Emission reduction strategies for the transport sector in Romania

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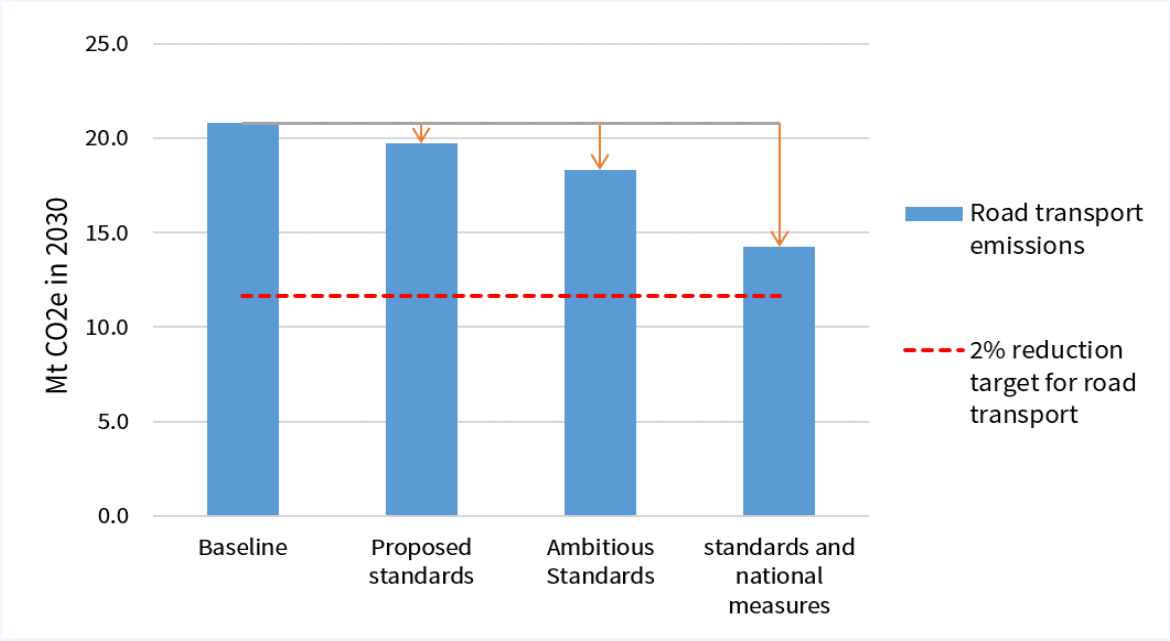
It is the overarching goal of the EUKI to foster climate cooperation within the European Union in order to mitigate greenhouse gas emissions. It does so through strengthening across-border dialogue and cooperation as well as exchange of knowledge and experience.

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Executive Summary

Transport is the third largest source of greenhouse gas emissions in Romania. Since 1990, transport emissions in Romania have been increasing; in the context of needing to be decarbonised by the mid-century under the Paris Agreement, this trend needs to be rapidly reversed. Romania is already experiencing amplified climate change and warming compared to Europe. If no action is taken, Romania risks not meeting their medium term European reduction targets. The objective of this report is to show how Romania can decrease their transport emissions from a broad range of European and national measures. In particular, the report focuses on reductions in road transport emissions that fall under the jurisdiction of the European Climate Action Regulation that enforces a 2% emissions reduction target in 2030 compared to 2005. Finally, policy recommendations are presented to enable Romania to meet the most ambitious targets.

The effect of mitigating measures such as vehicle efficiency standards, modal shift, and demand reduction, among many others, are calculated using Transport & Environment's in-house transport model, the EUTRM. The main results of the scenarios investigated are shown below. Crucially, Romania will need to employ more ambitious measures than those described in this paper, across the whole economy to meet the 2030 climate targets.



The scenarios in detail:

Baseline: If Romania takes no action and the proposed 2030 CO2 standards for road vehicles are not implemented, Romania will fall short of its 2030 targets by 9.2 Mt of emissions. Under the CAR regulation, this may result in requiring the purchase of up to 59 million allowances. Assuming that the other sectors just meet their target, no flexibilities, and an allowance price of €100/tonne, this would be €5.9 billion, if loopholes in the regulation are not used.

Proposed Standards: If the European Commission's 2030 CO_2 standards for cars, vans, and trucks are implemented, Romania will fall short of its 2030 targets by 8.1 Mt of emissions; the proposed standards would close *the gap* between the target and the projected baseline emissions by only 12%.

Ambitious Standards with Electrification: If the European Commission's 2030 CO_2 standards for cars, vans, and trucks would be strengthened to their technical and economically viable potential, this would mean 40% 2030 CO_2 reduction targets for cars and vans; for trucks this would be 43%. Within these standards, the electrification of road transport would be encouraged to ensure the eventual full decarbonisation of the sector. In 2030, sales of electric vehicles would reach 50% for vans, and 30% for trucks. In parallel, all new sales of city buses in Romania would be electric by 2030. Despite these significant gains, in this scenario Romania is set to miss its 2030 targets by 6.7 Mt of emissions; ambitious standards would close the gap by 27%.

National measures: There is a wide range of national measures that can help reduce demand and enable shifting to cleaner modes. Measures include shifting car passengers to trains, buses, walking, and cycling; improving road freight logistics and shifting road freight to rail; and getting more people into each car and bus. Taken in isolation, ambitious national measures could close the gap by 42%; combining national measures with ambitious standards and electrification would see Romania falling short of the target by 2.6 Mt, with all measures combined delivering 71% of the effort.

The result of this study shows that Romania needs to employ as much ambition as possible to reduce its reliance on the over achievement of other sectors (particularly in the buildings sector) to make up the projected gap in transport. Otherwise, even more ambitious policies would be required, including a systematic upheaval of the transport sector to fast track electrification and zero emission vehicles.

Policy Recommendations:

This report cites independent research to set the ambitious levels based on technical and economic feasibility. To realise the full potential of these measures only requires political will. Below is a summary of the key policy recommendations for Romania to meet its targets.

EU Level:

- Romania should adopt ambitious vehicle standards, and in particular insist on the 2025 targets. For cars, vans, and trucks this is a real 20% reduction by 2025.
- A separate sales target for zero emission vehicles should be agreed for 2025 to drive the supply of electric vehicles in Europe. This can be done either via a dedicated ZEV mandate or by adding a malus to the currently proposed bonus system for cars.

National Level:

- Road charging: harmonise rates at which vehicles are charged across the whole network, ensure all tolls are inclusive of separate infrastructure and (air and noise) pollution costs so that more polluting vehicles pay more, extend the toll charge for HDVs to secondary roads so that the damage they cause is accounted for wherever they drive. This will additionally prevent HDVs from using secondary roads to avoid the toll, and so relieve congestion on those roads.
- To encourage more car passengers to buses, trains, riding, and walking, Romania should invest in high quality, affordable public transport and walking and cycling infrastructure, share relevant data with other transport providers and internet mobility platforms to enable Mobility as a Service (MaaS), introduce measures to encourage bike sharing, and reduce the number of car parking spots and increase parking fees.

- To putting more passengers in cars, introduce city road pricing and/or congestion zones, facilitate the use of short and long distance car and ride sharing, and adapt fiscal incentives to deter private car use by ending tax benefits for company cars.

- To shift freight from trucks to (electric) trains, the Romanian regulator must ensure that the railway infrastructure manager is treating all trains equally regarding track access, explore the idea of obliging the state-owned company to rent unused electric locomotives to new entrants that do not have the access to capital to buy such rolling stock, improve the flexibility and speed of freight services by investing in rail infrastructure that's not as complex or time-consuming as large cranes, and increase competition in the rail freight market.

- Fuel taxes and tax reform: as a complementary measure to distance-based tolling, Romania should engage in discussions with neighbouring countries to align their diesel tax rate to that of petrol, and look to increase this to be more in line with the EU average. Collaboration on this measure is vital so as to avoid fuel tourism in which truck drivers divert to re-fuel in the country with the lowest fuel tax rate. This not only increases traffic in certain areas, but makes it difficult for neighbouring countries to use fuel tax as a tool to reduce greenhouse gases.

Outside the CAR:

- For aviation, at a national level, Romania should introduce a ticket tax on flights to generate revenues and stem demand. Ending the sector's kerosene tax exemption can be done domestically and through bilateral agreements (if EU wide unanimity to end it is not achieved) a measure that could be initially phased in with neighbouring countries.

- At the EU level, Romania should support measures that aim to reform the EU ETS as a means of introducing more effective carbon pricing.

- For shipping, Romania should implement tighter air pollution standards for ships calling at Romanian ports, consider mandates for zero emission shipping on specific domestic/short-sea shipping routes, make on-shore power supply available, and ensure the transparency and cargo data collection in the EU MRV (when revised) in order to break market barriers to the uptake energy efficiency technologies in shipping.

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1. Introduction and context

1.1. Climate change

Prior to the 1950s, CO_2 concentration levels in the earth's atmosphere hadn't surpassed 280 ppm in the last 400 000 years[i]. On 2 May 2013, the global concentration of CO_2 in the atmosphere reached 400 ppm for the first time over the course of one day[ii]. 400 ppm is significant because it is the central point of the uncertainty zone of the planet for the so-called safe operating space for humanity. According to the same paper, the upper-bound concentration for humanity to thrive is 350 ppm, a level surpassed in the mid-1980s[iiiiv]. As of June 2018, the seasonally adjusted average concentration stands at approximately 407 ppm[v], and rising. The increase in CO_2 is the most important of anthropogenic emissions that increases the amount of heat retained in the Earth's atmosphere and results in climate change[vi]. Climate change pertains to increases in the frequency and severity of natural disasters and droughts, to ocean acidification, temperature change, and sea-level rise, to name a few.

On 12 December 2015, 196 nations around the world adopted unanimously the Paris Agreement that aims to mitigate global greenhouse gas emissions. Specifically, the signatories agreed to take measures to hold the increase in temperature 'to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change'[vii]. This would mean limiting the CO_2 concentration to between 450 ppm and 480 ppm. The European Union, and by implication Romania, is signatory to this Agreement. For the EU, the Agreement translates to a full decarbonisation of the economy (i.e. no net CO_2 equivalent emissions) by early 2030 to limit warming by 1.5°C, or by 2050 to limit warming by 2°C, compared to pre-industrialisation levels[viii].

Climate change is a global problem requiring global efforts to combat it, however there are specific threats and costs associated for Romania that have already been observed. Over the period from 1907 to 2007 the mean annual air temperature in Romania increased by 0.5 degrees[ix]. In the last decades, precipitation has decreased in the south during winter and in the west during summer, but seen an increase in the north, particularly during autumn; significantly more periods of dry spells were observed from 1961 to 2010. Coastal erosion has become a particular issue over the last decades for Romania's 243 km of coastline, leading to a decrease in beach surfaces, particularly in southern parts which consist of an almost uninterrupted chain of tourist resorts, interspersed with towns and harbours (while the north contains the Danube Delta Biosphere Reserve, Europe's largest nature reserve)[x]. The tendency to longer, more frequent and more severe heatwaves in the Carpathian Region (encompassing Croatia, Hungary, Slovakia, Czech Republic, Poland, Ukraine, Romania and Serbia)[xi] will exacerbate these events. As a peripheral country on the south-eastern frontier of Europe, the number of climate change migrants that arrive in Romania will likely increase.

Climate change is a global problem caused by human activities that has and will have increasing environmental, social, and economic costs. As the 44th largest emitter in the world[xii], and the 10th largest emitter in Europe[xiii], Romania must play an important and leading role in reducing greenhouse gas emissions to avoid catastrophic climate change. *This report will detail a roadmap that will aim to help Romania to meet its climate obligations for the fastest growing sector in terms of emissions: transport.*

1.2. Scope of this report

The main legal framework that this report is based on is the Climate Action Regulation (CAR)[xiv], formally the Effort Sharing Regulation (ESR). As will be described in greater detail, the GHG emissions that fall within this regulation and the focal point of this report is land transport, i.e. passenger transport in cars, trains, and buses and freight transport in trucks and trains. Motorcycles are not considered in this report as they are a small percentage of road transport emissions and they have a clear and proven decarbonisation pathway through battery electric powertrains. The report will look at measures that can be taken to

decarbonise these sectors and in particular will use T&E's in-house transport model to show how much reduction is possible from each measure in reaching the 2030 target.

In this sense, the report will show the impact of what is accepted as technically possible in terms of some measures like the fuel efficiency improvement of vehicles, but also what is required to shift or reduce demand of transport. The emissions from shipping and aviation will also be discussed, but their emissions will not be modelled, among other reasons because they are not included under the CAR. Finally, for all of these modes of transport, this report offers pragmatic, technically feasible, and economically viable policy recommendations to pave the pathway for not only the achievement of the Romanian 2030 emission reduction targets, but policy that will make the ultimate decarbonisation of transport an attainable reality by the mid-21st century.

1.3. Why does this report differ from other reports

A number of studies have been carried out regarding energy efficiency and energy security in Romania. Fewer, however, cover transport specifically. Having said that, three papers in particular are worth mentioning: a joint World Bank and Romanian Government report (2013)[xv], a report by Bankwatch (2016)[xvi], and a paper by Vasile et al. (2012)[xvii].

The report by the Romanian government and the World Bank (2013) provides an overview of the challenges facing Romania in decarbonisation and details Romania's national measures thus far. In terms of transport, the report points out that an increase in passenger car ownership is leading to an increase in cars users and corresponding decrease in public transport (though the data for this assumption is not clear). A lack of funds is highlighted as a barrier to upgrades to transport infrastructure, which is described as being badly maintained (and, particularly in the context of bicycle networks, irregular). Poorly maintained rail infrastructure is blamed for declining passenger numbers. Finally, without intervention to offer better transport alternatives and encourage their use, the report notes that as the number of car owners increases, the use of cars is also likely to grow. One of the drawbacks, however, is that this is only a review of the situation (now dating 5 years), and provides no solution, or in depth analysis of sectors.

The second report by Bankwatch (2016) looks at how Romania can develop their economy in line with EU and national climate mitigation policies, challenging the notion that economic growth necessarily means energy consumption growth. The report notes that energy intensity in Romania is roughly twice that of the EU average, with great potential in the transport and buildings sectors for efficiency gains. It found that of the 50 largest 'aid' schemes offered by the Romania state in the last decade (totalling €778 million), 36% was earmarked for the automotive industry. The report suggests that the government should ensure state aid contributes to real sustainable development by investing in more sustainable transport, such as trains (and limit aid to other inefficient modes).

Finally, the paper by Vasile et al. (2012) considers measures to reduce greenhouse gas emission in the transport sector in Romania. The paper notes that although the energy efficiency of vehicles is generally improving, this is offset by increased average length of travel, the increase of the fleet, and other variables, such as driving style, and traffic jams, which ultimately translate into an increase in greenhouse gases emissions. It details a number of national level measures taken to reduce emissions in the transport sector, and finally concludes that to ensure the future adaptability of transport to changing climate change scenarios, the design stage of transport infrastructure must focus on climate change adaptation. While being a good overview of some of the national measures taken by the Romanian government to reduce emissions in the transport sector, this paper does not comprehensively provide examples for further opportunities to reduce emissions, nor does it calculate these based on the 2030 emission reduction target for Romania. Moreover, this paper is now somewhat dated.

This paper, therefore, fills a gap in the literature by presenting decarbonisation strategies focused solely on transport and based on updated in-house modelling. Between 2000 and 2016, greenhouse gas emissions from transport (including international bunkers) increased from 10.3 million tonnes CO_2eq to 17.8 million tonnes CO_2eq[xviii]. Given this and the above, this report is timely in its analysis of transport policies and provision of decarbonisation strategies.

1.4. Transport & Environment and the EUKI project

The European Climate Initiative[xix] (EUKI, from German Die Europäische Klimaschutzinitiative) is a project financing instrument by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB). The overarching goal of EUKI is to foster climate cooperation within the European Union in order to mitigate greenhouse gas emissions. It does so through strengthening cross-border dialogue and cooperation as well as exchange of knowledge and experience[xx]. Under the EUKI initiative, T&E is undertaking a project called "Delivering the EU-2030 and Long Term Climate Objectives in Central, Eastern and Southern Europe, with a Specific Focus on Transport"[xxi], which has four overarching objectives, namely:

1. To provide accurate information on the potential of transport decarbonisation measures to meet climate targets in the targeted countries.
2. To foster NGO led development of national climate and energy plans
3. To enhance or create communication and exchanges between national organisations for target countries
4. To Identify additional savings through EU funding and measures - transformational projects in the transport sector

Transport & Environment coordinates this project which involves research and dissemination at national level in close collaboration with some of our national partners in Southern and Eastern EU Member States, specifically Romania, Spain, Italy, Hungary and Poland. Transport & Environment has more than 28 years expertise on transport decarbonisation policies and, thanks to that, T&E is uniquely placed to gather evidence, critically analyse, and recommend clear policy pathways to achieving decarbonisation of the transport sector[xxii] from an impartial perspective.

1.5. Introduction to EUTRM

Transport & Environment has used its in-house model, the European transportation roadmap model (EUTRM) to analyse the effect of different policies on GHG emissions. The EUTRM is a demand driven bottom-up model that can compute GHG emissions in five year intervals, but has recently been modified to compute at yearly intervals for the years between 2016 and 2030. Passenger transport and freight demand are based on purchasing power parity (PPP) adjusted GDP, which is determined by historical and projected gross domestic product (GDP), population, and fuel price for each country. All transport demand within a Member State is met with effectively unlimited transport capacity for freight but with natural limits on motorisation rates for passenger cars through new or second hand sales.

The EUTRM is initialised and calibrated with historical data. For the example of trucks, the vehicle stock and number of new vehicles (both in number and in weight category), mileage, fuel consumption, transport activity, and load factor are considered. The bottom-up structure allows for vehicle based policy changes. Continuing the example of trucks, these can include policy driven modal shift (moving freight from road to rail), engine technology uptake (hybrid, electric, hydrogen), fuel efficiency (efficiency standards or market development), and logistical improvements (increase in load factors, the amount carried by each truck). Therefore, the strength of the EUTRM is in its ability to combine multiple policy decisions and show their effect on the business as usual case, and to quantify the relative importance of policies on GHGs.

Note on modelling fuel efficiency improvements: Cars and vans are type-approved by a laboratory test, known as the New European driving cycle (NEDC), to give a standardised method for determining fuel

efficiency. Developed in 1997, a vehicles is placed on a chassis-dyno and the technician follows acceleration and braking patterns from approximated driving profiles based on urban/city driving, country road, and highway driving. The gap between what is measured in the lab during type approval and on the road was about 10% in 2000, however in 2017 it had grown to what appears to be a fleet average ceiling of 42%[xxiii], for a number of reasons[xxiv]. The introduction of the new test cycle (the WLTP, the worldwide harmonised light vehicles test procedure), should partially help this, as the driving profiles are much more representative than in the NEDC. Aligning NEDC fuel consumption results with those measured with WLTP will vary between manufacturers and cars, and will not be known until 2019 and 2020 as the new WLTP regulation comes into force. This is one of the reasons the Commission opted for percentage reductions rather than g CO_2/km figure; the efficiency improvements should be as much as possible real world improvements. When modelling car fuel efficiency in this report, reductions are based on NEDC fuel consumption and the gap kept is kept constant at 42%.

1.6. Baseline situation, modelling assumptions and projections

Projecting Romanian emissions in 2030 relies on the historically observed relationship between wealth and transport demand[xxv]. As will be shown, holding this assumption and without explicit measures to reduce the fuel efficiency of vehicles, an increase in the economy will lead to an increase in transport activity and thus an increase in emissions. The key socio economic assumptions that are exogenous and static inputs to the EUTRM are detailed in Table 1. These assumptions are in line with the Commission's Reference Scenario[xxvi] although in 2050 the activity levels in the EUTRM are 5-10% higher. In 2016, the inputs are calibrated to be in line with the data from the Statistical Pocketbook: EU Transport in figures, 2018 (with 95.6 G p-km in passenger cars, and 18.0 G t-km of road freight, measured by territoriality[xxvii]).

Along with these assumptions, the oil price is kept constant. This assumption alone is the single most import difference between the projections of the Commission's 2016 Reference Scenario and the EUTRM in 2050: an increase in oil price makes transport more expensive, limiting demand and according to the report incentivises manufacturers of cars and trucks (OEMs, original equipment manufacturers) to produce more efficient vehicles, despite no historical evidence of this[xxviii]. The oil price is kept constant in the EUTRM for two main reasons, firstly, to negate an otherwise uncontrollable and external influence on transport demand, and secondly, as if the EU and indeed the world do begin to take a trajectory of decarbonisation, the demand for oil will decrease, and from simple economic principles, price will not go up.

Table 1: Main socio-economic assumptions in the EUTRM.

Metric	2016	2020	2030	2050
Population (millions)	19.8	19.7	19.0	18.0
GDP (2013 € billions)	155	171	204	273
Passenger car activity (G p-km)	91	104	136	218
Road Freight activity (G t-km)	16	18	22	33

In the baseline, only fully legislated policies are included. The only law directly pertaining to the efficiency are the 2021 car and 2020 vans standards; these standards are included in the model. The monitoring and reporting regulation (MRV), a measure that will allow hauliers to compare like trucks against each other and choose the most fuel efficient for their operations, is assumed to increase large truck (>16t) fuel efficiency by 10% between 2010 to 2030[xxix] and 6% for smaller trucks[xxxxxxi]. Other proposed legislation, such as the Commission's proposal on truck CO_2 standards and the 2030 standards for cars are still being debated in the European Parliament and Council. As they are still subject to change, these are not considered in the business-as-usual baseline. In terms of national law, despite the many options available, Romania has not implemented any law that will work to decarbonise transport. These options and their implementation will be explored in the following sections. In short, the baseline presents a business-as-usual scenario; there

will be no transformational and disruptive changes to the transport system, but a steady increase in demand and thus emissions will be observed by all modes.

1.7. Who should read this report

National level NGOs

NGOs that represent civil society with a focus on climate change and decarbonisation of the economy, ideally with experience on national and EU climate regulations. This report should be considered as a handbook on how to navigate the often complex legislation concerning climate, decarbonisation and sustainable transport with an aim contributing actively and positively to decision-making processes on these matters.

Decision and policy-makers at national, regional and local level.

Lawmakers at all levels have the responsibility to design and implement policies that must deliver greenhouse gas emission reductions in order to achieve the nation's and the EU's climate commitments. This report should for them be seen as technical and policy input, which offers accurate, positive, plausible options for the decarbonisation of the transport sector.

Private sector and individuals

European companies are world leaders in clean technology, to remain so requires ambitious regulatory framework that will not only keep European companies there, but will push for innovation and novel solutions.

Individuals, ultimately, hold the most power. Voting either at the ballot box or with your wallet gives signals to lawmakers and private companies that a sustainable, decarbonised future is what we need and what we want in order to secure our future. In a world full of information, this report aims to gives honest, accurate accounts and recommendations for an ambitious but feasible roadmap for 2030 and to the mid-century.

2. Environmental and political climate in Romania

2.1. The rise and fall of emissions in Romania

This section will describe the last quarter of a century of emissions in Romania, the dominant and fast growing sectors, and the upcoming legislated targets and decarbonisation ambitions. From 1990, Romanian greenhouse gas (GHG) emissions from all sectors (including 'bunker', those emissions from international aviation and shipping) have sharply decreased from around 218 Mt CO_2e to 103 Mt CO_2e, a reduction of 53% (Figure 1). These emissions reductions were not due to government *environmental* policy, but were driven by major political and social events, such as the 1989 Romanian Revolution, new government fiscal policy from 1996, and the global financial crisis of 2007 and 2008, which all led to sharp contractions in emissions. As the economy contracted, demand for goods, transport, and electricity and heating reduced along with their associated emissions. These figures belie a stagnation since 2013, and important aspect that will be discussed in further detail in this report. Crucially, from here on in, will Romanian emissions continue to decline or will they begin to increase as the economy modernises and reinvigorates? The fastest growing sector is transport with a 17% share in 2016, having increased emissions by 35% since 1990. Waste is the only other sector to have grown over the same period. The 2016 mix represents a marked change from 1990 where the transport emission share was only 6.1%, whereas industry (39.7%) and public electricity and heat (30.5%) were responsible for most of the country's emissions.

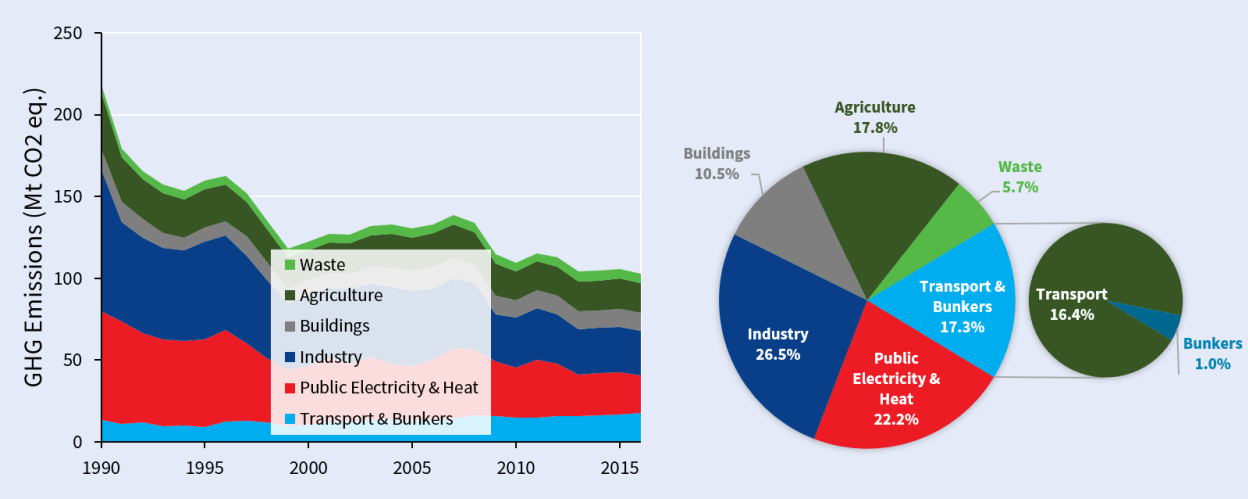

Figure 1: evolution and 2016 share of Romanian CO_2e emissions. Source: UNFCCC reporting[xxxii].

2.2. European climate law for GHG emissions

In this section the environmental laws applied by the European Union that Romania must abide to are introduced and discussed. In general, the laws set Member States or specific installations targets, with fines or severe expenses incurred for not meeting the reduction target.

2.2.1. Emission trading scheme (ETS)

The European Union emissions trading system (EU ETS) is a scheme to reduce CO_2 emissions by trading and selling emissions permits on a free market where the availability of permits (and hence allowable emissions, reduces over time. The system operates in 31 countries (all 28 EU countries plus Iceland, Liechtenstein and Norway) and limits emissions from more than 11,000 heavy energy-using installations (such as power stations and metal factories) and, since 2012, airlines, although only for flights within Europe. The most relevant sector to this report are those emissions emitted by aviation.

2.2.2. Effort Sharing Decision (ESD)

The Effort Sharing Decision, one of the key instruments of the EU to mitigate climate change, was established in 2009 and sets emission reduction targets for each Member State for the sectors not covered

under the EU Emissions trading system. This covers sectors such as surface transport, agriculture, and buildings. In Romania, Agriculture is the largest sector (29% of ESD emissions, while transport is 26%) The law is in force for the period 2013-2020. The collective reduction target for the EU as a whole is 10% by 2020 compared to 2005; the target for Romania was to limit emissions *growth* by 19%. The targets were established based on GDP of the countries[xxxiii,xxxiv]. This means some richer countries have reduction targets of 20% while other countries had to limit their emissions growth to 20%. Member States must ensure that their emissions are less than the trajectory made from the average of their 2008, 2009 and 2010 emissions in 2013, then tracing a straight line to the 2020 target[xxxv]. As shown in Figure 2, Romania is well below its 2020 targets. Romania should thus turn its attention to its 2030 targets.

2.2.2.1. Climate Action Regulation (CAR)

The EU has just finalised the process on the piece of legislation that continues the ESD and sets the emission reduction targets for member states for the period 2021-2030[xxxvi]. This time however the emission reduction targets are tighter - the overall reduction target for the EU in 2030 for the non-ETS sectors is 30% by 2030 compared to 2005 levels; Romania's target is a 2% reduction. The regulation includes flexibilities such as using ETS allowances and access to credits from the land use sector[xxxvii]. Romania can reduce its target by 1.7% from this flexibility alone[xxxviii]. While flexibilities make it easier for Member States to achieve their targets, they are worse for the climate because it will be by credits, not real emission reductions, to meet the targets.

The banking and borrowing mechanism of the CAR is based on comparing reported emissions for a given year compared to a straight line drawn to the 2030 target. If emissions are below the line, the country is overachieving its emission reduction objectives and can bank (or sell) a part of the difference. Similarly, if reported emissions are above the line, a country can borrow (or buy) a limited part of the future allowances to comply with the yearly target.

A complexity of the CAR is the so-called starting point for calculating where to start drawing this straight line - the trajectory to the 2030 target from which the annual balance will be calculated. This seemingly irrelevant technical detail will determine how many emission allowances a country will be able to bank from the first year, 2021. In April 2018, the decision on how to compute the starting point for emission allocation was formalised[xxxix]. The starting point baseline (i.e. the amount of emissions) is computed as the average of greenhouse gas emissions during 2016, 2017 and 2018. The starting point also has a time dimension. This will be either the reported average emissions in May 2019, or the average of 2016, 2017, and 2018 emissions in 2020, whichever results in a lower allocation. If the Romanian ESD emissions continue to increase, it will be the former of these options.

Finally, the CAR includes an extra flexibility instrument called Safety Reserve, which is essentially a pool of credits worth 105 Mt CO_2e. To access it, Member States have to meet a series of requirements, namely: have a 2013 GDP per capita below the EU average; not exceed their emission allocations in the period 2013-2020 (i.e. overachieve their targets); and exhaust the other available flexibilities. If these conditions are met, the country can access an amount of the credits in the safety reserve, not exceeding 20% of its overall overachievement in the period 2013-2020. Based on these conditions, Romania is likely to gain access to this flexibility mechanism, however the amount of extra credits for Romania is uncertain for the moment.

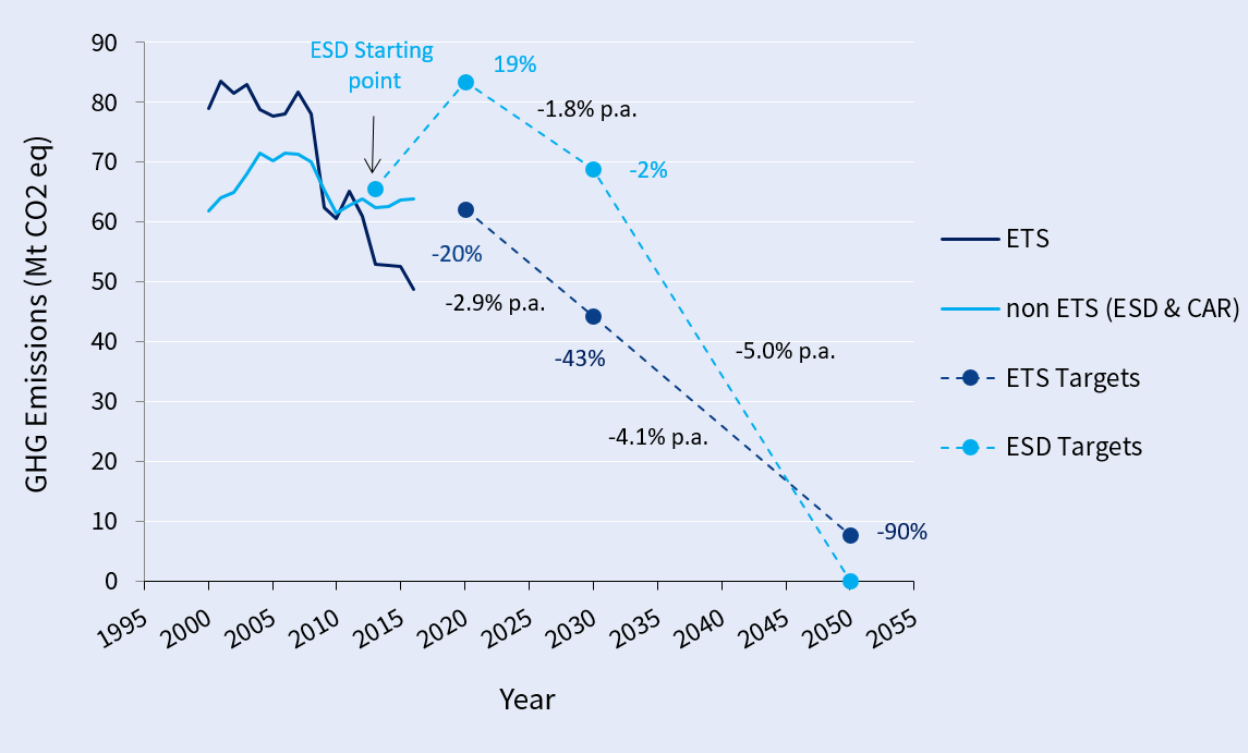

Figure 2: Evolution of Romanian ETS and ESD emissions. Source: UNFCCC reporting and EEA contributions of sector allocations.

2.2.3. Renewable Energy Directive (RED)

The Renewable Energy Directive (RED)[xl] established a policy for the production and promotion of energy from renewable sources in the EU[xli]. The relevance for transport is that all EU countries must ensure that at least 10% of the energy used in transport (via biofuels or electrification) come from renewable sources by 2020. Although the RED is not specifically a climate law, its goal of increasing the share of renewable energy will see benefits for the climate. The REDII, which formally ended negotiations in June 2018, is the revision of the RED and will apply from 2021 to 2030. The REDII sets a binding target for advanced fuels, which include advanced biofuels, renewable electricity, hydrogen, etc, in an attempt to promote the use of sustainable and cleaner forms of transport. In addition, the EU is slowly moving away from food-based biofuels that are unsustainable and have negative impacts on climate and environment[xlii], by eliminating a binding target for food-based biofuels and setting a limit on their use.

The use of advanced fuels will be promoted thanks to the binding target of 7% established on the REDII. Furthermore, the use of advanced biofuels and electricity will be multiplied by 2 and 4 times respectively, to make it more attractive for Member States and boost the support. Importantly, in terms of CO_2 emission accounting, renewable fuels are zero rated.

It is up to each Member State to decide the policies to pursue to reach (or exceed) this target; to date, Romania has not indicated an intention to exceed this target. In 2016, Romania's overall renewable energy share was 6.2%[xliii]. Of the liquid biofuels, 100% are from food based biofuels, reaching 257 ktoe, or 4.5% of energy, so still within the 7% cap. Renewable electricity in rail was 35.5 ktoe while in road it was 1.3 ktoe. Applying the corresponding multipliers makes the total renewable energy share (RES). If the trends from 2014 to 2016 were to continue, food-based biofuels would reach the 7% cap in 2019. In this report the biofuel share is assumed to stay constant from 2016 levels for two main reasons: Romanian biofuel is largely made up of palm oil[xliv], which will have to be phased out requiring a significant change of feedstock; there is no indication from the Romania government as to whether there is a policy to actively increase this share. This report will not be exploring the best ways for Romania to reach its 2030 REDII target.

2.3. Global law for aviation and shipping

2.3.1. Maritime and IMO

Romania has the seventh smallest intake of inbound freight in the EU at 20.2 Mt and the eighth smallest in terms of outbound tonnage at 25.3 Mt[xlv]. Nevertheless, Romania's port of Constanta is the 23rd largest in the EU in terms of container traffic. In terms of emissions, 2016 domestic and international emissions totalled 0.2 Mt CO_2e. These official reported figures are based on fuel consumption reported by ports, and as such they are likely to be an underestimate. Unlike domestic shipping, which is covered by the EU submission [xlvi] of nationally determined contributions (NDCs) and the CAR, the GHG emissions from international maritime activity is not covered by any European measure. In May 2018, the International Maritime Organisation (IMO) agreed an initial decision to reduce ship emissions by 50% in 2050 compared to 2005.

2.3.2. Aviation and CORSIA

Domestic and intra-EU flights are covered by the EU-ETS, a system which continues to under-price carbon and whose declining cap remains out of sync with the reductions required by the Paris Agreement. Flights to and from third countries (outside the EU) are not covered by any climate measure. Rather, parties to the International Civil Aviation Organisation (ICAO), the UN aviation agency, agreed to adopt a global market-based mechanism (CORSIA; carbon offset and reduction scheme for international aviation) to offset aviation emissions above 2020 levels. CORSIA won't reduce emissions from the aviation sector - the objective is to purchase emission reductions from other sectors. However even that limited objective won't be achieved, as the system is likely to be flooded with worthless offset credits and airlines will be permitted to burn biofuels with few sustainability criteria in place. Offsetting has been proven to be a discredited mitigation measure. The European Commission's own research[xlvii] has found that only 2% of offset projects actually delivered emission reductions"

In 2016, the number of passengers in Romania whose journey would have been covered by CORSIA was 0.9 million, compared to 7.1 million domestic and intra-EU passengers. Although these passengers represent only a fraction of the passenger numbers (12%), in terms of emissions they are responsible for 40% all aviation emissions[1]. Since 2012, the numbers of departing passengers in Romania has *almost doubled* (an increase of 90%), with significant growth in domestic departures (148%). Most passengers are intra-EU passengers (6.2 million), most coming from Germany (2.2 million passengers in 2016) and the UK (2.1 million passengers in 2016). While these passengers pay the air passenger duty (APD) of £13 from the UK and the *Luftverkehrabgabe* of €7.46 from Germany, raising substantial revenues for those countries, flights from Romania have no such tax and thus Romania is forfeiting considerable revenues. A ticket tax will have the benefit of raising revenues which can be used to put downward pressure on this skyrocketing demand. At the same rate as the German ticket tax, Romania could have earnt €46.7 million on intra-EU flights, and €6.4 million on domestic flights (assuming no change in passenger demand).

2.4. History of climate mitigation in Romania

2.4.1. National law and transport measures

Measures have been implemented in Romania to reduce emissions in the non-ETS sectors. Looking at the transport measures, Romania has invested in or implemented several measures, namely:

- National Action Plan on Climate Change 2016-2020. The plan has three core aims: 1). develop economic incentives for climate-friendly transport through pricing instruments (higher fuel taxes and parking fees, for example); 2). Increase the efficiency of urban transport through demand management measures to address congestion and emissions; 3). Reverse the long-term decline of

[1] T&E analysis based on ETS and UNFCCC reported emissions, Eurostat and WTO passenger numbers, Plane Finder transponder data

passenger rail by restructuring and upgrading the priority network and promote changes in the corporate governance of the railway sector.

- National Political Framework for Market Development in Transports, Relevant Infrastructure and Alternative Fuels (2017): This policy framework is still open for consultation, however, sets a number of policies: it will be mandatory to have 143 recharging points in urban agglomerations by 2020; and by 2030, 70 recharging points will be made available along the TEN-T corridors (at distances that average approximately 70 km). Other measures include: scrap scheme for EV (for the purchase of an electric car, a state grant of 45 000 lei, almost 10,000 euros; for a hybrid purchase (emitting no more than 50 g/km), a state grant of 20 000 lei, around €4 400).
- General Transport Master Plan (GTMP, 2015). Member States receiving EU structural and cohesion funds for transport infrastructure must work out a roadmap setting the major objectives of their national transport system in the long term (current plans looking to 2030). The Plan concludes that updating and repairing Romania's rail line would be unaffordable, and, therefore, suggests channelling resources into the main lines[xlviii]. Secondary lines were proposed to be handed to local authorities (with no state funding) or closed. The railway network is to be 40% shorter than the existing one, and account for 90% of the demand.

2.4.2. Road charging and infrastructure

Romania continues to rank the lowest out of all EU countries for road quality (extensiveness and efficiency)[xlix,l]. In May this year, Romania's Transport Minister Lucian Sova[li] said it would cost €4 billion to repair the potholes across Romania's 17 000 km of national roads (those connecting major cities)[lii]. On the other hand, Bucharest has reportedly missed out on almost €2 billion worth of EU funds due to failed highway projects; at the end of 2016, Romania had only 685 km of highway (by comparison, Belgium, with half the population and 13% land area, had 1 700 km)[liii].

What's more, Romania has one of the oldest vehicle fleets in Europe with passenger cars averaging 16.2 years and medium and heavy-duty vehicles averaging 15 years (where the EU average is 11 years and 12 years, respectively)[liv]. Road charging is one of the most important means for curbing the emissions of trucking. Directive 2011/76/EU, commonly known as the Eurovignette Directive, is the European legislation that establishes how EU Member States can toll trucks for their use of infrastructure. There is no EU obligation on Member States to introduce a road toll for trucks but, if they choose to do so, then the toll has to be in accordance with this Directive. The external costs of trucking can be significant in terms of pollution[2], and for infrastructure wear and tear, noise, and congestion[lv].

Romania is one of nine EU countries that apply time-based charging[lvi], the so-called 'vignette' system. Vignette charges allow a user to purchase a vignette ticket for a certain time-period, allowing users to drive as much as they'd like during that time. The Romanian road use charge, called the Roviniete[lvii], charges all vehicles for using the road infrastructure across Romania's road network[lviii]; the National Company of Administration of Road Infrastructure (CNAIR) manages this along with SCALA Assistance[lix]. Enforcement is carried out through license plate number checks by cameras along the highway[lx]. The National Company for the Administration of Road Infrastructure (CNAIR) is the state-owned institution responsible for maintaining Romania's current road network, and manages an annual budget of over RON 4 billion (EUR 897 million); the state-owned National Company for Road Investment (CNIR; created in 2016), on the other hand, is in charge of building and repairing new roads[lxi].

The Roviniete time-based charge is differentiated according to vehicle weight and axle number, taking no account of the emission class of the vehicle[lxii]. As such, Romania is missing out on an important opportunity to incentivise the uptake of cleaner vehicles. A study performed for T&E showed that in the EU, heavy duty trucks are responsible for €143 billion in external and infrastructure costs but only cover 30% of such

[2] For pre-Euro 6 vehicles.

costs[lxiii]. One solution to this, is to extend the toll road network for HDVs. The Roviniete already applies across the whole network, but as it doesn't differentiate according to emission class, it fails to recover all of the external costs caused by vehicle air and noise pollution. Without toll differentiation for EURO class, the cost for the external damage caused by vehicles falls to the State, meaning it will be paid by all, and not just by those that pollute (as is currently the case for those roads that do not charge according to EURO class).

2.4.3. Environmental performance of transport

In this last piece of historical analysis, a closer look at how Romania has decarbonised its economy, if at all. Historically speaking, economic growth (that may be measured by gross domestic product) leads to an increase of transport activity. Figure 3 shows exactly this trend: a GDP that increased from 1995, both passenger transport (measured in passenger kilometres, p-km) and road freight activity (measured in tonne kilometres, t-km) increased. After the financial crisis, car activity and emissions plateaued while heavy duty vehicle activity dipped sharply with the contraction of the economy.

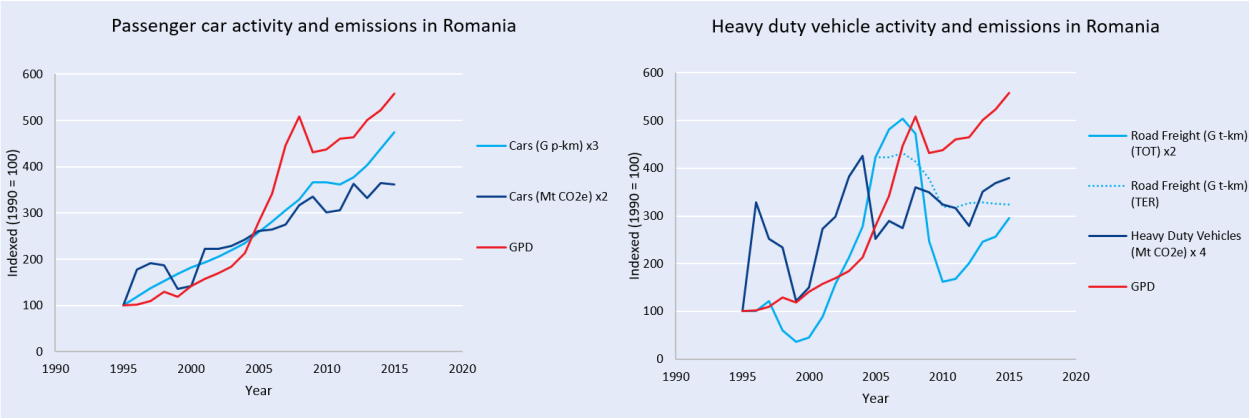

Figure 3: Evolution of Romanian GDP, transport activity and emissions. Note that the car passenger activity has been scaled with a factor of 3, car emissions with a factor of 2, and heavy duty vehicles emissions with a factor of 4 and tonnage with a factor 2 to aid visual comparison.

In order to see if a decoupling of emissions and activity has actually occurred in the last 20 years, the environmental transport performance is shown in Figure 4. For the EU28 as a whole the passenger km of activity per emission has been steadily increasing (i.e., more passenger movements per unit of fuel burnt). The Romanian car fleet performs much better in comparison, achieving 12.1 pkm/kg CO_2e compared to 9 pkm/kg CO_2e in the EU in 2015. This could be linked to higher load factors of cars, and smaller more efficient cars, despite being older. For road freight, however, Romanian environmental performance has appeared to sharply decline compared to the EU average, achieving only 3 tkm/kg CO_2e in 2015 compared to 8 tkm/kg/CO_2e in the EU. This may be due to neighbouring countries refuelling in Romania to due cheaper prices, but conducting transport work in other Member States, skewing these statistics.

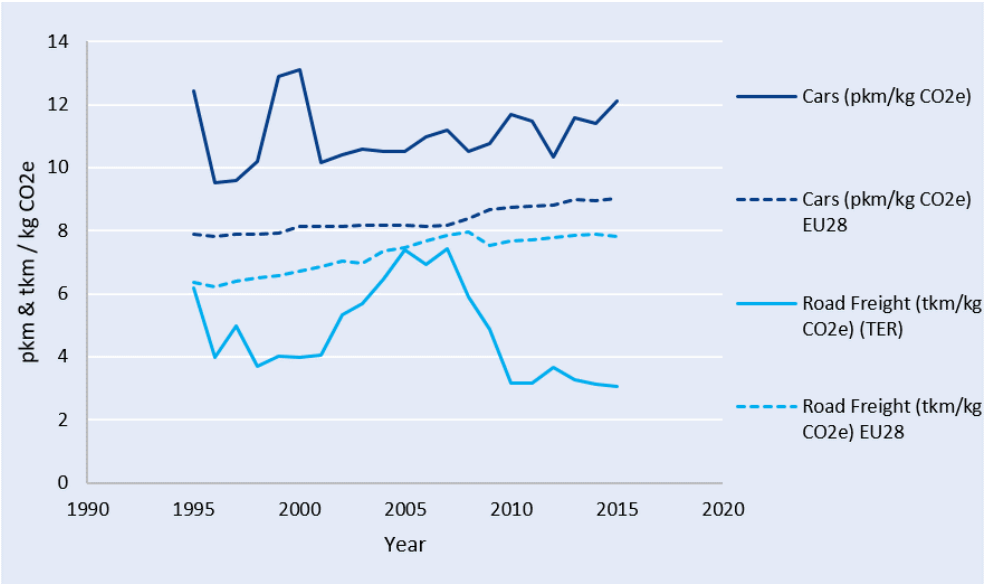

Figure 4: Comparison of the evolution of Romanian environmental transport performance against EU 28 average.

2.5. Where will Romanian transport be if no action is taken?

In terms of emissions, road transport in Romania[3] is on a trajectory to exceed its 2% CAR reduction by 9.2 Mt (Figure 5) in a business-as-usual scenario. Here lies another import assumption of this report: the equal distribution of reduction effort across sectors in the CAR. In publications released by the European Commission, it is stated that transport in the EU should only reduce its emissions by between 18% and 20%. As the biggest sector in the CAR, and a sector where clear technological pathways exist for decarbonisation, it is surprising that the industry and building sectors need to reduce their emissions more than transport. The authors of this report would argue that transport should achieve *at least* the CAR target, and beyond where possible.

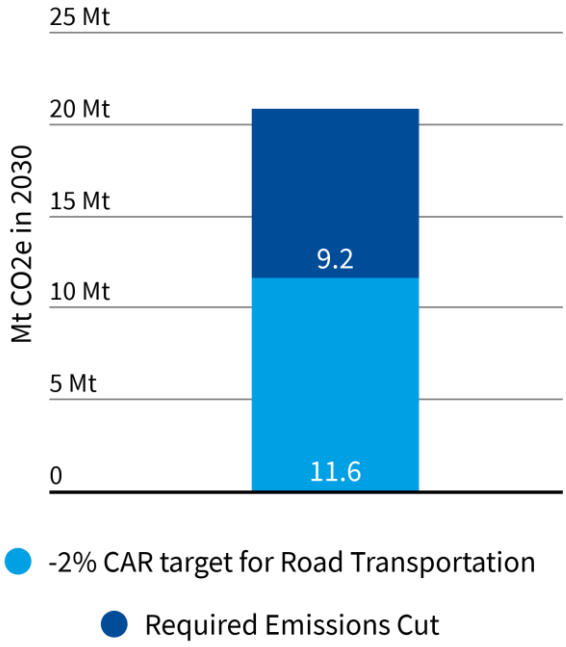

Figure 5: Baseline projection of road transport emissions in Romania will reach almost 21 Mt CO_2e, compared to the CAR reduction target of 11.6 Mt CO_2e. Romania must reduce its projected 2030 road transport emissions by 9.2 Mt CO_2e.

[3] Not including emissions from motorcycles

Given the above assumptions of the contribution that should be made by the transport sector, Romania will exceed its target by 79% when looking at transport only. If the cost of CO_2 allowances were to be €100/tonne, this would translate to €920 million in 2030 alone. However, the actual loss will be far greater, because of the aforementioned yearly targets. With the starting point assumed to be at May 2019, the cumulative allowances (tonnes of CO_2) that Romania would be liable to pay for would amount to 59 million (without the use of flexibilities or safety reserve). At the assumed price of €100/tonne, this equates to a sum or €5.9 billion in the period 2020-2030, an amount only from the transport sector, unless other CAR sectors would decrease their emissions considerably. If the EU and Romania were not to take any action on GHG emission mitigation, consequences to the environment aside, this could result in a significant financial burden for Romania and would require a reduction in emissions of 1.0 Mt CO_2e per year in transport to decarbonise the sector by 2050.

3. How the EU can help

It was shown that road transport was the biggest sector of CAR emissions. Figure 6 further breaks road transport down into its constituent parts. As can be seen, the largest share of emissions in 2016 was from passenger cars, followed by those from heavy duty trucks and buses[4]. In this section, the specific EU mechanisms to ratchet up climate ambition in transport will be explored. Firstly, a look at the current proposals (under negotiation) and how much they can help Romania reduce their emissions. Secondly, more ambitious targets based on technical and economic analysis will be explored to see what EU CO_2 vehicle standards *should be*. Note: In this report, the emissions from motorbikes are not considered for measures to reduce emissions or in the calculation of targets and trajectories.

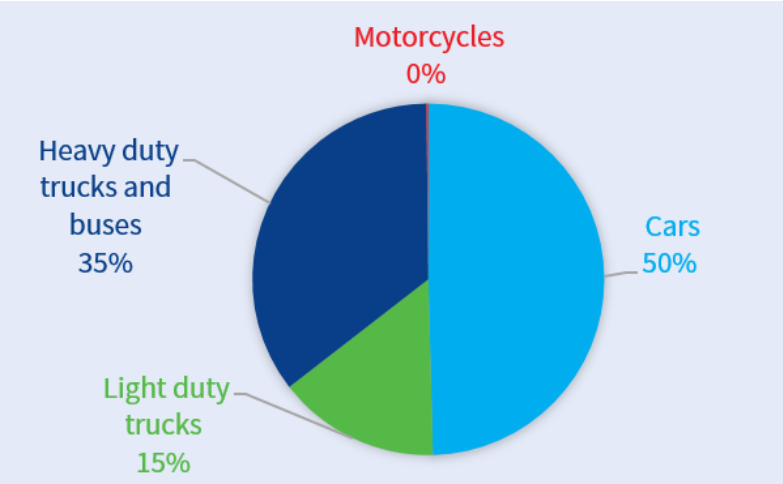

Figure 6: Road transport split by mode in Romania 2016[5].

3.1. Proposed EU measures for transport

In November 2017, the European Commission released a proposal for car and van CO_2 standards for 2025 and 2030. The proposed reductions for cars are 15% in 2025 and 30% in 2030 compared to 2021. Although there was no zero emission vehicle (ZEV) mandate in the proposal, a bonus system is included whereby car manufacturers are able to reduce their fleet-wide CO_2 targets if they sell more zero and low emission vehicles than the sales benchmark proposed (15% sales in 2025 and 30% in 2030). For example, if 16% of sales were zero and low emission vehicles (ZLEVs), the CO_2 standards could be reduced by 1%, making the target easier to reach[lxiv]. The bonus is capped at 5% reduction. There is however no malus or penalty if a manufacturer sells less ZLEVs than the benchmark. The proposed van standards are also 15% reduction in 2025 and 30% reduction by 2030 (with baseline year of 2020) with the ZLEV bonus system. Unlike the 2020 and 2021 targets that were given in gCO_2/km, the percentage reduction allows for the change to the new driving test cycle (WLTP) from the existing one (NEDC).

In May 2018, the Commission proposed truck fuel efficiency standards. The truck standards do not include CO_2 improvements from modifications to the trailer (for example from better aerodynamics), only the tractor. Furthermore, the truck standards apply to only a select subgroup of trucks ('regulated categories', 4, 5, 9, 10) which cover approximately 80% of truck emissions in terms of CO_2 emissions per year and historical sales (Figure 7[lxv]). Under the proposal which, like for cars and vans, is currently being debated, these regulated truck sales must reduce their emissions by 15% in 2025 and at least 30% in 2030 (the latter to be revised by 2022), compared to 2019. Similar to the cars and vans draft, no ZEV mandate is proposed but rather a somewhat weak system of super credits, a point which will be discussed further on in the report.

[4] The UNFCCC category *1.A.3.b.ii. light duty trucks* are mostly vans, i.e. light duty vehicles used to carry up to 8 passengers or with a maximum permissible mass of 3.5 tonnes, including load.

[5] UNFCCC reporting by Member States. Accessible: https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2018

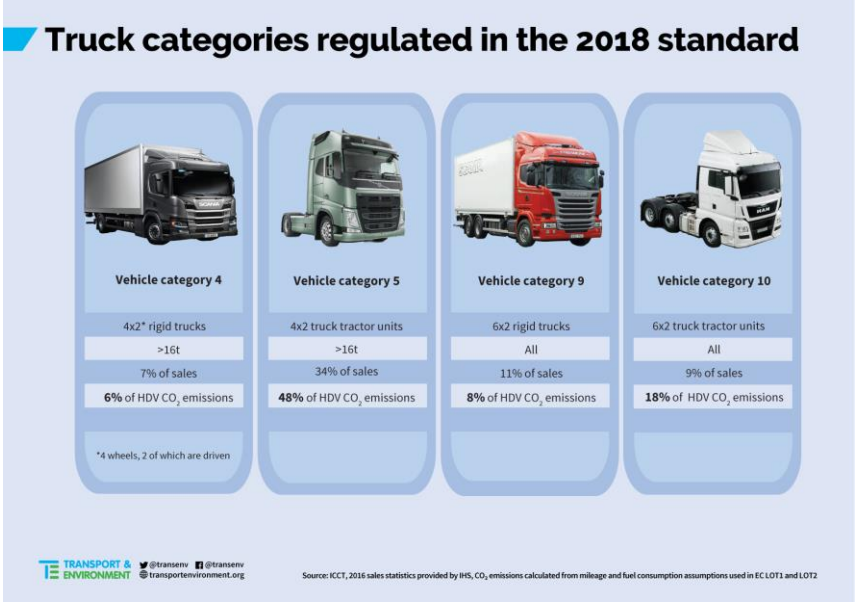

Figure 7**: Regulated trucks in the Commission's truck CO_2** standards proposal

If vehicle makers meet the Commission's proposals, but don't exceed them, it will deliver 27% of the required cuts for all of road transport, or 6.8 Mt of the required 24.9 Mt CO_2e (Figure 8). The reduction in emissions does not equal the reduction in new vehicle efficiency owing to the time taken for fleet renewal. From the fleet of approximately 28.5 million, there were 1.2 million new vehicle registrations in 2017[lxvi], or a 4.2% renewal rate. The Romanian vehicle fleet is on average older than in the EU average, which means that older, more polluting vehicles tend to remain in the fleet longer than for other Western European countries. Therefore, in the situation that only the proposed CO_2 standards for road vehicles were to be implemented, Romania would have to come up with a range of national measures to be able to cut the remaining 8.1 Mt of emissions. Clearly, more has to be done and can be done, at the EU level before having to revert to national measures.

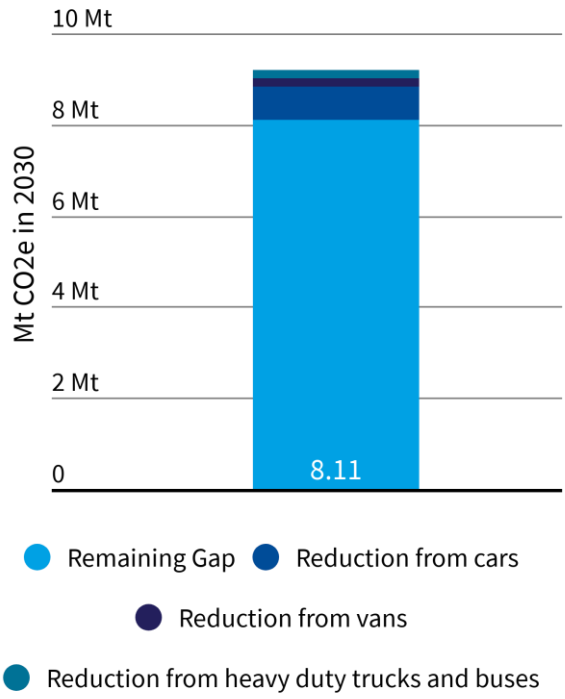

Figure 8: Reduction in Road transport emissions from Commission proposals on car, van, and truck fuel efficiency standards for 2030

3.2. What ambitious and feasible EU measures in Romania can deliver

3.2.1. Ambitious and technically feasible fuel efficiency standards

CO_2 emissions of new cars can feasibly be reduced by over 50% by 2030 as shown by International Council on Clean Transportation (ICCT)[lxvii]. This is also more in line with the ambition levels necessary for transport to deliver the Paris Agreement goals. Van CO_2 standards were shown to be optimum in the Commission impact assessment[lxviii] at a 40% reduction, by comparing the required investment in technology from the OEMs and the fuel savings that would generate for consumers - typically businesses and tradespeople. As regards ZEV vans, there is a clear lack of models and choice on EU market[lxix], which the bespoke ZEV sales target for new vans in 2025 and 2030 is indispensable to address.

The truck fuel efficiency proposal should eventually include the trailers and non-regulated trucks. Owing to the large variety of trucks and their operations, fuel efficiency will be calculated with the simulation tool VECTO (Vehicle Energy Consumption Calculation Tool)[lxx]. This tool could be easily and feasibly modified to not only account for all categories of trucks, but their trailers as well. This will allow manufacturers to have a holistic approach to reducing the real world emissions of the truck. If this were the case, the ICCT shows that a 24% reduction (tractor unit only) is economically viable and technically feasible by 2025, increasing to a 45% reduction (with trailers included) in 2030[lxxi] compared to a 2015 fleet average truck. Trailers are not included in the 2025 reduction target, so the Commission proposal of a 2025 reduction of 15% for regulated trucks is assumed to remain. The "at least" 30% target for 2030, on the other hand will be reviewed and finalised no later than 2022. After trailers are regulated in the early 2020s, T&E expects that total reductions from tractor and trailer (where applicable) should average 45% compared to a 2015 baseline (or approximately a 43% reduction compared to the 2019 baseline). There is currently very little information on applying vehicles standards to coaches[6]. However, it seems reasonable to expect that the technology improvements leading to efficiency gains employed in trucks could be utilised in coaches. Therefore, we assume that the efficiency gains proposed by the Commission for trucks could feasibly be applied to coaches (i.e. a 15% by 2025; at least 30% in 2030, compared to 2019).

3.2.2. Zero emission vehicle sales targets and promotion

The other main mechanism available to Europe is a zero emissions vehicle (ZEV) sales target (also known as a benchmark or mandate). There are also complementary measures to promote electrification of the fleet, for example by accelerating standardisation and deployment of EU charging infrastructure. The renewable electricity share in transport (RES-T) target is also one such mechanism, however with a multiplier of 4 recently agreed on in the revision of the Renewable Energy Directive, this will not necessarily lead to a large uptake. Finally, there are some modes, particularly vans[lxxii] and buses[lxxiii] where evidence suggests that electrified versions are already economically viable on a total cost basis; all that is missing is the supply from European OEMs[lxxiv]. Importantly, an uptake in electrification should not allow OEMs to reduce ambition on internal combustion engines; selling an EV should not reduce the efficiency of the other vehicles.

For passenger cars, there remains a constrained supply and choice of plug-in vehicles (PHEVs and BEVs) in Europe; as carmakers in Europe are lacking a regulatory push to invest in sufficient capacity and increase sales[lxxv]. But an increased offering is expected in 2019/20 as carmakers have to meet their 2021 CO_2 targets. The complexity of PHEV dual drivetrain systems will eventually be too expensive to compete with BEVs in the context of rapidly falling battery prices and no investment required for pollutant suppression. A clear ZEV sales target (or mandate) would create volume certainty and ensure OEMs invest and offer sufficient supply of appropriate ZEV models in the future. The target of at least 20% sales in 2025 and over 40% in 2030 is in line with carmakers' own projections[lxxvi]. This would spur the investment in OEM factories and supply

[6] We consider buses to fall under two broad categories: coaches, for intercity travel, and city buses; those that operate under a fixed timetable in metropolitan areas.

chain (e.g. battery cells) in Europe, as well as recharging networks, and enable power companies to anticipate the future electricity demand that will help investment of clean renewable energy. Alongside a ZEV mandate for cars to stimulate supply, the best practices of other European countries as detailed by the ICCT[lxxvii]. These include tax exemptions, priority parking and priority lanes, and zero emission zones in cities (discussed in the national measures section) that help promote ZEVs on the one hand and restrict ICE vehicles on the other.

Electric buses are a well proven technology, the salient example being Shenzhen in China where 100% of the city bus fleet (16 400 buses) were replaced with electric. In Europe, electric urban buses are gaining traction, according to an independent market monitoring and analysis orders for electric buses doubled in 2017 compared to 2016 reaching around 10% of the total European city bus market. New electric bus suppliers are emerging in Europe. Unlike other Central and Eastern European countries like Poland, Hungary and Bulgaria, Romania lacks a national electric bus manufacturer. Major European electric bus manufacturers include Solaris (Poland) and VDL (Netherlands). In Romania, the electric bus fleet is currently among the smallest in Europe with only 11 e-buses delivered to date. According to an industry survey by UITP data, 41% of city buses procured in the EU by 2025 will be zero emission, rising to 62% by 2030[lxxviii]. Joachim Drees, CEO of MAN Trucks and Buses, has proven to be more ambitious and expects that European cities will only procure electric buses from 2025 onward[lxxix] while the proposal for the Revision of the Clean Vehicle Directive suggests that Romanian cities will have to procure 29% "clean buses" by 2025 and 43% by 2030[lxxx] which is the lowest target attributed to a Member State. However, based on the favourable total cost of ownership compared to diesel and gas buses and the desire for municipalities to improve air quality and reduce noise, it is unlikely that cities would procure expensive and polluting buses that rely on imported oil or gas after 2030[lxxxi,lxxxii]. Therefore, based on the above we assume 50% of new city buses purchased in Romania will be zero emission from 2025 and 100% from 2030[7].

Small electric vans are already economically viable as shown by example of the success of the Street Scooter and independent studies[lxxxiii]. As small vans make up approximately 40% of total van sales, the main limitation is the number of models available. We assume BEV sales of vans (no PHEVs, owing to their expense and the price sensitivity of business operators) reach sales of 50% by 2030.

Finally, there has been an increasing number of battery electric trucks (BETs) in most weight categories in China, the US, and in Europe. They have been shown to have a favourable total cost of ownership (TCO) in many operations today[lxxxiv] or within the next decade[lxxxvlxxxvi]. In Romania, 21% of vehicle km and 20% of tkm are journeys less than 300 km, and 34% of road freight movements are less than 500 km[lxxxvii]. These types of journeys could feasibly be covered by battery electric trucks with today's technology (in terms of battery energy density).

Another technology that is currently undergoing significant testing and offers a pathway to electrifying road freight is the e-highway[lxxxviii]. This is charge-on-the-move technology, where trucks connect to overhead wires with a pantograph on arterial routes. Hybrid versions or on board battery storage can be used off the e-highway grid[lxxxix]. This technology would require an EU wide coordinated and standardised roll-out to reap maximum benefit. According to the German Ministry of Environment, e-highways are the cheapest option to electrify heavy duty road transport[xc]. Indirect forms of electrical power are more inefficient. Hydrogen and power-to-liquid technology require from 3 to 5 times more electrical energy than for direct use of electricity[xci]. Additionally, these e-fuels are much further from maturity and much more expensive, and this may hinder any significant market share before the late 2020s, too late to be deployed to achieve the 2030 climate goals.

[7] Vehicle kilometres, fleet population, and new registrations from the TRACCS database for 2010 are used as a proxy for possible sales.

As is the case for cars, a ZEV mandate spurs investment in new technology and will lead to a diverse option of trucks with electric drivetrains. We assume that a significant portion of these journeys will be electrified in BETs, with 20% of new truck sales <16t and 10% truck sales >16t being battery electric trucks by 2030. This is close to the TNO analysis[xcii] under which 33% of new truck sales (in categories 4, 5, 9 and 10) must be zero emission in 2030 to meet the EU climate targets. The results of adding ZEV mandates for cars, vans and trucks and their promotion are shown in Figure 9. Ambitious standards and electrification can cut up to 2.5 Mt CO_2e emissions from the baseline, with cars contributing 1.05 Mt CO_2e and heavy duty vehicles 0.99 Mt CO_2e. Despite these ambitious standards, the cuts still fall short on the target, closing the gap by 27%.

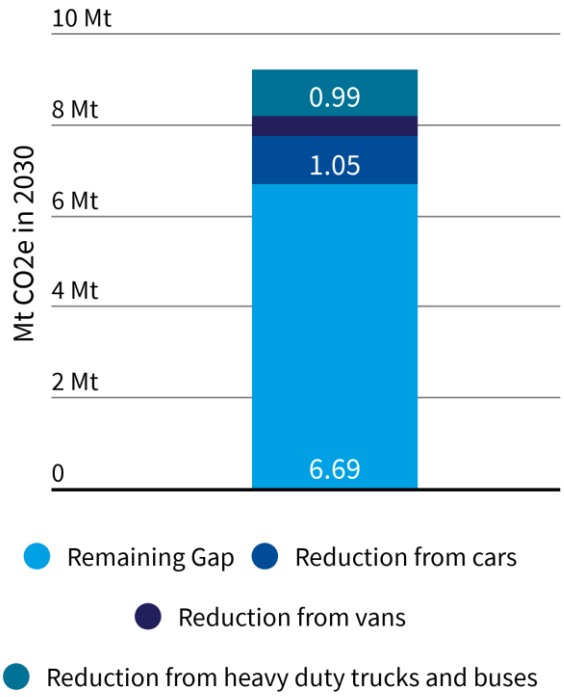

Figure 9: Combination of ambitious 2025 and 2030 standards, and ZEV mandates and promotion

3.2.3. Other EU measures

Other measures that fall under the jurisdiction of the EU include *Eurovignette*[8] (road charging for trucks) and the ongoing construction of the TEN-T network with harmonisation in the EU with respect to signalling (ETRMS) and rail gauge. These measures will indeed help with incentivising and facilitating modal shift, demand reduction, and logistic efficiency, however it will largely be up to each Member State to implement and lever these frameworks to maximise the benefits. These, among many more options, are described the following section.

[8] Directive 2011/76/EU

4. What national measures are needed in Romania to achieve the 2030 GHG reduction targets

4.1. What has been proposed or considered in Romania

In this section, the various mechanisms available to Romania will be discussed. Although some measures have quantifiable impacts, the effect of the full combination of measures that may partially overlap is difficult and arguably futile. Thus, each measure is discussed and analysed and a thorough assessment given as to how the measures may reduce GHG emissions. All inputs into the model are summarised towards the end of the section.

4.1.1. Fuel taxes and tax reform

Figure 10 shows that, in real terms, the excise duty applied to fuel in Romania had been increasing from 2009[9] from a sales weighted average of about €0.32/l to €0.44/l in 2016, but then dropped off sharply in 2017 to €0.36/l. This compares to the EU average in 2017 at €0.53/l. As is the case in the EU, there is a significant difference between the taxation of petrol and diesel. In 2016, the Romanian state earned €2.3 billion from fuel duty; had the diesel duty been the same as the petrol duty, revenues would have been €2.5 billion, or 6% more, all else being equal. Similarly, if Romanian taxes were not only equalised but also €0.17/l higher to be in line with the current EU average, revenues would be €3.4 billion, a 48% more than they were. As the price of fuel paid at the pump is not just excise duty, but the price of fuel itself (including refining, distribution, and profit) and VAT, the relative increase paid at the pump would be around 16% for both petrol and diesel. Further, there is a sales weighted average reduction offered to truckers of €0.0426/litre in Romania[xciii].

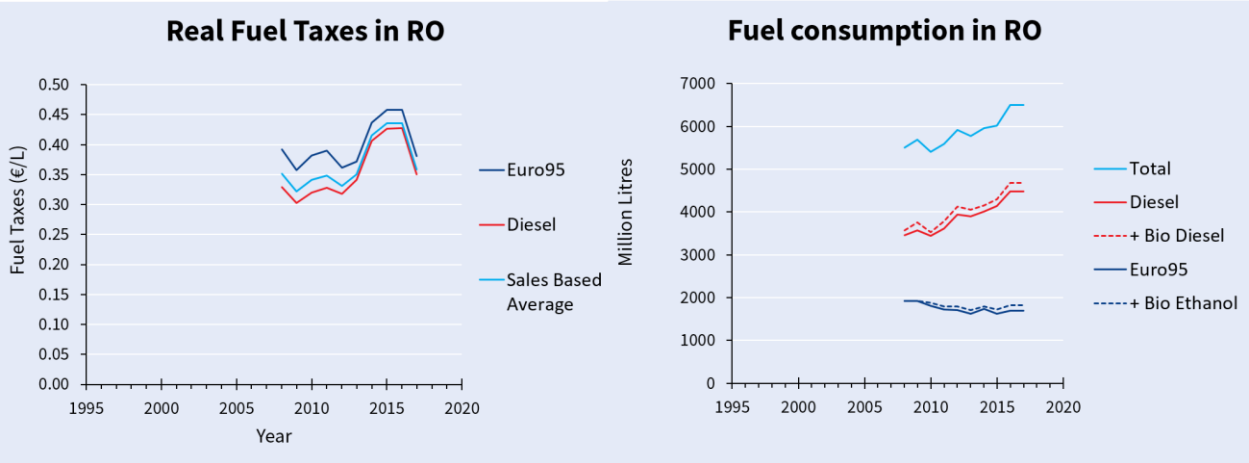

Figure 10: Evolution of fuel taxes and fuel consumption in Romania.

Fuel taxation is not only a means to earn money for the state, it helps internalise the externalities of transport (societal costs of infrastructure, congestion, health problems related to pollution, injuries and loss of life due to accidents) and more significantly, it influences the long term behaviour and choices of passengers and freight operators. With a long term elasticity[10] of -0.9 for petrol and -0.2 for diesel car use (we take an average of -0.55) the decrease in ICE vehicle activity based on the implementation of all above measures would decrease by around 9% - demand in EVs would remain unchanged. Of course, as the population becomes wealthier, the excise duty should be adjusted accordingly to offset the income elasticities that increase demand. However, it may have other effects such as increasing carpooling or

[9] T&E analysis on the Fuel bulletin database and Eurostat data.

[10] Elasticity is the measure of how one variable (here, car use) changes with another variable (here, fuel price). In the most general case, as a something becomes more expensive, demand for it reduces. For the case described here, increasing the fuel price by 30% with the elasticity of -0.1 results in a change in demand of 30% x -0.3 = -9%, that is a 9% reduction.

modal shift to bus or train. In terms of the change in freight movements, this could lead to a preference of more efficient vehicles (which would only be available with the European standards) and an improvement in logistics efficiency. According to Ricardo, the EU average elasticity for trucks and vans is also -0.3. These types of measures would reduce the transport activity of road modes, and with appropriate policy can enable cleaner modes such as rail to increase their share of transport.

4.1.2. Facilitate and encourage electromobility

Which vehicles carmakers place on the market across EU countries, or supply, in EU is governed by the car and van CO_2 standards. Including the ZEV sales target into the 2025 standards currently under discussion as described under EU measures will help Romania to have a bigger offer of ZEV models as well as make them more affordable due to economies of scale. But this cannot and should not occur in a policy vacuum in the Member States. Romania has failed to submit its national policy framework for the deployment of alternative fuels infrastructure (under the Directive 2014/94/EU) and has been referred to the Court of Justice of the EU for failing to do so, although to date the procedure has not commenced. The absence of targets for publicly accessible recharging points for 2020 is a risk to the large scale market deployment of electric vehicles. Currently less than 1 000 electric vehicles are on the roads in Romania[xciv] and they can access about a hundred public charging points. Short and long term targets, a comprehensive set of pro-EV measures and financial support is needed for Romania to transition to zero emissions transport. Romania clearly needs more ambition if the country doesn't want to lag behind other neighbouring countries and wishes to solve its air quality problem. Interestingly Romania does have policy support for EVs with a €4,450 subsidy available for the purchase of BEVs (€1,100 for PHEVs) in addition to which full-electric and hybrid vehicles are exempt from paying registration tax upon purchase. However, in the face of the low EV registration numbers, this subsidy doesn't seem very effective. The current state of the market in Romania poses many risks to the cross-border continuity of Europe's roads and jeopardises the transition towards a low-carbon economy and away from dependence on foreign fossil fuel imports.

Considering the 2019 deadline for submitting its alternative fuels policy framework, Romania will lag behind by three years compared to other nations that have submitted their framework policy on time. Romania should not orient itself towards natural gas based transport and should give a clear signal that it intends to decarbonise the transport sector in the most effective vary - i.e. with electro-mobility. This will give confidence to market actors that will invest in the transition to zero emissions once the government sets ambitious targets with adequate measure to reach them.

4.1.3. Road charging and low emission zones

As discussed previously, Romania has one of the oldest vehicle fleets in Europe. To a large extent this accounts for Romania's poor air quality in cities. In a 2013 study of 386 cities across Europe showing the average number of days exceeding the EU limit for particulate concentration, Bucharest ranked 57th, counting 69 days above the limit[xcv]. In addition to this, Romania (Bucharest) ranks second on TomTom's list for most congested cities in Europe (and fifth globally) where an average 218 hours a year are lost due to congestion[xcvi].

Tolling can play an important role in the uptake of cleaner, more fuel efficient vehicles and ZEVs. Firstly, applying CO_2 differentiation of road charges based on tailpipe emissions would complement and gradually replace differentiation based on air pollution. For cars, EURO class differentiation should play a role but it must be based on Real Driving Emission test results and not on the discredited laboratory tests. There are significant differences between the EURO emissions class for both trucks and cars. The development of the EURO III class for heavy duty vehicles in 2000 introduced explicit limits on NOx, and this has been dramatically reduced since. For example, the move from EURO V to EURO VI saw a significant reduction in NOx (up to -80%) and particulate mass (-66%)[xcvii]. A redesign of the toll charge therefore should ensure effective differentiation between each of the EURO classes that accurately accounts for the pollution caused by those vehicles. Moreover, the time-based charging system should be transferred to a distance-based

charging system as this has been proven to better account for the external costs of vehicles and encourage efficient transport behaviour.

Smart tolling could help relieve both of these issues. Indeed, the introduction of a smart toll system in Germany has shown not only a decrease in heavy truck empty headings[xcviii], encouraging efficient transport behaviour, but in addition has increased the purchase of cleaner trucks, which benefit from a lower toll rate than dirtier models[xcix]. The external costs of trucking can be significant in terms of pollution[11], and for infrastructure wear and tear, noise, and congestion[c]. Tolling can play complementary role in the uptake of cleaner, more fuel efficient vehicles and ZEVs. A 75% toll discount for all zero emission trucks across Europe would provide a financial incentive to encourage the purchase of zero emission trucks, which would help create a bigger market for zero emission vehicles.

Finally, tolls can be used to reduce congestion and to create zero emission zones. Cars spend a lot of time in cities, but a disproportionate amount of that time is spent parked. A duration based charging system, whereby users pay per hour of city access, can reduce the amount of cars in city centres without limiting mobility. In Bucharest, vehicles with a weight exceeding 5 tonnes are restricted access to certain areas of the city: between 08.00-19.00, vehicles over 5 tonnes are banned from entering the city (outside of these times, access is only granted with a permit).[ci] Another measure that would reduce air pollution in cities in Romania is a congestion charge. Using a time-based congestion charge could encourage collective mobility (i.e. train, bus, or carpooling) and (as traffic reduces) allow for more space to become available for better cycling/walking infrastructure or parks. Congestion charges could be further differentiated to promote the use of cleaner vehicles so that those vehicles that do continue to enter cities are more likely to emit less.

4.1.4. Shifting car passengers to buses, trains, riding, and walking

Shifting passengers from cars to buses and trains can be divided into two broad categories, intercity and metropolitan. 37.4% of the entire Romanian railway network is electrified[cii], which is lower than the EU average of 53.2%. The existence of rail in itself does not induce passengers to use it, however. Train schedules must be reliable, pricing fair and competitive with other modes, punctual services, and finally, modern and well-maintained rolling stock that can offer services such as wifi and clean toilets. Long distance coach journeys have also seen a rapid expansion in Europe with competition and market liberalisation[ciii]. Companies like Flixbus have expanded rapidly offering regular services that are reliable, easy to book, and cheap[civ]. Coaches do not only compete with car transport; they can offer cheaper services than rail owing to their comparatively low costs such as infrastructure and vehicle costs compared to rail. Coaches should therefore not be granted discounts to road charging or exemptions to any future vehicles standards to ensure that they both do not too heavily undercut rail but also pay their fair share of infrastructure and societal costs (CO_2, pollutant, and noise emissions).

In cities, in order to shift car passengers to public transport, an essential component is appropriate infrastructure for walking and cycling. While a journey by car is typically characterised by door to door transport, a public transport journey is often part of a multimodal trip, and may involve walking or cycling to a bus stop, a bus trip to the metro station, a metro trip, and then a walk to reach the final destination from the metro station. Although walking in itself will not be able to offer the same transport capacity as cars, it is an integral element of facilitating the journey.

Cycling enables short distance trips to be completely replaced, especially with the rapid uptake of electric bikes, making cycling a transport solution for more people. The most successful cities and countries (such as the Netherlands and Copenhagen) have high cycling rates owing to extensive infrastructure that is separate from the road and gives cyclists priority over cars. The I'Velo scheme[cv] launched in Bucharest in 2010 (originally "I Love Velo") has been working on such issues, including the availability of city bikes. This

[11] For pre-Euro 6 vehicles.

scheme provides free bike rentals in most of Romania's major cities including: Bucharest, Brasov, Cluj-Napoca, Iasi, Oradea and Constanta. In particular, I'Velo aims to change the perception around cycling, normalising its use as a means of alternative transport for work as well as leisure; as part of this normalisation, the scheme has set up a number of categories: I'Velo Urban, I'Velo Relax, I'Velo Student, and I'Velo Corporate[cvi]. In addition, the Green Revolution Association (one of the partners of I'Velo) organises 8-9 month annual Bike-to-Work schemes, partnering with organisations to provide bikes for the summer and spring seasons for employees[cvii].

Alongside cycling and walking, the public transport itself must also be reliable and affordable. Public transport is relatively cheap in Romania compared to Western Europe, with a single trip in Bucharest costing RON2.5 (€0.55) for a Metro trip and RON1.3 (€0.25) - bus/tram.

In 2016, the Romania-wide modal split of passenger transport in terms of pkm (not by trips made) was 75.0% by car, 14.7% by bus and coach, 3.9% by rail, and 6.4% by tram and metro. Considering car transport was 95.6 billion pkm, shifting 5% of this activity to buses would imply a 25% increase in capacity. From 2000 to 2015, bus and coach activity grew by 43%; the implication here is that a 5% shift would appear to be feasible. Romania will need to see continued and increased investment and policy choices to make it happen.

4.1.5. Putting more passengers in each car and sharing resources

The transport system is on the verge of a paradigm shift from the tradition of private car ownership to models around sharing and mobility as a service (MaaS). This has largely been through a revolution in digitalisation and application based services (Blablacar, Uber), and business models that facilitate infrastructure sharing (Car2go, DriveNow, Zity). Evidence[cviii] shows that these developments can lead to a significant reduction of single occupancy private car use and an increase of public transport use, leading to a strong reduction in congestion, local air pollution, and CO_2 emissions[cixcx]. The French environment and energy management agency (ADEME) found that each shared car replaces in average 5 to 6 private vehicles, while freeing up at least 2 parking places.[cxi] These benefits will occur when more vehicles are shared and private car ownership is reduced; when these shared vehicles are electric, the benefits are even greater. Modelling by the International Transport Forum found that in Lisbon ridesharing services could make public transport more efficient and thus end congestion, reduce traffic emissions by one third, and decrease required parking space[cxii]. Survey by the Pew research centre[cxiii] and work by the Union Internationale des Transports Publics (UITP)[cxiv] indicate that car and ride sharing complement public transport, but do not replace it.

As citizens abandon their cars and opt for shared resources, more active forms of transport (walking and cycling) become attractive as streets are cleared of congestion and cars, liberating space for appropriate footpaths and cycling paths. The technology behind these applications can enable more passengers per car, as pooling services are enabled. This can be reinforced with favourable conditions for cars with multiple (more than 2) occupants on key city roads. While the development of shared mobility seems unstoppable, whether the transition from ownership models to sharing will lead to short term increase in congestion because of induced demand will largely vary from city to city.[cxv]

4.1.6. Eco-driving, speed limit reduction, communicating intelligent transport systems (C-ITS), and connected vehicles

Eco-driving is a program for drivers that can reduce CO_2 emissions from cars, vans, trucks and buses by training drivers to reduce speeds, anticipate traffic situations to maintain more constant speeds, and reduce the severity of accelerations or braking. One source with authors from the industry[cxvi] has shown that the benefits of eco-driving is highly dependent on how many eco-drivers there are and the level of congestion. It showed that in congested roads, eco-driving has a maximum benefit of 4% if all drivers adopted and use eco-driving practices, while in free flowing traffic, the benefit ranges from a 4% benefit, if 25% of drivers employ eco-driving, up to 15% in the ambitious scenario of all drivers employ eco-driving.

Other studies from car manufacturers showed that eco-driving could bring a potential saving[cxvii]. However, the JRC[cxviii] and others[cxix] found that the impacts of eco-driving tends to decrease over time. This implies that the benefits would require extensive and repetitive training programs of all drivers to see appreciable benefit. Although this may be feasible for professional drivers where the burden may fall on transport companies, such a broad program for all drivers is unlikely.

Reducing speed can have a significant impact on CO_2 emissions, particularly at highway speeds, as aerodynamic drag increases proportionally to the square of a vehicle's speed. With full compliance of speed limits, the EEA reports that modern cars could reduce their CO_2 emissions per kilometre by up to 12% (in line with findings from Ricardo[cxx]), but in a more realistic scenario, it would more likely be 3%[cxxi]. Imposing lower speed limits comes under the jurisdiction of the Autonomous Communities, and there has been precedent in the EU (in France[cxxii] and Belgium[cxxiii], for example). In Romania, a national urban speed limit of 50 km/h is in place, while rural areas are only limited to 90 km/h, and motorways to 130 km/h (enforcement is ranked quite low, moreover)[cxxiv]. Reducing speed limits in cities will improve pedestrian and cyclist safety with less severe injuries and smaller probability of fatalities[cxxv] (CO_2 savings will generally not be particularly high, however). Romanian authorities reported a relatively high 1 861 road traffic fatalities in 2013 (the WHO puts that figure at 1 881), with 39% of those deaths being pedestrians and another 9% cyclists. The WHO suggests that reducing average speed by 5% can result in a cut in the number of fatal crashes by 30%, and moreover, states that when combining motorised traffic with pedestrians and cyclists, the speed limit should be under 30 km/h[cxxvi].

In addition to pricing pressure, technology can play a role in making transport more efficient. The flow of real time information regarding cargo space and arrival time is underutilised in road haulage. Internet applications are being developed and increasingly used, enabling road haulage companies to be more aware of goods available to be transported near their trucks. These tools can help to eradicate dead mileage and reduce empty legs. Increasing the cost of road transport will increase the uptake of such technologies as road is currently too cheap for this technology to be adopted at the extent necessary to have an impact on logistic efficiency

From Ricardo 2016[cxxvii] and the European Commission[cxxviii] state that widespread and rapid deployment of C-ITS can deliver reduce the fleet emissions from cars by 1.0%, buses by 1.7%, vans by 0.8%, and 0.7% for trucks. The maximum potential for each mode does not exceed 4.5% (for buses) in 2050, which gives an indication of improvements to new vehicles.

4.1.7. Shifting freight from trucks to trains

Modal shift has long been lauded and promoted as a key driver to decarbonize freight transport. The railway network in Europe is largely electric and far more energy efficient than today's truck transport[cxxix]. In 2011, 86% of train-km for freight were performed on electric traction in the EU. However, only 60% of freight railway total energy consumption is performed by electric traction. In 2016, railways transported 17.4% of freight in Europe in terms of tkm[12]. Romania is above the EU average, at 30.3% and 13.5 billion tkm. Although in the EU as a whole 50% of rail freight is international, in Romania international undertakings represent only 20% of tkm. Clearly, the priorities of the TEN-T network to enable smoother international freight, particularly to and via Romania's neighbours Bulgaria and Hungary and beyond to other EU Member States is vital for increasing rail freight viability. Increasing the rail freight share is not at all simple, as described in greater detail by the Rail Freight platform coordinated by T&E[cxxx]. One specific example of why is that a significant portion of the Romanian rail network is single track (over 70%)[cxxxi], greatly decreasing its ability to compete with road transport.

[12] Not including transport by pipelines

Rail is highly dependent on the type of goods being transported in the country. As shown in Figure 11, Romanian rail mainly transports fossil fuels and bulk commodities such as coal and iron. In the context of a decarbonising energy, the amount of coal transported will have to reduce to zero. On the one hand, this may open up more slots for other rail freight. On the flip side, a lot of this transport is on dedicated lines that go directly to the power stations, and thus will likely be unused. Secondly, a distance of 300 km and below is where road transport is typically superior to rail in terms of flexibility and operational costs (i.e. infrastructure charges, loading costs, fuel taxes, driver costs, and capital costs for purchase of equipment). For rail freight to and from Bucharest, this distance essentially covers most of the country. Furthermore, road transport is comparatively trouble-free when crossing borders.

Freight modal shift to rail is also considered in the World Bank and Romanian Government report (2013) and the report by Bankwatch (2016). These reports identify investment as a main barrier to an increased shift in freight to rail. Speed is another barrier when it comes to competition with the road freight sector. There are currently over 500 speed restrictions in the local railway network (covering nearly half of the network)[cxxxii].

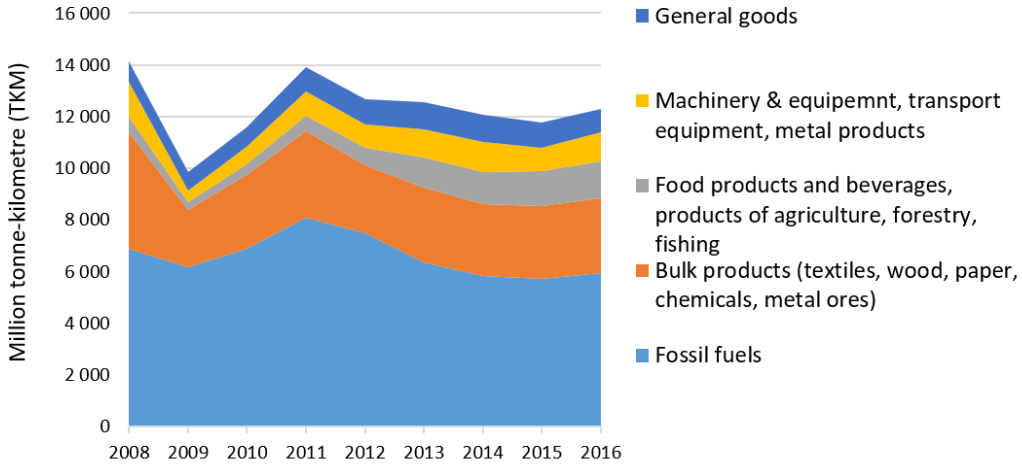

Figure 11: Evolution of freight carried by rail by type of goods carried and Madrid with a 300 km radius area centred on Bucharest, overlaid[cxxxiii].

This year marked the opening of the first railway segment in 30 years. Romania's state railways company CFR opened the Sighisoara-Danes railway segment to traffic in July[cxxxiv]. The line allows speeds of up to 160 km/h on the Sighisoara – Atel segment, and is part of the wider modernisation of the Sighisoara-Atel sector (100 km railway between Sighisoara and Coslariu) with EU funds to allow faster travel time of trains.

Whatever potential growth that is possible for rail is unlikely to materialise without improvements in rail capability and greater customer service by rail freight operators. This shift in business model (i.e. a more customer-oriented and international vision) will come from a better environment for competition whereby more train operators can compete fairly with the state-owned operators. This also is somewhat reliant on road charging, as the cost of road has to increase significantly so that the external costs of road transport (such as air pollution, GHG emissions and infrastructure costs) are internalised.

4.2. What national measures can deliver in Romania

The previous sections described and quantified where possible the potential impacts of policy on transport demand, modal shift to cleaner transport, and policies to increase the efficiency of the transport system. These policies can have complex interactions and not necessarily result in accumulative benefits. Therefore, these inputs are based on careful consideration of each measure so as not to overstate the potential of any given measure or combination of measures. On the other hand, these measures could be

seen as targets that Romania would need to achieve in order to meet its climate targets while designing policy. For example, to ensure car passengers are shifted to walking and cycling by the amount stated below, impact assessments should investigate how to achieve this, and what type of policy and investment is required to get there. In Table 2: Summary of inputs of Romanian National level policies, the inputs to the model are detailed along with a brief justification and the policy levers required. Note that rebound effects of more efficient vehicles and lower fuel costs for electric vehicles (where reduced costs induce more demand), are not considered in this study, as the combination of other measures are assumed to be designed to negate this effect.

Table 2: Summary of inputs of Romanian National level policies

Policy Lever	Reduction by 2030 (* 2025)	Measure	Main policy interactions and justification
1	7.50%	SHARE OF LDV ACTIVITY SHIFTED TO BUS (%)	Fuel tax normalisation, new electric buses being able to offer cheaper services, congestion zones blocking cars, coach market expansion. 7.5% of car passengers represent 40% of current bus passengers, so this shift implies bus and coach passenger growth of 4% p.a. between 2020-30
2	15.00%	BUS LOAD FACTOR INCREASE (PASSENGERS/VEHICLE)	As more passengers are lured onto buses (policy lever 1), buses will tend to be filled, increasing efficiency. This will be supported by service improvements (that will follow from increased ridership), pricing, and multimodal ticketing.
3	5.00%	SHARE OF LDV ACTIVITY SHIFTED TO RAIL (%)	This represents a 36% increase of current tram, metro and train ridership. This will be facilitated from fuel tax normalisation, TEN-T network implementation, inter-modality, train pricing and improved punctuality, competition offering new and more attractive services.
4	3.00%	MODE SHIFT FROM LDV TO WALK/BIKE (%)	As part of a city infrastructure investment (foot and bike paths), congestion charges that reduce traffic in order to reclaim space, more people willing to take public transport.
5	10.00%	LDV LOAD FACTOR INCREASE (PASSENGERS/VEHICLE)	Car sharing, priority access to carpooling cars. High congestion charge for single occupancy vehicles, higher vehicle registration tax, low emission zones, higher fuel prices and taxes, car ownership not a status symbol anymore (social justification)
6	9.00%	LDV ACTIVITY - REDUCTION FROM BASE CASE (%)	Combination of fuel tax harmonisation with the EU, low emission zones, congestion zones, toll roads and distance based charging. Some of the reduction in demand has been through modal shift (policy levers 1,3,4)

7	5.00%*	FREIGHT TRUCK LOGISTICS IMPROVEMENTS (%)	Fuel taxes normalisation and ending rebate to truckers, road charging, and digitalisation.
8	10.00%	SHARE OF HHDV ACTIVITY SHIFTED TO RAIL (%)**	Combination of diverse measures required to enable rail freight to be more competitive. Trucks should be charged for their pollution and infrastructure damage through fuel taxes and road charging. Improved connections with investment from the TEN-T.
9	6.25%*	FREIGHT TRUCK PAYLOAD INCREASE (METRIC TONS/VEHICLE)	Eurovignette and distance based charging, digitalisation.
10	5.00%	REDUCTION IN IN-USE FUEL CONSUMPTION OF ON-ROAD VEHICLES	C-ITS, eco-driving, congestion relief through time based charging, reduced and heavily enforced speed limits.
11	50.0%	LDV EV SALES	A national target implemented above ambitious standards, from charging infrastructure implementation, road charging, low emission zones, national targets. Note that this measure overlaps with EU ambitious standards, reducing the effect of CO_2 standards owing to the additional EV sales implied here.

Figure 12 shows the result of applying only these national measures, without the EU measures on CO_2 standards and electrification. As stand-alone measures, they amount to about 3.8 Mt CO_2e reduction compared to the baseline. This illustrates that Romania, and the rest of Europe, do benefit a great deal from EU measures such as CO_2 standards and electrification.

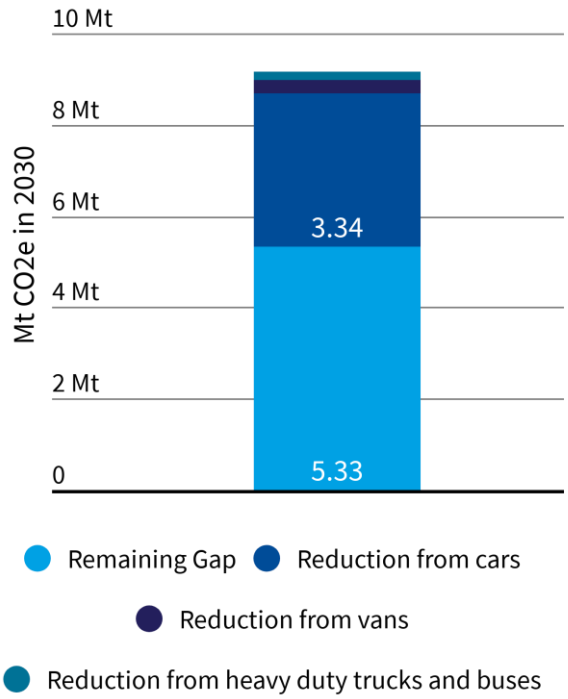

Figure 12: What national measures can deliver on their own in Romania, without EU standards and EV sales targets.

Figure 13 shows the combination of ambitious standards, ZEV sales target, and national measures. The measures together can completely close the gap, and surpass it. Although the measures described to reach this goal are ambitious, no measure goes beyond what independent research says is technically and economically feasible.

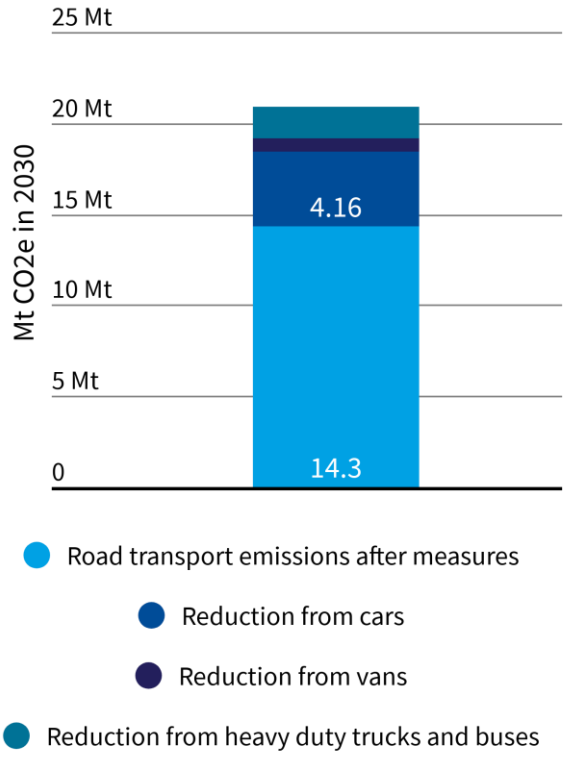

Figure 13: Combination of European and Romanian measures to achieve 2030 targets.

5. Long term impacts of climate change mitigation policies in transport

Figure 14 shows the projections of the different scenarios discussed in this paper, until 2030. In all scenarios, the policies and consumer behaviour are again frozen in time, as was the case when defining the baseline for the modelling projections. This perspective shows the benefit in exceeding the 2030 target: in the scenario with all ambitious measures in place, the emissions can almost be extended with a straight line to zero emissions in 2050. What is sure is that beyond 2030, *even more effort* will be required to reach full decarbonisation by the mid-century, necessary to abide by the Paris Agreement. Full electrification of the vehicle fleet will be necessary, and the electricity grid in the meantime will need to phase out fossil fuel generation.

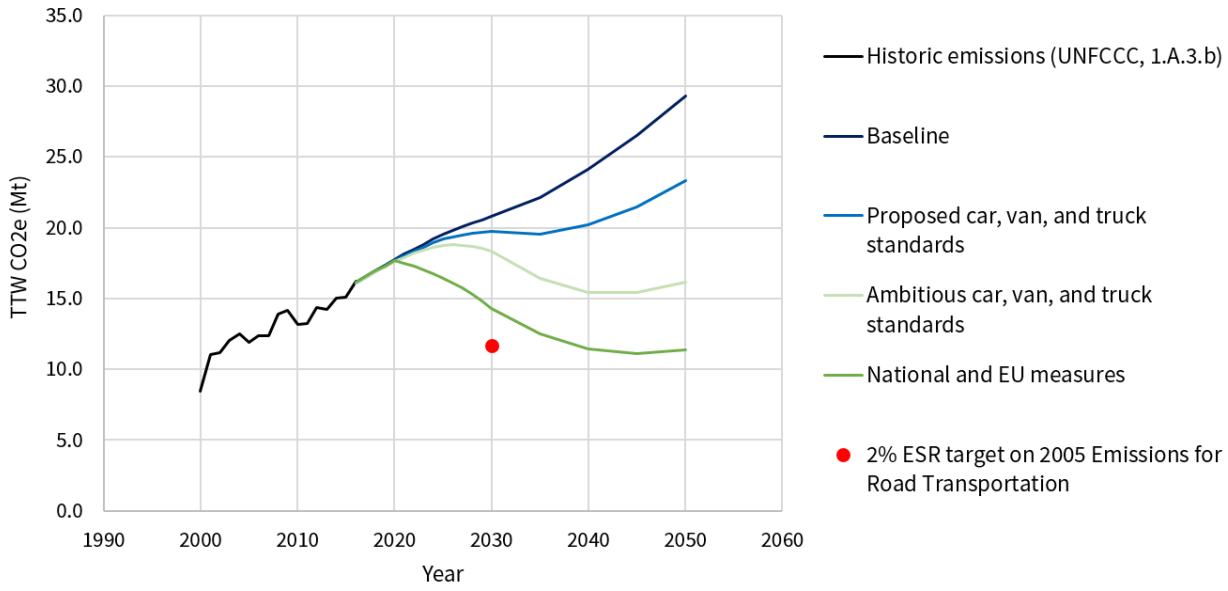

Figure 14: Long term trajectories of tank-to-wheel CO_2 emissions in Romania, compared to the 26% reduction target on 2005 levels.

5.1. Co-benefits

Reducing GHG emissions from transport is first and foremost a positive for the environment. As discussed in the opening paragraphs of these reports, Romania is already experiencing climate change that is amplified compared to what is being observed in the rest of Europe. Environment aside, there are other compelling arguments to reduce fossil fuel use. Most of the EU's oil is imported, thus the energy security of the continent is dependent on unstable regions in the world and on top of this, and money is flowing out of the EU economy to these regions[cxxxv].

Dependence on foreign oil will be reduced. The electric revolution can bring a lot of jobs in the EU - more jobs if we take the lead. This is particularly important in Romania as it has 2.00% of its active employment (174 321 workers) directly employed in the automotive industry[cxxxvi], which could see its economy thrive with the right investments. Electric cars do not have emit pollutants, a huge benefit for air quality, health, reduction in noise pollution and liveable cities.

6. Policy recommendations

This report has shown the potential of a wide range of European and Romanian specific measures that can be met on technical and economically viable metrics based on independent research. The main barrier to their uptake would be a political one. With strong political ambition, Romania can invest in future

technologies that are beneficial for the society and the environment. In this section, we outline the key and concrete actions that Romania can take to make it happen.

6.1. Vehicle standards

Cars and Vans

- Agree without a delay a binding and ambitious 2025 CO_2 standard for new cars and vans of at least 20% in 2025. This is the key policy that will reduce CO_2 emissions from cars and vans in the coming decade, as well as driving investments into zero emission vehicles and more fuel efficient petrol and diesel cars. The 2025 target is indispensable to help Romania achieve its Climate Action Regulation goals in 2030.
- To ensure CO_2 reductions are achieved on the road and the current gap between laboratory results and the real-world decreases, a not-to-exceed limit should be set for all manufacturers in 2021. This limit should be verified using either a newly developed Real-world Driving Emissions test for CO_2 or the Fuel Consumption meters.

Trucks

- Agree without a delay a binding and ambitious 2025 CO_2 standard for regulated trucks of at least 20% effective reductions in 2025. Similarly for light duty vehicles, this is the key policy that will reduce CO_2 emissions from trucks in the coming decade, as well as driving investments into zero emission vehicles.
- In the 2022 review, Romania should push for trailers to be included in the regulation, along with ambitious standards for all truck categories. The efficiency improvement targets should be set as close as possible to the technical and economically feasible potential, which is 43% reduction for the tractor and trailer. For tractor trucks this means the 2030 target should be set at at least 30% effective reductions.
- Monitor and report carbon emissions and fuel consumption of buses and trucks. Transparent fuel consumption information enable public authorities and truck hauliers to make more informed choices based on total-cost of ownership and actual fuel consumption

6.2. ZEV mandate and promotion

Romania should support the Commission in the creation of a joint undertaking for the research and development of battery technologies. Such a joint venture could be half funded by the EU budget and half funded by industry stakeholders. The EU could then use such a body to improve the European market for battery technologies while also researching how to reduce the environmental impact of the supply chain, as well as the best means to integrate electromobility into smart electricity grids.

Cars and Vans

- As part of the EU CO_2 standards for cars and vans, a separate sales target for zero emission vehicles should be agreed for 2025 to drive the supply of electric cars in Europe. This can be done either via a dedicated ZEV mandate or by adding a malus to the currently proposed bonus system. This will spur innovation into electric powertrains and the supply chain in Europe, driving better offer and more affordable choice of clean cars. While plug-in hybrid cars should be included they should be rewarded less than zero emission vehicles such as battery cars, in line with their CO_2 emissions.
- Romania should without delay finalise its National Policy Framework on the infrastructure for alternatively fuelled vehicles such as plug-in cars. An ambitious target for the number of publicly accessible recharging infrastructure would speed up the sales and uptake of plug-in cars while providing market certainty to electro-mobility players. This requires a joint approach to all levels of government to ensure infrastructure is rolled out rapidly and in the right locations, in a demand-driven way with innovative business models promoted.

- Sustainable and reliable support schemes and financial incentives to boost demand for plug-in cars should be put in place. Notably, the bonus-malus tax system which in a revenue neutral way helps the purchase of zero emission cars should be seriously considered.

Trucks and buses

- Romania should push for Europe to introduce a well-designed benchmark system with a bonus and a malus or a mandate for zero emission trucks of 5-10% by 2025 and 25-35% by 2030 and for buses of at least 50% by 2025 and 100% by 2030
- Romania should consider reducing rates for electricity for transport in the short term to help enable the uptake of battery electric trucks and buses.
- Within the Weights & Dimensions Directive (96/53/EC), an additional one tonne of legally permissible weight for trucks up to 26 tonnes that are powered by "alternative fuels", including electric powertrains. This allowance does not apply to tractor trailer trucks, however. Romania should push to change this law so that all trucks can benefit from additional tonnage to account for the alternative technology. As the batteries can range from 1t to 4t, Romania may consider pushing for a small increase in gross vehicle weight (GVW) to accommodate these technologies so there is no or reduced penalty on the payload. The Commission is also expected to progress the implementation of rounder, more aerodynamic truck cabs during 2018. This will be a benefit to both battery electric trucks and to the new best in class ICEs.
- Cities across Europe have significant potential to push investment to electric trucks and to shift their urban buses fleet to zero emission. This bottom-up pressure will further incentivise vehicle makers to invest in zero emission trucks and buses, as a coalition of cities can constitute the majority of the population on the continent.
- Require 100% of newly publicly procured buses and trucks to be zero emission from 2030. This should be reflected in the review of the Clean Vehicles Directive.

6.3. Fuel taxes and tax reform

- As a complementary measure to distance-based road charging, Romania should align their diesel tax rate to that of petrol, and should consider increasing excise duty to be more in line with the EU average.
- The rebate offered to truckers of €0.0426/litre in Romania should be scrapped.

6.4. Road charging

- Reassess toll charging for those concessions that are ending soon to ensure tariffs are set at a fair rate. Ideally, the rates at which vehicles are charged should be consistent across the whole network.
- Reassess toll charging for those concessions that are ending soon to ensure tariffs are set at a fair rate. Ideally, the rates at which vehicles are charged should be consistent across the whole network.
- Ensure all tolls are inclusive of separate infrastructure and (air and noise) pollution costs. Toll rates should be differentiated so that more polluting vehicles pay more than cleaner vehicles on the road.
- Extend the toll charge for HDVs to secondary roads so that the damage they cause is accounted for wherever they drive. This will additionally prevent HDVs from using secondary roads to avoid the toll, and so relieve congestion on those roads.
- Tolls have additional benefits for road transport as they improve logistic efficiency and can be used to encourage the uptake of cleaner vehicles provided rates are differentiated according to the environmental performance of a vehicle

6.5. Shifting car passengers to buses, trains, riding, and walking

- Invest in high quality, affordable public transport. Share relevant data with other transport providers and internet mobility platforms to enable Mobility as a Service (MaaS) and offer a real alternative to private car ownership.

- Improve the city infrastructure to encourage walking and cycling. This should lead to public space reallocation with less road space for cars, and more bike lanes.
- Introduce measures to encourage bike sharing, including appropriate locations for shared bikes, larger bike lanes, adequate street signs.
- Reduced the number of car parking slots and increase parking fees to incentivise the use of public transport.

6.6. Putting more passengers in cars

- Introduce city road pricing and/or congestion zones as a policy to reduce private car use.
- Facilitate the use of short and long distance car and ride sharing, as the occupancy of these vehicles is above average.
- Adapt fiscal incentives to deter private car use: end tax benefits for company cars, equalise taxation between petrol and diesel

6.7. Eco-driving, speed limits and communicating intelligent transport systems (C-ITS)

- As shown in this report, eco-driving has a potential to reduce CO_2 emissions from vehicles but to be effective, most or all drivers need to employ eco-driving, especially on the long term that would require regular trainings or better, mandatory use of eco-driving modes on cars that would moderate how the car is driven to maximise efficiency. Car manufacturers have been pushing the European Commission to qualify eco-driving as an eco-innovation. However, it does not qualify as as an eco-innovation as there is no guarantee that the driver will use or respect it, creating here an important loophole. A mandatory system would however qualify. A simpler approach to encourage eco-driving is simply to rigorously enforce speed limits that achieves similar benefits.

6.8. Shifting freight from trucks to trains

Shifting freight to trains, and ideally electrified trains, requires a holistic and concerted approach for policy and investment. If Romania want to shift more freight from road to rail then there are a number of measures that can help to achieve that.

- Apply a moderate toll to reduce the distance that rail becomes cost-competitive with road. Trains pay per kilometre of track access, and rail is more costly than road due to the increased requirements regarding labour and infrastructure, as well as the prices that rail companies set for their service.
- The Romanian regulator must ensure that the railway infrastructure manager is treating all trains equally regarding track access. This means equal treatment for new entrants and foreign trains. An independent and unbiased infrastructure manager is essential to a well-functioning railway market.
- Explore the idea of obliging the state-owned company to rent unused electric locomotives to new entrants that do not have the access to capital to buy such rolling stock and, therefore, use cheaper and more polluting diesel locomotives
- Improve the flexibility and speed of freight services by investing in rail infrastructure that's not as complex or time-consuming as large cranes. For example, a company in Switzerland has developed a system[cxxxvii,cxxxviii] whereby special trucks can quickly load containers and trailers from trucks to trains and vice-versa. The infrastructure is not expensive but there's a lot of potential to improve the ease at which trains are loaded.
- Increase competition in the rail freight market. Although the rail market is already open to competition in Romania, this has had so far an insignificant impact on modal shift. A common issue across Europe is that new entrants compete for pre-existing rail freight volumes rather than trying

to get the business of freight that's being moved by road. This is indicative of how rail is often reserved for captured markets and rarely tries to adapt services to compete with road freight.

6.9. Aviation and Maritime

Although these modes were not explicitly modelled and fall out of the framework of the CAR, aviation and maritime activity and their associated emissions are significant in the Romanian transport sector. Romania can push for the following measures to ensure that these emissions are properly regulated and kept at bay.

Aviation:

- A ticket tax on flights could yield significant revenues (€46.7 million based on 2016 passenger numbers) and help curb demand, helping to combat excessive tourism
- Retain and reform the EU ETS as a means of introducing more effective carbon pricing and put the sector on a long-term path to decarbonisation
- End the sector's kerosene tax exemption, starting with domestic aviation, and using Article 14 of the Energy Taxation Directive to begin ending the exemption for international flights on a regional basis.

Shipping:

- Implement tighter air pollution standards for ships calling at Romanian ports, both for SOx and NOx emissions;
- Electrify Ro-Ro ships (passenger and cargo) involved in short-sea shipping;
- Making on-shore power supply available, especially for RoRo and cruise ship terminals;
- Consider mandates[cxxxix] for zero emission shipping on specific domestic/short-sea shipping routes which can switch to batteries/hydrogen fuel cells in the immediate future;
- Ensure the transparency and cargo data collection in the EU MRV (when revised) in order to break market barriers to the uptake energy efficiency technologies in shipping;
- LNG as maritime fuel will make the decarbonisation of Romanian shipping very painful because of insignificant GHG benefits at the expense of huge infrastructure and ship retrofitting costs[cxl].

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