July 2021.

[106] European Commission (2024), News Article of 29 January 2024, Update: Technical issues related to the CBAM Transitional Registry and Import Control System 2 (ICS2).

[107] See, e.g., Abedinaj, D. (2023), RIFS, Three Challenges for the CBAM's Transitional Phase.

[108] Directive 2003/87/EC, Art. 30a et seq.; see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.

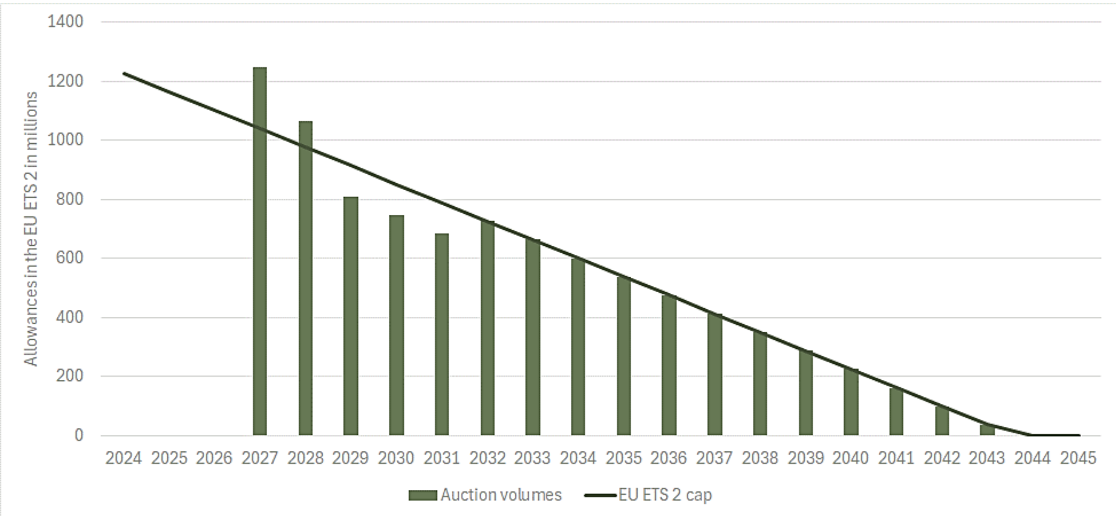
[109] Directive 2003/87/EC, Art. 30b in conjunction with Annex III.

[110] Directive 2003/87/EC, Art. 30e.

[111] Directive 2003/87/EC, Art. 30d.

The **total number of allowances issued in EU-ETS 2** will be reduced annually at its start by 5.10% and from 2028 onwards by 5.38% and **will reach zero by 2044** (see Fig. 2), **thereby guaranteeing that the road transport and heating sectors will emit no further CO_2 by burning fossil fuels**. While the price of allowances is generally determined by supply and demand, the ETS Directive contains safeguards to avoid "excessive" prices in certain circumstances. First, to avoid a disruptive increase of fuel prices at the start of the system, the auctioning of EU-ETS 2 allowances will start in 2027 with an amount corresponding to 130% of the auction volumes actually calculated for 2027. These 30% additional allowance will be deducted from the auction volumes calculated for the period 2029-2031 and may be auctioned until May 2028 (**"frontloading"**, see Fig. 2 for a possible scenario).[112] Second, a **"price cap" of EUR 45** applies until 2029 – corresponding to a carbon price of about EUR 0.13 per litre of gasoline or EUR 0.14 per litre of diesel. If this is reached, additional allowances will be released from the market stability reserve but only to a limited extent and, except in special exceptional cases, no more than twice a year. The European Commission will review the scheme and report by the end of 2029, including on whether the mechanism should be maintained. If necessary, it will propose an amendment to the ETS Directive.[113]

Fig. 2: Approximate Auction Volumes and Cap of EU-ETS 2 Allowances



Source: carboneer[114]

2.1.1.9 Energy Taxation Directive (ETD)

As an integral part of the "Fit For 55" legislative package of July 2021, the European Commission, put forward a proposal[115] to revise the **Energy Taxation Directive 2003/96/EC (ETD)**[116]. It aims at contributing to achieving the EU climate targets for 2030 and 2025 by taxing – and thereby pricing –energy sources more in line with their CO_2 emissions, to incentivise consumers to reduce their use of fossil forms of energy in general and of fuels and electricity for road transport in particular. Accordingly, fuels would be taxed according to their "energy content" and "environmental performance" rather

[112] Directive 2003/87/EC, Art. 30d.
[113] Directive 2003/87/EC, Art. 30h (2) and (5).
[114] Carboneer (2024), The EU ETS 2 – pricing emissions in buildings and road transport.
[115] European Commission (2021), Proposal COM(2021) 563 for a Council Directive restructuring the Union framework for the taxation of energy products and electricity (recast); see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.
[116] Council Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity.

than their volume. Consequently, fossil fuels such as gas oil and petrol would be taxed at the highest and electricity at the lowest rate.

However, the adoption of the proposal requires unanimity in the Council which has not been reached yet. In June 2024, the Belgian presidency concluded that the positions of the Member States remained divergent, requiring further work to reach an agreement.[117] Consequently, an essential element of the overall legislative framework for the decarbonisation of road transport is still missing (see also below Section 3.2.1.1).

2.1.1.10 Critical Raw Materials Act (CRMA)

The **Critical Raw Materials Act (CRMA)** of 11 April 2024[118] is likewise of high relevance for automotive supply chains. The CRMA identifies two sets of raw materials: 17 "strategic"[119] and 34 "critical" raw materials[120]. The focus is on prioritising investment projects related to raw materials classified as "strategic". This involves several raw materials with high relevance for the automotive sector such as lithium, cobalt and rare earth metals. For this high-priority group, ambitious domestic capacity targets are formulated for the year 2030, differentiating between raw material extraction (minimum 10% of annual domestic consumption), refinery (40%) and recycling (25%).[121] Moreover, the remaining imports shall be diversified based on the rule that in no processing stage any single third country accounts for more than 65% of annual domestic consumption.[122] Projects can be recognised as strategic projects if they make a significant contribution to the EU's security of supply of strategic raw materials[123] and fulfil further feasibility and sustainability criteria. This includes projects aimed at developing extraction, refining and recycling capacities within and outside the EU. An important supplement of the trilogue agreement is that also projects aiming for the production of suitable substitutes are apt to apply as strategic projects.

The national authorities must create single points of contact for the administrative approval processes for strategic projects.[124] Approval procedures for mining projects may take a maximum of 27 months and for pure refining or recycling projects a maximum of 15 months.[125] Strategic projects with funding difficulties can receive dedicated advice from the EU and Member States on how to access additional funding channels.[126] This includes existing EU funds. However, the regulation does not provide for any new specific EU raw materials funds to support strategic projects. To promote circularity for all critical raw materials, Member States shall also set up national programs that include measures to increase material efficiency, the collection, sorting and processing of waste and the use of secondary raw materials.[127] However, no new EU-wide incentive instruments for the development of a pan-European recycling infrastructure are planned.

[117] Council of the EU (2024), Ecofin report of 24 June 2024 to the European Council on tax issues, pp. 17 et seq.
[118] Regulation (EU) 2024/1252 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020.
[119] Regulation (EU) 2024/1252, Annex I.
[120] Regulation (EU) 2024/1252, Annex II.
[121] Regulation (EU) 2024/1252, Art. 5(1a).
[122] Regulation (EU) 2024/1252, Art. 5(1b).
[123] Regulation (EU) 2024/1252, Art. 6(1).
[124] Regulation (EU) 2024/1252, Art. 9.
[125] Regulation (EU) 2024/1252, Art. 11(1).
[126] Regulation (EU) 2024/1252, Art. 16.
[127] Regulation (EU) 2024/1252, Art. 26.

2.1.1.11 Net-Zero Industry Act (NZIA)

In 2024, the EU legislators adopted the **Net-Zero Industry Act (NZIA)**.[128] For the first time it defines concrete targets for the deployment of production capacities for net-zero technologies in the EU. By 2030, domestic manufacturing capacity for net-zero technologies shall reach a share of 40% of the annual deployment needs of the EU.[129] Moreover, by 2040, it shall account for 15% of the world market for the corresponding technologies.[130] Compared to the list of 8 strategic net-zero technologies proposed by the Commission, the final agreement foresees a more streamlined approach. It includes a unique list of net-zero technologies covering 19 technology groups.[131] These involve several items with direct relevance for automotive supply chains such as "battery and energy storage technologies", "sustainable alternative fuels technologies" and "renewable fuels of non-biological origin technologies".

To reach the designated goals, the NZIA includes a range of support measures applicable to projects creating production capacities for the listed technologies. The support framework is organised in two stages.

First, a basic form of support is provided to all net-zero technology manufacturing projects. This includes a definition of upper limits for the permit granting process of 12 months for small-scale (< 1 GW capacity) and 18 months for large-scale (≥ 1 GW) projects.[132] Member States are asked to install specific administrative contact points.[133] They serve as single points of contact for project applicants and shall guide them through all the steps of the permit granting process. Moreover, to support domestic manufacturing from the demand side, the NZIA introduces new criteria for public procurement procedures involving net-zero technologies. This involves mandatory minimum requirements for the environmental sustainability of production, which will be later spelled out by an implementing act.[134]. Moreover, new resilience criteria are defined, including the rule that not more than 50% of the value of a net-zero technology or its main specific components shall stem from a single third country.[135]

Second, specific rules apply to so-called strategic net-zero projects, as an equivalent to the strategic raw material projects defined by the CRMA. Net-zero technology manufacturing projects shall be recognised by Member States as "strategic" if they contribute to the capacity goals of the legislation, provide European industries with the best available technologies and fulfil a selection of further criteria.[136] Strategic net-zero projects shall be assigned a special priority status in national permit granting procedures, including the speed of handling any lawsuits related to permit granting.[137] Even stricter time limits apply to the permit granting procedure, consisting of 9 months for small-scale (< 1 GW capacity) and 12 months for large-scale (≥ 1 GW) projects.[138] Moreover, strategic net-zero projects can apply for specific advice on project financing by the newly established Net-Zero Europe Platform.[139]

---

[128] Regulation (EU) 2024/1735 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724.
[129] Regulation (EU) 2024/1735, Art. Art. 3c(1a).
[130] Regulation (EU) 2024/1735, Art. 3c(1a), Art. 3c(1b).
[131] Regulation (EU) 2024/1735, Art. 3a(1).
[132] Regulation (EU) 2024/1735, Art. 6(1).
[133] Regulation (EU) 2024/1735, Art. 4(1).
[134] Regulation (EU) 2024/1735, Art. 19(1).
[135] Regulation (EU) 2024/1735, Art. 19 (4a).
[136] Regulation (EU) 2024/1735, Art. 10(1).
[137] Regulation (EU) 2024/1735, Art. 13.
[138] Regulation (EU) 2024/1735, Art. 13(1).
[139] Regulation (EU) 2024/1735, Art. 28.

However, just like the CRMA, the NZIA does not foresee any new dedicated EU support fund.

2.1.1.12 Coherence of the EU Regulatory Framework

When the European Commission proposed the aforementioned legal acts, it claimed that they were complementary to each other, thereby together forming a coherent EU strategy for the transformation of the European automotive industry towards zero-emission vehicles in which each element has its part to play. In this respect, the European Commission highlighted the following interdependencies and synergies with a special focus on the **CO_2 emission standards for road vehicles** (cars and vans as well as lorries and buses):[140]

- By ensuring a reduction of road transport emissions by supplying new zero-emission vehicles to the market, the CO_2 emission standards for road vehicles support Member States in meeting their targets under the **Effort Sharing Regulation**. Since they incentivise electrification of vehicles, they contribute both to the EU's energy efficiency objectives and by providing a complementary route to using renewable energy also to the EU's renewables objectives.
- Similarly, the CO_2 emission standards for road vehicles are complementary to the new **emissions trading system for road transport and buildings (EU-ETS 2)**. They address the supply of more fuel efficient and zero-emission vehicles, setting requirements on vehicle manufacturers with regard to their new vehicle fleets. The EU-ETS 2 concerns the fuel use in the entire vehicle stock. It could increase both the demand for more fuel-efficient and zero emission vehicles, thus facilitating the fulfilment of the CO_2 efficiency objectives of the vehicle manufacturers.
- The CO_2 emission standards for road vehicles are also a complementary measure to the **Renewable Energy Directive (RED III)**, which aims to decarbonise the production of electricity used in electric vehicles and incentivise the uptake of renewable and low carbon fuels for the combustion engine vehicles in the stock.
- The synergies of the CO_2 emission standards for road vehicles with the existing **EU-ETS 1** and with the **RED III**, which aim to decarbonise power generation, so that zero-emission vehicles are progressively powered by renewable energy sources thus achieving decarbonisation of full well-to-wheel emissions.
- The CO_2 emission standards for road vehicles are also complementary to the new **Euro 7 Regulation**, which regulates the remaining emissions of other pollutants, including of microplastics from tyres and particles from brake systems of zero emission vehicles.
- While the CO_2 emission standards ensure the supply of zero-emission vehicles, the **Alternative Fuels Infrastructure Regulation (AFIR)**, 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 addressed by the **Effort Sharing Regulation**, which also incentivises Member States to take action in their road transport sectors.

[140] See, e.g., European Commission (2021), Proposal COM(2021) 556 for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, pp. 3 et seq.; European Commission (2023), Proposal COM(2023) 88 for a Regulation amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, pp. 2 et seq.

In our opinion, the **interaction between the EU-ETS 2 and the CO_2 emission standards for new road vehicles** within the overall EU regulatory framework is of particular importance.

While CO_2 emission standards focus exclusively on the supply side, the **EU-ETS 2 can increase the demand for zero- and low-emission vehicles** and positively influence the way they are used as well as the choice of alternative modes of transport. This is because the CO_2 price is tilting relative prices of transport technologies in favour of low emission technologies. As the EU has so far failed to amend the Energy Tax Directive in such a way that energy taxes are mainly based on energy content and embedded GHG emissions, the EU-ETS 2 must play an even greater role in altering relative fuel costs and ultimately TCO in favour of climate-friendly vehicles.

Furthermore, if and to the extent that EU-ETS 2 comes into effect with an – undisputed[141] – declining cap on the overall allowed allowances and emissions, the CO_2 emission standards will not lead to additional emission savings. If they were not in place, and therefore new vehicles would emit more GHGs, due to the cap the existing vehicle fleet would have to achieve more emission savings within the EU-ETS 2.

In this context, four **subsidiary functions of CO_2 emission standards** to the EU-ETS 2 can be identified:

1. **Backstop:** Even if the EU-ETS 2 would fail or be abolished, or more allowances would be released to counteract price increases, the decarbonisation of road transport would still be achieved over time through new vehicles – provided that fleet renewal is not curbed by high vehicle prices.
2. **Sharing the burden:** buyers of new vehicles in particular are making their contribution to the decarbonisation of the overall vehicle fleet.
3. **Industry and policy commitment:** CO_2 emission standards mean that the industry cannot avoid developing and marketing zero-emission vehicles. However, politicians are also committed. They cannot abandon the goal of zero emission vehicles without significant loss of credibility. Nevertheless, unrealistic CO_2 emission standards that lack flexibility when important market conditions change substantially may turn out not be politically sustainable.
4. **Relief for EU-ETS 2:** The low and decreasing emissions of the new vehicle fleet will mitigate the upward price trend in EU-ETS 2 – in case sufficient fleet renewal takes place. This reduces the pressure to relax the decreasing cap and increases the credibility of the EU- ETS 2.

However, irrespective of the actual synergies of the original proposals as intended by the European Commission in the first place, the overall coherence of the finally adopted EU regulatory framework is not guaranteed due to, e.g., modifications in various legal acts during the legislative process and differences in their eventual implementation in the 27 Member States.

Given the **complexity** of the entire regulatory architecture of the interlinked EU regulatory framework with its **ambitious targets, tight deadlines, and multitude of highly detailed requirements** affecting all sectors of European society and economy, its implementation is a major challenge for the EU, its Member States, public authorities, companies and citizens. Especially innovative approaches – such as the new CBAM – are prone to **implementation hiccups**.

[141] However, it is possible that, due to political pressure to counteract rising prices in the EU-ETS 2, additional allowances could be released from the market stability reserve or – if this is insufficient – added as newly generated allowances. This would jeopardise the cap on allowances.

Given the central role the CO_2 emission standards play in the overall EU strategy, the above **stock-take of the interlinked elements** as well as the following **analysis of the domestic and global problems** of the **EU regulatory framework** (Sections 2.1.2 and 2.1.3) also show that **manufacturers alone cannot influence all conditions required to realise the transformation towards the decarbonisation of road transport**.[142] Other players – Member States, fuel suppliers, those responsible for building and financing recharging infrastructure etc. – also need to make their contribution.

As the Draghi Report states, "while there are clear regulatory frameworks for carmakers (emission targets) and corporate logistics (corporate sustainability reporting, inclusion of road transport in ETS 2) that increase the demand for EVs and charging infrastructure, there is no parallel obligation for energy providers to supply stable and powerful grid access of sufficient capacity for charging."[143] And after all, potential customers cannot be forced to buy the EVs they might not want for various reasons (price, "range anxiety" etc.).

In the light of the above, it is anything but impossible that the **"reality check"** will eventually force EU policy makers to adjust at least parts of the regulatory framework to various implementation challenges and new developments.

Therefore, it is necessary to **review the EU regulatory framework** timely in the light of already visible inherent inconsistencies and deficiencies, experiences gained and the constantly changing global context, in order to enable it to effectively **achieve its objectives within the EU internal market**. To this, the Draghi Report recommends to "adopt a **technology-neutral approach** in the review of the Fit-for-55 package" that "**takes stock of market and technology developments**.[144]

[142] The legal system of the EU and its Member States is based on the rule of law and, therefore, no obligation can be imposed on anyone the fulfilment of which is beyond their control (*ultra posse nemo obligatur*). Therefore, if manufacturers were to violate the CO_2 emission standards due to deficiencies of other elements of the EU decarbonisation strategy, the CO_2 emission premiums for non-compliance could at some point constitute a violation of the principle of proportionality pursuant to Art. 5(4) TEU, especially if they would threaten the very basis of the manufacturers' economic existence.

[143] Draghi Report – Part B, p. 151.

[144] Draghi Report – Part B, p. 153 et seq.

2.1.2 Domestic Problems of the EU Regulatory Framework

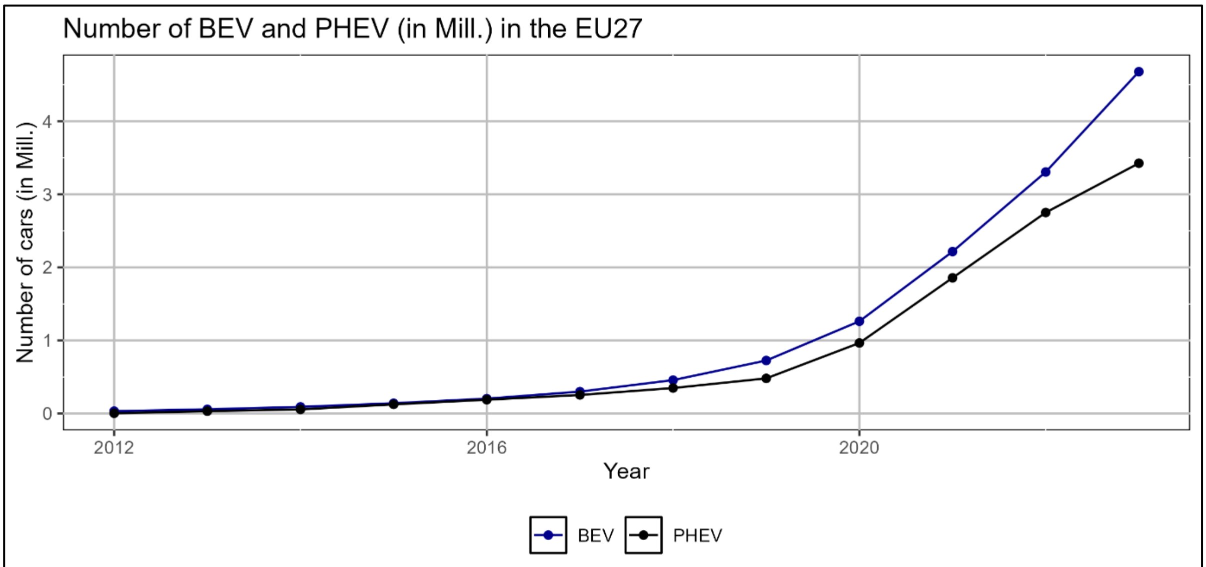
With regard to the EU itself, the following **domestic problems** of the EU regulatory framework can be identified which could endanger the transformation of road transport towards climate neutrality driven by a globally competitive EU automotive industry:

2.1.2.1 Slow Electrification in EU Fleet Because of Weak Demand

The EU decarbonisation strategy's main focus on new vehicles and strict CO_2 emission standards for cars, vans, lorries and busses, which can be achieved almost exclusively through electrification of the powertrain, puts sales of new electric vehicle (EV) at the centre of achieving the decarbonisation targets for road transport in the EU. This is particularly true for passenger cars and vans. As the EU fleet-wide CO_2 emission targets for 2025 are already ambitious and the strict limits for 2030 will come into effect soon, the rapid electrification of vehicles and especially the scaling up of BEV sales are crucial. For this to happen, both sufficient supply and demand must be in place.

The argument put forward by proponents of strict CO_2 emission standards is that an insufficient supply of BEVs or PHEVs – grouped as (chargeable) electric vehicles (EVs) – was the main obstacle to the electrification of cars and vans and that strict CO_2 emission standards would force the EU automotive industry to accelerate its supply of EVs.[145] In the period from 2017 to 2023, the stock of electricity-driven passenger cars and vans in the EU did experience very dynamic growth (see Fig. 3).[146] In recent months, though, growth has slowed considerably.

Fig. 3: Stock of Battery-Electric and Plug-In Hybrid Electric Passenger Cars and Vans in the EU



Source: EAFO (2024)

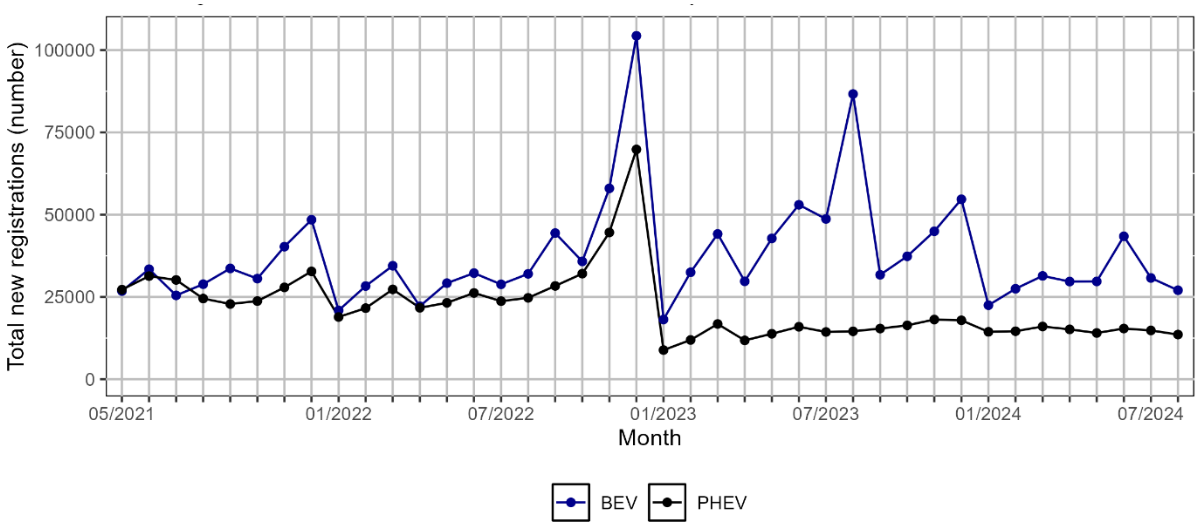
In Germany, the EU's largest automotive market, new registrations of electric vehicles have experienced a significant slump recently, as shown in Fig. 4 for passenger cars . This not only applies to BEV, but even more strikingly to PHEV which are key in the transition zo ZEV. The reduction of purchase premia at the beginning of 2023 and their sudden and complete abolishment by 18 December 2024

[145] See, e.g., European Commission (2021), SWD(2021) 613 Impact Assessment Part 1 Accompanying the Proposal for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, p. 13, pp. 16 et seq.

[146] EAFO – European Alternative Fuels Observatory (2024), Vehicles (registrations and fleet).

have slowed down the adoption of electric passenger cars in Germany significantly, with no sign yet of a return to previous growth trends.

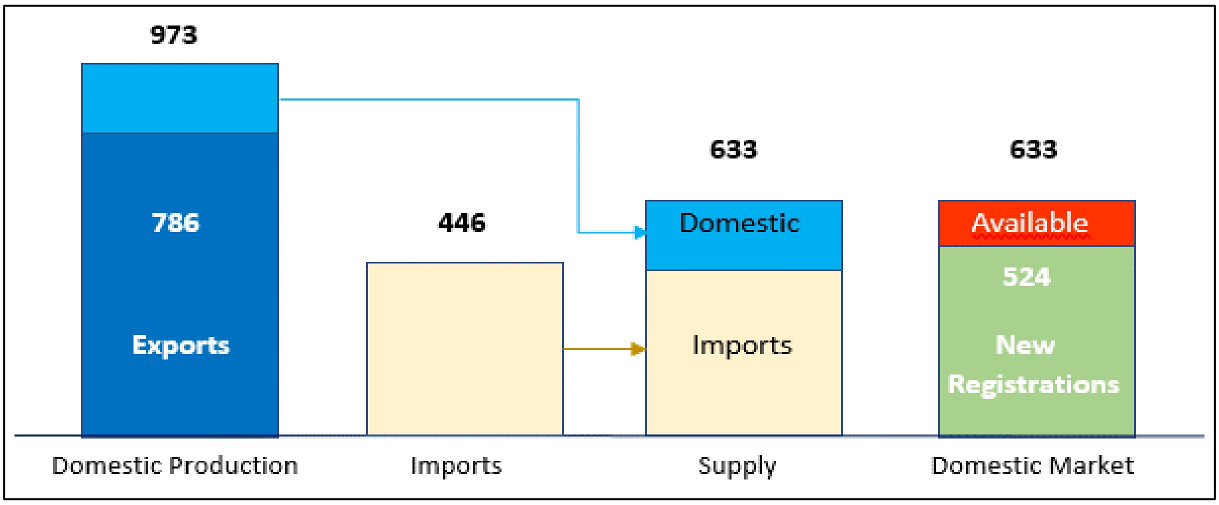
Fig. 4: New Registrations of BEVs and PHEVs in Germany



Source: KBA (2024)

The suspicion that the current weakness in sales of electric vehicles is primarily a demand problem is underpinned by the following chart on the German market for EVs in 2023:

Fig. 5: German EV Market 2023 (in thousand vehicles) – Approximately 100.000 unsold EVs



Source: Deutsche Verkehrszeitung (DVZ)[147] with data from Destatis, KBA, CATI, cep stylised modified illustration

Independently, the EV share is still considerably low and would have to increase sharply in the coming years in order to reach the EV – and especially BEV – sales targets consistent with the decarbonisation pathways EU legislators had in mind when counting heavily on electrification of new vehicles.

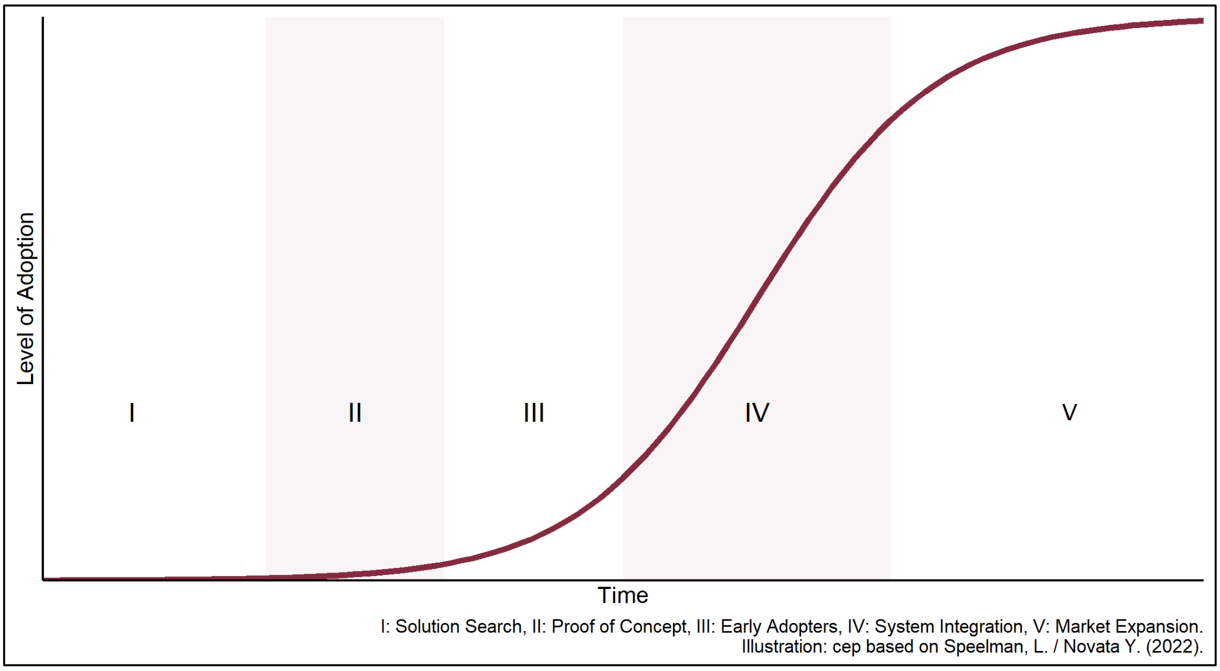
To understand the interplay of supply and demand in a market where a new technology (EV) heads on to replace an existing and well-established technology (internal combustion engine, ICE), the analytical framework of the stylised "S-curve of technology adoption" can provide valuable insights (see Fig. 6).

[147] DVZ of 19 June 2024, Konjunktur und Märkte, Marktanalyse: E-Autos haben es schwer.

The S-curve results from system feedbacks such as learning curves, returns to scale, technological reinforcement and social diffusion. Although the speed of transition and the exact form are context-specific for each innovation, all transitions follow a five-phase pattern of technology adoption:[148]

- Phase I: Visionaries conceptualise a new technology.
- Phase II: Innovators move the concept to working prototypes or pilots.
- Phase III: Early adopters form niche markets. Performance increases, costs decline, but the innovation is still more expensive than the incumbent technology and not widely available.
- Phase IV: The innovation reaches mass market as it outperforms incumbents in cost and performance (steep part of the S-curve).
- Phase V: Sales growth slows as the innovation reaches market saturation.

Fig. 6: Stylised S-Curve of Technology Diffusion



Source: Rocky Mountain Institute (RMI)[149]

According to this categorisation of the adaptation phases, the current situation for EVs can best be described as the end of phase III since the characteristics of phase IV still do not apply to most of electric vehicles: The purchase price of EVs is still higher than that of ICEVs, and smaller, more economical vehicles for the volume market are not widely available yet. Of the nearly 600 electric car models available, two-thirds are large vehicles and Sports Utility Vehicles (SUV).[150] The Draghi Report refers to "recent survey results" that "identify higher prices as the key impediment to private Battery Electric Vehicle (BEV) uptake" and that "in March 2024, there were 115 BEV models (and 286 model variations) with a range between 300 km and more than 600 km available in the EU, but only 13 (mostly small)

[148] Id.
[149] Speelman, L. / Novata, Y. (2022), Harnessing the Power of S-Curves, Rocky Mountain Institute (RMI).
[150] IEA – International Energy Agency (2024), Global EV Outlook 2024 – Trends in Electric Cars.

BEV models with a purchase price between EUR 20,000 and EUR 35,000 and an average range of around 200 kilometres".[151]

However, not only the purchase price, but also the total cost of ownership (TCO) of BEVs is in many cases higher than those of ICEVs.[152] While BEVs generally have higher upfront costs, their lower operating expenses and potential for home charging can make them more cost-effective regarding TCO than ICEVs in the long run, especially for larger vehicles, high-mileage usage, and when factoring in available incentives. However, in countries with high electricity prices charging costs at public charging stations can very often exceed fuel costs – especially when providers of public charging services are local monopolies that set higher prices for external customers without a contract.[153] Furthermore, users of home charging stations have faced rising electricity prices, so that mainly homeowners with a photovoltaic system on their roof achieve lower TCO when no purchase subsidies are paid. BEVs are also still outperformed by vehicles with combustion engines in terms of range and possible towing capacity as well as resale value[154].

It is still mainly early adopters and homeowners who buy battery electric vehicles (BEVs) or plug-in hybrids (PHEVs). Hybrids still play an important role because of their flexibility and the fact that the battery capacity of reasonably affordable BEVs is still quite limited. Fossil fuel costs are frequently lower than corresponding electricity costs at public charging points[155] – when including charging time as opportunity cost – and real battery ranges of PHEV are relatively small. Therefore, electric driving requires a lot of discipline from consumers with regard to charging. Consequently, users of PHEVs often do not use their cars in the most climate-friendly way – which is the main criticism of this technology and a reason why PHEV sales are no longer subsidised in many countries.[156] However, it has been shown that with higher fuel prices PHEVs are predominantly electrically driven, while the combustion engine is only used when it is really needed or when it is more efficient – e.g. at high speeds on motorways.[157] Similar effects can be expected when carbon prices in the EU-ETS 2 will increase fuel prices.

Important enabling conditions for the transition to e-mobility in road transport are not yet sufficiently in place. The number of public charging stations is growing much slower than the number of EVs on roads in the EU.[158] As long as this is the case, EVs are mainly attractive to drivers who can charge their vehicle at home and who do not frequently undertake longer journeys. Carbon pricing is not yet widespread and strong enough to equalise the TCO of electric and fossil-fuelled cars or to make efficient use of PHEV. Rather, in some Member States – like Germany, Sweden and France – the end of government subsidies for the purchase of EVs[159] has increased the TCO disadvantage of electric cars.

Overall, sales of EVs are mainly limited by lacking demand caused by high TCO, low resale values due to technological outdatedness, inconvenience and inadequate availability of public charging points and also partly due to a still limited supply of affordable small- and medium-size electric cars. As long as carbon prices are not determined by market forces in the EU-ETS 2, and the BEV technology – including

151 Draghi Report – Part B, p. 150.
152 ADAC (2024), ADAC Kostenvergleich: Elektrofahrzeuge und PlugIn-Hybride mit Benzinern und Dieselfahrzeugen.
153 LichtBlick (2024), Ladesäulencheck 2024: Laden unterwegs teurer als Tanken.
154 Autovista24 of 2 May 2024, Monthly Market Update: BEV residual values suffer across Europe in April.
155 ADAC (2024), Plug-in-Hybrid-Autos: Modelle, Reichweiten, Kosten, Verbrauch.
156 Id.; Mobile.de of 23 August 2022, Plug-in-Hybride: Diese Modelle bekommen 2022 noch Förderung.
157 Grigolon, L. / Park, E. / Remmy, K. (2024), Fueling Electrification: The Impact of Gas Prices on Hybrid Car Usage.
158 ACEA (2024), Automotive Insights 01 – Charging ahead: accelerating the roll-out of EU electric vehicle charging infrastructure.
159 Oliver, M. (2024), Tesla suffers sales slump as European electric car subsidies slashed, The Telegraph of 22 May 2024.

charging – does not achieve a cost and performance advantage over the established ICE technology, the decarbonisation strategy mainly by electrification will only be successful with high subsidies, the financial viability of which is questionable.

The overall problem with this decarbonisation strategy for road transport so far is that TCO parity with conventional vehicles is anything but certain. Whether, when and where TCO parity will be achieved is highly dependent on external factors beyond the direct control of the manufacturers. But at the same time, these factors crucially affect their ability to meet the CO_2 targets. Furthermore, the strategy focuses mainly on new vehicles, which are subject to increasingly stringent CO_2 emission standards, while largely ignoring the role of the entire vehicle fleet and the factors that negatively impact fleet renewal such as high purchasing cost and TCO of new vehicles.

Both aspects also apply to HDVs, whose slow growth in demand will be confronted with the urgent need to sell zero- and low-emission vehicles as CO_2 emission standards become increasingly stringent from 2025. Here, too, the trajectory of the imposed emission reductions is steeper up to 2030 than in subsequent years, although suitable and reasonably affordable technological options are expected to be available even later than in the case of passenger cars and vans – especially for long-haul HDVs.[160] Charging infrastructure with adequate capacity is lacking even more behind the needs for a rapid transition.

Apart from that, the goods transport sector is way more price sensitive due to fierce competition. As lorries are business investments, the TCO of EVs or HDVs running on alternative fuels must be lower than those running on Diesel in order to allow for competitive transport operations. Without strong public support – the granting of which is increasingly questionable – this is mostly not the case. Hence, EV sales are limited by lacking demand while HDV producers are forced to sell a sufficient number of EVs to comply with the CO_2 standards regulation. This puts European HDV manufacturers at a strategic disadvantage because non-European manufacturers can focus on individual segments of the market which might already be ready for the ZEV transition without them having to worry about ICE sales. Considering the long term, the target of a 90% reduction in 2040 is probably not entirely technology open, either. To require urban buses to be electric by 2035 risks to harm the development of public transport if they continue to have higher costs than buses running on biogas – especially in view of the tight public finances. Consequently, less new buses can be purchased with the same budget and outdated and worn out Diesel buses are kept longer in service – reducing the attractivity of public transport.

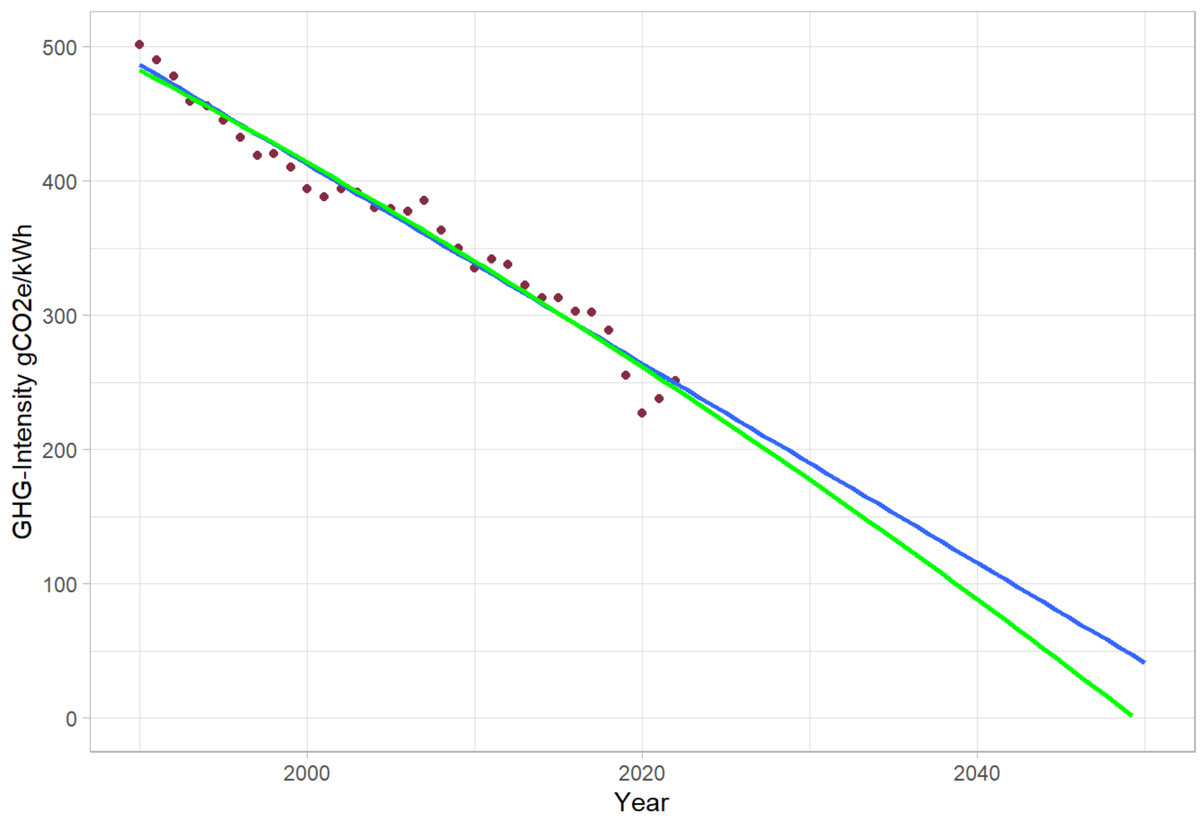
2.1.2.2 Slow Decarbonisation of Electricity Generation

Over the last twenty years, the GHG intensity of the electricity mix in the EU has been significantly reduced. However, it should be noted that both the initial level of GHG emissions in each Member State and the pace of decarbonisation vary considerably. Assuming a linear continuation of the current trend, significant further progress in decarbonisation can be expected by mid-century. However, complete decarbonisation of the European electricity mix would still not be achieved. This would require additional efforts beyond the current trend. It is quite possible that this will be achieved.

[160] Aryanpur, V., Rogan, F. (2024), Decarbonising road freight transport: The role of zero-emission trucks and intangible costs, Sci Rep 14, 2113 (2024).

Decarbonising the electricity mix is crucial for the competitiveness of the European automotive industry. One reason for this is that the argument that EVs are climate-friendly is intuitively all the more plausible the lower the GHG emissions from electricity generation are (see Fig. 7).

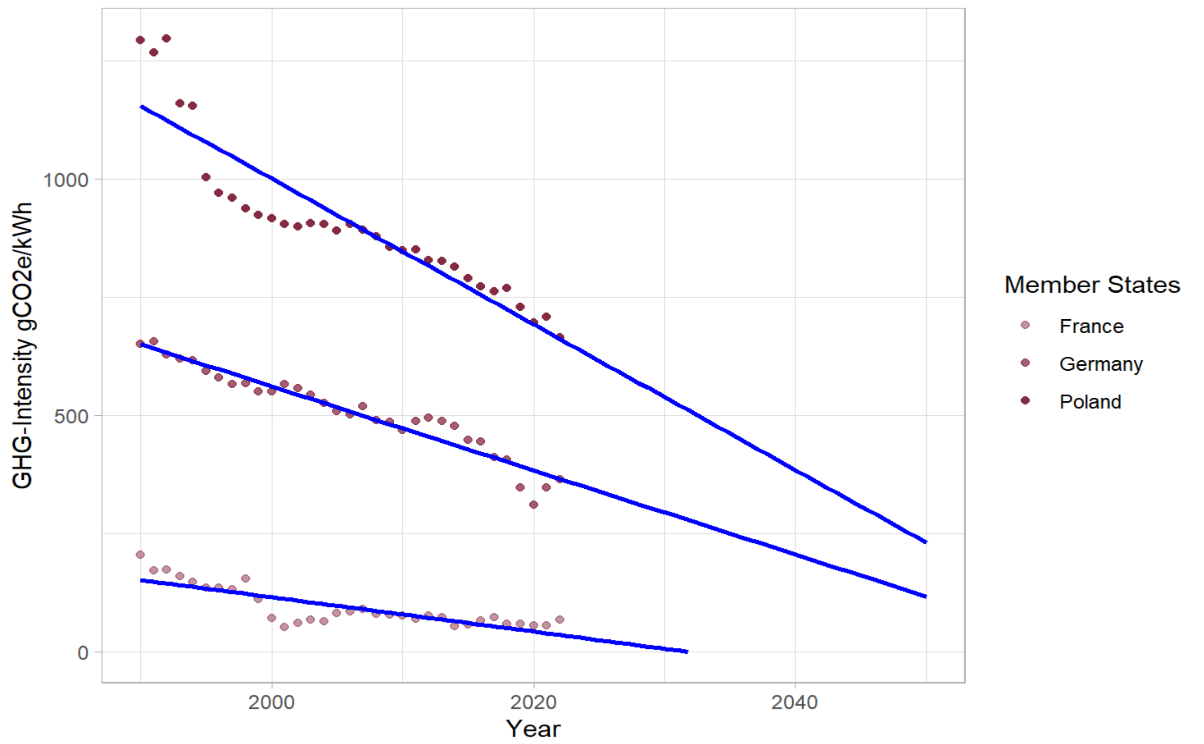
Fig. 7: GHG-Intensity in Electricity Generation (EU)



Blue line: linear trend, green line: quadratic trend; Illustration: cep, Data: European Environment Agency, Data Download: 2024-08-29

It should be noted that the Member States are very heterogenous in this respect. Some Member States – like Poland and Germany – still have a very GHG-intensive electricity mix, while others – like France – are already *de facto* climate-neutral (see Fig. 8).

Fig. 8: GHG-Intensity in Electricity Generation in France, Germany, and Poland



Blue line: linear trend; llustration: cep, Data: European Environment Agency, Data Download: 2024-08-29

Despite the intuitive importance of this argument, it is probably less relevant than it seems at first glance. It is true that in some cases significant amounts of GHGs are still emitted in the production of electricity. However, electricity production is subject to the European emissions trading scheme (EU-ETS 1). This ensures that the total amount of GHG emissions remains limited by a cap. Higher emissions from power generation are therefore offset by lower emissions, e.g., from industry. Consequently, despite the intuitive force of the argument, the GHG intensity of the electricity mix does not call into question the climate friendliness of electromobility.

However, considering the GHG intensity of the electricity mix leads to a second important argument. If, *ceteris paribus*, the expansion of electromobility increases the demand for electricity, but the average electricity mix is still relatively GHG-intensive, then the demand for EU-ETS 1 allowances generates an increase in the EU-ETS 1 price and thus an additional cost burden on industry, including the EU automotive industry. To put it bluntly, a rapid uptake of electromobility combined with a high GHG intensity of the electricity mix could lead to an additional cost burden for European industry. The mismatch between the pace of electrification of transport and of the decarbonisation of electricity generation would then also be a cause of competitiveness problems.

2.1.2.3 Dependency on Imports of Batteries and Critical Raw Materials

The Draghi Report criticises that "the push towards rapid market penetration by EVs has not been followed in the EU by a synchronised push towards the conversion of the supply chain".[161] This concerns especially battery production and access to critical raw materials.

Of the 34 raw materials/commodity groups classified as critical in the CRMA, at least 11 are of specific relevance to electromobility (see Tab. 1). These are raw materials that combine high economic importance with a high supply risk. In the case of battery electric vehicles (BEV), a significant proportion of the raw material value is focused on battery parts. Lithium-ion batteries currently dominate the market for EV batteries. Their main advantages compared to other battery chemistries like lead acid batteries are their high energy density and long service life.[162] The critical raw material graphite is used as the material for the anode. Lithium nickel manganese cobalt oxides (Li-NMC) have become a standard solution for the composition of the cathode. This metal composite contains four raw materials classified as critical by the EU: lithium, nickel, manganese and cobalt. New lithium-free batteries[163] and cobalt-free batteries[164] have been undergoing the testing phase for some time. Some have already reached the stage of market entry.[165] For the medium term, however, analysts assume that the market dominance of lithium-ion batteries will remain unchanged.[166] For instance, Fraunhofer ISI (2023) forecasts that global demand for lithium-ion batteries for EV applications will increase to around 2,800 GWh by 2030, roughly four times as much as in 2022.[167]

Another focus of the use of critical raw materials in e-mobility is the permanent magnets contained in electric motors. These are magnets that are able to generate a constant magnetic field without the support of an external energy source. Their high strength enables better motor efficiency and the production of lighter vehicles.[168] The currently dominant neodymium iron boron (NdFeB) magnets contain several critical raw materials, including the rare earth metals neodymium and praseodymium as well as dysprosium and terbium as additives to increase heat resistance. The impact of batteries on the vehicle weight of BEVs increases the need for lightweight construction, and thus the demand for aluminium and aluminium-based alloys. BEVs also have a significantly larger number of chips than ICE, which increases the demand for the semiconductor silicon.

For almost all of these critical materials, the EU is currently highly or even exclusively dependent on imports from third countries (see Tab. 1). The share of EU-internal secondary production from recycling is currently low to very low, with a few exceptions (copper, cobalt, nickel), and is even estimated to be close to or equal to zero in the case of five items, including rare earth metals. There are many reasons for this, including low collection rates for End-of-Life products, difficulties in dismantling resource-rich components like permanent magnets and the high fixed costs of recycling processes. The lowest recycling rates are recorded for those raw materials with particularly high import dependencies.

---

161 Draghi Report – Part B, p. 154.
162 IEA – International Energy Agency (2024), Batteries and secure energy transitions. World Energy Outlook Special Report.
163 Lawson, A (203), 'Breakthrough battery' from Sweden may cut dependency on China, The Guardian of 21 November 2023.
164 ACS – American Chemical Society (2024), Next-generation batteries could go organic, cobalt-free for long-lasting power.
165 Farrell, N. (2024), World's first lithium-free electric car launched by China, Fudzilla of 2 January 2024.
166 McKinsey (2023), Battery 2030: Resilient, sustainable, and circular. Report.
167 Fraunhofer ISI (2023), Lithium-Ion Battery Roadmap –Industrialization Perspectives Toward 2030. Fraunhofer Institute for Systems and Innovation Research ISI.
168 GKN Powder Metallurgy (2024), Permanent Magnets.

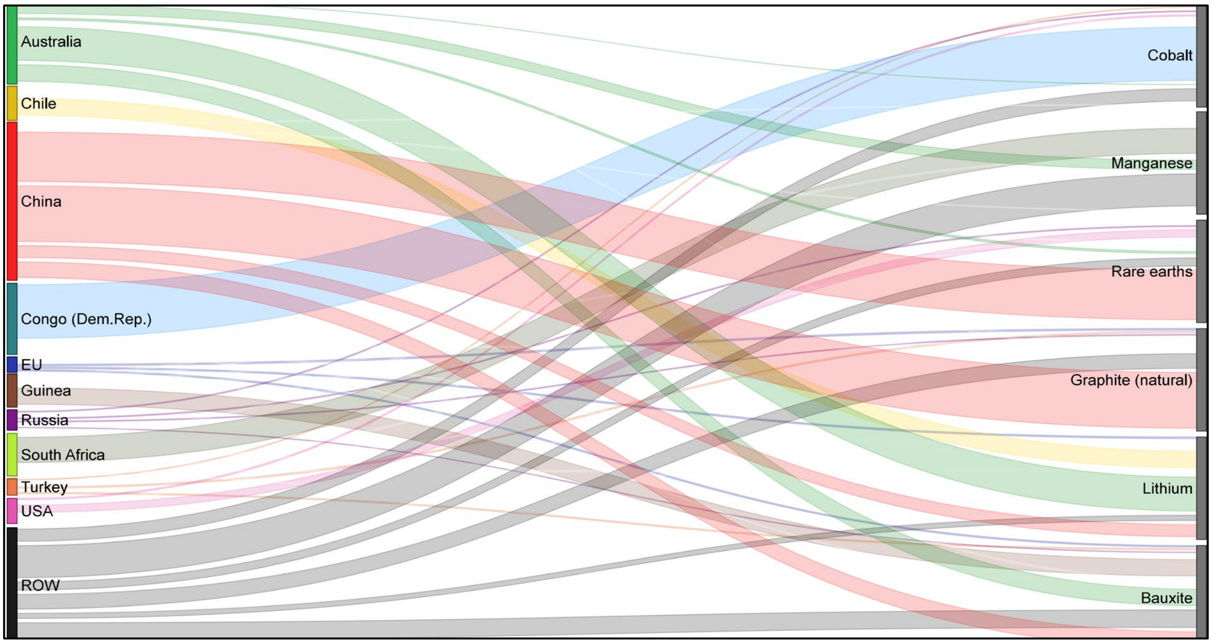
Tab. 1: Critical Raw Materials with Specific Relevance for BEVs

Raw Material(s)	Relevant Component(s)	EU Import Dependency[a)]	EU Recycling Input Rate
Bauxite/Aluminium	Car interior/exterior (alloying element)	89%	32%
Boron	Motor (permanent magnets)	100%	1%
Cobalt	Battery (cathode)	81%	22%
Copper	Battery (wires, collector foil); Motor (cables)	48%	55%
Graphite (natural)	Battery (anode)	99%	3%
Heavy rare earth metals (a.o. dysprosium, terbium)	Motor (permanent magnets)	100%	1%
Light rare earth metals (a.o. neodymium, praseodymium)	Motor (permanent magnets)	100%	1%
Lithium	Battery (cathode)	100%	0%
Manganese	Battery (cathode); Car interior/ exterior (alloying element)	96%	9%
Nickel	Battery (cathode); Car interior/ exterior (alloying element)	75%	16%
Silicon	Electronic control (chips); Car interior/ exterior (alloying element)	64%	1%

[a)] Calculated as: (imports - exports) / (EU production + imports - exports). Reference Period: 2016-2020.
Sources: European Commission (2020; 2023)[169]; cep illustration

This is coupled with a difficult supply situation on the international raw materials markets. The critical raw materials relevant for BEVs are characterised by a strong to very strong concentration of global supply (see Fig. 9).

Fig. 9: Shares of Countries/Regions in Global Mining Production (2023)



Source: USGS (2024)[170]; own illustration; ROW: Rest of the world.

[169] European Commission (2023), Study on the Critical Raw Materials for the EU 2023 – Final Report; European Commission (2020), Critical Raw Materials for Strategic Technologies and Sectors in the EU. A Foresight Study.
[170] USGS – US Geological Survey (2024), USGS Mineral Commodity Summaries 2024.

China's dominance in the mining of rare earth metals and natural graphite is particularly striking. In the subsequent refinery stage, it is even more pronounced and also extends to lithium and cobalt. Prices and the supply situation on the global markets are therefore significantly influenced by the raw materials and trade policies of a few countries. This was demonstrated a few years ago, for example, by the effects of China's changed export regulations for rare earth metals.[171]

Hedging external raw material procurement against such risks is aggravated by various uncertainties. These relate above all to the real extent of economically exploitable resources and the technological risk of substituting raw materials. Moreover, without alternative procurement channels established, it is only possible to hedge against price risks, not against the risk of a short-term physical shortage.

The overarching goal of the CRMA – diversification of the supply routes for critical raw materials – is therefore a step in the right direction. Given the uncertainties in the development of domestic capacities and the time needed, it is also right not to rely solely on domestic primary supply as an alternative source. Petravatzi & Gunn (2023) estimate that the overall process from resource exploration to the commissioning of mining and smelting capacities could span a regular period of 20 years, despite optimistic assumptions regarding the length of the approval process (2-3 years).[172]

However, the specific measures in the CRMA fall well short of the ambitious capacity targets. In view of the long capital commitment, the envisaged maximum periods for approval procedures do little to accelerate the amortisation of projects. This hardly improves the marketability of mining investments. The CRMA also does not provide for any additional EU development funds. In view of the high investment risk, a targeted provision of public capital could become an anchor for reducing financing costs and for crowding-in private investors. There is also a lack of concrete EU-wide incentive instruments for the development of raw material recycling capacities. Finally, a clear strategic roadmap for the third procurement channel, the development of new raw material partnerships with third countries, is lacking as well. Concrete plans for the implementation of partnership agreements are needed, most of which currently still take the form of very general memoranda of understanding.

2.1.2.4 Low Incentives to Decarbonise New and Existing ICE Vehicle Fleets

CO_2 emissions of new and existing cars with combustion engines do not only depend on their measured fuel efficiency under laboratory conditions but also on their mileage, the driving style and the percentage of biofuels – or later e-fuels – in the fuel blend used. The mileage of passenger cars can be reduced by partially switching to public transport, travelling in groups, cycling or walking. In the case of PHEV, an increased proportion of electric driving can also reduce emissions. Commercial vans and lorries are usually used applying a more fuel-saving driving style when competition forces firms to minimise fuel costs. Mileage can to a small extent be reduced by optimisation of routes and somewhat also by an increased use of multimodal transport. Carbon pricing has the potential to increase substantially the incentives for transport users to use any of these decarbonisation strategies.

Unfortunately, only few Member States have introduced carbon pricing in the road sector, and carbon prices are still considerably low. The EU-ETS 2 will establish an EU-wide carbon price for transport fuels only by 2027. In addition, the effectiveness of this instrument is at risk due to the "price cap" of

[171] Mancheri, N. A. (2015), World trade in rare earths, Chinese export restrictions, and implications. Resources Policy, 46, 262-271.

[172] Petavratzi, E. / Gunn, G. (2023), Decarbonising the automotive sector: a primary raw material perspective on targets and timescales. Mineral Economics, 36(4), pp. 545-561.

EUR 45[173] that found its way into legislation in order to appease opponents to the EU-ETS 2 fearing social revolt against high fuel prices like the "Yellow Vest" movement in France.[174] With a corresponding carbon price of approx. EUR 0.13 per litre of gasoline or EUR 0.14 per litre of diesel, the incentives for owners of ICE vehicles to change their behaviour to reduce CO_2 emissions will be limited. Moreover, there is another risk: As the provisions for the release of allowance from the market stability reserve in case the allowance price exceeds EUR 45 will most likely not suffice to maintain the price below this price cap, political pressure can be expected to change the rules in order to defend the price cap by all means. This scenario is more likely when citizens are not compensated for higher mobility costs due to increasing carbon prices. The continuously necessary addition of allowances to defend the price cap would then water down the cap for allowances and transform the EU-ETS 2 into a *de facto* carbon tax of EUR 45. In this case, the automatic CO_2 emissions reduction mechanism via the decreasing cap of the EU-ETS 2 would be abolished.[175]

In April 2024, sales of petrol cars in the EU increased by 7.3% while sales of more fuel-efficient hybrid cars (HEV) – i.e. cars with ICE combined with an electric engine but without the possibility to charge the battery externally – surged by 33.1%[176], and PHEVs lost market share to 6.7%[177]. As most of these cars will be on the roads until well beyond 2035, it is important that renewable ethanol – which reduces GHG emissions from petrol and hybrid cars by more than 78% on average compared to fossil petrol – plays a role in EU transport decarbonisation.[178] The market share of diesel vehicles fell, but still is slightly higher than that of BEV, so biodiesel also plays an important role – especially in the decarbonisation of the legacy car fleet[179], but even more so of vans and HDVs propelled by diesel. For HDVs, besides conventional biodiesel and diesel produced from hydrotreated vegetal oil (HVO), biogas can also reduce CO_2-emissions when increasingly blending natural gas (LNG) in propelling gas engines that are currently used in the long-haul HDV-fleet. Therefore, it is not quite understandable why HDVs running on biogas or biofuels are often not supported appropriately, e.g. through reduced toll charges.

Regulatory requirements and incentives for fuel suppliers to increase the share of biofuels are limited.[180] Energy taxes based on volume rather than CO_2 content do nothing to promote alternative fuels – like biomethane replacing compressed natural gas (CNG) or liquified natural gas (LNG) –, either, since they do not give them a tax advantage against fossil fuels.[181] Against this background, it is unfortunate that the revision of the Energy Taxation Directive, which envisages a stronger alignment of energy taxes with CO_2 emissions, has not be finalised yet by the EU legislators. Vehicle manufacturers have little incentives to make ICEs fit for higher biofuels blends like E20 (20% ethanol in petrol) – where the relevant norm is still pending[182] – or B10 (10% of biodiesel in diesel), let alone even higher blends. This is even more the case as any progress in this direction will not count towards the vehicle manufacturers' decarbonisation obligations set out in the CO_2 emission standards. This discourages vehicle

[173] EU-ETS Directive 2003/87/EC, Article 30h; see Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.
[174] Hanafi, O. et al. (2019), Carbon pricing in France and Germany, cepInput 11/2019.
[175] Menner, M. / Reichert, G. / Voßwinkel, J. S. (2023), Climate Dividend, cepInput 15/2023.
[176] ePURE – European Renewable Ethanol (2024), Sales of hybrid cars surge in Europe, confirming importance of sustainable liquid fuels.
[177] ACEA of 22 May 2024, New car registrations: +13.7% in April 2024; battery electric 11.9% market share.
[178] Id.
[179] European Biodiesel Board (2024), High level EBB position on 2040 EU Climate Target
[180] European Court of Editors (2023), Special Report: The EU's support for sustainable biofuels in transport.
[181] Verband der Deutschen Biokraftstoffindustrie (2023), Politikinformation Biokraftstoffe.
[182] ADAC (2023), ADAC befürwortet umweltschonendes Super E20-Benzin; Auto-Motor-Sport of 17 October 2023, 15 Prozent weniger CO_2 – aber keine Zulassung.

manufacturers from supplying vehicles with internal combustion engines – including efficient hybrids of all kinds[183,184] – that can run with increasing biofuel blends. That is unfortunate since "an increase in the market penetration of low-emission fuels could compensate for a slower than expected uptake in BEVs".[185]

Apart from biofuels, e-fuels will have to play a role in decarbonising the transport sector in the medium and long run. However, there are many reservations about the future use of e-fuels in road transport, relating to efficiency and price considerations as well as the widespread idea that e-fuels should only be used in maritime transport and aviation, which are difficult to decarbonise.[186] But, this view does not sufficiently take into consideration the strong demand for low-carbon fuels that is generated in road transport once or if a strong carbon price signal prevails due to the decreasing cap of the EU-ETS 2. Hence, **the EU risks to miss the transitory potential of road transport to accelerate the development of electrolysers and carbon capture technologies**, which are critical to the production of e-fuels, and the build-up of e-fuel import facilities[187] – without the need of direct subsidies. Once progress in battery cost and performance as well as in charging options leads to a real advantage of new electric cars over the incumbent ICE technology, market forces will drive many buyers away from the latter and an increasing amount of e-fuels could be available for the other sectors. They will then benefit from the cost degression of e-fuel production that will have been pushed in the case of passenger cars mainly by demand from a sector with high willingness to pay.[188] This boost in demand for e-fuels could be more cost-effective than direct subsidies for producers or importers, as there will be competition to meet demand rather than to receive subsidies.[189]

Price forecasts for imported e-diesel are around EUR 2.80 after tax in 2030, which would be about 40% higher than the price of fossil diesel.[190] At an EU-ETS 2 price of around EUR 300 per tonne of CO_2, price parity would be achieved. If fossil fuels were increasingly blended with e-fuels, the price impact on motorists and the goods transport sector would be smaller.[191] Fuel costs would increase even less pronounced for passenger cars and vans if in addition the fuel efficiency of combustion engines is increased through hybridisation and other measures. Hence, from a consumer perspective, hydrogen-based e-fuels are not necessarily the so-called "champagne of the energy transition"[192].

2.1.2.5 Slow Capacity Growth of Alternative Fuels

In addition to insufficient economic incentives on the demand side, the market uptake of alternative fuels is also curbed by constraints to resource availability on the supply side. For traditional crop-based

---

183 Wirtschaftswoche of 30 May 2024, Warum Toyota den Hybridmotor als klimaneutrale Alternative aufrüstet.

184 Focus Online of 7 July 2024, Range Extender - Flop-Elektromotor aus Europa ist nun der große Renner chinesischer Hersteller. Lee, J. (2024), Hyundai plans range extender EVs with 900+ km range as stopgap to full electrification, as BEV demand slows, Paultan.org of 28 August 2024.

185 Draghi Report – Part B, p. 154.

186 See, e.g. Transport & Environment (2023), Biofuels and e-fuels in trucks will make it harder for aviation and shipping to go green.

187 Focus Online of 30 August 2024, Nicht nur für die Luftfahrt – Experte räumt mit Vorurteil über E-Fuels auf.

188 Id.

189 For a similar argument on the scaling-up of green hydrogen production see Menner, M. / Reichert, G (2020), EU Hydrogen Strategy, cepPolicyBrief 14/2020.

190 Transport & Environment (2023), Scholz is fuelled with illusions – How costly e-fuels are threatening the EU's climate targets; Energy Motor of 26 March 2024, Did Germany just kill the electric car?; Vision Mobility of 23 March 2024, T&E-Analyse: E-Fuel-Tankfüllung würde 210 Euro kosten.

191 Verband der Deutschen Biokraftstoffindustrie (2023), Politikinformation Biokraftstoffe.

192 Hillig, T. (2022), Green hydrogen to de-risk the energy transition, European Sustainable Energy Week, European Commission – Newsblog of 3 May 2022.

biofuels, this primarily concerns the availability of agricultural land and the competition with food production. While the current share of arable land used for cultivating biofuel feedstocks is at the global level still of moderate scale (about 5%)[193] a climate strategy for road transport focusing on first-generation crop-based biofuels would increase land demand significantly. Therefore, advanced second- and third-generation biofuel feedstocks are needed. Their origin as by-products from crop cultivation, from waste streams or from non-agricultural sources like algae implies a drastic reduction in land use and thus also in the ecological effects from land preparation and cultivation attributable to these feedstocks. However, producing biofuels from these alternative feedstocks requires new production technologies and thus high investment needs. With initially low production volumes, unit costs are high. Although the production capacity of crop-based biofuels and advanced biofuels from sources like used cooking oil, animal fats or algae could still be extended considerably and thus eventually become cost-competitive, this will only happen if more favourable legislation is put in place[194]. The caps on the use of biofuels in road transport in the RED III limit investments in this sector and hence this path to decarbonisation of road transport is restrained, too. The potential volumes of the new proposed feedstocks for mature biofuels[195] are well over 100 million tons in 2030, whereas the 1.7% limit represents only about 6 million tons.[196] Hence, a large part of the potential is not available for road transport, although the potential could be realized better with the help of motorists' demand with high willingness to pay when higher biofuel targets would be set for the medium run.

E-fuels can help harvesting the worldwide potential of renewable energy by facilitating storage and distribution of renewable energy.[197] The EU will depend on energy imports – even considering its production potential in Southern and Northern Europe – while other regions like Chile, Sub-Saharan Africa, Middle East, or Australia have abundant resources of wind and sun. As e-fuels are chemically identical to conventional fuels, they enable decarbonisation by using an existing infrastructure and addressing a large and growing fleet stock of vehicles, aircrafts and ships as well as industry and millions of heating devices – preserving the economic value of these assets.[198] However, planned production capacity is still low and to a large extent not financially secured yet.[199] Temporary demand-side measures as quotas for the blending at the EU fuel pumps could help decarbonising EU road transport and ramp up the production of e-fuels that will later on be indispensable for the decarbonisation of aviation and maritime transport.[200] This is the more important as the largest project for a production facility in Europe for e-fuels has just been cancelled since reportedly "the market for liquid e-fuels in Europe is developing more slowly than expected" as the transition towards more climate-friendly technologies is taking place "far too hesitantly" in the aviation and maritime sectors while the automotive sector was not "in mind with this fuel, where e-fuels will in any event not play a significant role".[201] Similarly, another fuel

---

[193] Morone, P. / Cottoni, L. / Giudice, F. (2023), Biofuels: Technology, economics, and policy issues, in: Handbook of biofuels production, pp. 55-92.
[194] Id.; European Biodiesel Board (2024), High level EBB position on 2040 EU Climate Target.
[195] Directive (EU) 2018/2001, Annex IX, Part B.
[196] European Commission, Directorate-General for Energy (2022), Assessment of the potential for new feedstocks for the production of advanced biofuels – Final report. European Waste-based and Advanced Biofuels Association (2024), EWABA Press Release on Annex IX revision.
[197] E-Fuel Alliance (2023), 5 Key Demands for a Global Scale-Up of E-Fuels Production.
[198] Id.
[199] Potsdam-Institut für Klimafolgenforschung (2023), E-Fuels – Aktueller Stand und Projektionen.
[200] International Energy Agency (2023), The Role of E-fuels in Decarbonising Transport.
[201] Kahle, C. (2024), Ørsted: Bau der größten E-Fuel-Fabrik Europas wurde gestoppt, Winfuture of 19 August 2024.

producer recently announced that it was pausing a project to produce 800,000 tonnes of bio-kerosene and bio-diesel from plants and waste that was to be built in Rotterdam.[202]

On the supply side, capacity expansion of e-fuels is primarily limited by the availability of renewable hydrogen. The mineral industry claims that "scientifically sound calculations" have shown that suitable production possibilities exist worldwide so that synthetic products, such as hydrogen and e-fuels, can completely replace the global supply of fossil mineral oil products.[203] Nevertheless, there is no obligation for the fuel suppliers to decarbonise their fuels comparable to the obligation of the automotive industry to reduce their tailpipe emissions (CO_2 emission standards).

Meanwhile, the development of import channels, domestic production capacities and transport infrastructure for renewable hydrogen is only making slow progress.[204] On the emerging markets for renewable hydrogen, refineries that produce e-fuels for road transport are competing with sectors such as steel, fertilisers and shipping.[205] Regarding aviation – another sector which is more heavily reliant on this technology path for achieving climate neutrality – there is, however a complementarity with e-kerosene production, since e-Diesel and e-Petrol are by-products of e-kerosene refining – so that their commercialisation helps reducing the e-kerosene price.[206] Technically, with increasing e-fuels production, the availability of CO_2 as raw material could become a further bottleneck, requiring a rapid build-up of carbon capture and transport capacities. Hence, the e-fuels uptake will also depend on the success of the EU Industrial Carbon Management Strategy[207] and its goal to promote the use of captured CO_2 as a resource to replace fossil fuels in industrial production (Carbon Capture and Use, CCU). However, there is the prospect of mutual pull effects: CO_2 demand by e-fuel production could support the build-up of CCU supply chains and, *vice versa*, thus increase the range of available emission mitigation options.

2.1.2.6 Higher Costs for EU Industry in Comparison to Importers

The EU-ETS 1 will be a burden for European automakers in various respects. Firstly, they will face higher steel and aluminium prices due to the phasing-out of free allowances for domestic steel producers and the corresponding cost of CBAM allowances to be purchased by importers of steel and aluminium. Secondly, they face additional costs for natural gas – used mainly for drying paint and heating assembly halls – due to carbon pricing. Thirdly, the carbon pricing of natural gas and coal in the EU-ETS 1 will also make electricity more expensive, as often gas and sometimes coal determine retail prices of electricity ("merit order")[208].

High energy prices also affect the cost of aluminium and steel production in the EU. In either case, electricity price compensation – if granted by the corresponding Member States – cannot make up for

---

[202] Id.
[203] UNITI – Bundesverband mittelständischer Mineralölunternehmen (2023), UNITI-Positionspapier zur geplanten Änderung des Brennstoffemissionshandelsgesetzes und der Anhebung des CO2-Preises, p. 2.
[204] pwc (2024), Navigating the global hydrogen ecosystem. Report.
[205] Nationaler Wasserstoffrat (2023), Treibhausgaseinsparungen und der damit verbundene Wasserstoffbedarf in Deutschland. Grundlagenpapier, 1.Februar 2023.
[206] UNITI – Bundesverband mittelständischer Mineralölunternehmen (2021), UNITI informiert – E-Fuels nur im Flugverkehr – ist das technisch und wirtschaftlich sinnvoll?
[207] European Commission (2024), Communication COM(2024) 62, Towards an ambitious Industrial Carbon Management for the EU.
[208] Ströbele, W. / Pfaffenberger, W. / Heuterkes, M. (2013), Energiewirtschaft – Einführung in Theorie und Politik, pp. 249 et seq.; Reichert, G. / Schwind, S. / Voßwinkel, J. S. (2022), EU Emergency Intervention in the Electricity Market, cepAdhoc 10/2022.

the comparative cost disadvantage against third country competitors importing cars to the EU since it is restricted to be only partial. This problem exists as indirect emissions and emissions embedded downstream in the value chain – like metals built in cars – do not carry a similar carbon price in case of imported vehicles. For vehicles produced in the EU, however, indirect and embedded emissions are directly accounted for in the EU-ETS 1 and the costs will be passed down the value chain once free allowances are phased-out. This worsens the cost disadvantage of domestic producers, as the carbon footprint of upstream stages is thus not reflected in the prices of cars imported from third countries.

In addition, the expansion of wind and solar energy requires high investments in expanding the electricity grid, which leads to higher grid fees especially during the years after anticipatory investments to cope with future grid needs when new grid capacity is still underutilised.[209]

Finally, EU automakers are facing competition from highly subsidised Chinese EV imports. When their loyal home market for internal combustion engines disappears by 2035 due to the ICE ban, they will lose their strong and competitive second pillar that generated profits to compensate for less profitable EV production. Hence, they may face difficulties to profitably offer EVs for the decarbonisation of EU road transport.

[209] Kurmayer, N. J. (2024), Power industry calls for long-term plans and tariff flexibility to finance grid expansion, Euractiv of 21 March 2024.

2.1.3 Interim Conclusion on Risks at Home

The EU's road transport decarbonisation strategy poses a multiple challenge to the competitiveness of the automotive industry. The path to very low-emission and ultimately zero-emission BEVs requires the EU automotive industry to develop and market vehicles whose benefits customers are not yet fully convinced of. Moreover, the uptake of these vehicles would require enabling conditions that are not fully under the control of manufacturers. Hence, although many different PHEVs and BEVs have already been brought into the market, demand is still weak, and decarbonisation of road transport is slow.

For achieving the EU decarbonisation targets in EU road transport and for preserving the competitiveness of the European automotive industry in the EU internal market, several risks have been identified:

- As long as potential users of electric vehicles (EVs) do not experience them as better technology than internal combustion engine vehicles (ICEVs) in terms of total cost of ownership (TCO), range and convenience of charging, the transition will not be self-propelling market-driven and risks to fail due to lack in demand.
- A potential failure of the future EU Emissions Trading System for road transport and buildings (EU-ETS 2) to deliver a sufficiently high carbon price in road transport would lead to a persistent TCO disadvantage for EVs in all vehicle segments and, for example, risks continued inefficient use of plug-in hybrids (PHEVs) in passenger cars.
- If the roll-out of charging infrastructure keeps lacking behind EV sales, the adoption of EVs will be mainly limited to drivers with the opportunity to charge their vehicle at home and/or who have limited range needs. For lorries and buses, the current EU policy is not proactive enough.
- Slow decarbonisation of electricity generation endangers the positive climate effects of the transition to battery electric vehicles (BEVs). Together with high electricity prices in EU Member States, this could disincentivise potential EV buyers who do not see the point of paying extra for questionable climate effects.

> The EU's "pure-electric" strategy for cars and vans – with strict CO_2 emission standards and a *de facto* ban on ICEVs in 2035 – as well as the "electric-centred" strategy for HDVs – considering also hydrogen-fuelled vehicles – is at **risk of failing due to lack of demand**. Compensating for ZEV disadvantages would require massive public support, the financial viability of which is questionable. Moreover, it offers few incentives for the decarbonisation of fuels.

- The strategic focus on BEVs increases the EU's external dependencies on raw material markets characterised by high supply concentration and geopolitical uncertainty.
- High costs and supply risks of batteries and critical raw materials can bring EU industry in a competitive disadvantage versus EV imports from China and other international competitors.
- CBAM cannot avoid carbon leakage via vehicle imports as in the EU the carbon price increases the cost of products in the value chain downstream of CBAM sectors – like vehicles produced in the EU. However, imported cars are featuring no or lower carbon costs for their built-in steel and aluminium and electricity used for production.

> The strategy focused on EVs risks **carbon leakage** through import competition when there is no level-playing field in the EU internal market with respect to imports.

2.2 At Global Scale: Risks to the EU Automotive Industry in Global Markets

The EU automotive industry exported more than 4.7 million cars in 2023, generating a EUR 90.6 billion trade surplus for the EU.[210] Main destinations of exported cars in terms of value were the US (24.7% share), the UK (19.2%), China (11.9%), Turkey (7.7%) and Switzerland (4.6%). In terms of vehicles exported, the UK (26.1%) ranks before the US (16.9%).[211] Still 31.1% of cars are exported to countries other than the top 5 export markets. For the EU automotive industry, the market conditions in current and future export markets are crucial to serve costumers there. Hence, manufacturers are keeping an eye on the global car market.[212] For example, in the US the demand for high-performance combustion engines could remain robust, which will influence the strategies particularly of German premium manufacturers.[213] A ban on ICEVs will initially only be in place for Europe as of 2035, while developments in the USA and China are much more open.[214] In general, decarbonisation policies in destination countries for car exports will shape the demand for different types of drive trains depending on their timing and whether they favour exclusively electric vehicles or leave a substantial role for biofuels or e-fuels. With the decline in the supply of combustion engines in Europe, production figures outside the continent could increase.[215] Therefore, the future interaction between regulatory developments and market demand will have a significant influence on the strategic direction of EU car manufacturers.[216]

As a consequence, EU manufacturers must adapt to global market conditions in order to remain competitive. Ideally, they should face a level playing field. This is important since, first, their home market gives automakers close market feedback and mostly provides them with a loyal customer base. If international competitors face legislation in their home countries that is open for efficient hybrids or ICEs running on biofuels or e-fuels, they might have stronger incentives to follow a multi-technology strategy and to head for car markets with similar decarbonisation strategies – especially those providing cheaper access to biofuels or wind and solar energy to produce e-fuels or suffering from less developed electricity nets. Second, the EU automotive industry's competitiveness in global markets is also affected by electricity and raw material prices in the EU compared to its main competitors. Third, geopolitical changes and trade conflicts might affect free trade and the availability of raw materials in a distinctive way across countries. Section 2.2.1 will analyse these conditions in global markets.

In this context, an important aspect of EU legislation is – or should be – whether it fosters competitiveness of the EU automotive industry also in global markets. Key factors in this respect are the potential loss of competitive advantage in ICE technology due to the shut-down of the home market due to strict CO_2 and Euro-7 emission standards, as well as higher prices for energy due to insufficient energy price compensation for carbon costs and for steel due to the phase-out of free EU-ETS 1-allowances. Moreover, the current CBAM might be insufficient to protect EU the automotive industry from carbon leakage. Finally, the EU has to ask itself if its EU-ETS 2 as designed now is really a model for socially acceptable carbon pricing in transport to the effect that other countries might also introduce a similar scheme to foster the uptake of efficient low and zero emission vehicles. These global aspects of the Fit-for-55 legislation will be dealt with in Section 2.2.2.

[210] ACEA (2023), EU vehicle exports: main destinations.
[211] Id.
[212] Wittenberg, K. (2024), Verbrenner-Aus: Neue Strategien von VW, Mercedes und BMW, Chip.de of 28 April 2024.
[213] Id.
[214] Fasse, M., Hubik, F., Backovic, L. (2024), Deutsche Autohersteller sortieren mehr Verbrennungsmotoren aus, Handelsblatt of 22 April 2024.
[215] Id.
[216] Id.

2.2.1 Status quo of Other Markets

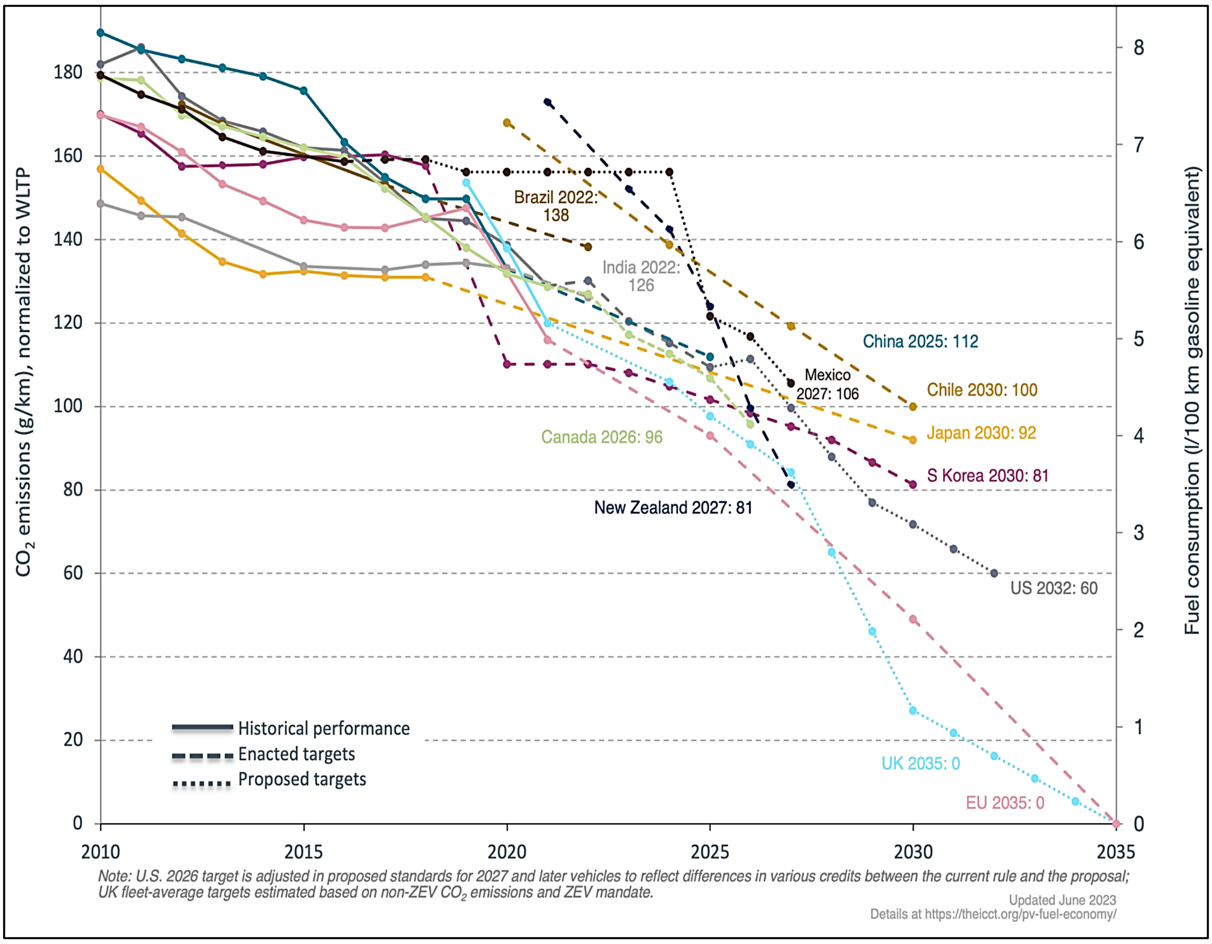
This Section outlines whether and when the most important markets will ban ICEs, if hybrids will be still allowed and how strict their CO_2 emission standards are. At the same time, it shows how global competitors in car production react to the decarbonisation policies in their home country – possibly in contrast to the reaction of EU carmakers to the EU's pure-electric strategy. This will shed light on risks of depriving EU carmakers from a home market for alternatives to BEVs and FCEVs that may strive in the global markets. Subsequently, demand perspectives in important markets are highlighted. Furthermore, the risks of competitive disadvantages from high energy and raw material prices in the EU are analysed. Finally, geopolitical risks for EU carmakers are discussed.

2.2.1.1 Regulation and Policies in Other Markets

In the following, key features of the relevant regulation on CO_2 emissions of cars and vans in important automotive supply and demand markets are portrayed. Moreover, information is provided on the volume of the respective markets and – if available – on the strategies of local carmakers.

In a graphical summary Fig. 10 shows the evolution of CO_2 emission standards in different countries.

Fig. 10: Passenger Car CO_2 Emissions and Fuel Consumption – Normalised to WLTP



Source: International Council on Clean Transportation (ICCT)

Tab. 2 summarises the main aspects that will be elaborated in the following Sections.

Tab. 2: CO_2 Emission Regulation in Countries with Considerable Car Markets

Countries	CO_2-Standards [g CO_2/km - Year] [a]		Start of ICE Ban						Production / Sales in 2023 Cars, Vans & Pickups [million]	
			Pure ICEV		PHEV Hybrids		Other Hybrids			
	Cars	Vans	Cars	Vans	Cars	Vans	Cars	Vans	Production	Sales
Producers										
EU	49 *(2030)*	90 *(2030)*	2035	2035	2035	2035	2035	2035	12.5	10.5
UK	27†(2030)		2035	2035	unclear	unclear	unclear	unclear	0.9	1.9
China	112 *(2025)*		2035	2060†	2060†	2060†	2060†	2060†	26.1	25.8
Japan	92 *(2030)*		2035	2040	-	-	-	-	7.8	4.0
India	126 *(2022)*		2040†	2040†	2040†	2040†	2040†	2040†	4.8	4.0
S. Korea	81 *(2030)*		2035	2035	2035	2035	2035	2035	3.9	1.5
Iran			-	-	-	-	-	-	1.1	1.0
Turkey			2040†	2040†	2040†	2040†	2040†	2040†	1.0	1.0
Indonesia			2050†	-	2050†	-	2050†	-	1.2	0.8
Taiwan			2040†	-	2040†	-	2040†	-	0.2	0.4
US	45 *(2032)* [b]	56 *(2032)* [b]	2035*	2035*	-	-	2035*	2035*	7.6	12.3
Mexico	106†*(2027)*		-	-	-	-	-	-	0.9	1.4
Canada	96 *(2026)*		2035†	2035†	-	-	2035†	2035†	1.4	1.7
Brazil	138 *(2022)*		-	-	-	-	-	-	1.8	2.2
Others										
Switzerland	49◊*(2030)*		2035◊	2035◊	2035◊	2035◊	2035◊	2035◊		0.3
Israel			2030†	2030†	2030†	2030†	2030†	2030†	-	0.3
Chile	100 *(2030)*		2035	2035	2035	**2035**	2035	2035	-	0.2

* ICE bans up to now only in: California, Vermont, New York, Washington, Oregon, Maryland, Massachusetts, Virginia, Rhode Island, New Jersey, New Mexico and Washington DC.
† Proposed.
◊ With creditability of synthetic fuels for new vehicles.

[a] Worldwide Harmonized Light Duty Test Procedure (WLTP) or other test procedure normalised to WLTP, except for US.
[b] US combined test procedure.

Source: CO_2 standards and ICE bans: International Council on Clean Transportation (ICCT); for US: EPA, coltura.org;
Production and sales statistics: ACEA, International Organization of Motor Vehicle Manufacturers (OICA).

2.2.1.1.1 Asia

China

Public multi-technology strategy

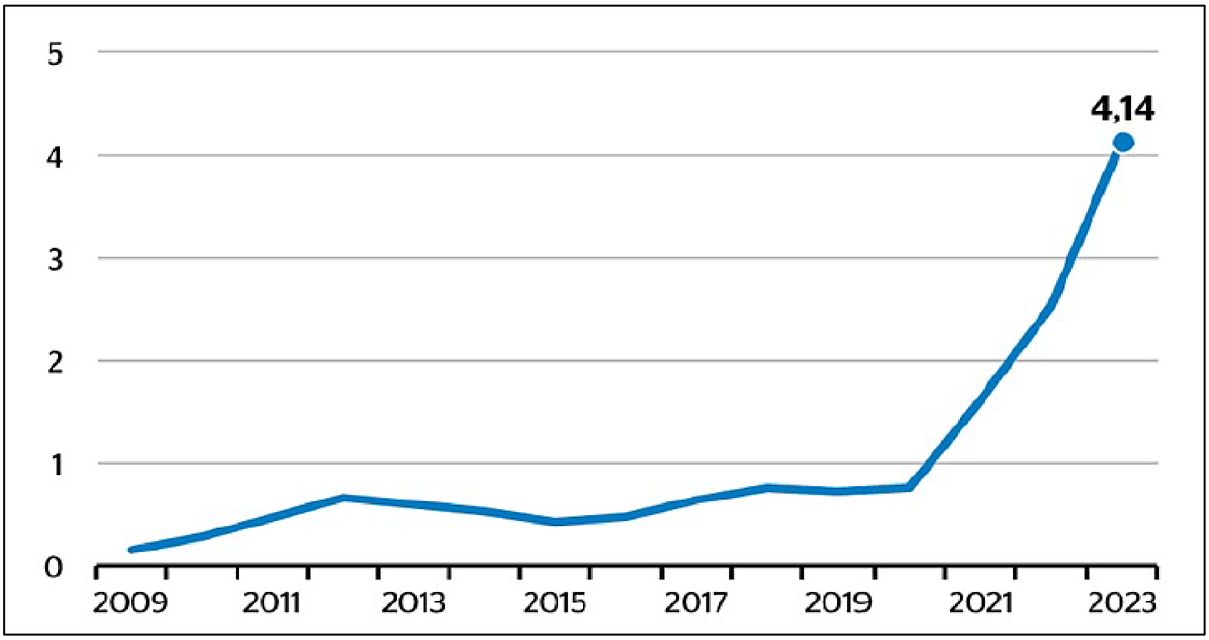
Although the Chinese government is focussing on technology leadership in the production of electronic vehicles, it has refrained from an early ban on ICE technology or a drastic tightening of CO_2 emission standards. Accordingly, the fleet of newly registered cars in China must reach a target of 112 g CO_2/km by 2025 (see Tab. 2). Instead, in its strategy for the development of a green and low carbon automotive industry up to 2060 (“Roadmap 1.0”) of 7 December 2023, the Chinese Ministry for Industry and Information Technology opts for a further development of vehicles with combustion engine operable with different types of fuels including hydrogen, ammonia, liquid biofuels and renewable synthetic fuels.[217] According to market analysts, “the ICE survives in China in a modified form as a relatively cheap and simple hybrid or modern engine that can run on different synthetic fuels.”[218] Moreover, “China is undogmatic about technologies and wants to keep export opportunities open to all countries, including those that do not rely on electricity.”[219] Even though e-mobility is growing rapidly in the two dozen largest Chinese metropolises, experts believe there will not yet be an adequate charging infrastructure in rural areas, meaning that combustion engines will still be on the road for a long time to come. Hence, China wants to hold “all the technological cards”.[220]

Carmakers’ strategies

In the decisions whether to produce EVs or ICEs and whether to produce for the Chinese market or for exports, Chinese automakers pursue different strategies: BYD focuses on expanding market share in China with EVs and Dual Hybrid Transmission (DHT) PHEVs. SAIC has been expanding with ICEVs into developed markets like Western Europe. Chery exports around 55% of its vehicles, mainly 12-volt ICEVs with key markets being Russia, South America, Africa, and Central Asia. In line with its exporting strategy, Chery is planning an assembly plant in Europe. “We want to build cars for the world and not for China,” explains Chery’s Head of Europe Jochen Tueting why Chery’s new products are developed in the heart of Europe. “In order to survive on the global markets, combustion engines are also clearly part of our strategy for the future.”[221] Li Auto favours extended range EVs (EREVs), where the battery can also be charged by an ICE, thereby seeing rapid sales growth. Overall, analysts see potential for growth of car sales in ASEAN countries, with Chinese automakers seemingly seizing opportunities faster than EU and US counterparts.[222] Meanwhile, Chinese car exports have shown exponential growth in recent years (see Fig. 11).

[217] Wissenschaftliche Dienste des Deutschen Bundestags, Sachstand: Regelungen in China und den USA zu Verbrennungsmotoren und emissionsarmen Alternativen, WD 5 – 3000 – 018/24.
[218] JSC Automotive (2024), Our Knowledge for your Planning: China Powertrain Electrification Report.
[219] Hägler, M. (2024), Womit keiner rechnet: Verbrennermotoren in China, Zeit Online of 8 March 2024 (own translation).
[220] Id.
[221] Freiwah, P. (2024), Europa-Chef von China-Hersteller über EU-Ermittlungen – „Viele der Angriffspunkte sind obsolet“, Merkur.de of 9 April 2024 (own translation).
[222] JSC Automotive (2024), Der Verbrenner überlebt, aber in veränderter Form, Pressemitteilung vom 16. Januar 2024.

Fig. 11: Chinese Exports of Passenger Cars (Mio. Vehicles)



Source: CAAM, Graph: Deutsche Verkehrszeitung (DVZ)[223]

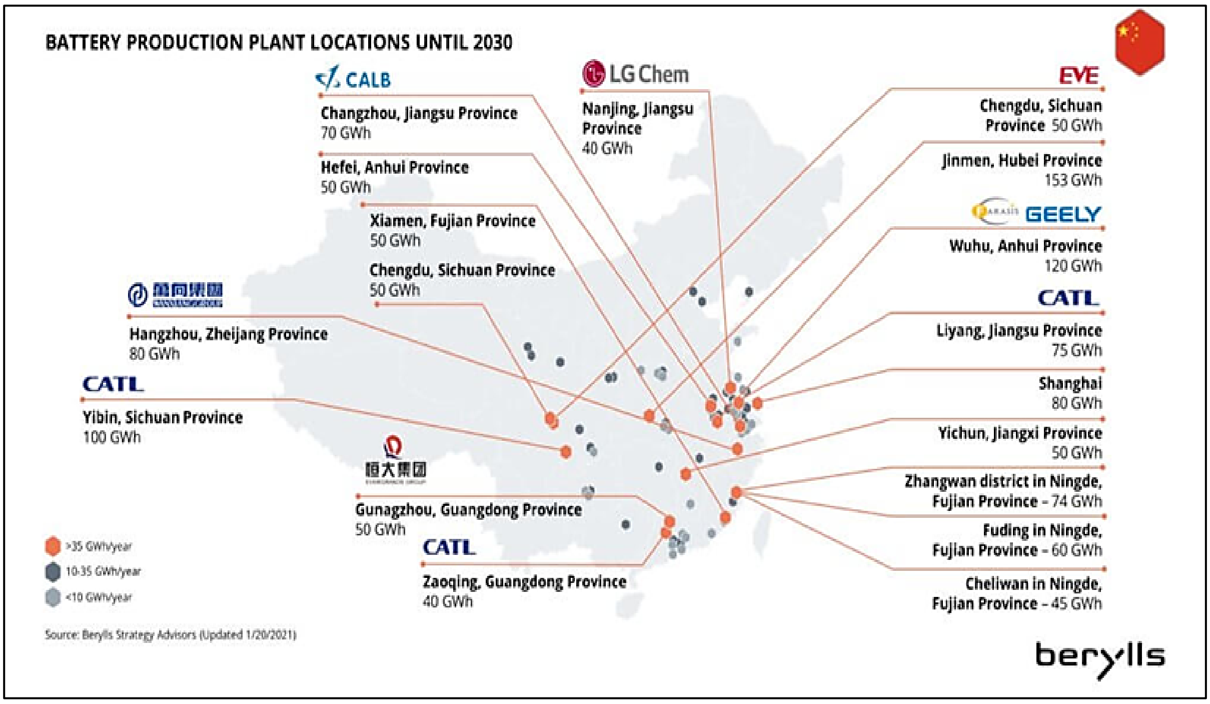
Electric Vehicles

Chinese domestic EV manufacturers – such as BYD, NIO, and Xpeng – have become influential global players, with impressive sales growth. This reflects the growing popularity and competitiveness of Chinese e-mobility brands and improved perception of Chinese EVs. Chinese EV companies are gaining some ground in the EU market due to competitive pricing, attractive features, and supportive regulations, while facing challenges in the US market due to stringent regulations and tariffs since they are seen as a threat there.[224]

Moreover, European and US car manufacturers are increasingly relying on Chinese brands to meet the demand for electric drivetrain components and other EV technologies. In addition to accounting for 76% of global battery cell production capacity – that will be considerably extended up to 2030 to reach a yearly capacity of over 2000 GWh (see Fig. 12) –, China has a dominant position in every aspect of the supply chain, including the sourcing of raw materials required for battery manufacturing. This level of control further solidifies China's central role in the EV ecosystem.[225]

[223] DVZ of 19 June 2024, Marktanalyse: E-Autos haben es schwer.
[224] Shandilya, D. (2023), The Growing Threat from China in The Global Electric Vehicle Landscape, LinkedIn of 2 July 2023.
[225] Id.

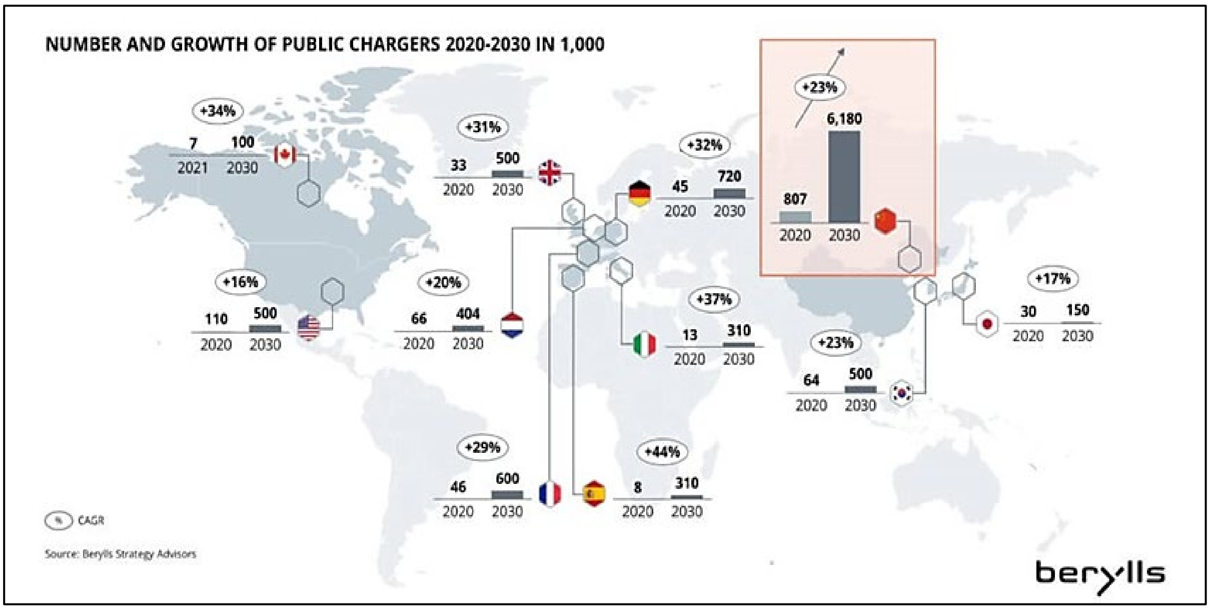
Fig. 12: Planned “Giga-Factories” for Battery Production in China Until 2030



Source: Berylls Strategy Advisors

With respect to enabling conditions for e-mobility, China has already a comparatively large network of public charging points and plans to increase it considerably until 2030 (see Fig. 13).

Fig. 13: Expected Number of Public Charging Points in Key Auto Markets by 2030



Source: Berylls Strategy Advisors

Japan

At 92 g/km the CO_2 emission standard for 2030 in Japan is significantly less stringent than in the EU. Stricter limits for the period after 2030 have not been announced yet. However, Japan plans to ban sales of new ICE-only cars by 2035, leaving sales of HEVs and PHEVs unrestricted.

The Japanese car manufacturer Toyota Motor Corporation (TMC) is not only the biggest global carmaker but also the global market leader in HEV[226], producing mainly gasoline-electric hybrids. For its forthcoming BEVs TMC is betting strongly on solid-state batteries that would allow a strong increase in range and very short charging-times.[227] However, it plans to "drastically increase the production of electric cars without neglecting other drive systems such as combustion engines and fuel cells."[228] CEO Koji Sato made clear that the enemy was carbon dioxide, not the type of drive. Therefore, the most important question was how emissions could be reduced worldwide. This would require a "realistic approach". After all, in many countries only a small proportion of the electricity came from renewable energy sources and TMC would not want to leave any customers behind.[229]

Nissan, Japan's number two carmaker, was an early EV adopter, coming out with the Leaf EV in late 2010. It aspires that EVs will account for 60% of its global offerings by 2030. Nissan's offerings of new EVs, plug-ins and hybrids are planned to increase across all global markets, including the US, Europe, Japan, the rest of Asia, Australia and Africa. With its new "Arc plan", Nissan wants to demonstrate its "continuous progression and ability to navigate changing market conditions".[230]

In China – contrary to the trend of other foreign carmakers – TMC has increased its share of car sales since 2017, thanks to continued demand for its ICEV.[231] To remain strong in the Chinese market, TMC wants to better fulfil the wishes of Chinese customers through closer cooperation with its Chinese partners BYD, China FAW and GAC.[232] Meanwhile, Nissan is planning to cut capacity of production in China in face of declining market shares.[233]

India

Since 2022, the fleet of newly registered passenger cars must comply with a CO_2 emission standard of max. 126 g/km. Stricter limits for the future have not been set yet (see Tab. 2). At the COP26 in 2021, India signed the "Declaration on accelerating the transition to 100% zero emission cars and vans", committing itself to working towards 100% zero emission vehicle sales globally by 2040.[234] However, this pledge is not legally binding.[235]

Indian major carmaker Tata aims for climate neutrality by 2040 for passenger cars and by 2045 for commercial vehicles – moving from conventional fuels to natural gas, blended fuels like flex fuels and

---

226 Automobil Industrie of 25 October 2023, Hybridtechnik 30 Jahre Toyota Prius.
227 Lebowitz, M. (2024), Why Toyota May Have the Best Strategy in the EV Race, Yahoo Finance of 18 February 2024.
228 Kölling, M. (2024), Noch kein Ende für Benziner: Toyotas neue Führung setzt auf Mehrgleisigkeit, Neue Zürcher Zeitung of 9 April 2024 (own translation).
229 Id.
230 Euronews of 25 March 2024, Japan's Nissan promises aggressive electrification push to cut costs, boost global sales.
231 Inside Future Mobility of 3 April 2024, Global car makers contemplate exit from China.
232 Kanning, T. (2024), Wie Toyota in China zu neuem Schwung finden will, FAZ.net of 1 August 2023.
233 N Kawakami, A. / Matsumoto, S. / Okinga, S. (2024), Nissan and Honda to cut China production as EV race heats up, Nikkei Asia of 12 March 2024.
234 Accelerating to Zero Coalition (2024), Signatories.
235 Accelerating to Zero Coalition (2021), Zero Emission Vehicles Declaration.

biofuels and subsequently zero-emissions vehicles including BEVs and hydrogen-powered vehicles (HPVs).[236]

South Korea

The Korean CO_2 emission standard for passenger cars is currently set at 81 g/km. Comparable to Japan, this is less stringent than in the EU. No stricter future standards have been announced yet, either. However, South Korea plans to ban sales of all ICE based cars, including hybrids, by 2035.[237]

Nevertheless, South Korea's carmaker Kia will add more hybrid cars to its portfolio in coming years as a response to the faltering global uptake of electric cars. In a bid "to manage fluctuation in EV demand" and to take account of the "predicted increase in sales of electrified combustion cars", Kia will launch nine new hybrids by 2028 "across most major model lines globally".[238] Moreover, in its home market Korea, hybrids are expected to be the best-selling form of powertrain at the end of the decade.[239] South Korea's Hyundai is now also planning to develop more hybrids and EREVs.[240]

Turkey

Turkey also signed the nonbinding "Declaration on accelerating the transition to 100% zero emission cars and vans" but does not have CO_2 emission standards yet.[241]

2.2.1.1.2 North America

USA

The US Environmental Protection Agency (EPA) established new federal emission standards for motor vehicles of the model-years from 2027 to 2032, which are intended to increase sales of electric vehicles. The CO_2 standards steadily tighten from 139 g CO_2 per mile in 2027 to 73 g per mile – or 45 g CO_2/km – in 2032, determined by the "US Combined" test cycle.[242] US States can establish stricter air quality laws than the Federal Government. California's Advanced Clean Cars II regulations require all new passenger cars, light trucks and SUVs sold in California to be zero-emission vehicles or PHEVs by 2035.[243] Several other states adhere to this ICEV sales ban: Vermont, New York, Washington, Oregon, Maryland, Massachusetts, Virginia, Rhode Island, New Jersey, New Mexico and Washington DC.[244]

US carmaker Ford is investing in the build-up of a full EV line-up while also expanding its hybrid electric vehicle offerings. By the end of the decade, Ford plans to offer hybrid powertrains across its entire conventional passenger cars portfolio ("Ford Blue line-up") in North America.[245] Simultaneously, Ford

[236] Barooah, S. B. / Bhatia, S. (2023), How Tata Motors is working on a twin strategy for carbon neutrality , Economic Times Auto of 19 January 2023.
[237] Just Auto of 16 March 2022, South Korea to phase out ICE vehicles by 2035.
[238] The FOAT of 5 April 2024, Kia adds new hybrid models as electric car demand falters.
[239] Id.
[240] Paultan.org of 28 August 2024, Hyundai plans range extender EVs with 900+ km range as stopgap to full electrification, as BEV demand slows.
[241] Accelerating to Zero Coalition (2024), Signatories.
[242] EPA (2024), Regulatory Announcement – Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles: Final Rule.
[243] California Air Resources Board, Cars and Light-Trucks are Going Zero - Frequently Asked Questions.
[244] Coltura, Gasoline Vehicle Phaseout Advances Around The World.
[245] Ford Newsroom of 4 April 2024, Ford Updates EV, Hybrid Plans, Readies Manufacturing Plants.

is also investing in HEVs.[246] General Motor (GM) wants to eliminate tailpipe emissions from light-duty vehicles by 2035. Nonetheless, GM is incorporating its PHEV technology to select vehicles in North America to meet stricter emissions regulations.[247] For the global leading carmaker TMC – second in sales in the US market – hybrid cars can help reduce CO_2 emissions more and faster than battery electric vehicles, which remained too expensive for many buyers. TMC executives have recently stated that factoring in a cleaner manufacturing process for hybrid cars and the limited availability of critical battery materials, such as lithium, hybrids were a safer short-term bet.[248]

Recently, carmakers and suppliers are adding capacity to build HEVs and PHEVs for the US market, responding to increased consumer demand.[249] For instance, the market share of HEVs – above all produced by Toyota, Honda and other Asian carmakers – has been consistently higher than the EV share in recent years.[250] However, there are other reasons, too. The US presidential election in November 2024 puts the federal EV subsidies and emissions rules at risk. Since most legacy automakers currently lose money on EV, and hybrids are a more profitable path to reducing CO_2 emissions if a future administration changes course, analysts consider hybrids a "big hedge against an administrative change that cools down the push from a regulatory standpoint".[251] Suppliers such as Schaeffler are making long-term investments to expand capacity for hybrid production.[252]

Canada

In Canada, the CO_2 fleet limit value is set at 96 g/km by 2026. By 2035, all new vehicles sold in Canada will have to be either 100% free of tailpipe emissions or be plug-in hybrids with an all-electric range of at least 80 km ("Canadian ZEV mandate").[253] The option to comply with the Canadian ZEV mandate by selling plug-in hybrids is capped at 20% from 2028 onwards.[254]

Canada was the third-largest source country for light vehicle imports into the United States during 2021. Hence, US CO_2 emissions regulation is also very relevant for the Canadian car industry.

Mexico

CO_2 emission standards in Mexico are still quite moderate, amounting to 106 g/km in 2027. Mexico has not yet adopted phase-out targets for internal combustion engines (see Tab. 2). However, Mexico is a signatory to the non-binding COP26 declaration on accelerating the transition to 100% zero-emission car and van sales by 2040[255].

The Mexican automotive industry is exporting 90% of its total production, with 80% of the vehicles being shipped to the U.S. and Canada.[256] Hence, it is heavily influenced by the legislation there.

---

[246] CNBC of 8 December 2023, Why automakers are turning to hybrids in the middle of the industry's EV transition.
[247] Wayland, M. (2024), Will GM's Shifting Hybrid Strategy Disrupt Its EV Business Plans?, Motortrend of 31 January 2024.
[248] Ewing, J. / Dooley, B. (2024), Toyota, a Hybrid Pioneer, Struggles to Master Electric Vehicles, The New York Times of 7 September 2024.
[249] White, J. (2024), US automakers race to build more hybrids as EV sales slow, Reuters of 15 March 2024.
[250] Lebowitz, M. (2024), Why Toyota May Have the Best Strategy in the EV Race, Yahoo Finance of 18 February 2024.
[251] Id.
[252] Id.
[253] Hundal, T. (2024), Here's Why Canada's Car Market Could Get Weirder Than You've Ever Imagined, The Autopian of 17 January.
[254] Livingston, B. (2024), Time to Reboot: The Federal ZEV Mandate Requires Flexibility, C.D. Howe Institute Working paper.
[255] Accelerating to Zero Coalition (2024), Signatories.
[256] Investment Reports of 5 June 2023, José Zozaya Presidente AMIA (The Mexican Association of the Automotive Industry).

2.2.1.1.3 Other Important Car Markets

United Kingdom

The UK has recently postponed its ICE ban from 2030 to 2035 – leaving still open the treatment of hybrids. Originally the ban for hybrids was delayed by 5 years to 2035. It is still unclear whether a similar delay of 5 years will apply for hybrids with the new 2035 deadline.[257] Then Prime Minister Rishi Sunak justified the ICE ban postponement with the need to strengthen the UK's automotive industry so not to be reliant on heavily subsidised carbon intensive imports from countries like China – hence he wanted to give more time to prepare.[258]

The main destination of car exports from the UK are the US, China and EU countries like Germany, France and **Belgium. Its fastest growing export markets in 2022 were the United Arab Emirates and South Korea.[259]**

Brazil

Brazil has CO_2 emission standards set at 138 g/km that apply since 2022. A ban of ICEVs is not in sight (see Tab. 2).

A consortium of the Mercedes-Benz Group, Stellantis, Bosch and the Brazilian company Ipiranga and others established in 2021 two partnership agreements with the Institute for Research on Energy and Nuclear Power (Ipen) to develop H_2 vehicle technologies: One projects involves developing low-temperature fuel cells operating at around 100 °C, to utilise ethanol as a fuel for electric cars; the other one aims to create a system that can combine ethanol and H_2 to fuel traditional combustion engines.[260]

Non-Producer Countries with ICE Bans

Israel proposed an ICE ban already for 2030 and Chile already legislated the ban for 2035, but both car markets are rather small (see Tab. 2).

Switzerland initially followed the EU in its CO_2 emission standards – including the limit of zero tailpipe emissions from 2035. However, with the recent decision in favour of the crediting of synthetic fuels for new vehicles, ICEs and hybrids can still be sold in Switzerland after 2035. Synthetic fuels may contribute to compliance with CO_2 emission standards even before if for the implementation of this decision a crediting system is established that enables importers and manufacturers of vehicles to factor the CO_2 emissions saved by the use of e-fuels into the fleet limits.[261]

---

[257] Roberts, G. (2023), PM confirms ban on sale of new fossil fuel cars and vans to be delayed, FleetNews of 20 September 2023.
[258] Id.
[259] OEC.world, Cars in United Kingdom.
[260] Zaparolli, D. (2021), Electric vehicles powered by ethanol, Pesquisa, issue #308, October 2021.
[261] Harttmann, C. (2024), Straßengüterverkehr: Schweiz beschließt Anrechnung von eFuels, Transport of 5 April 2024.

2.2.1.2 International Demand Perspectives

In the following, some relevant demand aspects in leading car markets as well as in selected developing countries are picked up that can serve as illustrative examples what challenges an imposed pure-electric strategy might bring upon the EU automotive industry.

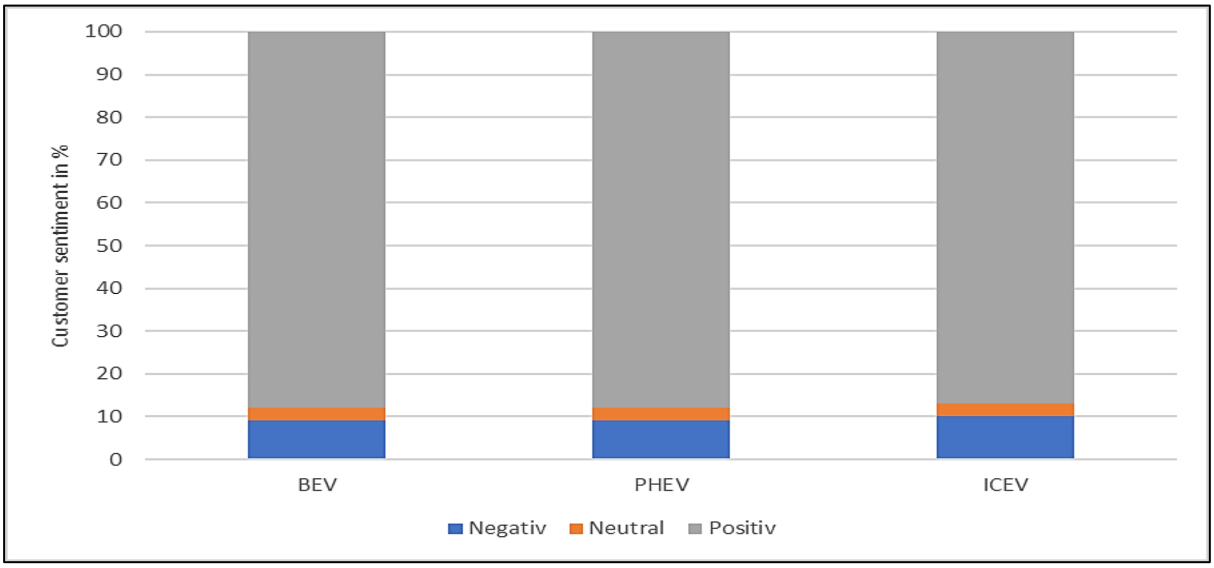
2.2.1.2.1 Lead Markets

China

Recently, the world's largest auto market China has become increasingly contested. Traditional international manufacturers like Volkswagen Group and TMC ceded ground to Chinese rivals and saw their share of sales shrink in 2023, especially due to the overtaking of Chinese firms in the growing EV market.[262] As a consequence, foreign automakers that lost market shares to local rivals in China have boosted exports – accounting for more than 20% of China's total car exports in 2023.[263]

Chinese customers do not show pronounced differences between different types of powertrains, either, as shown in Fig. 14.

Fig. 14: China: Customer Sentiment Towards Different Powertrain Types



Source: Berylls Strategy Advisors, cep illustration

USA

Under the EPA's original proposal for the new Corporate Average Fuel Economy (CAFE) standards which act as CO_2 emission standards, it was forecasted that 60% EVs by 2030 and 67% by 2032 were needed to meet the requirements. However, as the final legislative act softened those requirements, less EVs will be needed[264] – reducing also the need for charging infrastructure, which is expected to lag behind developments in Asia or Europe. (see Fig. 11). The EPA released updated projections on the

[262] Li, Q. / Goh, B. (2024), VW, Toyota saw China market share shrink in 2023, Reuters of 10 January 2024.
[263] Yan, Z. / Goh, B. (2024), Foreign auto brands boost exports as China sales remain weak – data, Reuters of 22 January 2024.
[264] Lindquist, J. (2024), (The EPA) Drives Me Crazy – New US Rule on Tailpipe Emissions Conflicts With Energy Reality, RBNEnergy Daily Blog of 12 April 2024.

sales trajectories of various powertrain technologies consistent with compliance with the final CAFE standards (see Tab. 3).

Tab. 3: US: Powertrain Share Projections Under Different Compliance Scenarios

Projected New Vehicle Market Share Under Various Compliance Scenarios							
Pathway	Technology	2027	2028	2029	2030	2031	2032
Pathway A: Higher BEV Pathway (base case)	ICEV	64 %	58 %	49 %	43 %	35 %	29 %
	HEV	4 %	5 %	5 %	4 %	3 %	3 %
	PHEV	6 %	6 %	8 %	9 %	11 %	13 %
	BEV	26 %	31 %	39 %	44%	51 %	56 %
Pathway B: Moderate HEV and PHEV Pathway	ICEV	62 %	56 %	49 %	39 %	28 %	21 %
	HEV	4 %	4 %	3 %	6 %	7 %	6 %
	PHEV	10 %	12 %	15 %	18 %	24 %	29 %
	BEV	24 %	29 %	33 %	37 %	41 %	43 %
Pathway C: Higher HEV and PHEV Pathway	ICEV	61 %	41 %	35 %	27 %	19 %	17 %
	HEV	4 %	15 %	13 %	16 %	15 %	13 %
	PHEV	10 %	17 %	22 %	27 %	32 %	36 %
	BEV	24 %	26 %	30 %	31 %	34 %	35 %

Source: EPA, Table from RBNEnergy Daily Blog[265]

As can be seen, the more plug-in hybrids (PHEV) and other Hybrids (HEV) are sold, the less internal combustion engine vehicles (ICEV) can be sold and the less battery electric vehicles (BEV) must find a client for carmakers to comply with the US CO_2 emission regulation. Such a relationship will also hold roughly in other countries while emission norms are not too strict.

After demand for electric cars had fallen suddenly in the second half of 2023, 2024 started with slowing sales of battery-powered cars. Fewer buyers of new cars are considering EVs for their next vehicle – a lack of access to charging infrastructure being the main reason.[266] Meanwhile, hybrids are gaining an advantage: TMC reported an 84% sales growth for its hybrids and EV, with Prius sales increasing by 363%, while Ford had a 32% increase in hybrid sales. Recently, in the US tests of a prototype flex fuel plug-in hybrid running on an E85 ethanol gasoline blend showed lower operating costs and CO_2 emissions when run on E85 gasoline than in battery mode on public charging.[267]

Overall, the shift in the total car fleet in the US to more efficient cars with low or zero CO_2 emissions will be rather slow. This is because vehicles last almost for 20 years on average in the US.[268] There's also a need to continue improving gas and EV fuel economies, meaning that in the process of fleet turnover, attention needs to be given to gas vehicle fuel economy standards.[269] Hence a reduction of ICEVs sales together with an increase in sales of more efficient hybrids would have a strong positive

[265] Id.
[266] Naughton, N. (2024), Hybrids are more popular than ever as shoppers cool on EVs, Yahoo News of 14 March 2024.
[267] RFA – Renewable Fuels Association (2024), The World's First Flex Fuel Plug-in Hybrid Electric Vehicle.
[268] Woody, M. et al. (2023), Decarbonization potential of electrifying 50% of U.S. light-duty vehicle sales by 2030, Nature Communications 14, 7077 (2023).
[269] Id.

effect on decarbonisation in case that demand for BEVs still lacks behind the ambitious policy goals for BEV sales of the base case.

Canada

According to a recent study[270], Canada should be able to meet the 2035 100% ZEV mandate for about 270,000 passenger cars. However, it is unlikely to meet it for the 1,240,000 remaining light vehicles – pickup trucks, vans and SUVs/crossovers – comprising 82% of the total light vehicles market.

2.2.1.2.2 Developing Markets

In Brazil, most gasoline cars are "flex cars" running on a blend of gasoline and ethanol produced from sugar cane. Most diesel cars run on a blend of fossil diesel with biodiesel. With a mature and structured biofuel market, the country is not likely to move away from alternatives linked to ethanol and biodiesel anytime soon.[271] Brazil's continued reliance on flex fuel vehicles — that can burn either gasoline or ethanol — is also the result of a lack of adequate charging infrastructure and the high EV prices. Hybrids with both a flex motor and battery-charging capability without the need of charging by cord are seen as an interim solution for reducing GHG emissions until the market is developed enough to stop using fossil fuels.[272] Brazil's National Association of Automotive Vehicle Manufacturers (ANFAVEA) projects that EVs will be cost-effective in 2031 and at least a third of new cars will be powered by electricity to some degree in 2035, either plugin or full hybrids. Flex cars could fall to around 50% of light vehicle registrations in 2030 from almost 99%, with hybrids gaining around 39% of market share over the same period.[273] A study finds that in the run-up to climate neutrality by 2050, a biofuel-focused strategy for the transport sector in Brazil is cheaper than a battery electrification strategy.[274]

In other sugarcane-producing countries in Africa, Latin America, and Asia[275]—especially India, the second largest producer in the world after Brazil – the demand for flexible hybrid vehicles might also increase. The ethanol infrastructure may well serve into the farer future for fuel cell electric vehicles that can run on ethanol.[276] Hybrid solutions that combine electric power trains with ethanol fuelled combustion engines might have high demand in the near and wider future in these countries. Especially in India, hybrids have become favourites of customers due to their reliability, affordability and lower maintenance cost. Meanwhile, limited range, lack of charging infrastructure and expensive insurance are concerns to be addressed for EVs to gain larger market shares.[277]

In addition, customers are concerned that electricity generation in India is largely thermal and therefore EVs do not contribute to reducing CO_2 emissions.[278] Regarding biofuels different from ethanol, the Sustainable Alternative towards Affordable Transport (SATAT) scheme has been started by the Indian

---

270 Livingston, B. (2024), Time to Reboot: The Federal ZEV Mandate Requires Flexibility, C.D. Howe Institute Working paper.
271 Guedes, L. / Moreira, G. (2023), Standard engines to endure in Brazil amid EV growth, Argusmedia.com of 20 December 2023.
272 Id.
273 Id.
274 Poggio, M. et al. (2024), The role of bioenergy in Brazil's low-carbon future, Energy and Climate Change, Vol. 5, 2024.
275 See United Nations Industrial Development Organisation UNIDO (2022), Unlocking the Bioethanol Industry, for a comprehensive discussion of the potential and benefits of bioethanol production for developing countries and the view that „the use of biomass for bioenergy can go along with food production, without direct competition".
276 Zaparolli, D. (2021), Electric vehicles powered by ethanol, Pesquisa, issue #308, October 2021.
277 Philip, L. (2023), Hybrid vehicles have overtaken pure-play electric cars in India. What is the road ahead for EVs?, Economic Times Auto of 24 December 2023.
278 Id.

Ministry of Petroleum and Natural Gas to encourage entrepreneurs to set up compressed biogas (CBG) plants. However, it would need an "aggressive push for pan-India implementation".[279]

2.2.1.2.3 Global stocktake of energy demand in road transport

In 2021, the world produced 25 000 TWh of electric energy and the global road vehicle fleet totalised around 1.6 trillion vehicles consuming 19 138.9 TWh of energy from liquid fuels.[280] It is estimated that the total replacement of combustion engines by electric would require an increase in energy production of 1.7 times – with the need of replacing fossil fuels in energy production.[281] Currently, 91% of the produced bioenergy is crop-based ethanol and biodiesel blended with fossil fuels, with the US and Brazil as the leading producers, and in 2019, the world consumed 1 111 TWh of energy from these liquid biofuels.[282] The current bioenergy production would have to increase 17 times to meet the demand to decarbonise the global vehicle fleet on its own.[283] Hence, "the future of energy supply in the transport sector is not a case of electricity versus bioenergy, but the coexistence of both" and "hybrid solutions promise an interesting way to contour energy demand".[284]

2.2.1.3 Prices for Energy and Materials

An important dimension of global competitiveness of industries is the cost of energy and raw materials. Therefore, the higher the energy intensity of production and the more raw materials are required, the more relevant energy and raw material prices become. In this respect, the Draghi Report points out that "structurally higher energy costs […] contribute to the serious competitive disadvantage for the EU on the cost side" and that "higher energy costs are especially relevant for the energy-intensive battery production".[285]

2.2.1.3.1 Gas Prices

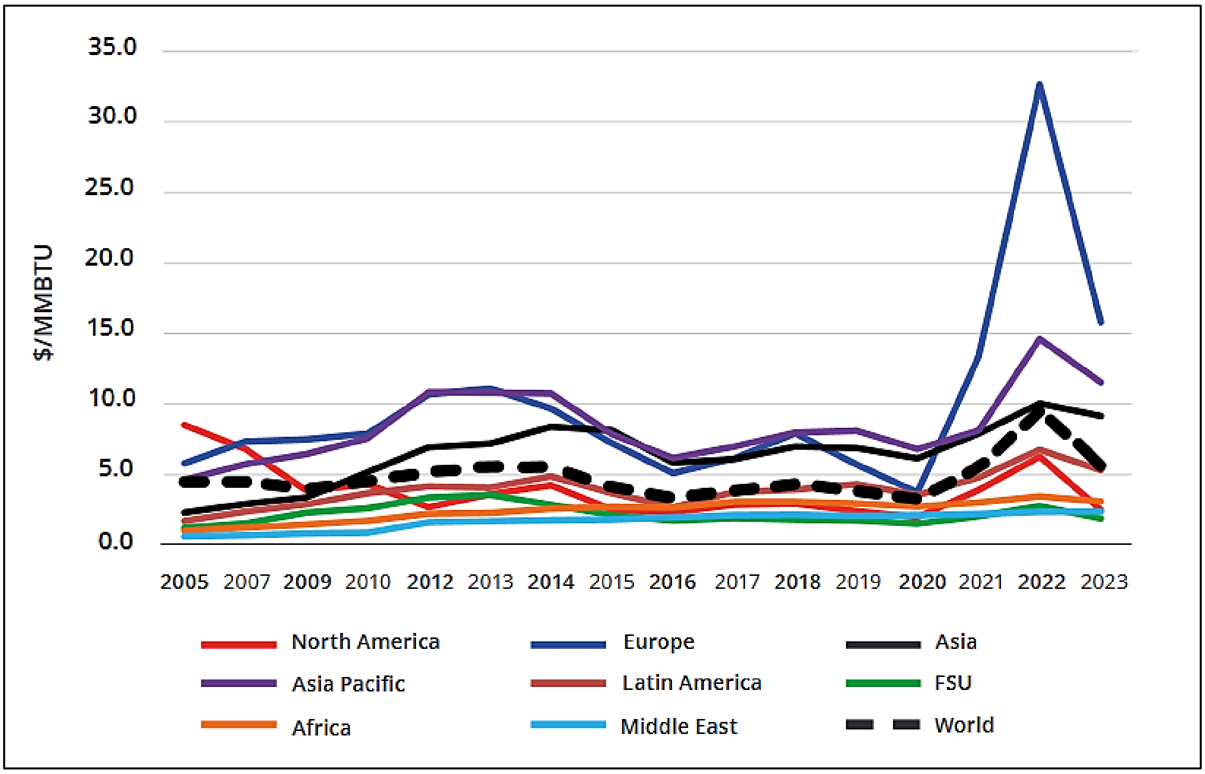
Natural gas is needed in the automotive industry mainly for melting aluminium, drying paint and heating assembly halls.

In 2022, competitors in other world regions faced considerably lower gas prices than European manufacturers (Fig. 15). The reason for higher gas prices was that demand for natural gas started to increase drastically in Asia due to post-Covid-19 recovery, supply shortages and unusual weather conditions which led prices to sky-rocket in autumn/winter 2021[286]. The price hike was then reinforced in Europe by the war in Ukraine, which started in February 2022, with reduced supply of Russian gas. Recently, gas prices have started to fall moderately, but they will probably stay higher than before the price shock since alternatives to Russian gas are more expensive and rising carbon prices will increase the cost of natural gas, too.[287]

---

[279] Mattoo, R. / Saxena, P. (2023), Fuel efficiency improvement and emission standards in road transport, The Energy and Resources Institute.
[280] Giehl, A. et al. (2023), Ethanol and electricity: Fueling or fooling the future of road passenger transport?, Energy Nexus Vol. 12, December 2023.
[281] Id.
[282] Id.
[283] Id.
[284] Id.
[285] Draghi Report – Part B, p. 149.
[286] Wetzel, D. (2021), Der Gaspreis-Schock offenbart Deutschlands Scheuklappen beim Klimaschutz. Welt of 27 September 2021; The economist of 21 September 2021, Natural-gas prices are spiking around the world.
[287] CMC Markets of 20 August 2024, Gaspreis explodiert: „Krise ist nicht vorüber".

Fig. 15: International Comparison of Gas Prices[a)]

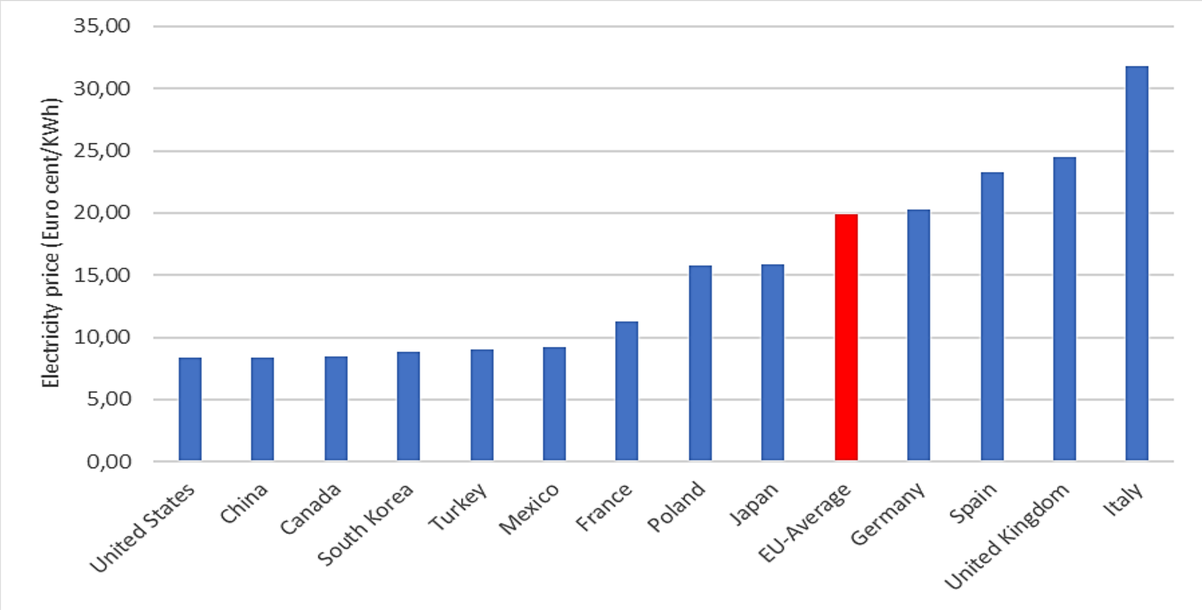


[a)] 1 MMBtu (million British thermal units) corresponds to 293 kWh.
Source: IGU, Wholesale Gas Price Survey 2024 Edition

2.2.1.3.2 Electricity Prices

Electricity prices are an important direct cost component for the automotive industry. Indirectly, high electricity prices affect also the cost of domestically produced raw materials like aluminium or copper.

Fig. 16: International Comparison of Industrial Electricity Prices (2022/2023)



Source: Prognos AG[288], cep illustration

Furthermore, in terms of electricity costs competitors of European automakers in China, the US, Japan, South Korea, Canada, Turkey and Mexico had a big advantage facing considerably lower electricity prices. The EU average of electricity costs was more than twice as much – and even higher in EU countries with large automotive industries like Germany, Spain and Italy. The reason was that natural gas was the price determining marginal energy sources in electricity production in most EU countries. France with its high share of nuclear power had a cost advantage outside the EU only with respect to Japan and the UK. With the unwinding of the 2021-2022 gas price shock, the high electricity prices in Europe have started to come down lately. However, they will probably stay higher than before since gas imports are now more expensive than Russian gas and any rise in carbon prices will also increase gas prices.

2.2.1.3.3 Steel Prices

Steel is a global commodity which has a more or less uniform price worldwide. Nonetheless, European steel prices will be affected by rising CO_2 costs as free EU-ETS 1 allowances are phased-out for EU steelmakers and imports are facing equivalent CBAM costs. This will affect the competitiveness of EU automotive industry in global markets if there is no rebate of CO_2 costs for exporters.

2.2.1.3.4 Copper and Aluminium Prices

Copper and aluminium are also global commodities, each with more or less uniform global prices. Since their production is highly electricity-intensive, their price in the EU will also be affected by the impact of higher electricity costs due to higher gas prices, but also by the effect of carbon prices on electricity prices. This is even the case if there is voluntary electricity price compensation granted by Member States since they are allowed to cover only part of the cost.[289]

---

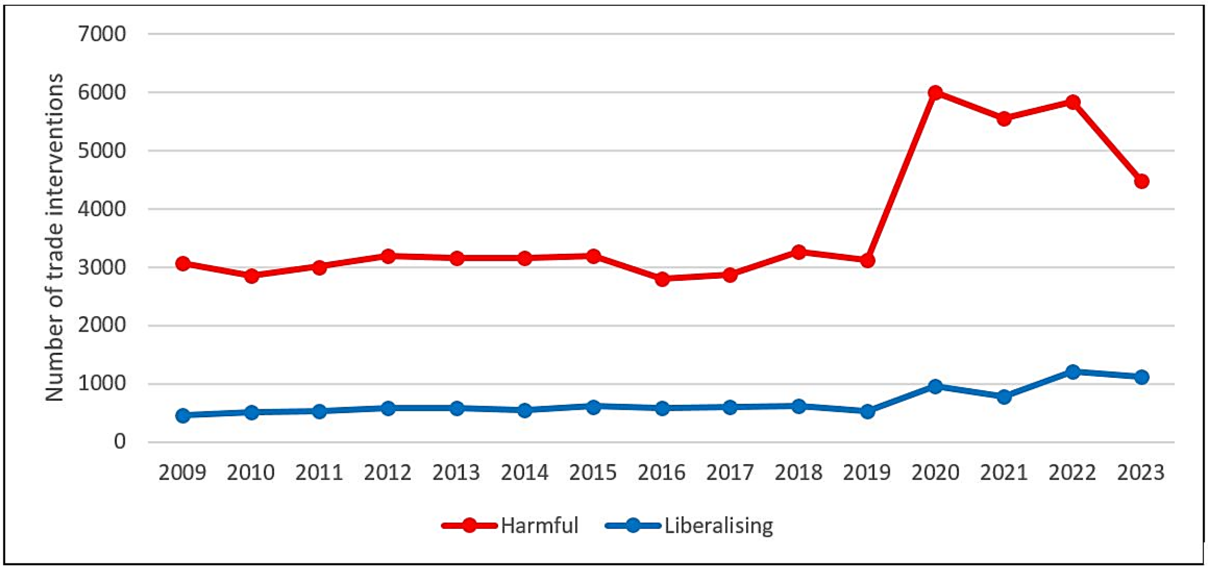
[288] Prognos (2023), Internationaler Energiepreisvergleich, Studie im Auftrag der Vereinigung der Bayerischen Wirtschaft.
[289] See, e.g., Bonn, M. / Reichert, G. / Voßwinkel, J. S. (2019), Reform der Strompreiskompensation, cepStudy.

2.2.1.4 Geopolitical Landscape

The last years have been characterised globally by many overlapping political and non-political crisis events, such as the CoVID-19 pandemic, the war in Ukraine and the escalation of tensions in the Middle East. Apart from the direct effects on international supply chains, this has also contributed to a change in risk perception among business leaders. In the most recent Global Risk Perception Survey (GPRS) conducted by the World Economic Forum, the majority of respondents (63%) expect upheavals and an increased risk of global catastrophes for the medium-term outlook over the next ten years.[290]

Moreover, structural shifts in geopolitical tectonics are expected. Two-thirds of GRPS respondents expect the emergence of a multipolar or fragmented world order in which middle and great powers contest, set and enforce regional rules and norms. A thinking in terms of spheres of influence, originating from foreign and security policies, is already increasingly applied to the economic debate. This is particularly evident in the realm of trade policies. The Global Trade Alert Database reports a significant rise of harmful trade interventions worldwide since 2020 (see Fig. 17).[291] Measures to subsidise domestic production are playing an increasingly dominant role as an instrument. Their share in the total number of harmful interventions rose from 55% to 65% between 2018 and 2023.[292] There are clear signs of a subsidy race, especially for green technologies of the future. The US Inflation Reduction Act, with its volume of USD 370 billion in state aid, has taken this race to a new level. It is one form of response to the surge of Chinese exports in products like electric vehicles and lithium-ion batteries.[293] Another observed form of response is to shield against Chinese foreign competition by raising tariff barriers on the Chinese imports concerned, as also recently been exemplified by the US[294] and the EU.[295]

Fig. 17: Evolution of Number of Trade Interventions at Global Scale



Source: Global Trade Alert (2024)

[290] World Economic Forum (2024), The Global Risks Report 2024 – 19th edition.
[291] Global Trade Alert (2024), Global Dynamics – Total number of implemented interventions.
[292] Id.
[293] Global Trade Alert (2024), The Green Goods Trade War is in Full Swing. Zeitgeist Series Briefing No.19.
[294] Global Trade Alert (2024), Trade Barriers Rise in Response to China's Export Surge. Zeitgeist Series Briefing No.22.
[295] European Commission (2024), Commission investigation provisionally concludes that electric vehicle value chains in China benefit from unfair subsidies. Press Release of 12 June 2024.

At the same time, the emerging economic blocs become more and more integrated internally. This is reflected in the growing number of regional free trade agreements. These go beyond mere tariff reductions and take the form of general regulatory convergence. The harmonisation of regulations on product approval and environmental protection is intended to create common markets that increase cooperation in the dissemination of standards. Beyond the regulatory sphere, influence is also exerted through the development of a cross-border infrastructure geared to the needs of the country's own economic structure. The best example of this is China's Belt-and-Road Initiative with its almost global outreach.[296] The lock-in effects for the partners involved threaten to further increase the divisions between economic blocs.[297] As a consequence, the Chinese automotive industry might benefit from growing regional markets and strong regional production networks, with other Belt-and-Road countries providing cheap resources and intermediate goods to Chinese automakers. This might put further cost pressure on European manufacturers.

[296] OECD (2018), The Belt and Road Initiative in the global trade, investment and finance landscape. In OECD, OECD Business and Finance Outlook 2018 (pp. 61–101).
[297] Aiyar, M.S., et al. (2023), Geo-economic fragmentation and the future of multilateralism. International Monetary Fund. Staff Discussion Note SDN/ 2023/001.

2.2.2 Global Problems of the EU Regulatory Framework

With regard to markets outside the EU, the following **global problems** of the EU regulatory framework can be identified which could endanger the transformation of road transport towards climate neutrality driven by a globally competitive EU automotive industry:

2.2.2.1 CO_2 Emission Standards

In a worldwide comparison, the EU CO_2 emission standards for passenger cars are by far the strictest – with the exception of the UK – and has the most comprehensive and ambitious CO_2 reduction targets for HDV manufacturers globally. Already adopted bans on new ICE vehicles also apply to PHEVs only in the EU, South Korea and Chile. In contrast, PHEVs will continue to be permitted in the states of the USA, where a ban on ICE has been adopted, and in Canada. In Japan not even HEVs will be banned. The UK may postpone the ban on hybrids for 5 years, countries that signed the nonbinding "Declaration on accelerating the transition to 100% zero emission cars and vans" might reconsider the role of PHEV, too. China has announced to ban PHEVs and hybrids no earlier than 2060.

With regard to competitors and sales markets, it is questionable against this backdrop whether the EU's "pure-electric" strategy for cars and vans will actually benefit the EU automotive industry, as originally intended by the European Commission. On the contrary, strict emission standards that quickly narrow down the variety of suitable technologies will deprive it from its competitive advantage in the ICE technology and will lead to the cessation of ICE related research and development at universities, car manufacturers and suppliers in the EU with the corresponding loss of knowledge and high-skill employment. However, the greater loss of jobs and added value will be caused by the relocation of production of combustion engines and hybrid vehicles, for which there will most likely be a continued demand for decades to come in other regions of the world and possibly even in the EU, if this is permitted. As a result, the EU automotive industry will not only be forced to give up its competitive advantage over combustion engines when producing vehicles in the EU both for the EU market – since they cannot be sold anymore by 2035 – and for export markets – since without a flourishing home market it does not pay to keep ICE production in the EU –, but also its profitable second business pillar alongside the production of electric vehicles. Moreover, since hybrid cars and vans depend far less on strategic raw materials than EVs, the EU will also lose strategic independence and resilience.

2.2.2.2 Emissions Trading for Road Transport and Buildings (EU-ETS 2)

Besides its prominent role as an efficient and effective decarbonisation tool for road transport and buildings in the EU, the EU-ETS 2[298] will also be in the spotlight of international climate protection experts and governments. Foreign governments and their advisors will keep a watchful eye on the extent to which the EU succeeds in decarbonising the transport and building sectors cost-effectively with the support of the EU-ETS 2. The question is whether it will just serve as a fig leaf with a politically acceptable maximum price for allowances, but no binding cap, and whether Europe continues to pursue the transformation to climate neutrality mainly through subsidies to incentivise the purchase of EVs such that automakers can comply with strict CO_2 emission standards? Or will the EU quickly abandon the "cap-and-trade" EU-ETS 2 as soon as its carbon price rises more sharply and resistance in the population grows? Or will the EU manage to organise carbon pricing in these sensitive sectors in a socially equitable way through appropriate redistribution of revenue ("climate dividend")[299] and

[298] Menner, M. / Reichert, G. (2022), Fit for 55: Climate and Road Transport, cepPolicyBrief 06/2022.
[299] Menner, M. / Reichert, G. / Voßwinkel, J. S. (2023), Climate Dividend, cepInput 15/2023.

hardship schemes? The success of the EU-ETS 2 and its social effects will play a pivotal role – especially for poor countries – in (a) assessing whether it is favourable to include a similar emissions trading system in their climate policy toolbox and (b) whether to follow the ambitious decarbonisation path of the EU in those sectors or not.

2.2.2.3 Emissions Trading for Energy and Industry (EU-ETS 1)

As was shown in Section 2.1.2.6, a high price of EU-ETS 1 allowances can lead to higher electricity prices and hence production costs when there is not sufficient energy price compensation by Members States. These higher costs do not only affect the competitiveness of the EU automotive industry in the EU internal market, but also its chances on the world market where competitors face lower electricity costs (see Section 2.2.1.3).

A similar cost disadvantage exists with respect to fossil fuels or raw materials – like steel and aluminium – used in production that is covered by the EU-ETS 1. Here the problem arises because the free allowances that were provided to shelter exporting firms from carbon costs of the EU-ETS 1 are being phased-out and not replaced by a similar carbon leakage protection mechanism (see Section 2.1.2.6).

2.2.2.4 Carbon Border Adjustment Mechanism (CBAM)

The EU Carbon Border Adjustment Mechanism (CBAM), which was explicitly introduced to protect EU companies affected by the cost increases caused by the EU-ETS 1 from carbon leakage, unfortunately fails with regard to export competitiveness and cannot effectively replace the expiring allocation of free allowances as a means of carbon leakage protection.

While free allowances stripped the carbon price off the cost of products subject to the surrender of EU-ETS 1 allowances, EU producers in CBAM sectors will have to pay for EU-ETS 1 allowances and will pass on the costs to their customers insofar as competing imports face corresponding CBAM costs. Consequently, there will be a cumulative cost disadvantage in the EU caused by the cost of EU-ETS 1 or CBAM allowances included in the cost of all respective components of vehicles manufactured in the upstream value chain and containing materials produced in CBAM sectors. Therefore, EU car manufacturers and suppliers will face higher costs for their products that they want to sell on the global market. Unfortunately, the EU legislator has not attempted yet to equip the CBAM legislation with an instrument that deducts the allowance costs from the products destined for export – either from the exported CBAM products or from the exported products further down the value chain. This sets the EU automotive sector in a disadvantaged position in global markets.[300]

[300] Jousseaume, M. / Menner, M. / Reichert, G. (2022), CBAM: Damaging to Climate Protection and EU Export Industries, cepStudy of 13 July 2021.

2.2.3 Interim Conclusion on Risks in Global Markets

Automotive companies typically operate in many international markets. In each of these markets they compete with different companies under different conditions.

The decarbonisation of the new road vehicle fleet is in no other major market as rapid and consistent as in the EU. In addition, many countries with considerable demand and/or automotive industries pursue medium and long-run **"multi-technology strategies"** – reflected in corresponding CO_2 emissions legislation. Technology-open strategies are also frequently pursued by vehicle manufacturers there, that can **benefit from strong home markets** for these technologies.

Analysts sympathise with carmakers' multi-track approaches notwithstanding that electric car offensives must now take priority.[301] The reason is that a pure bet on electric cars could be risky for high-volume manufacturers. Risks could arise from exploding raw material costs for batteries if demand picks up. As a large proportion of BEV sales depend on state subsidies, sales usually slow down if purchase subsidies are reduced – as has been recently the case in China.[302] Also regulatory shifts – as the softening of the ICE ban in the EU opening up a future for cars with ICE running on climate-neutral fuels – could have an impact. Hence, automakers should be able to react quickly to new conditions.[303]

Against this background, it is **questionable if EU legislation should limit the choices of EU automakers to adapt to market conditions in the global vehicle markets** by imposing in their home market a "pure-electric" or "electric-centred" strategy.

This **would strip the EU vehicle producing industry of a potential demand – from loyal regular costumers at home – for climate-friendly vehicles** running on biofuels or e-fuels that will have strong demand also in other world regions – if being affordable, fuel-efficient and produced in a climate-neutral manner. This is in contrast to other world regions that foster such home markets.

Nearly four billion people live in countries with inadequate electrical infrastructure for EV.[304] Moreover, vehicles with ICE powertrains are far cheaper to buy and are likely to remain so — making them the practical choice in developing economies.[305] Hence, for many developing countries a plausible strategy to decarbonise their road transport might be to use partly domestically produced biofuels, e.g. ethanol in Brazil or India[306], or e-fuels, in countries with abundant wind and/or solar radiation, in efficient hybrid vehicles suitable for such clean fuels.

The **current EU legislation risks a shut-down in Europe of automotive suppliers, production lines and R&D departments as well as related knowledge creation at universities dedicated to the improvement of ICEVs and hybrid vehicles – just to relocate them to other world regions**.
The production of these kinds of vehicles in other regions with higher negative environmental impact and higher CO_2 emissions ("**carbon leakage**") would do a grave disservice to the environment and the climate globally as well to employment and value generation in the EU.

301 Knölling, M. (2024), Noch kein Ende für Benziner: Toyotas neue Führung setzt auf Mehrgleisigkeit, Neue Zürcher Zeitung of 9 April 2024 (own translation).
302 Id.
303 Id.
304 KPMG (2021), Place your billion-dollar bets wisely – Powertrain strategies for the post-ICE automotive industry.
305 Id.
306 United Nations Industrial Development Organisation UNIDO (2022), Unlocking the Bioethanol Industry.

In addition, the lack of reimbursement of costs for EU-ETS 1 or CBAM allowances for EU products destined for export leads to cost disadvantages for EU car manufacturers and suppliers on the global markets and hampers their global competitiveness, too.

From a political perspective, internationally the European Green Deal will also have to pass the litmus test of demonstrating that its instruments are working in an effective and efficient manner while not eroding the domestic industrial base or its resilience and competitiveness – and can thus become a blueprint for other countries. This includes the social acceptability of efficacious carbon pricing, the efficacy of carbon leakage protection, the financial feasibility of support strategies etc.

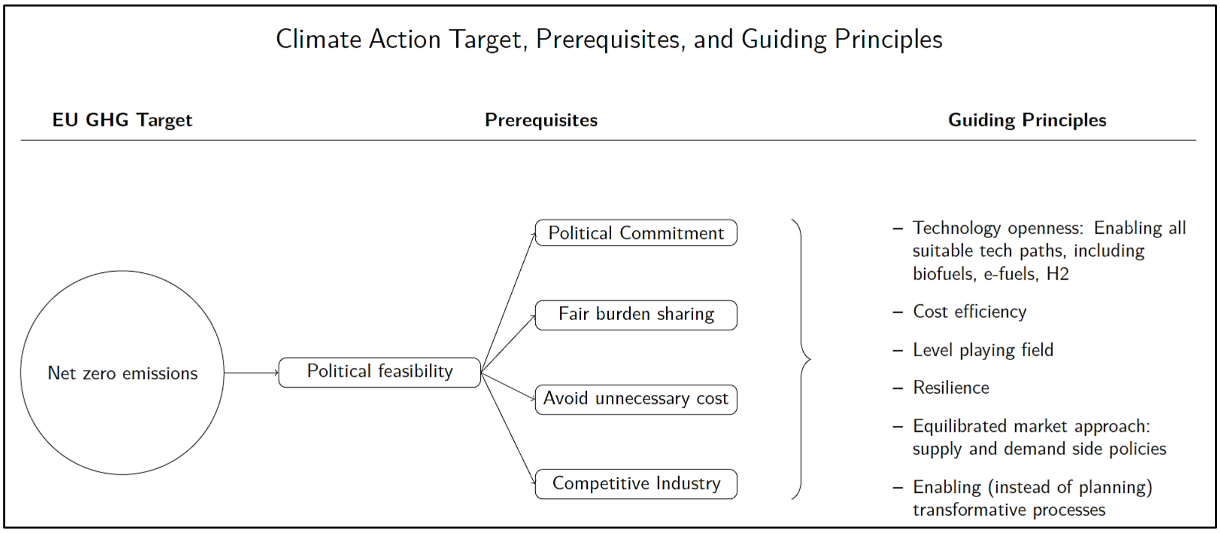
3 At the Crossroads: Where Should Europe Navigate?

We agree with the Draghi Report[307] that the EU should "ensure that the EU remains a leader in the global automotive industry, preserving jobs, R&D facilities, and manufacturing within the region" and that for this reason key objectives should be to "avoid the radical displacement" of EU production and the "rapid take-over of EU plants and companies by State-subsidised competitors". Moreover, the Draghi Report[308] also rightfully highlights not only the importance to "re-establish a competitive leading position for the EU for the 'next generation' of vehicles" but also the need to "maintain the European production base with current technological advantages as long as international markets show demand". In the following we show how the achievement of these objectives can be assisted by EU policy.

3.1 Guiding Principles

The European Union has set itself the goal of becoming net climate-neutral by 2050. In order to achieve this transformation, the EU must remain committed to this target and to use effective and efficient instruments for its attainment throughout the entire transition period. In addition, it is necessary to continue to take measures to remain climate-neutral even after this goal has been achieved.

Fig. 18: Climate Action Target, Prerequisites, and Guiding Principles



Source: cep illustration

A prerequisite for achieving this target is therefore a long-term, reliable and overall resilient climate policy. To be sustainable in the long term, this policy needs to be backed by a democratic majority. This will only happen if large parts of the population are convinced that climate protection is necessary, or at least acceptable, and that respective measures will have acceptable effects.

In order to provide citizens and businesses with long-term planning security, political commitment by key policy actors to the goal and to a coherent package of measures is necessary.

307 Draghi Report – Part B, p. 152.
308 Id.

An ambitious climate policy in the EU can only be successful in the long term if citizens have the impression that the burden is fairly distributed. The question of fair burden-sharing will be easier to resolve the lower the overall burden is. Therefore, avoidable costs should be avoided wherever possible.

A significant part of Europe's prosperity comes from industrial added value. It is therefore essential that the European Union maintains a competitive industrial base, also in the context of climate change policy. If Europe's industrial base were to erode, this would lead to new distributional conflicts that would be difficult to resolve and would considerable damage the social acceptance of climate policy.

There is also the consideration that the EU's climate neutrality target alone cannot effectively protect the climate. The EU is too small on a global scale. However, the EU can set an example for other countries. However, others will not follow the EU's example if climate neutrality can only be achieved at the expense of industrial competitiveness.

From the above, we derive the following guiding principles for the design of climate policy in general and for the decarbonisation of road transport in particular:

3.1.1 Technology Openness

In the context of climate policy, legislators should and must determine which climate targets are to be achieved and by when. The way in which this is achieved should avoid unnecessary burdens. To this end, industry should be given the opportunity to test and use different technologies and **the legislator should refrain from prescribing the use of certain technologies**. It may happen that the paths chosen by the industry turn out in retrospect to be inefficient. However, this risk alone is not a sufficient reason for a political decision. Politicians know even less than industry itself which paths will turn out to be worthwhile. In this context, it is certainly desirable that there should be competition between different technologies, because and if this competition can determine which technologies prove to be particularly suitable in the context of climate policy.

3.1.2 Cost Efficiency

The goal of achieving net climate neutrality in a relatively short period of time is ambitious. Pursuing this goal will place a burden on the economy. These burdens should be kept as low as possible so that climate protection can be achieved at the desired pace.

Avoiding unnecessary costs also means having fewer problems with fair burden sharing and **political and social acceptance**. Industry will also be less burdened by cost-effective measures. **Instruments should, whenever possible, be chosen in such a way as to achieve the desired objectives at the lowest possible cost.** Cost-effectiveness is also a key criterion for assessing climate policy.

3.1.3 Level Playing Field

Climate policy entails costs for businesses. **In terms of international competitiveness, climate policy should not result in European companies losing out to non-European companies.** This would jeopardise Europe's industrial base. Nor could European climate policy serve as a model for other countries if it put European industry at a disadvantage. In terms of international competition, it is therefore important to ensure that by and large a level playing field is maintained.

3.1.4 Equilibrated Market Approach: Supply and Demand Side Policies

Climate policy instruments must take account of the supply and demand side. It helps no one if companies develop products that are not bought, or if incentives are given for products that are not produced. Carbon pricing, for example, creates incentives for buyers to switch to low-carbon alternatives. But these need to be available. Conversely, there is nothing to be gained by forcing industry to market products for which there is no demand. In order to be socially accepted, carbon pricing needs a redistribution of revenues in a fair and socially equilibrated way.

3.1.5 Enabling – Instead of Planning – Transformative Processes

The goal of climate neutrality goes hand in hand with a transformation of the entire value chain. As value chains are complex and finding the best strategies is a learning process, policies should not prescribe exactly how this transition should take place (planning approach). Instead, policies should enable industry to achieve this transformation (enabling approach). This involves policy makers setting the necessary incentives that infrastructure is pre-emptively provided where needed, adapting the regulatory framework to technological innovation, etc. **The enabling approach requires a mix of predictability (commitment) and flexibility from policy makers**.

3.1.6 Resilience

Climate change policy must be designed to be sustainable over the longer term. It should be resilient to economic crises, geopolitical upheavals and short-term political moods. At the same time, **climate policy should be designed in such a way that it does not reduce the ability of businesses and individuals to adapt to unforeseen events**. For businesses, for example, this means that climate policy should not force them into unilateral dependencies on individual countries, technologies or market segments.

3.2 Further Development of the EU Regulatory Framework

EU policy for a decarbonised road transport and globally competitive EU automotive industry should follow an equilibrated market approach that encompasses suitable demand and supply policies – based on the guiding principles developed above in Section 3.1. In addition, future competitiveness of the EU automotive industry hinges on supporting policies to foster its innovative capability. In order to follow new pathways to decarbonised road transport and a competitive EU automotive industry, the following aspects should be considered in the further development of the EU regulatory framework:

3.2.1 Demand Side

3.2.1.1 Role of Carbon Pricing and Climate Dividends

Carbon pricing is an essential tool to reduce the TCO of electric cars, vans, lorries, buses and coaches or other zero-emission vehicles relative to fossil-fuelled vehicles. It is also crucial to incentivise behavioural changes in the use of PHEV, HEVs and ICEVs in the existing vehicle fleet. In addition, the EU-ETS 2 ensures with its decreasing cap the attainment of the CO_2 reduction targets in the road transport and buildings sectors. Therefore, the **EU-ETS 2** should be the main steering instrument for the decarbonisation of road transport. To achieve this, it is crucial that the price of allowances can rise as far as is necessary to balance supply and demand ("whatever-it-takes-prices") without leading to social imbalances due to of uncompensated higher mobility and heating costs for low- and middle-income households. Unfortunately, current rules on the spending of EU-ETS revenue do not allow for their widespread financial redistribution.[309] The funds provided by the Social Climate Fund do not suffice for this purpose, either, and only very vulnerable households and mobility users will be able to benefit.[310] Therefore, other solutions have to be found to counter social imbalances. In addition to carbon pricing via the EU-ETS 2, **energy taxes** should be based on GHG content rather than volume. Therefore, the Member States should soon finalise their negotiations in the Council on the respective proposal of the European Commission for a revision of the Energy Taxation Directive 2003/96/EC (ETD). Otherwise, an essential element of the overall legislative framework highly relevant for the decarbonisation of the road transport sector would be missing (see above Section 2.1.1.9). Both the EU-ETS 2 and the revised ETD will provide the necessary price signals to incentivise the choice of transport modes, the purchase of vehicles and their use – leading to cost-effective decarbonisation of road transport.

A policy strategy based on carbon pricing can achieve its goals with less strict CO_2 emission standards as has been shown even in the Impact Assessment (IA) of the European Commission itself accompanying the Communication "Stepping up Europe's 2030 climate ambition"[311]. This will enable a more cost-efficient decarbonisation of road transport and give the necessary recharging infrastructure development more lead time. BEVs will more quickly able to reach TCO parity. From that point on demand will cease to be the bottleneck in the transition to E-mobility. To implement this policy switch it is, however, crucial to combine "whatever-it-takes-prices" with a comprehensive redistribution of EU-ETS 2 revenues to the public such that households up to the upper middle class are compensated on average for higher CO_2 costs. In addition, provisions for particular hardships must also be ensured in order to avoid social imbalances and public resistance to the EU's decarbonisation policy.

---

[309] Menner, M. / Reichert, G. / Voßwinkel, J. S. (2023), Climate Dividend, cepInput 15/2023.

[310] Id.

[311] European Commission (2020), Staff Working Document SWD(2020) 176, Impact Assessment – Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people.

This is important, since households will have to bear not only direct carbon costs but also higher end product prices due to higher transportation costs. In this context, EU legislation needs to be amended to allow Member States to use their EU-ETS 2 revenues to be redistributed largely by per capita payments ("climate dividends").[312] Since revenues from carbon pricing have regressive distributional effects, it is better to use them for redistribution and to use tax revenues – which have more progressive effects – for support measures for infrastructure roll-out, R&D subsidies or other measures to ease market failures.[313]

3.2.1.2 Total Cost of Ownership for Low-Emission Vehicles

The market-uptake of zero- and low emission vehicles (ZLEVs) crucially depends on their TOC compared to conventional vehicles. Apart from carbon pricing that increases the cost for fossil fuel-based vehicles, any measure that can help reduce electricity prices, charging and refuelling costs and the production costs for batteries will reduce TCO of EVs and favour their market acceptability. Similarly, measures to increase the production of alternative fuels will make the operation of combustion engines with alternative fuels more affordable.

3.2.1.3 Attractive Infrastructure

Apart from favourable TCO, charging and refuelling infrastructure is a key enabler or drag for the rapid uptake of EVs or vehicles running on (blends of) alternative fuels. The EU must ensure that the roll-out of infrastructure precedes and keeps pace with market demand – especially in Member States with high transit flows.[314] In addition, the electricity grid must be upgraded appropriately, since this is reportedly a big bottleneck for the roll-out of fast-chargers, especially for HDVs.[315], as also highlighted by the Draghi Report.[316]

3.2.2 Supply Side

3.2.2.1 Respect Technology Diffusion Patterns

The market-uptake of new technologies cannot be planned by legislators and governments – unless they are willing and capable to finance any additional costs through subsidies for potential customers. Thus, we do not recommend setting vehicle manufacturers under pressure to fulfil potentially unrealistic production paths regardless of their profitability or demand conditions. This is even more plausible if one considers that new technologies need time to reap cost reductions from mass production and to mature. In case of BEVs, this refers especially to new battery technologies. Besides, only with a more decarbonised electricity supply can BEVs really exploit its potential for high life-cycle emission savings.

It is also important to avoid putting European car manufacturers in a situation where they are *de facto* unable to meet the legal targets and must make the corresponding payments. However, the legislator should avoid a situation in which an important industrial sector can only continue to operate through systematic non-compliance.

---

[312] Menner, M. / Reichert, G. / Voßwinkel, J. S. (2023), Climate Dividend, cepInput 15/2023.
[313] Id.
[314] Transport and Environment (2024), HDV charging manual.
[315] Handelsblatt of 4 August 2024, Deutsche Autoindustrie sieht gravierendes Standortproblem.
[316] Draghi Report – Part B, p. 150 et seq.

3.2.2.2 Rethink Bans and Regulatory Requirements

The binding and decreasing cap in emissions trading (EU-ETS 2) guarantees that CO_2 emissions of road transport will reach the net-zero target in 2050. Hence, there is no need to ban technologies or to regulate automakers meticulously. In a market economy relative prices determine the allocation of goods and transport services. If these prices incorporate the costs of decarbonisation – as it is achieved by the CO_2 price of the EU-ETS 2 –, relative total user costs (TCO) are changing in favour of low-emission technologies. As a consequence, higher CO_2 prices will foster demand for EVs, more efficient vehicles or the wider use of alternative fuels.

In this respect, **a larger portfolio of technological options increases efficiency and resilience** of the market outcome. Therefore, strict CO_2 emissions standards should play only an auxiliary role. Moreover, valid options on world markets should not be banned in the EU internal market since this would lead to relocation of production, employment and associated CO_2 emissions to other countries ("carbon leakage").

Since a cap-and-trade EU-ETS 2 will ensure compliance with the EU climate targets, **it is uncritical for the achievement of the decarbonisation goals if the EU decides to establish more flexibilities in the CO_2 emission standard legislation** in order to **(a) enable a more market-driven transition that can adapt to changing demand** circumstances and **(b) regain technological openness** for the EU automotive industry to maintain a strong home-market for efficient ICEVs and hybrids that can run on climate-neutral fuels and be sold to other world regions that are going to demand such vehicles for decades.

For this purpose, different **policy options** are available alongside the continuing carbon pricing policy that will be discussed in Section 3.3.

Re-Assessment of Policy Scenarios of the Commission with Higher Degrees of Technology-Openness

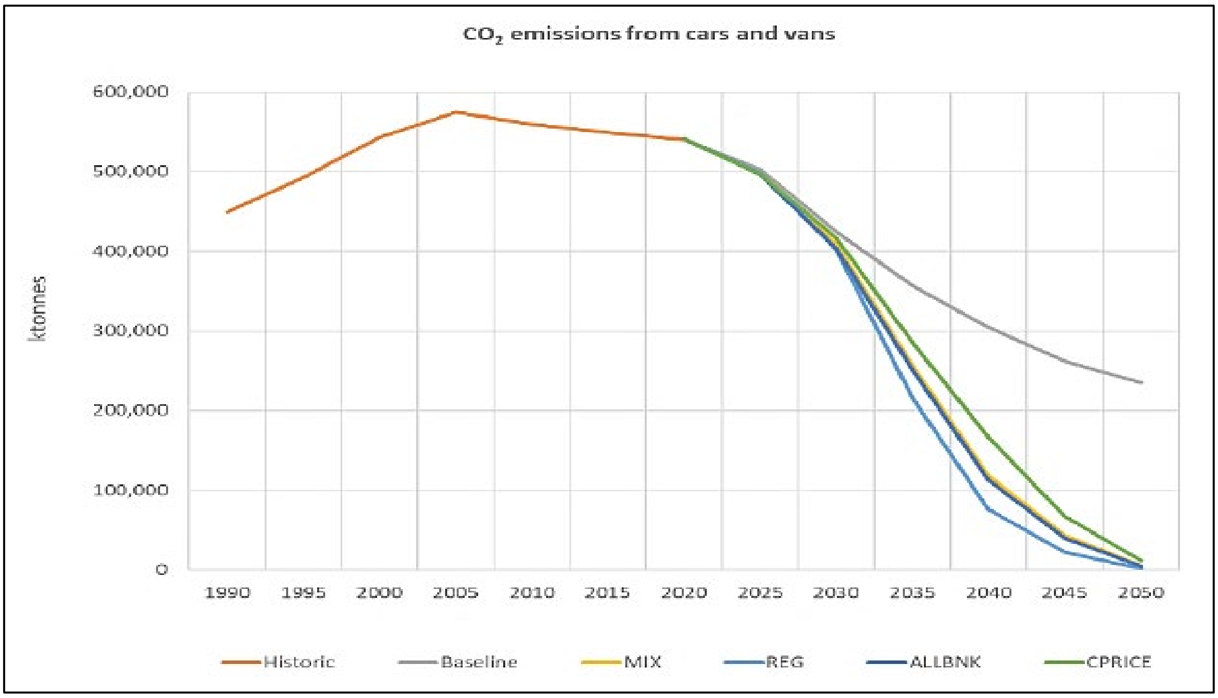
The assessment of some of the options discussed below can be based on the **quantitative assessment of similar options analysed by the European Commission** in the run-up of the current regulation.

First, there was the Impact Assessment (IA)[317] of the European Commission accompanying the Communication "Stepping up Europe's 2030 climate ambition" (henceforth: IA 2030 Climate Ambition) – that set the stage for the "Fit for 55" climate package. In addition to a "baseline scenario", three main scenarios covering all sectors were calculated: the REG scenario, which relies on strong and strict regulation, the "CPRICE scenario", which relies more heavily on carbon pricing – modelled as a **carbon tax of EUR 60** in all sectors – and the "MIX scenario", which lies in the middle.

Fig. 19 shows the projections resulting from the various scenarios for CO_2 emissions from cars and vans up to the year 2050. Note that realistic EU-ETS 2 prices that can easily be imagined to be much higher could lead to a faster and more complete decarbonisation in the CPRICE scenario than depicted here.

[317] European Commission (2020), Staff Working Document SWD(2020) 176, Impact Assessment – Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people.

Fig. 19: Climate Neutrality Policy Scenarios: CO_2 Emission Reduction for Cars and Vans



Source: EU Commission (2021), Impact Assessment for CO_2 emission standards for cars and vans, Fig. 3[318]

Second, to assess the effects of different CO_2 emission standards, the European Commission had undertaken an impact assessment (henceforth: IA CO_2 emission standards for cars and vans)[319] accompanying the Commission Proposal COM(2021) 556 for a "Regulation amending CO_2 emission standards for new passenger cars and new light commercial vehicles [Regulation (EU) 2019/631]", which was the base for the eventually adopted CO_2 emission standards. The IA analysed different options for "target levels" (TL) of CO_2 emission standards for cars and vans under the assumption that other sectors follow the MIX-scenario of the IA 2030 Climate Ambition and the carbon price is set at EUR 35 in 2025 and EUR 48 in 2030.[320].

Tab. 4: Target Levels of Policy Options (Impact Assessment for CO_2 Standards for Cars/Vans)

	2025		2030		2035		2040	
Option	Cars	Vans	Cars	Vans	Cars	Vans	Cars	Vans
TL_Low	15%[a)]	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%

[a)] Proposed % reduction of EU fleet CO_2 emissions compared to 2021

Source: European Commission (2021), Impact Assessment for CO_2 emission standards for cars and vans[321]

As Tab. 4 shows, the current legislation resembles TL_High – only the 2030 targets being slightly lower. Note that also the TL_Med target level requiring only a 70% reduction of tailpipe CO_2 emissions by 2035 would be compatible with complete reduction by 2050 (see Fig. 20) even at low carbon prices.

[318] European Commission (2021), SWD(2021) 613 Impact Assessment Part 1 Accompanying the Proposal for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, Figure 3, p. 12.

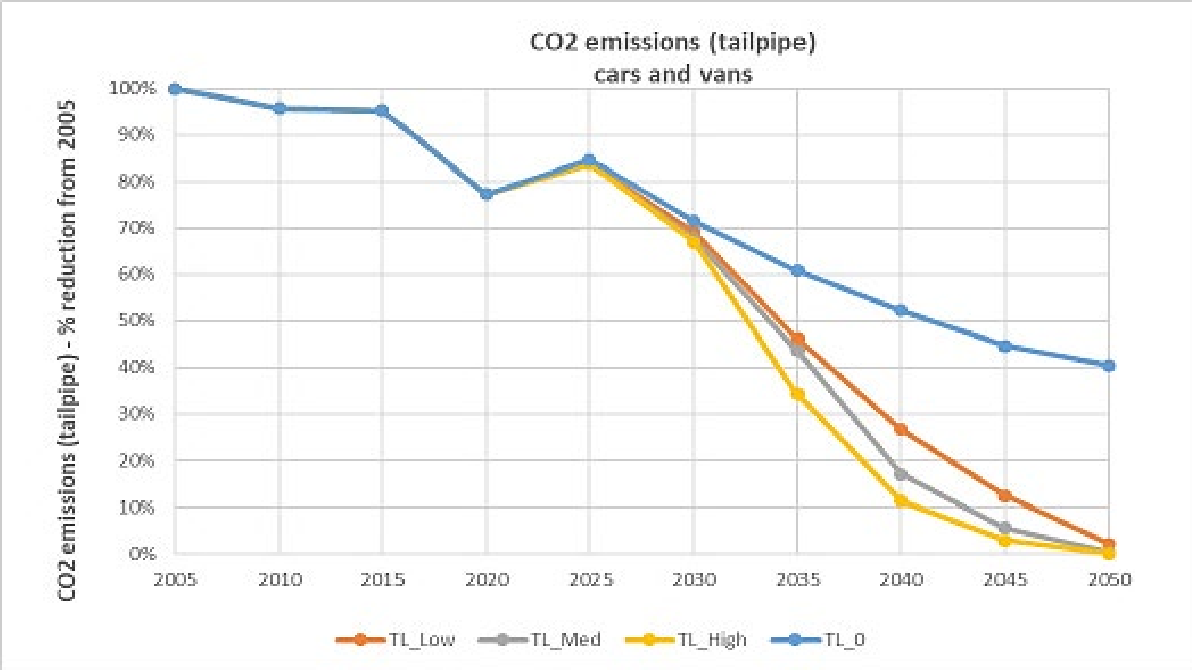
[319] Id., p. 33.

[320] Id., Part I, Figure 3, p. 12 and Part II, Table 26, p. 56.

[321] Id., Table 3, p. 26.

Even TL_Low would come quite close to full decarbonisation – and this in a model that does not take into account the binding cap but only a rather moderate carbon price in the EU-ETS 2.

Fig. 20: Tailpipe CO_2 Emissions of Cars and Vans Under Different "Target Level" Options



Source: EU Commission (2021), Impact Assessment for CO_2 emission standards for cars and vans, Fig. 14[322]

A similar exercise was undertaken also for HDVs in the corresponding Impact Assessment.

Tab. 5: Target Levels of Policy Options (Impact Assessment for CO_2 Standards for HDVs)

	2025	2030	2035	2040
TL_Low	15%[a)]	35%	50%	70%
TL_Med	15%	40%	60%	80%
TL_High	15%	50%	70%	100%

[a)] Proposed % reduction of EU fleet CO_2 emissions compared to 2021

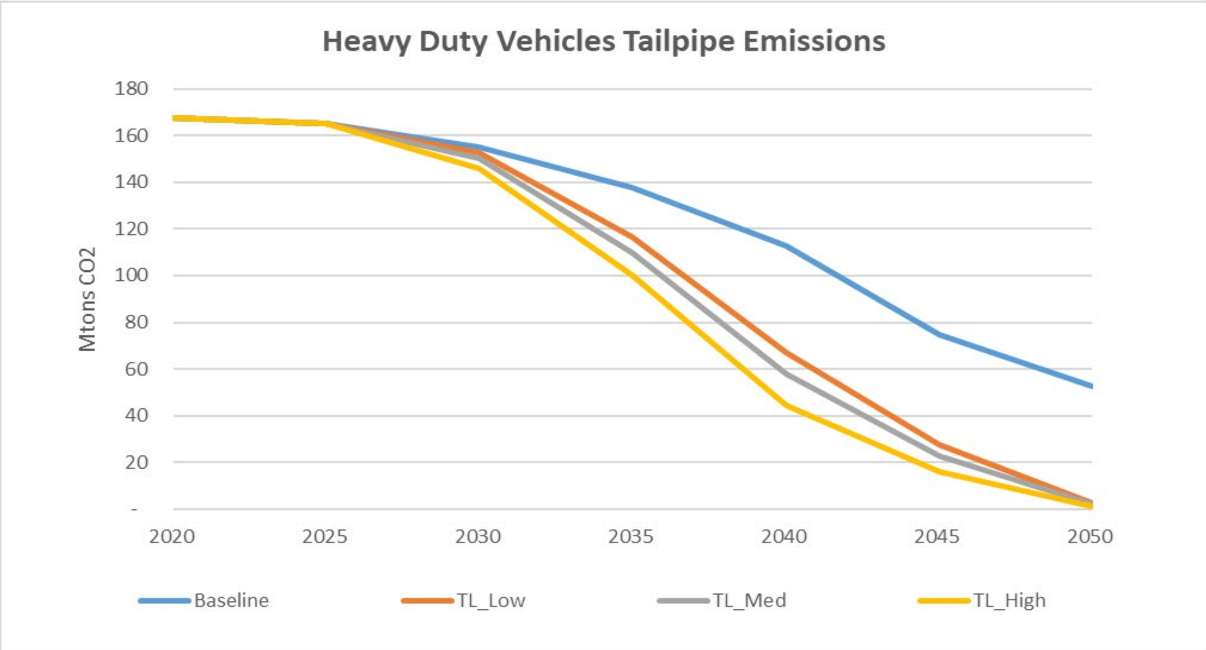
Source: European Commission (2023), Impact Assessment for CO_2 emission standards for HDVs[323]

Here, also a target level between TL_Med and TL_High found its way into legislation. Again, note that also TL_Med would be compatible with full decarbonisation of HDVs even at the low carbon prices. Also here, even TL_Low would come quite close to full decarbonisation.

[322] Id., Figure 14, p. 57.

[323] European Commission (2021), SWD(2023) 88 Impact Assessment Part 1 Accompanying the document Proposal for a Regulation amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, Table 2, p. 22 f.

Fig. 21: Tailpipe CO_2 Emissions of HDVs Under Different "Target Level" Options



Source: European Commission (2023), Impact Assessment for CO_2 emission standards for HDVs, Fig. 9[324]

> Summarizing, the **modelling of the EU Commission** assuming still moderate carbon prices shows that the **long-term target of fully decarbonised road transport can be achieved also with more flexibility on CO_2 emission standards** for cars and vans as for HDVs.
>
> This includes scenarios with a postponement of the "ICE-ban" for cars and vans to 2040 or even a less than 100% reduction target for 2040. Also, HDVs can easily be given more flexibility.

However, the timetable for emission limits is putting pressure on European manufacturers. There is a risk that they will either have to pay fines for non-compliance or make payments to non-European manufacturers through pooling (see above Sections 2.1.1.1). While pooling is a way of achieving the overall fleet target cost-effectively, both fines and pooling payments are detrimental to the competitiveness of the European car industry.

As fleet limits do not have a direct climate protection function in the context of the EU-ETS 2, but rather a supporting function, their design could be carefully modified to strengthen the competitiveness of the European automotive industry without jeopardising the objective of reducing GHG emissions. On the contrary, with a little more flexibility, manufacturers can avoid non-compliance or pooling payments to non-European manufacturers and use their competitiveness to drive the transition to climate neutrality. The credibility of European climate change policy will be considerably enhanced by achieving GHG mitigation with the significant involvement of European companies and by preserving the European industrial base.

[324] European Commission (2021), SWD(2023) 88 Impact Assessment Part 1 Accompanying the document Proposal for a Regulation amending Regulation (EU) 2019/1242 as regards strengthening the CO_2 emission performance standards for new heavy-duty vehicles and integrating reporting obligations, Figure 9, p. 40.

Accordingly, the EU must find a way to bring about this needed flexibility in the EU internal market and a perspective for a home market of efficient ICEVs and hybrids that can be operated with alternative fuels and will find global demand beyond 2035. Several options will be discussed below (Section 3.3).

As an illustration, Table 6 gives an idea how different vehicle categories might evolve under the target levels for CO_2 emission reductions considered in the corresponding Impact Assessment for cars and vans. As has been shown, at least TL-Med will achieve a complete reduction of CO_2 tailpipe emissions by 2050. With a binding cap of the EU-ETS 2, TL_Low would reach the same target by then, too.

Tab. 6: New Cars and Vans Powertrain Composition Under Different Target Level Options

	Cars				Vans			
	ICEV[a)]	PHEV	BEV	FCEV	ICEV	PHEV	BEV	FCEV
2030								
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 %

Source: European Commission (2021), Impact Assessment for CO_2 emission standards for cars and vans[325]

[325] European Commission (2021), SWD(2021) 613 Impact Assessment Part 1 Accompanying the Proposal for a Regulation amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition, Table 4, p. 34.

3.2.2.3 Establish Effective Carbon Leakage Protection

The EU-ETS 1 is crucial for the cost-efficient decarbonisation of energy production and industry. Nevertheless, current EU climate policy does not provide for an effective and comprehensive system of carbon leakage protection. The "Fit for 55" legislative framework fails to create a level playing field regarding the cost caused by EU climate measures for European companies facing international competition both in markets inside and outside the EU. Therefore, solving the carbon leakage problem urgently needs to be at the top of the EU agenda 2024-2029.[326]

In particular, the negative effect of the current CBAM legislation on the competitiveness of export industries and downstream sectors has to be addressed.[327] While export rebates could solve the problem for CBAM sectors, their WTO compatibility is contested. And this is the reason why the European Commission is reluctant to establish carbon leakage protection measures for exports along these lines. Hence, serious consideration should be given to finding a WTO compatible solution – possibly along the lines of a VAT-like CO_2 consumption tax[328].[329] This concept would have the advantage that it exempts exports by definition and that it would also solve the negative effect of the EU-ETS 1 on the competitiveness of downstream sectors like the automotive industry – both in the EU internal market and in export markets.[330] Moreover, electricity cost compensation must also be granted in full.

3.2.2.4 Diversify Raw Material Supply

Beyond the administrative simplifications provided for in the CRMA (see above Section 2.1.1.9), the investment conditions for projects to diversify the supply of raw materials must be significantly improved. As the development of domestic extraction capacities will be subject to geological, economic and social (acceptance) limits, two supply pathways are of central importance: sourcing from reliable third countries and raw material recycling. The instrument of strategic resource partnerships introduced by the EU has great potential for the first pathway. However, for it to be effective, the agreements reached to date must be brought to life quickly.

To build stable long-term resource partnerships with developing and emerging economies, the EU must give them the space to upgrade their position as a production location within the joint supply chains in the long-term. They need a clear perspective for the path from pure raw material suppliers to the more value-added and knowledge-intensive process steps at the downstream level. Gradual, conditional trade integration and intensive cooperation in the (further) development of standards are potential means to initiate such a development. Overall, the choice of partners and cooperation instruments should be about establishing an appropriate risk-return ratio in the overall portfolio of partnerships for various critical resources. In the case of particularly systemically important resources such as battery raw materials and those with a high supply risk, a special focus should be placed on reducing their risk contribution. This will generally involve a greater need for redundancy among raw material suppliers and/or greater concessions from the EU to cooperation partners.

---

[326] Reichert, G. / Menner, M. / Schwind, S. (2024), Future EU Climate Policy: Challenges and Chances – A Roadmap for Reconciling Climate Action and International Competitiveness, cepInput special of 21 May 2024.

[327] BDI / DIHK (2024), Position Paper: Implementierung des CO_2-Grenzausgleichsmechanismus.

[328] Neuhoff, K. et al. (2016), Ergänzung des Emissionshandels: Anreize für einen klimafreundlicheren Verbrauch emissionsintensiver Grundstoffe.; Neuhoff, K. et al. (2016), Inclusion of Consumption of carbon intensive materials in emissions trading – An option for carbon pricing post-2020.

[329] Jousseaume, M. / Menner, M. / Reichert, G. (2022), CBAM: Damaging to Climate Protection and EU Export Industries, cepStudy of 13 July 2021.

[330] Id.

To realise the potentials of raw materials recycling, the chicken-and-egg problem between supply and demand for secondary raw materials must be solved. Capacity building must be initiated to strengthen the competitiveness of recyclates as a result of cost reductions. Project-specific funding alone will not suffice for this. Instead, on the supply side, EU-wide measures are needed to increase the rates of waste collection and product dismantling as well as financial incentives for recyclers during the market uptake phase. On the other hand, demand-side requirements to increase the use of recyclates should be avoided so as not to place an additional cost burden on the automotive industry and its suppliers.

3.2.3 Innovation Capability in Europe

3.2.3.1 R&D Support for New Propulsion Technologies & Advanced Materials

A prerequisite for long-term competitiveness is to think beyond the spectrum of technologies known today. The pressure to decarbonise will also generate new, potentially disruptive technological solutions for the automotive industry in the future, be it in the development of new drive technologies or advanced materials for production. The task of EU innovation policy must be to create the conditions for Europe to continue to play a leading role in this area in the future. To this end, the right framework conditions must be created at all stages of the innovation process. This starts with the EU-level funding of Research and Development (R&D) in the field of automotive applications through the central funding program Horizon Europe. The funding of R&D for the decarbonisation of road transport should remain an essential part of the Climate, Energy & Mobility Cluster in future programming periods. The possibility of co-programming and joint governance of research areas with private actors, as offered by the instrument of European Partnerships[331], is helpful to enable a steering of R&D promotion on the basis of real industry needs. In particular, means should be devoted to exploring the development of new and advancement of existing propulsion technologies, to reduce dependencies and set the stage for an open competition of different technologies. At the same time, the conditions for turning inventions into new business models need to be improved, from access to venture capital to administrative simplifications for start-ups.

3.2.3.2 Measures to Address Skill Shortages

Potential future bottlenecks in the supply of young talent and experienced professionals for knowledge-intensive industry segments like the automotive industry must be addressed in a targeted manner. An important step is the expansion of university study programs that are closely tailored to the needs of an industry that is strongly research-based. Specialised master's degree programs that involve an intensive exchange with local manufacturing companies can lay the foundation for regional "talent factories", overcoming the problems of finding the right matches on local labour markets, and providing companies with a reliable flow of highly qualified workers. For the attraction of skilled workers from non-EU countries, global recruitment campaigns are needed that convey the advantages of working and living in the EU. In the future, these should culminate in greater harmonisation of high-skilled immigration policies, including common support programs for organising the move to Europe.

[331] European Commission (2024), European Partnerships in Horizon Europe.

3.3 Options to Increase Technology Openness for EU Automakers

The **EU-ETS 2** caps CO_2 emissions in the buildings and road transport sector and **guarantees that decarbonisation goals in road transport are finally reached**. With this safeguard in place, in order to allow for a more market-driven transition, the EU can provide more technology openness by introducing flexibilities within CO_2 emission standards that enable automakers to adapt to changing conditions.

3.3.1 Options for Cars and Vans

In the following, different **policy options with the potential to bring about technology openness** for EU carmakers in the sales of cars and vans in the EU are outlined and discussed:

1. The EU could modify the paths for percentage reductions of CO_2 tailpipe emissions of new vehicles established in the CO_2 emission standards legislation. Here, we consider four options for **target modifications** that could put some relief in the forced transition of the EU automotive industry:

   (A1) **Postponement** of 100% reduction target for fleet emissions to 2040 and relaxed earlier targets

   This would postpone the factual ban on ICE in the EU by five years and slow down the pace of the forced transition to EVs. It resembles the “TL_Med” scenario of the IA CO_2 emission standards for cars and vans (see Tab. 5). Option A1 would maintain technological openness for a few years longer than at present, allowing for a more market-driven transition and ensuring that the enabling conditions can be advanced at a more realistic pace. It follows the same logic as the present legislation, that by 2050 almost all vehicles on the road would have to be ZEV. With an average life of cars of about 12 years in the EU, many of the cars registered by end of 2039 will then be replaced by BEV. Interestingly, in 2040 the “TL_Med” scenario has a higher share of FCEVs than the status quo “TL_High” (see Tab. 6). Support of the domestic market for global sales of ICE based vehicles would continue only until 2040.

   (B1) **Relaxed target**: Lowering emissions reduction target in 2035 to (90–x)% and lowered earlier targets

   Lowering the EU fleet-wide CO_2 emission target in 2035 would remove the factual ICE ban for newly registered cars in the EU, thereby ensuring technology openness for carmakers beyond that date. It should also be accompanied by lowering earlier targets to allow for a more market-driven transition and to ensure that the enabling conditions can be advanced at a more realistic pace. This option resembles the approach of EU legislators for HDV, where finally a 90% reduction limit was established. Since 90% is still restricting technology openness, a reduction of less than 90% should be considered for cars and vans – in line with the “TL_Low” scenario. The lower the target, the more pronounced the effects. Support of the domestic market for global sales of ICE based vehicles would remain beyond 2035.

   (C) **Carbon Correction Factor**: Lower overall reduction targets dependent on alternative fuels supply

   Another option to safely lower the CO_2 emission standards is to reduce the EU fleet-wide CO_2 emission target each year to the extent that sales of alternative fuels have increased and thereby have brought about additional decarbonisation. This would partly balance the responsibility for CO_2 reduction between car manufacturers and fuel suppliers. The additional supply of alternative fuels could result from fuel suppliers’ efforts to reduce the amount of EU-ETS 2 allowances to surrender, leading to cost advantages for alternative fuels at the pump. In principle, similar effects as in option (B1) would arise, but only to the extent that the EU fleet-wide CO_2 emission targets are significantly reduced – which is quite uncertain and depends on fuel suppliers. But their efforts could be reinforced by higher RED III quotas.

(D) **Conditional relaxation of reduction target** when enabling conditions are not fulfilled

This option links the obligations of carmakers to the implementation progress of enabling conditions: If an assessment of the progress made on prerequisites for target feasibility such as the infrastructure for charging and refuelling shows that progress has been insufficient, the targets for car manufacturers will be reduced accordingly.

(E) **Postponement and subsequent freezing** of 2025 CO_2 emission targets

This most drastic option abandons the path to ever stricter CO_2 emission standards and maintains the postponed 2025 target values perpetually. This is feasible, because supply of EVs is already on its way and demand for efficient and low emission vehicles will be brought about by respective carbon prices in the EU-ETS 2 if price ceilings are avoided. Even with assumed low carbon prices of EUR 60 per tonne CO_2, the "CPRICE scenario" reaches approximately the 2050 target – with a less steep reduction trajectory in the next two decades (see Fig. 19). Hence, to rely solely on the EU-ETS 2 will be in line with climate neutrality by leaving the transition fully market-driven. Option E will thereby bring about the highest level of technology openness, cost efficiency and support for ICE based vehicle sales in global markets. However, under this option, the EU-ETS 2 would have to do without the supporting functions of the emission limit values described above. In particular, the absence of the backstop, relief and commitment functions could prove problematic.

2. In case the EU legislators do not want to modify the target values in the CO_2 emission standards legislation, there are **options to establish more flexibility** for manufacturers to comply with their specific CO_2 emission targets. In the following we consider three mechanism:

(F) **Phase-in**

One possible adjustment to the fleet limit values could be introducing a phased approach, in which only a fraction of the fleet, e.g. 90%, is used to determine the average fleet emissions rather than the entire fleet. This does not imply weakening the climate objective, as overall emissions are capped through the EU-ETS 2. The relief function of the EU-ETS 2 and the binding function for industry and policymakers will remain largely intact. The main burden will continue to fall on new car buyers. However, their payments are now less likely to be used to finance penalty payments or pooling-side payments to foreign carmakers and contribute therefore to the profitability and competitiveness of the EU automotive industry.

(G) **Banking and Borrowing**

In contrast to the legislation on CO_2 emission standards for HDVs, there is no provision that makes it possible to carry forward excess CO_2 reductions by means of "emission credits" ("banking") and to compensate for shortfalls by incurring "emission debts" ("borrowing"). Banking and borrowing can reduce the inefficiency of rigid CO_2 emission targets and increase the resilience of road transport by giving individual manufacturers more flexibility to adapt to changing circumstances. They also help to counteract the negative effects of a potential mismatch between manufacturers' development and modelling cycles and the stepwise tightening of emission standards. It should be possible to transfer both debts and credits to the subsequent period with higher reduction targets.

3. Beyond the flexibilities in the transition, following two options are available to secure a strong home-market for **efficient ICEVs and hybrids apt for the use of climate-neutral fuels** beyond 2035.

   (H) **Type Approval** for vehicles running exclusively on alternative fuels

   This option resembles the proposal by German Transport Minister Volker Wissing[332]. It would serve the purpose of providing a home-market for ICEVs and hybrids running on alternative fuels. However, it should not be restricted to e-fuels but also apply to advanced biofuels. Unfortunately, this option alone would have no effect on the pace of enforced transition to EVs until 2035, so that it should be combined with some of the flexibility Options E-G.

   (I1) **Hybrid Exemption** from ICE Ban by banning only pure ICEVs by 2035

   Alternatively, the EU could substitute the factual ICE ban with an explicit sales ban on pure ICEVs by 2035 – as it is foreseen in several US states and China. The sales of PHEVs and certain types of hybrids – that must be suitable for alternative fuels – would continue to be permitted in the EU. While this solution does not lead to a more market-driven transition to EVs up to 2035 in the EU, it would however align the EU rules closer with rules in China or the US.

Table 7 summarises the effects on technology openness, on the facilitation of a more market-driven transition in the EU and on the competitiveness of the EU automotive industry in global markets.

Tab. 7: Evaluation of Policy Options to establish Technology Openness for Cars and Vans

Policy Option	Technology Openness	Market-Driven Transition	Competitiveness in Global Market
Target Modifications			
(A1) Postponement 100% CO_2 reduction target in 2040 Lowered CO_2 reduction target before	++ [a)]	++ [a]	+ [a]
(B1) Lower Target (90–x) % CO_2 reduction target in 2035 Lowered CO_2 reduction target before	+++ [b)]	+++ [b)]	++ [b)]
(C) Carbon Correction Factor Lower targets when more alternative fuels supplied	++	++	+
(D) Conditional Target Relaxation Lower targets in case of insufficient enabling conditions	+++	+++	0
(E) Postponement and Freezing Stick to delayed 2025 CO_2 targets forever	++++	++++	++++
Flexibilities			
(F) Phase-In Initially, only a fraction of the fleet counts to the target	+	+	0
(G) Borrowing and Banking Excess reductions can be transferred between periods	+	+	0
Post-2035 Solutions			
(H) Type approval For vehicles running exclusively on alternative fuels	++	0	++
(I1) Hybrid exemption Explicit ban only for pure ICE from 2035/40	+	0	+++

[a)] only until 2040
[b)] depending on the chosen value for the policy parameter x

[332] See Section 2.1.

3.3.2 Options for Lorries and Buses

For lorries and interurban buses, similar options are available **with the potential to increase the degree of technology openness.**

In general, the CO_2 emission standard legislation for HDVs gives manufacturers already a higher degree of technology openness since it explicitly considers H2ICEVs as zero-emission vehicles. Moreover, the final target level in 2040 is not a complete reduction of tailpipe CO_2 emissions but only a 90% reduction.

Differences with respect to the options discussed for cars and vans above, first refer to the 2045 target year for postponement of the strict reduction target of 90% (A2). This option also includes a postponement of pure-electric quotas for urban buses. Second, the level of the lowered final target in 2040 is set to a (80-x)% reduction (B2). Third, there is no need to consider borrowing and banking, as EU legislation already establishes corresponding provisions until 2039. Fourth, there is no need to consider an explicit hybrid exemption as is in the case of LDVs.

Table 8 summarises the effects on technology openness, on the facilitation of a more market-driven transition in the EU and on the competitiveness of the EU HDV industry in global markets.

Tab. 8: Evaluation of Policy Options to establish Technology Openness for HDVs

Policy Option	Technology Openness	Market-Driven Transition	Competitiveness in Global Market
Target Modifications			
(A2) Postponement 90% CO_2 reduction target in 2045 Lowered CO_2 reduction target before	++ [a)]	++ [a]	+ [a]
(B2) Lower Target (80–x) % CO_2 reduction target in 2040 Lowered CO_2 reduction target before	+++ [b)]	+++ [b)]	++ [b)]
(C) Carbon Correction Factor Lower targets when more alternative fuels supplied	++	++	+
(D) Conditional Target Relaxation Lower targets in case of insufficient enabling conditions	+++	+++	0
(E) Postponement and Freezing Stick to postponed 2025 CO_2 targets forever	++++	++++	++++
Flexibilities			
(F) Phase-In Initially, only a fraction of the fleet counts to the target	+	+	0
Post-2040 Solutions			
(H) Type approval For vehicles running exclusively on alternative fuels	++	0	++

[a)] only until 2045
[b)] depending on the chosen value for the policy parameter x

4 Conclusion

We identify the following **risks** to the **decarbonisation targets** for the EU road transport sector and to the **competitiveness** of the European automotive industry **in the EU internal market**:

As long as potential users of electric vehicles (EVs) do not experience them as a better technology than internal combustion engine vehicles (ICEVs) in terms of total cost of ownership (TCO), range and convenience of charging or refuelling, the transition will not be self-propelling market-driven and risks to fail due to lack in demand. Failure of the future EU Emissions Trading System for road transport and buildings (EU-ETS 2) to deliver a sufficiently high carbon price in road transport would lead to a persistent TCO disadvantage for EVs and risks continued inefficient use of plug-in hybrids (PHEVs). If the rollout of charging infrastructure keeps lacking behind EV sales in the EU, the adoption of electric cars and vans will be mainly limited to drivers who have the opportunity for charging their vehicle at home and/or who have limited range needs. For lorries and buses, the current EU policy is not proactive enough. Slow decarbonisation of electricity generation endangers the positive climate effects of the transformation to EVs. Together with high electricity prices in EU Member States, this could disincentivise potential EV buyers who do not see the point of paying extra for questionable climate effects.

The EU's "pure-electric" strategy for cars and vans – with strict CO_2 emission standards and a *de facto* ban on ICE vehicles in 2035 – as well as the "electric-centred" strategy for HDVs – considering also hydrogen-fuelled vehicles – is at risk of failing because of lack of demand due to insufficient enabling conditions. Compensating for ZEV disadvantages would require huge public support, the financial viability of which is questionable. Moreover, it offers few incentives for the decarbonisation of fuels.

The strategic focus on battery electric vehicles (BEV) increases the EU's external dependence on raw material markets characterised by high supply concentration and geopolitical uncertainty. High costs and supply risks of batteries and critical raw materials can put EU industry at a competitive disadvantage compared to EV imports. Hence, this pure-electric strategy risks carbon leakage through import competition due to the lack of a level-playing field in the EU internal market with regard to imports.

EU legislation also affects the **competitiveness** of EU automotive production **on the global market** if it differs substantially from rules applying to competitors in other regions:

Many countries with considerable demand and/or automotive industries pursue medium- and long-term "multi-technology strategies", reflected in their CO_2 emissions legislation. While banning pure ICE, China still allows for ICEVs apt for alternative fuels and hybrids, states in the US and Canada allow for PHEV. Countries such as Brazil or India might opt for ethanol, others for e-fuels. Risks to the BEV focussed strategy could arise from exploding raw material costs for batteries if demand picks up. As a large proportion of BEV sales depends on state subsidies, sales usually slow down when purchase subsidies are cut – like recently in China and Germany.

Against this background, it is **questionable if EU legislation should limit the choices of EU automakers to adapt to global auto market conditions by imposing in their home market a *de facto* ICE ban for cars and vans or allowing for only a limited scope for HDVs with ICE**. It would strip the EU automotive industry of a potential demand – from loyal regular costumers – for climate-friendly vehicles that are not ZEVs and that might have strong demand also in other world regions if being affordable, fuel-efficient and produced in a climate-neutral manner. Nearly 4 billion people live in countries with inadequate electrical infrastructure for EVs. Vehicles with ICE powertrains are far cheaper to buy and are likely to remain so. For many developing countries, a plausible strategy to decarbonise their road transport could be to opt, at least in part, for efficient ICEVs and hybrids that run on domestically produced biofuels, such as ethanol in Brazil or India, or e-fuels in countries with abundant wind and/or solar radiation. Hence, demand will continue for efficient ICEVs and hybrids apt for such clean fuels.

Therefore, the current EU strategy risks a shut-down in Europe of automotive suppliers, production lines and R&D departments as well as related knowledge creation at universities dedicated to the improvement of ICEVs and hybrids – just to relocate them to other world regions. This marks not only a threat to EU's competitiveness in the current generation of climate-friendly propulsion technologies, but also in those of the future. The production of this sort of vehicles in other regions with higher negative environmental impact and higher CO_2 emissions ("carbon leakage") would do a grave disservice to the environment and the climate as well to employment and value generation in the EU.

From a political perspective, internationally the European Green Deal will also have to pass the litmus test of demonstrating that its instruments are working in an effective and efficient manner while not eroding the domestic industrial base or its resilience and competitiveness – and thus can become a blueprint for other countries. This includes the societal acceptability of efficacious carbon pricing, the efficacy of carbon leakage protection, the financial feasibility of support strategies etc.

Proposals for the Further Development of EU Legislation

In order to enable a **self-propelling, market-driven transition to a decarbonised and competitive EU automotive industry**, following **routes for further development of the EU legislation** are proposed:

(1) For cars and vans, EU legislation should provide for **technological openness**. With CO_2 emissions capped by the EU-ETS 2, the EU can and should grant **more flexibilities within the CO_2 emission standards** in order to (a) enable a market-driven transition, (b) respect technology diffusion patterns and (c) avoid putting EU carmakers in a situation where legal targets would be unattainable because of lacking demand due to insufficient enabling conditions which are beyond their control (see Section 2.1.1.12). A higher contribution of alternative fuels is also crucial for the decarbonisation of road transport. A home market for PHEVs, other hybrids or ICEVs using alternative fuels should still be permitted beyond 2035 (Section 3.2.2.2).

(2) For **HDVs**, the already higher degree of technology openness should still be increased by similar **flexibilities** and perspectives. HDVs running on biofuels should also be supported (Section 3.2.2.2).

Relevant policy options for routes **(1)** and **(2)** have been set out in **Section 3.3**.

(3) EU legislation should ensure that the roll-out of **infrastructure for recharging and refuelling** of all relevant alternative fuels anticipates and serves the needs (Section 3.2.1.3).

(4) In order to allow carbon pricing to shift total costs of ownership in favour of ZEVs, the **EU-ETS 2** must be politically safeguarded. To make CO_2 prices socially acceptable ETS revenues should be redistributed by a **climate dividend** and hardship provisions. **Energy taxes** should be based mainly on GHG emissions (Section 3.2.1.1).

(5) **Supply and price risks on global markets for critical raw materials** should be managed by a smart diversification strategy, stable resource partnerships and a thriving domestic recycling economy (Section 3.2.2.4).

(6) The **EU's innovation capacity for mobility technologies** should be maintained through targeted R&D support and removal of barriers to their commercialisation (Section 3.2.3.1).

Centrum für Europäische Politik
FREIBURG | BERLIN

Authors:

Dr. Martin Menner
Policy Analyst
menner@cep.eu

Dr. Götz Reichert, LL.M. (GWU)
Head of the Department on Energy | Environment | Climate | Transport
reichert@cep.eu

Prof. Dr. Jan. S. Voßwinkel
Scientific Advisor of cep
NGU Nürtingen-Geislingen University
vosswinkel@cep.eu

Dr. André Wolf
Head of the Department on Technology | Infrastructure | Industrial Development
wolf@cep.eu

Centrum für Europäische Politik FREIBURG | BERLIN
Kaiser-Joseph-Straße 266 | D-79098 Freiburg
Schiffbauerdamm 40 Räume 4205/06 | D-10117 Berlin
Phone: + 49 761 38693-0

The **Centrum für Europäische Politik** FREIBURG | BERLIN,
the **Centre de Politique Européenne** PARIS, and
the **Centro Politiche Europee** ROMA form
the **Centres for European Policy Network** FREIBURG | BERLIN | PARIS | ROMA.

The cep institutes are specialised in the analysis and evaluation of European Integration Policy. They publish their scientific work independently of any vested interest, in favour of a European Union that respects the Rule of Law and the principles of the social market economy.