21. Transport: evolving EU policy towards a 'hard-to-abate' sector

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INTRODUCTION: THE EU'S ONGOING CLIMATE AND TRANSPORT POLICY CHALLENGE

Transport and fossil fuels have been intrinsically linked since the Industrial Revolution, from which time all transport modes (road, rail, waterborne, aviation) have come to rely on fossil fuel-based technologies. Transport's apparent addiction to oil in particular has become more problematic as climate change has moved ever higher up the political agenda. Historically, the EU has attempted to address the negative environmental externalities from transport by adopting different policy instruments on a mode-by-mode basis (van Lier and Macharis 2015: 120–121). Despite this, however, the EU has not been able to break the link between transport growth and emissions growth: between 1995 and 2018, overall passenger transport has grown by 30 per cent and freight by 40 per cent (European Commission 2020: 23), contributing to a rise in road traffic emissions from 620 to 786 million tonnes CO2 equivalent since 1990 (ibid). Transport's share of total greenhouse gas (GHG) emissions in the EU27 has increased, from 16.5 per cent in 1990 to 27.2 per cent in 2018, due to a combination of reductions in other sectors and the growth in transport volumes (European Commission 2020: 137). Thus, transport represents an acute climate challenge, and it is vital for the EU to act urgently if it is to meet its long-term goal of a 90 per cent reduction in transport emissions by 2050 (European Commission 2020b: 2). Achieving this reduction requires political support in particular for the replacement of fossil fuel technologies with batteries or alternative fuels. Some transport modes, like roads and railways, are further along in their technological development, compared to aviation and maritime which are only just starting their energy transitions. Thus, different transport modes face different challenges.

Until the Commission's launching of its European Green Deal (EGD) in 2019, EU climate mitigation legislation covering transport relied largely on regulatory measures such as standards for fuel efficiency and vehicle emissions, or instruments to incentivize investment in alternative fuels, for example promoting renewable energy and biofuels. With the launch of the EGD and associated 'Fit for 55' package (European Commission 2021a), a turn towards more market-based instruments, including efforts to extend the scope of the EU emission trading system (ETS), became evident, alongside efforts to tighten existing emission standards.

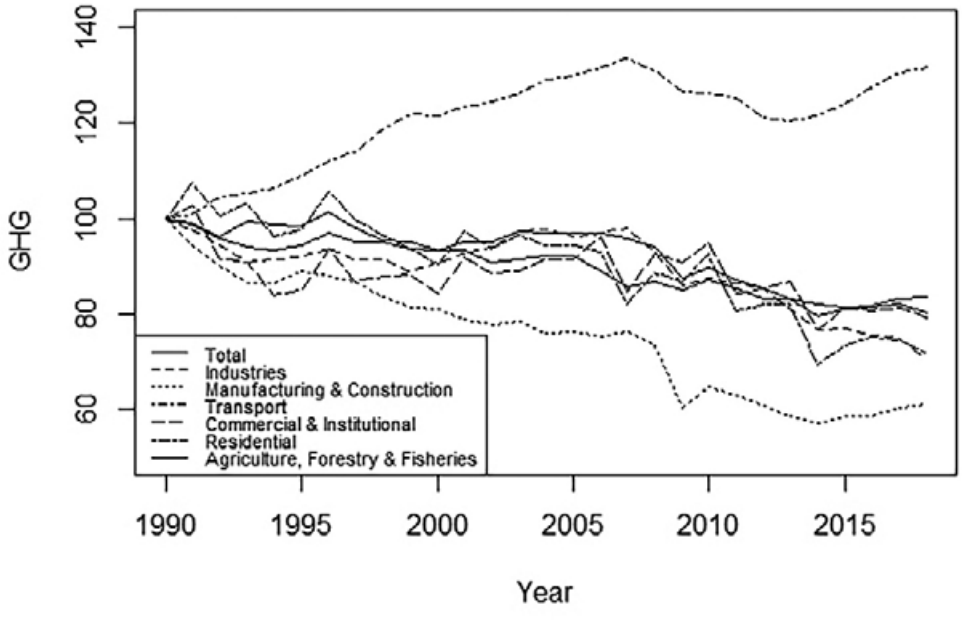
Historically, EU legislators have often been forced to water down policy proposals relating to environmental protection in transport, in the face of lobbying from structurally powerful incumbent industry actors, particularly large car manufacturers that often have close relationships with their national (Member State) governments (Dionigi 2017; Skete 2017). There have also been potentially effective policy instruments that have been neglected, or blocked, due to a lack of competence at EU level, especially regarding fiscal instruments which remain the responsibility of Member State governments, or which have been stymied because they

are seen to pre-empt action by global institutions that industry actors prefer to take the lead in developing regulation (Vogler, Chapter 10 in this volume). Industry actors have often used a global and EU competitiveness argument, linked to the Single Market, to limit the ambition of proposed legislation. Much of the growth in traffic, and hence emissions, can be attributed to the priority the EU has given to completing its Single Market programme, supporting free movements of persons and goods, and the encouragement of transport liberalization in that context (Stevens 2004; Kassim and Stevens 2010). Consequently, attempts to mitigate climate change relying on standards for individual vehicles have had little effect.

Despite these constraints, it is crucial for the EU climate change agenda to reduce transport's dependency on fossil fuels, phase in new technologies and invest in alternative fuel infrastructures. This chapter traces the development of this broad policy agenda, and is structured as follows. The first section gives an overview of the development of EU sustainable mobility strategies, examining what has been done to decarbonize transport over time (other transport issues like congestion are not discussed, as they do not directly relate to climate targets and decarbonization). Given their particular challenges, the specific situations facing each transport mode – road, waterborne/maritime, aviation and railways – are discussed one by one. For each, the chapter aims to identify the principal means of decarbonization, why it has been difficult for EU policymakers to change the existing fossil fuel-based regime in transport, but how they have in any case attempted to regulate it. Finally, the chapter places the mode-specific decarbonization discussion in a wider context of EU policy strategies associated with the European Green Deal and the 'Fit for 55' package (European Commission 2021a), considering the challenges that all modes face in phasing out fossil fuel and the prospects for decarbonization.

EU SUSTAINABLE MOBILITY STRATEGIES

The overall aim for the Commission has always been to build an EU Common Transport Policy, by removing national barriers to free movement of goods and persons, thereby supporting the Treaty guiding principles of free movement (Abbati 1987; Erdmenger 1981). As noted above, by increasing the volume of transport, such goals have obvious implications for the Commission's climate policy agenda, at least for as long as individual journeys rely on fossil fuels. Transport represents 24.6 per cent of total EU-27 GHG emissions (European Commission 2020a). Importantly, transport is the only EU sector with continued emission growth; all other sectors have seen a reduction (European Commission 2020a: 128) – see Figure 21.1 below. This is what makes transport such a key challenge in the transition to a low emission society by 2050. Road transport is particularly problematic, with the highest modal share and the highest share of transport emissions (European Commission 2020a: 38 and 50). The Commission has tried to address the problem of road traffic growth and associated emissions since the early 1990s, through different policy strategies to encourage modal shift, and specific legislation on vehicle standards. Its 1992 transport White Paper focused on developing a sustainable mobility framework (European Commission 1992). This set out two strategies for reducing transport's negative environmental impact: 'first, reducing operational pollution and second, a demand-side centred approach, that is making more efficient use of existing capacities and shifting transport volumes to more environmental friendly [*sic*] means of transport' (Teutsch 1998: 121). Yet, this apparent environmental focus notwithstanding,



Source: European Commission (2021: 126).

Figure 21.1 EU27 GHG emissions by sector (million tonnes CO2 equivalent)

the EU's transport policy during the 1990s continued to focus on liberalization, as part of the Single Market programme (Dyrhauge 2022). Specifically, EU liberalization of the different transport modes removed national barriers and enabled free movements in transport services across borders, which contributed to traffic growth and, especially, increased intra-modal competitiveness (keeping prices down) in road haulage and passenger aviation. Thus, the EU's transport liberalization agenda was at odds with its attempts to create sustainable mobility.

The subsequent transport White Paper, published in 2001, expressed the ambition to decouple transport growth from economic growth and promote modal shift away from road traffic, thereby reducing traffic growth and pollution (European Commission 2001). Modal shift policy is a potentially radical approach to address problems of both pollution and congestion. The concept aims to alter the balance between transport modes, mainly reducing road in favour of rail (Holden 2007). Related policy measures often include an element of 'command-and-control' to regulate behaviour by making it more expensive to drive whilst simultaneously making public transport more affordable, Measures of this kind have, however, been regarded essentially as matters for Member States. Moreover, rebound effects make it difficult to sustain modal shift because motorists start to internalize the extra costs of car ownership and use, which then requires policymakers to adopt further measures to prevent people from returning to their cars (Givoni 2013: 222–224). Unsurprisingly, road and aviation trade associations lobbied against the Commission's modal shift policy because it challenged their dominant positions in inter-modal competition, and the Commission later abandoned the overall objective of decoupling transport growth from economic growth (Dyrhauge 2013a:

143). At the time, because the technological development of low- and zero-emission cars was still in its infancy, decoupling of pollution from transport growth was only possible through modal shift, i.e. demand management (see below).

A decade later, the 2011 White Paper focused on making transport more efficient by creating multi-modal hubs that would link different modes, for example by improving rail links to airports (European Commission 2011). Crucially, the Commission clearly stated that curbing mobility was not an option (European Commission 2011: 5). Thus, the Commission would not seek to reduce traffic growth despite its negative impact on the environment and climate. Unsurprisingly, environmental groups criticized the Commission and argued that multimodal hubs tend to create more traffic by making it easier to transfer from one mode to another. This policy emphasis on efficiency and not curbing mobility set the tone for the Commission's later technology-driven policy approach that aimed to substitute fossil fuels with renewable energies for all transport modes.

OPTIONS FOR DECARBONIZING TRANSPORT

In 2019, the European Green Deal set a target for 'a 90% reduction in the transport sector's emission by 2050' (European Commission 2020b: 2). The goal is translated into different policy initiatives, presented in summer 2021 in the 'Fit for 55' policy strategy (summarized in Box 21.1). Overall, the Commission continues to see reduction in emissions as depending on technological developments and fuel substitution, as well as modal shift. The Commission's 2020 White Paper aims to increase uptake of zero-emission vehicles, specifically 30 million zero-emission cars and 80,000 low emission lorries by 2030, and to double high-speed rail traffic by 2030 (European Commission 2020b). But the document goes further, highlighting the need to pull 'all policy levers', and explicitly notes the need for 'internalisation of external costs (by implementing the "polluter pays" and "user pays" principles, in particular through carbon pricing and infrastructure charging mechanisms)'.

BOX 21.1 OVERVIEW OF KEY EUROPEAN GREEN DEAL AND 'FIT FOR 55' TRANSPORT-RELATED INITIATIVES

- Revision of the EU Emission Trading System (ETS) for aviation and extension to include maritime.
- Proposed creation of a parallel ETS dedicated to buildings and land-based transport.[1]
- Notification on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).
- ReFuelEU Aviation – sustainable aviation fuels.
- Revision of the Energy Taxation Directive (ETD).
- FuelEU Maritime – green European maritime space.
- Revision of the Directive on deployment of the alternative fuels infrastructure.
- Strategic rollout plan to support rapid deployment of alternative fuels infrastructure.
- Amendment of the Regulation setting CO2 emission standards for cars and vans.

Whilst road, waterborne transport and aviation all face the similar challenges of reducing emissions from fossil fuels and require increasing investment in alterative low-emission fuels, all modes have a different trajectory and particular challenges in meeting their objectives by 2050. For example, the Commission's aims for transforming shipping and aviation have a longer time frame than road transport, due to the fact that technological solutions are not as advanced. The following sections discuss each of these three transport modes in turn, describing the approaches that policymakers have attempted to adopt, and the reactions they have faced from powerful incumbent industries.

Road Transport

As noted above, road transport is the most common mode in the EU, and the most polluting. EU policymakers have, for many years, attempted to mitigate the negative environmental impact by regulating vehicle tailpipe emissions and fuel efficiency, and latterly, by promoting alternative fuels (including electrification). Whilst the EU has made progress by continuously revising and strengthening environmental standards, road traffic has continued to grow. Between 1995 and 2018, road freight traffic grew from 1,128 to 1,709 billion tonnes km, while passenger kilometres driven grew from 3,284 to 4,244 billion (European Commission 2020a: 37 and 50). While road transport GHG emissions have been relatively stable as a percentage of the sectoral total – 75 per cent in 1990 and 72 per cent in 2018 (European Commission 2020a: 141), their growth in absolute terms from 620 to 786 million tonnes CO2 equivalent (ibid) highlights how growing road traffic has undermined the positive effect of increasingly stringent environmental legislation.

The Commission's three sustainable mobility packages (2016, May 2017 and November 2017) aimed to help the European automotive industry prepare for the future and maintain global competitiveness (European Commission 2017b: 3). The packages included revised legislation on fuel standards for new passenger cars and light commercial vehicles (Regulation 2019/631) and promoting clean and energy efficient road vehicles (Directive 2019/1161). Since then, the proposal to revise the former effectively aims to ban new fossil fuel cars after 2035 (European Commission 2021b: 19). Although the proposal was met with support from most stakeholders, many large manufacturers argued that the emission threshold set out in both Regulation 2019/631 and the revised proposal could have severe impact on the industry's ability to finance new investments in the future (Euractiv 2020c). Car manufacturers have been especially concerned about the EU's political push for electric vehicles, and have lobbied for a technology-neutral approach that leaves it to them to find the most appropriate technologies to meet emission targets (Dyrhauge 2021a). Thus, it may be noted that EU road transport decarbonization policies associated with the European Green Deal not only incorporate climate targets, but also represent industrial policy, encouraging manufacturers to change their production practices whilst remaining competitive in a global market.

The difficulties policymakers must overcome in regulating emissions from cars through technological standards were revealed in stark fashion by the 2015 'Dieselgate' scandal. Almost all car manufacturers were found to be cheating in emission tests, showing the lengths to which they have been prepared to go to circumvent regulation, not only in the EU but worldwide (Dyrhauge 2021b). This resistance towards climate mitigation had already been evident in the EU 'auto oil' programmes of the 1990s, where the Commission and several car manufacturer trade associations entered into voluntary agreements that committed to achiev-

ing vehicle fleet averages of 140g CO2/km in 2008 and 120g CO2/km by 2012. Failure to make adequate progress throughout the 2000s culminated in the abandonment of the voluntary approach in favour of Regulation 443/2009 on emission standards for new cars (ten Brink 2010: 188–189 and 193). However, this change failed to prevent cheating in emission testing, until the practice was exposed in 2015 (Ewing 2017).

Car manufacturers' opposition to climate mitigation measures have also taken the form of more conventional lobbying activities, targeting EU policymakers. Indeed, the automotive industry has often used its structural power, and invoked its position as a key provider of manufacturing jobs, to limit the ambition of EU environmental legislation (Dionigi 2017 and Skete 2017; for more on the role of business actors, see Eckert, Chapter 6 in this volume). Moreover, the close relationship between the EU institutions and the automotive industry 'inherently prioritises the interests of incumbent firms that benefit from the existing technological regimes' (Meckling and Nahm 2018: 521). Nevertheless, despite their record of lobbying against stricter emission standards, in the wake of the public relations disaster of Dieselgate, car brands have come to publicly commit themselves to phasing out production of internal combustion engines by 2030–2035 and phasing in electric cars (Juul, 2021). Even Volkswagen, which has argued that the new emission standards will push up prices especially in the small car segment (Euractiv 2021a), has recognized that the future is electric for cars, vans and lorries. At times contradictory messages from the likes of Volkswagen reflect the growing maturity of battery technologies and increasing consumer demand for electric cars, but also a concern about the cost of radically changing production from fossil fuel technologies, which will affect all areas of production from employment skills to global supply chains. Here, the long phase-in period for battery vehicles preferred by the industry would benefit the big car companies but could compromise the EU's climate goals.

Although several Member States and cities support an EU-wide ban on fossil fuel car sales from 2035, this policy goal necessitates investment in alternative fuels infrastructure to enable refuelling and recharging throughout the EU. In response, the Commission's alternative fuels infrastructure initiative (European Commission 2017c) promotes standardized vehicle charging points across all Member States. National and subnational public authorities and private companies are responsible for the investment in alternative fuels infrastructure and making these available to the public. Investments in alternative fuels infrastructures need to be supported by fiscal incentives to make it cheaper to buy and own an electric car. Here, the EU's limited competences in taxation mean that the onus is on Member State governments to adopt such policy initiatives. The Commission has signalled its intention to steer Member States towards this with its 'Fit for 55'-linked proposal to revise the Energy Taxation Directive (2003/96/EC), intended to better align taxation of energy products and electricity with EU energy and climate policies.

In addition, the Commission's proposal to set up a parallel ETS to include road transport, intended to cap emissions from buildings and transport at 43 per cent below 2005 levels by 2030, would also have an effect on the relative costs of road transport types. In fact, this proposal was one of the most controversial aspects of the 'Fit for 55' package, owing to the potential for regressive social impacts, unless higher fuel costs can be addressed through other policies (Görlach et al. 2022; Romppanen, Chapter 15 in this volume). In view of its uncertain prospects at the time of writing, this proposal is not considered further here.[2] In short, however, whatever the fate of its proposed measures in policymaking with the other EU institutions, it seems fair to conclude that the Commission has recognized that successful transition to

zero-emission cars requires more sophisticated coordination across a range of policy fields and governance levels than has been the case to date.

Shipping

Global maritime emissions have come to be seen as a more urgent priority, particularly since the 2015 Paris Agreement once again left the task of regulation to the historically somewhat slow-moving International Maritime Organization (IMO) (Vogler, Chapter 10 in this volume; Rayner 2021). In 2018, 'navigation' represented 14 per cent of total EU transport emissions (European Commission 2020a). Most emissions occur in international waters, however, and thus are not included in national emissions statistics. This is particularly problematic for maritime nations like Denmark because it gives an inadequate picture of the country's total emissions. Furthermore, Member States with big international ports (e.g. Antwerp in Belgium and Rotterdam in the Netherlands), have much higher maritime emissions; indeed Dutch maritime CO2 emissions exceed those from cars (European Commission 2020a). Similarly, maritime emissions are higher for island states like Malta and Greece that rely on shipping and ferries. The international scale of operation of the shipping industry means that policy action is necessary from global institutions, as well as at the EU level, to adequately incentivize alternative fuels, reduction of emissions from existing fuel, renewal of fleets or retrofitting of existing ships with low-emission technologies.

In common with other sectors, the maritime sector has expressed some concern about the cost of change, especially fuel costs and investments in new, low-emission technologies. Like car manufacturers, powerful shipping interests prefer a goal-based policy approach, which enables actors to select the most appropriate technological solutions (European Commission 2021f: 103). Some more progressive shipping companies, however, have already started to invest in low emission and alternative fuel-powered ships. One example is Mærsk Line, one of the biggest shipping companies in the world, which in 2021 announced that due to customer pressure, it would introduce its first carbon-neutral vessel in 2023 (Euractiv 2021b). In other words, customer demand and (the prospect of) policy measures based on the polluter pays principle has put pressure on transport providers to reduce their dependency on fossil fuels.

As noted by Vogler (Chapter 10 in this volume), the EU has been relatively progressive in terms of pressing the IMO for greater ambition on shipping emission reduction, and willing to force the pace by acting unilaterally in advance of global agreement. The IMO's 2018 Strategy commits to reduce GHG emissions by 50 per cent by 2050 compared to 2008 levels, with the goal of reducing average carbon intensity (CO2 per tonne-mile) by at least 40 per cent by 2030 and by 70 per cent in 2050. For its part, the Commission has expressed the ambition that by 2030, zero-emission vessels would be ready for market in the EU (European Commission 2020b). The FuelEU Maritime policy initiative (European Commission 2021e: 23), launched as part of the 'Fit for 55' package, proposed reducing the GHG intensity of fuel used in ships, beginning with a 2 per cent improvement in 2025, reaching 75 per cent in 2050. The proposed regulation would directly apply to all ships above 5,000 tonnes with respect to their energy use at an EU port, all energy used between ports in EU waters, and half the energy used on voyages between an EU port and a port in a third country. Moreover, it would require that from 2030 a ship at berth must use onshore energy supply.

The FuelEU Maritime proposal built on existing provisions for monitoring, reporting and verification (MRV) of CO2 emissions in the maritime sector (Regulation 2015/757), under

which all companies with ships over 5,000 tonnes stopping in an EU port are required to monitor their emissions and annually report to the Commission. The MRV Regulation is a precondition for developing a market-based mechanism and integrating maritime emissions into the EU ETS (European Commission 2013). Like the ETS, the MRV Regulation is based on the polluter pays principle that internalizes the negative impact on climate and environment, thereby incentivizing the polluter to change behaviour and develop new technologies that are less polluting. The Commission has striven to have its approach form the basis for an equivalent system of international MRV at the IMO level (European Commission 2013: 5), although in this it has met with resistance (see Vogler, Chapter 10 in this volume).

The Commission's proposal to include maritime emissions in the (existing) EU ETS (European Commission 2020b) received mixed responses. Whilst environmental NGOs such as T&E (2020) were supportive, industry groups such as the World Shippers Council (WSC) see such proposals as potentially undermining IMO efforts to reduce emissions through an internationally agreed level playing field, raising competitiveness concerns (Euractiv 2020d). But without the introduction of bold measures, only incremental progress towards EU and IMO 2050 targets for reductions in maritime GHG emission looks likely.[3] EU policy measures, taken ahead of global agreements, are therefore arguably crucial for pushing the maritime sector as a whole towards decarbonization (Rayner 2021).

Aviation

Globally, in the face of growing disquiet about its climate impacts, the aviation sector has, like road transport, focused on technological solutions relating to fuel efficiency and the development of alternative fuels. But although improved aircraft design has delivered better fuel efficiency, combined technological developments have delivered only a 1–2 per cent improvement in fuel efficiency per year (Bows-Larkin 2015: 691). The development of alternative fuels has been similarly slow, partly due to the continued availability of low-cost aviation fuel, which remains untaxed according to international agreement (Vogler, Chapter 10 in this volume). Neither of these trends is compatible with EU climate goals.

Like road transport, aviation is another sector where the consequences of the Single Market programme and associated liberalization agenda (between 1984 and 1992) have been particularly significant. In particular, it led to the emergence of low-cost airlines which, by making flying more affordable, sparked a significant growth in air-traffic (Kassim and Stevens 2010). The sector was further encouraged by support for airport expansion as a means to promote regional economic development, including through European Investment Bank finance (Mertens and Thiemann, Chapter 5 in this volume). Between 1995 and 2018, EU airline passenger traffic grew by 140 per cent, equivalent to an annual growth of 3.9 per cent, causing EU aviation emissions to nearly double (European Commission 2020a: 50 and 137) and the sector's energy intensity and reliance on fossil fuels to become a growing concern. In 2018, aviation accounted for 13.2 per cent of total transport emissions (European Commission 2020a). Considering that just 2–4 per cent of the global population flew internationally in 2018, and 1 per cent of the world's population is responsible for 50 per cent of CO2 emissions from commercial aviation (Gössling and Humpe 2020), a very small group of high emitters is responsible for most of the emissions from passenger aviation.

As with shipping, the EU has tried to address aviation emissions both globally, in this case through the International Civil Aviation Authority (ICAO) which has been required by the

1997 Kyoto Protocol to handle climate issues, and at EU level (Kassim and Stevens 2010: 147; Staniland 2012; Lindenthal 2014). In doing so, it has met repeated opposition from the civil aviation lobby. At the EU level, from 2012 the Commission managed to incorporate aviation into the wider ETS, although due to a backlash from major airlines (see Vogler, Chapter 10 in this volume), the inclusion has been limited to flights internal to the European Economic Area (i.e. including Iceland, Liechtenstein and Norway). Although this widening of the ETS to aviation might be regarded as a policy success, airlines have not been treated as strictly as other industry sectors. Some 85 per cent of the aviation-related emissions cap has been distributed to airlines free of charge, and according to research by the principal environmental NGO following EU transport sectoral developments, the ten most polluting airlines in Europe received €683 million worth of free allowances in 2021 (T&E 2022).

As part of its 'Fit for 55' package, to incentivize further emission reduction the Commission sought to increase the ETS allowance price, partly by reducing the total number of allowances in circulation in the aviation sector. It further proposed that from 2024, the quantity of free allowances in the aviation sector should be successively reduced by 25 per cent annually, until in 2027 all allowances are auctioned (European Commission 2021b). Some airlines have sought to delay (by three years) the proposed phasing out of free allowances (T&E 2022). A further advantage enjoyed by the industry has been that aviation fuel has remained untaxed under the terms of the 2003 Energy Taxation Directive. Latterly, the Commission has acknowledged that aviation fuel's exemption from taxation constitutes a form of fossil fuel subsidy (European Commission 2020b), of the kind the EU has officially committed to end (e.g. in the Sixth Community Environmental Action Programme, and European Climate Law 2021). It has therefore proposed to end the full exemption in a revision to the directive, as part of the 'Fit for 55' package.

At the global level, the EU has attempted to influence ICAO policies on emissions reductions, especially by pushing for a system of emissions trading, thereby extending its own ETS to all ICAO members (see Vogler, Chapter 10 in this volume, for analysis of the EU's interaction with the global regime on this question). Dilemmas have emerged regarding the relationship between the EU ETS Directive and ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), the implementation of which threatens an oversupply of cheap offset credits that is likely to increase global aviation CO2 emissions (T&E 2021a and ICF Consulting et al. 2020). The Commission's 2021 proposal to revise the EU ETS Directive, which also implements CORSIA, attempts to reform the system and reduce the number of credits, but has met with opposition from airlines and the tourism industry concerned over the economic impact of overlapping measures (Euractiv 2021d). As with the case of maritime regulation, this highlights how the global governance structure for aviation places constraints on the kind of EU legislation that is possible.

Regarding alternative fuels, to accelerate the production, distribution and uptake of Sustainable Aviation Fuel (SAF), the 'Fit for 55' policy package included a proposed regulation called 'Refuel EU Aviation'. This imposes an obligation on jet fuel suppliers to supply an increasing share of aviation fuel blended with SAF at all EU airports, and requires airlines to increase their uptake (European Commission 2021d). In view of their harmful environmental effects, the proposal excludes first generation crop-based biofuels and instead focuses on advanced biofuels from waste and residues, in addition to E-kerosene. However, these technologies are still in their infancy and are unlikely to become mainstream before 2035 (Sharmina et

al. 2021: 460–462). Like the maritime sector, aviation will have to develop new technologies and increase alternative fuels production to be able to meet EU 2050 targets.

Railways

The challenges for the railways are completely different from the other transport modes. European railways have a small modal market share and low share of transport emissions (European Commission 2020a). Reflecting this (and the fact that most Member States are already in the process of electrifying their railways), there are no railway initiatives in the European Green Deal or 'Fit for 55' policy package. Instead, the Commission's long-held strategy is to revitalize the railways through market opening, with the aim of creating intra-modal competition between railway operators, which it believes will in turn lead to improved inter-modal competition that would reduce the modal share of the most polluting transport modes, like road and aviation (Dyrhauge 2013b). Most passenger railway services are domestic and the inter-modal relation between railways and road transport at domestic level is a Member State competence, where national public authorities determine prices, availability and accessibility to infrastructure.

International high speed rail connections have been improved through the Trans-European Network for Transport (TEN-T), established to build large-scale cross-border infrastructure covering all modes (Ross 1998; Dyrhauge 2013b; Stephenson 2010). Nevertheless, the EU does not have competences to build infrastructure. Instead, the Connecting Europe programme finances a small part of these large-scale prestige projects, with Member States responsible for the rest. The TEN-T projects, as cross-border infrastructure, require bilateral agreements between two Member States, and it is difficult for two national political agendas to align. Additionally, more infrastructure risks creating more traffic, instead of delivering genuine modal shift that redirects existing traffic away from congested and polluting infrastructure. Although modal shift away towards railways is often seen as the answer to sustainable mobility, the balance for both passenger and freight has remained stable over the past 25 years, despite efforts by the Commission to increase the share of rail freight (Dyrhauge 2013a and 2013b; European Commission 2020b: 38 and 50).

Thus, revitalizing rail by increasing the sector's modal share, both domestically and internationally, has so far failed. Only a few international high-speed railway services, like Eurostar, have been able to compete with airlines. Fierce competition from low-cost airlines (which, as noted above, are effectively in receipt of fossil fuel subsidies) has simply created more demand for transport services, instead of shifting the modal balance from air to rail (Givoni 2007). Many international passenger services and night trains have closed since 2010 due to a lack of demand and competition from low-cost airlines. However, the recent 'flyg skam' ('flight shame') campaign that started in Sweden in 2017, not only aims to reduce flying but also promote long-distance railways as an alternative (Jacobson et al. 2020). This social movement has now spread to other European countries, increasing pressure on national governments and railway companies to expand international night trains, international daytime services and offer online ticketing for these routes, comparable to airline systems.

The EU institutions designated 2021 as the European Year of Rail (Decision 2020/2228). The initiative consolidates existing policy initiatives and creates a bigger platform for the Commission to push its long-held strategy to revitalize the railways. Moreover, several Member States have promised more international night trains. In December 2020, France,

Germany, Austria and Switzerland pledged to start cross-border night trains (Euractiv, 2020), while the Swedish and Danish governments have made provision for a night-train service from Sweden via Denmark to Germany. However, the administrative process of setting up international railway services is extensive and most railways, with the exception of Austrian ÖBB, do not have experience of running commercial night trains and lack suitable rolling stock. Setting up new international services can take years because the railway company, in addition to buying new rolling stock, must apply for safety certificates, vehicle type authorization and access to track. These technical administrative processes have traditionally been matters for national authorities, but the fourth railway package shifted the processes of certification and authorization to the European Railway Agency (Dyrhauge 2022). This, in theory, leaves only the application for access to infrastructure with the national authorities, which should reduce the administrative burden and speed up the process of setting up new railway services.

The technical dimension of EU railway policy aims to reduce emissions through electrification of the network and upgrade signalling through the implementation of the European Rail Traffic Management System (ERTMS) (Dyrhauge 2013b). The implementation of ERTMS and electrification rely on financing by Member States, which are responsible for upgrading their own national railway infrastructure. Moreover, electrification has been delayed in some countries due to lack of financing or political prioritization. Recent developments in locomotives have focused on batteries and hydrogen engines, where both the Danish DSB and the German Deutsche Bahn have bought Siemens battery and hydrogen locomotives – Deutsche Bahn for its German rail services (Euractiv 2020a) and DSB for its regional services. Importantly, the new battery technology does not require overhead wires, and thus makes it cheaper for national infrastructure managers to electrify their networks. Although fossil-fuel derived electricity in high-speed rail services is still better for the climate and environment than flying (Givoni 2007), it is still necessary to consider the full energy cycle. Thus there is an increasing focus on sector-coupling between transport and energy.

In summary, overall the railways constitute the least of the EU's problems in terms of transport decarbonization; instead the Commission's main goal has been to reform and liberalize the sector, thereby making it competitive vis-à-vis the other transport modes, especially road freight and short-haul flying.

CONCLUSIONS: PROSPECTS FOR TRANSPORT DECARBONIZATION BY 2050

This chapter has described how, dating from the early 1990s, efforts to bring transport policies closer into line with climate objectives in the EU have faced a number of challenges. These include continued expectations of high levels of individual mobility and liberalized cross-border trade, lobbying by powerful incumbent industries, limited EU competence to act in some key respects, entanglement with global institutions, and concerns over the social impacts of measures that might lead to rising costs. On the other hand, public opinion and consumer expectations have shifted to support more ambitious climate action.

Sustainability has been part of the EU transport policy agenda since the early 1990s, yet the EU has not been able to combine its overarching principles of free movement with the creation of a sustainable mobility paradigm. Instead, transport liberalization has led to traffic growth that has reduced the effect of increasingly stringent environmental legislation. More recently,

however, for road transport at least, technological advancements in alternative fuels, and the significantly increased uptake of electric vehicles in particular, have made significant decarbonization conceivable within the next decade. The market share occupied by electric cars has increased notably in the EU, from 1.9 per cent in 2019 to nearly 10 per cent of new car sales in 2021 (T&E 2022). Further mainstreaming of new technologies will require continued political commitment at all levels, including sufficiently ambitious legislation that facilitates this paradigm shift. This chapter has noted how this commitment entails transport policy developing a more prominent industrial policy dimension, with a fuller set of instruments than hitherto. Without this continued political commitment, incumbent manufacturers may act on the commercial temptation to maintain production of combustion engine vehicles (InfluenceMap 2022). In terms of the EU's road-based emission reduction efforts, technological advances look likely to maintain their pre-eminence over more politically contentious forms of demand management and behaviour change, particularly where they raise the cost of motoring in potentially regressive ways that carry the risk for governments of a French 'gilet jaunes'-type political backlash (Kinninburgh 2019).

Whilst the EU can encourage technological development and strengthen regulations in order to facilitate transition to a low-emission paradigm, it is dependent on Member State willingness to a great extent. Modal shift away from the private car requires improving accessibility and affordability of public transport such as rail and busses, as well as making car travel more expensive, through different tax and pricing incentives, investment in fuel infrastructure, and public transport. Given the status of transport within the Treaties, these policy initiatives fall within Member States' competence. Importantly, a further difficulty arises in that such policies often experience a 'rebound effect' as individuals internalize the extra environmental taxes and revert to previous transport behaviour, often car driving. As a result, additional environmental taxes to encourage modal shift end up being fiscally attractive for public authorities, often going into the overall budget instead of being reinvested in sustainable mobility initiatives. An exception was the 2011 Eurovignette Directive, which set up a fund to reinvest part of the income from road taxes from lorries in sustainable transport projects (Dyrhauge 2014).

Investment in infrastructure projects, particularly airport and road expansion, is also problematic for climate targets as they facilitate traffic growth. This, as explained above, is even the case with TEN-T investments in international high-speed railway services. Moreover, given their complexity, many TEN-T rail projects have been delayed, which makes their contribution to 2030 climate goals even more doubtful. Modal shift from driving and flying towards railways is often seen as the answer to sustainable mobility. However, the modal balance for both passenger and freight has remained stable over the past 25 years in the EU.

While full decarbonization by 2050 is possible for railways and road transport, it is rather less likely for maritime and particularly aviation. This is due to the lack of readily available low-carbon technology, and the close involvement with global governance institutions that have a track record of stalling progress in those two sectors. This chapter has shown how the difficulties of transport decarbonization are not only technological but also highly political, touching on concerns including global competitiveness of industries that could face costly transitions, and sensitivities about restricting freedom to travel. Significant resistance to change from a range of incumbent industry actors has been evident. Given the typically long life cycle of ships and aircraft, investments made today will remain for decades. Thus, the political signalling for both public and corporate investment in alternative technologies is crucial, and in this respect the EU has an important role in transport decarbonization, not just at the European

level but on a global scale. The Commission's effort to revise the Energy Taxation Directive in such a way as to internalize more of the climate damage costs from burning aviation fuel represents a bold move in the direction of demand management but will be politically difficult, requiring as it does unanimity among EU Member States in the Council.

One further aspect worth touching on is the effect of particular crises that have hit the EU, in terms of the opportunity they present to transform expectations of transport and mobility, and the role of governments in ensuring the long-term sustainability, financial as well as environmental, of particular industries. As the COVID-19 pandemic struck, airlines in particular appealed to governments for state aid to see them through the slump in demand, presenting an opportunity to impose climate-related conditions, for example that greater investment be made in low-carbon innovation. The decision by the French government to attach environmental policy conditions to its state aid package for Air France highlighted the potential here. However, France was unusually enlightened compared to other Member State responses, where the opportunity to facilitate decarbonization for decades to come was missed (T&E 2021). Arguably, the opportunity was also missed in terms of shifting more decisively to electric vehicles and other forms of mobility (Quitzow et al., Chapter 24 in this volume). For now, countries are witnessing a gradual return to pre-pandemic levels of traffic and thus pollution. (While the consequences of Russia's invasion of Ukraine in February 2022 may present opportunities, these are beyond the scope of this chapter.)

Overall, despite the increased attention to the climate agenda and growing public support for transport decarbonization, the speed of change needs to increase if critics are to be satisfied that the EU is contributing all it can to meeting the Paris Agreement objective of holding temperature rise to the 1.5/2˚C judged necessary to limit the worst effects of climate change.

NOTE

1. For more on this proposal, see Romppanen, Chapter 15 in this volume.
2. A provisional agreement between Parliament and the Council was reached on this and other proposals in December 2022 (Council of the European Union 2022).
3. In December 2022, Parliament and the Council agreed that shipping emissions will be phased into the existing ETS between 2024 and 2026 (Council of the European Union 2022).

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