



Regulatory interventions in the transport sector

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Abstract

The European Union committed itself to reach climate neutrality by 2050. Against decreasing emission trends in various sectors, the transport emissions increased significantly since 1990 in the Czech Republic and Austria. For the climate neutrality it is very important to reduce transport emissions drastically. However, it is a sector difficult to regulate, because of different reasons. The European Green Deal is the base for the future emission reductions and related to it, different regulations will be adopted in both countries.

In the past there have already been Euro emission standards and low emission zones implemented. A new EURO 7 standard will come into effect from 2025. Carbon taxes are already in place in many countries but should be raised to increase the effect.

Both countries, the Czech Republic and Austria want to create a sustainable transport system by reducing the dependency on fossil fuels, multimodal transport approach and a shift of consumer good transportation from road to rail.

The sustainability of the transport system could be improved by raising individual responsibility, avoidance of unnecessary travel and business models like the car sharing.

1. Introduction

The European Union has set goals to decrease GHG emissions stepwise compared to 1990 in order to limit global warming and achieve climate neutrality by 2050. It is important to reduce emissions in several sectors to reach the net zero-emission target set by the EU member states. Sustainable and smart mobility is an integral part of the European Green Deal. Transportation is an important energy service in the modern society and serves the well-being of many people. The transport sector is also valuable for the European economy and accounts for 5-9% of the EU-27 gross domestic product. More than 10 million people were employed in 2018 in the transport sector (European Commission, 2020). However, the transport sector is one of the largest sources for greenhouse gas emissions in the European Union.

The overall emissions and most sectors show decreasing or stagnating emission trends, as shown in Figure 1 for the total emissions of Austria and Czech Republic. However, emission from the transport sector increased significantly in the last decades as shown in Figure 2. The emissions in the Austrian and Czech transport sectors strongly increased by around 75% (Anderl et al., 2021) and 66% (Krtkova et al., 2020) , in the EU by around 25%. The major reason is that mainly oil products are used as transport fuel and the sector is very low diversified regarding different energy sources. It will be a major challenge to decarbonize the transport sector (Mattioli et al., 2020), because already many people are living in cities, urbanization is expected to increase and urban planning is highly car-oriented in many big

cities (Nieuwenhuijsen and Khreis, 2016). In the transport sector, most CO₂ emissions (>75%) result from road transport (IEA, 2021). Passenger cars and motorcycles are responsible for approximately 62% and heavy and light duty vehicles for 38% of CO₂ emissions and it is expected that freight transportation will increase in the near future (Inkinen and Hämäläinen, 2020). The core objective of this seminar paper is to give an overview on existing policies, focusing on regulatory interventions, but also other measures which support sustainable transport and to present transport strategies of Austria and the Czech Republic.

The aim of this paper is to give a critical assessment of regulations in the transport sector. Because of the limited format of this paper not all transport modes can be assessed.

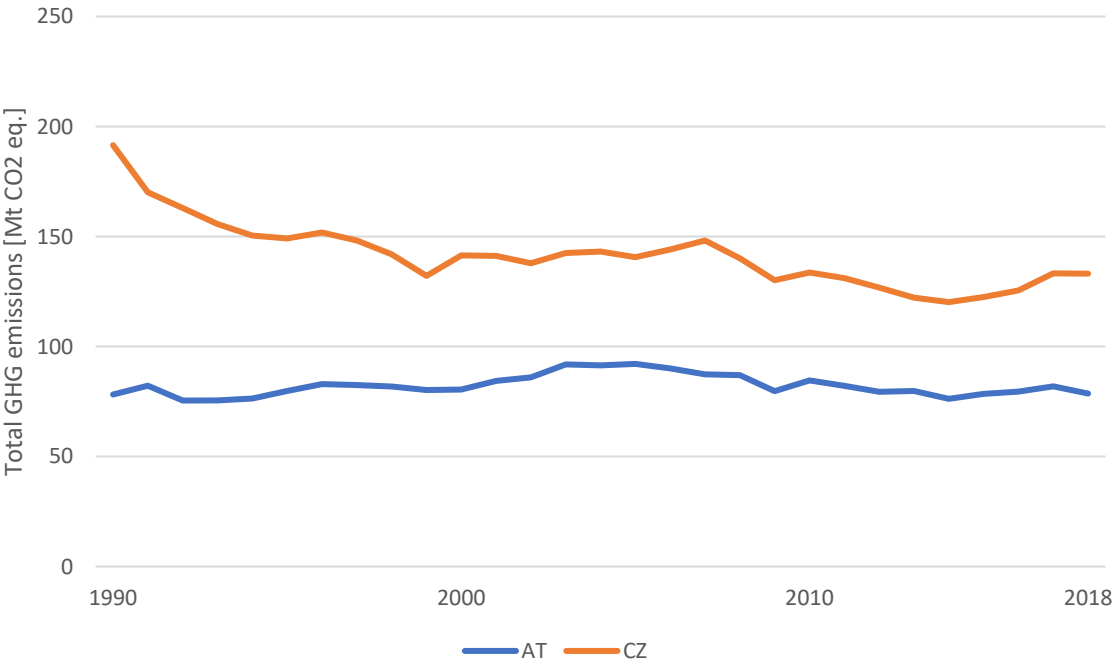


Figure 1 Total GHG emissions in Mt CO₂ eq. for Austria and the Czech Republic, sources: Environment Agency Austrian (Anderl et al., 2021) and National GHG inventory of the Czech Republic (Krtkova et al., 2020)

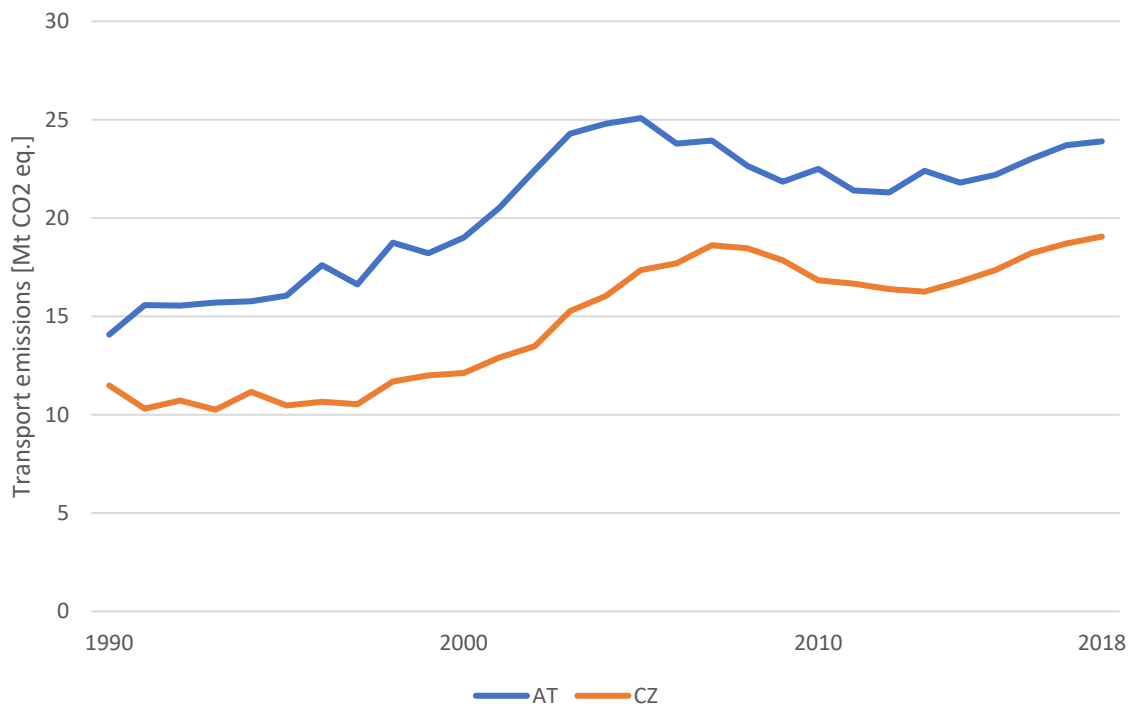


Figure 2 GHG emissions from transport sector in Mt CO2 eq. for Austria and the Czech Republic, sources: Environment Agency Austria (Anderl et al., 2021) and National GHG inventory of the Czech Republic (Krtkova et al., 2020)

2. Method and major literature

Major literature sources for regulations in transport is found from EU institutions since both compared countries have entered the European union and enjoy its rights, also must comply with obligations. Therefore, this section will focus on strategies, regulations, directives, and recommendations on economic, environmental and legal impact regulations. The next section, results, starts with reasons why it is important to regulate the transport sector. Afterwards findings from scientific literature and national policies from Czech Republic and Austria will be presented.

2.1. European Green Deal

The EU is committed to achieving climate neutrality by 2050, in order to meet its obligations under the Paris International Agreement. Achieving this will require a transformation of European society and economy, which will need to be cost-effective, fair and socially balanced. The European Green Deal was published in 2019 by the European Commission and has the goal to reach sustainability of the EU economy. Europe aims at becoming the first climate neutral continent by transforming the countries to modern resource-efficient economies where economic growth will be decoupled from resource exploitation. From the point of view of the transport sector, reducing greenhouse gas emissions can be considered one of the most

important goals of the sustainable and smart mobility strategy, emissions should be reduced in the EU by 2050 by 90%. Another goal is to have by the same year, 75% of the inland freight it currently transports on the road network shifted to railways and waterways (Ministry of Transport of the Czech Republic, 2021).

As part of the Green Deal, the Fit for 55 package is a set of proposals to revise climate-, energy- and transport-related legislation, for example the emission trading system, renewable energy directive, etc. and put in place new legislative initiatives to align EU laws with the EU's climate goals (European Council, 2022).

2.2. Fit for 55

This package serves to harmonize existing legislation. EU is working to revise its climate, energy and transport legislation. It is a partial step towards climate neutrality. The package contains suggestions for modification: EU Emissions Trading System, The Renewable Energy Directive, the Energy Efficiency Directive, taxation of energy products and electricity etc.

The Commission has proposed a revision of the CO₂ rules for passenger cars and vans. In practice, this means that from 2035 it will no longer be possible to market cars or vans with an internal combustion engine in the EU (European Parliament, 2022).

2.3. EURO 7

This standard should be implemented from 2025. This is a topic that has provoked a lot of debate. The commission assembled emissions experts from across Europe, known as CLOVE, to independently assess the shortfalls in the current car and truck emissions regulation and propose new emission limits and testes based on what is both economically and technically feasible. This group presented its recommendations that suggest stricter limits and rules for the transport sector, namely for e-catalysts. The other group are car producers. They started lobbying against a stronger EURO 7 emissions standard and created costs instead of going the greener way (Transport & Environment, 2021).

3. Results and discussion

To reach the net-zero emission goals of the EU, it is vital that also the emissions of transportation are reduced. The prices of transportation must reflect the environmental impact (Mattioli et al., 2020). The transport sector is difficult to regulate, because of different reasons for example, the urban planning of the last decades was and is still in most cities highly car oriented. Interestingly, as cars became popular in the United States and injuries happened on roads, because different transport modes came together, the initial idea was to create stricter regulations for car drivers. However, due to gaining influence of car companies and users, the

problem was readjusted and pedestrians were removed from roads. A promoting of other modes of transport means reclaim space back from car usage, which can result in public opposition (Mattioli et al., 2020). The transport sector is also a major factor in the economic progress of a country, but as the wealth of a country increases, usually the demand for products increases too and therefore the transport activities (Cigu et al., 2019). The global motorization rate increased from 20 vehicles in 1950 to 143 per 1000 inhabitants in 2015 and the number of light-duty vehicles reached 1 billion in 2010s (Hooftman et al., 2018). The importance of the automotive industry lies in its major scale and economic significance, because it has grown to one of the main industrial sectors since end of 19th century. The automobile industry is an important factor in the economy of different European countries and many companies which are suppliers of steel, rubber, etc. for big automobile companies are dependent on these business interactions. Car manufacturers have gained a privileged position and were sometimes considered as “too big to fail”. However, in the past there was also resistance and manipulation discovered as in the diesel scandal and more recently in the case of „Commission fines car manufacturers €875 million for restricting competition in emission cleaning for new diesel passenger cars “. Car manufacturers have violated EU antitrust rules by agreeing on technical developments in the area purification of nitrogen oxides. The problem was that the companies avoided competition which is a key factor in technology improvements. Technologies were already available to reduce harmful emissions beyond what is legally required under EU emissions standards, but the companies agreed illegally and in a cartel on how to proceed with the EU's ambitious goals in the form of AdBlue fraud (the selective catalytic reduction (SCR)-technology which eliminates harmful nitrogen oxide (NO_x). They were fined for this action.

Green deal unification can be a solution so that these situations do not recur in the future (European Commission, 2021).

Many regulations which aimed on energy efficiency improvements where not as effective as expected, because of phenomena like the rebound effect. Lower fuel consumption per kilometer led people to increase their transport activities. Politics have failed to motivate people to reduce short distance travelling by car, for example many of the daily car drives in Austria are less than one km (VCÖ, 2021). In the last years there was also a trend where the size of cars increased and many people who lived most of the time in cities also bought SUVs (Cozzi and Petropoulos, 2021).

Furthermore, (Hulkkonen et al., 2020) et al. explain in their review paper that the usage of passenger cars is an everyday habit of many people and good intentions to protect the environment are often forgotten when individual choices are made. They state that noise, congestion and increasing GHG are apparently not enough to lead to a changed behavior and decreasing usage of passenger cars. Two different approaches can be applied to realize a

behavioral change by promoting the sustainable way with incentives or to make the unsustainable mode of transport more difficult or expensive by applying sanctions.

Measures for a sustainable mobility are end of fossil-fuel subsidies, revision of current tax exemptions and increasing production and promotion of sustainable alternative fuels. The goal is furthermore to achieve less polluting transport, especially in cities. Air quality has become a main priority for regulatory interventions in urban areas, because more than 80% of urban citizens around the world live in areas with air qualities below the minimum standards (Ajanovic and Haas, 2021).

The effectiveness and success of different measure can be measured with following categories:

- Longevity
- Awareness
- Availability of alternatives
- Air quality

3.1. Regulations focused on automotive technologies and fuels

Since the 1990s emissions of new vehicles were regulated with the so called “Euro emission standards”. However, the Euro emission standards were measured in controlled environments of laboratories, which could differ largely from the real conditions and emissions in road transport. Therefore, the real driving conditions are demanded for testing of new passenger cars and light duty vehicles since September 2017 (European Commission, 2017). Global car markets are dominated by law originating from the EU, because they adopted for example the emission standards. In the 1990s Europe was the leader of ambitious emission regulations for internal combustion engine vehicles, but this might change in a few years. For NO_x, the US and especially California have currently stricter emission regulations than the EU. In Europe higher NO_x emissions from diesel (80 mg NO_x/ km) than gasoline (40 mg NO_x/ km) vehicles are allowed with EURO 6, whereas in the US no difference between engine types was made (fuel neutral approach). However, CO₂ emission targets are more progressive in the EU with the target of 95g CO₂/km. In addition, allowed CO₂ emission levels are adapted to the average weight of the car fleet. Higher weight means higher CO₂ levels. The question if the EURO 7 is even necessary arises with the upcoming ban of internal combustion engines. The European Parliament voted for a ban of internal combustion engine (ICE) vehicles by 2035 (CNN, 2022). However, the European Commission expects that between 2025 and 2035, almost 100 million new diesel and gasoline cars will be sold. Therefore, the EURO 7 can be a solution to decrease harmful emissions for the next years. These years in between should not be wasted by waiting for the end of ICE cars in the EU. Some argue that the proposed emission standards of EURO 7 cannot be fulfilled by diesel cars, but the technology is already available and the estimated

costs of 100-500 € per car are in an acceptable range compared to the whole price of a car (Transport & Environment, 2021). Apparently, biofuels will not be an exception of this sales ban, but biofuels can help to reduce emissions for passenger cars until 2035 and the technology can also be used to produce fuels for aviation and maritime transport. Since strong efforts are necessary to reduce the overall transport emissions, the sustainable production of biofuels can also help to contribute to reach the emission goals.

The latest directive on renewable energy states that a 14% share of renewable energies in transport must be reached until 2030 and the share of food crop-based fuels must be limited to 7% (Puricelli et al., 2021). Most of the renewable energy in the transport sector comes currently from food-crop based biofuels, but this is often not a sustainable way of producing biofuels. Therefore, the share of food-based biofuels was restricted.

While most European countries want to get rid of internal combustion vehicles, it is also in a sense of circular economy to convert biowaste and municipal organic waste to advanced biofuels for transportation, especially for long distance travel. There is still a large unused potential of residues to produce biomass-based gases or biofuels (IEA, 2020). Overall well-to-wheel emissions of battery electric vehicles depend on the country's electricity mix. The environmental performance of biomethane can be better comparing the whole life cycle (D'Adamo et al., 2021). Therefore, the focus should not lie on only one technology because sustainable biofuels could become a feasible solution for long distance transport. Most of the EU Member States have an existing infrastructure for natural gas and meet the important requirements for biomethane deployment, however a big issue is the lack of existence and reliability on the policy framework and support schemes (Wall et al., 2018).

3.2. Emission regulations for urban areas

To cope with increasing emissions and particulate matter issues in urban areas, some countries introduced low-emission zones in large cities. NO_x emissions are mainly caused by anthropogenic emissions from road transport. Nitric oxide (NO) and nitrogen dioxide (NO₂) are associated with different health concerns and lead to the production of surface near ozone, which has an impact on sensitive ecosystems.

(Krecl et al., 2021) analyzed the NO_x and NO₂ emissions in three European Cities. NO_x concentrations decreased by 2.1% and 2.6% per year in the urban background of Copenhagen and Stockholm, London showed a lower decrease of only 1.3% per year. In Sweden road traffic was the main source for NO_x emissions and decreased in total by 48.5% over 20 years. NO₂ emissions decreased slower than NO_x in all three cities. However, an increase in NO_x was again observed in Stockholm after the introduction of rapeseed methyl ester busses, which had 2.5 times higher NO_x emissions than diesel busses. Cleaner after-treatment or newer bus engines might be the reason of reduction after 2015.

3.3. Carbon tax

The energy and industrial sectors are integrated into the Emission Trading system of the EU. This is not the case for the transport sector. In recent years several European countries started a national pricing on carbon dioxide emissions. In contrast to the EU ETS where the certificate prices can vary, the national carbon tax is fixed. A report about effective carbon rates by the OECD showed that in 2018, 60% of all carbon emissions from energy use were still without any carbon pricing. In the report, also fuel excise taxes were considered as carbon rate although the main motivation for this tax was not climate related. In the 44 OECD and G20 countries only 19% of the goal to price all emissions with 60 € was reached (OECD, 2021). Austria wanted to launch the carbon tax in July 2022, but due to high oil prices the start was postponed (ORF, 2022). A carbon tax of 30 €/ ton CO₂ would result in price increases of petrol by 7.1 €ct and for diesel by 7.9 €ct. The long-run price elasticities for fossil fuels assessed by the Germany's Mobility Panel are between -0.4 and -0.7. meaning that a price increase of 10% would lead to 4-7% lower fuel consumption (Frondele and Schubert, 2021). There exists the risk of social discontent, because of sudden high carbon pricing as was seen by the Yellow Vests protests in France (Frondele and Schubert, 2021). Low-income households will also be more affected of carbon pricing and therefore, the higher expenditures will be reallocated to the environment. In literature different approaches are discussed, for example the indirect way of lowering the ecotax on electricity in Germany. In Austria, people will receive a so-called climate bonus depending on the region where they live.

3.4. Transport policies of the Czech Republic and Austria

The Austrian climate and energy plan propose different measures to achieve a reduction of transport GHG emissions:

- Expansion of public transport
- Electrification and mobility management
- Active mobility
- Shift from road to rail
- Increasing share of biofuels and e-mobility

The transport sector was the second largest emission source between 1990 and 2018. Not only passenger km increased, but also emissions from freight transport increased by 91%. Urban planning has a strong impact on transport activities. Therefore, climate targets should be incorporated into spatial planning. In Austria, the provinces and municipalities are responsible for offers in the regional and public transport (BMNT, 2018). Sustainable transport should be made more attractive by incentives in the municipalities.

The Austrian climate and energy plan was evaluated by the European Commission in 2019 before the COVID pandemic. Austria had lower taxes on fuels than other neighboring countries and this had therefore a smaller effect on emissions (European Commission, 2019). As a consequence, significant amounts of the sold diesel were exported in vehicle tanks. However, for low-emission mobility, diesel and gasoline consumption must be reduced in both countries and replaced with other fuels, for example biomethane, biofuels, hydrogen and e-mobility.

Besides CO₂, there are also other emissions of concern. NO_x and CO result from combustion of hydrocarbons. The main sources in fossil fuel-based plants and transportation. In contrast to the increase in CO₂ emissions, the NO_x emissions could be decreased since 1990, as seen in Figure 3, because of improvements in engine technology and post combustion treatment. The strategic document for transport policy of the Czech Republic aims therefore at decreasing the dependence on hydrocarbon fuels and progress to low-emission transport.

The vision of the transport policy is to ensure the development of a high-quality transport system whilst reducing emissions (Ministry of Transport of the Czech Republic, 2021). Three steps are part of the vision:

- Savings on the transport of passengers and goods
- Multimodal transport approach
- Accessibility in individual regions, combining transport needs and reduction of environmental impact.

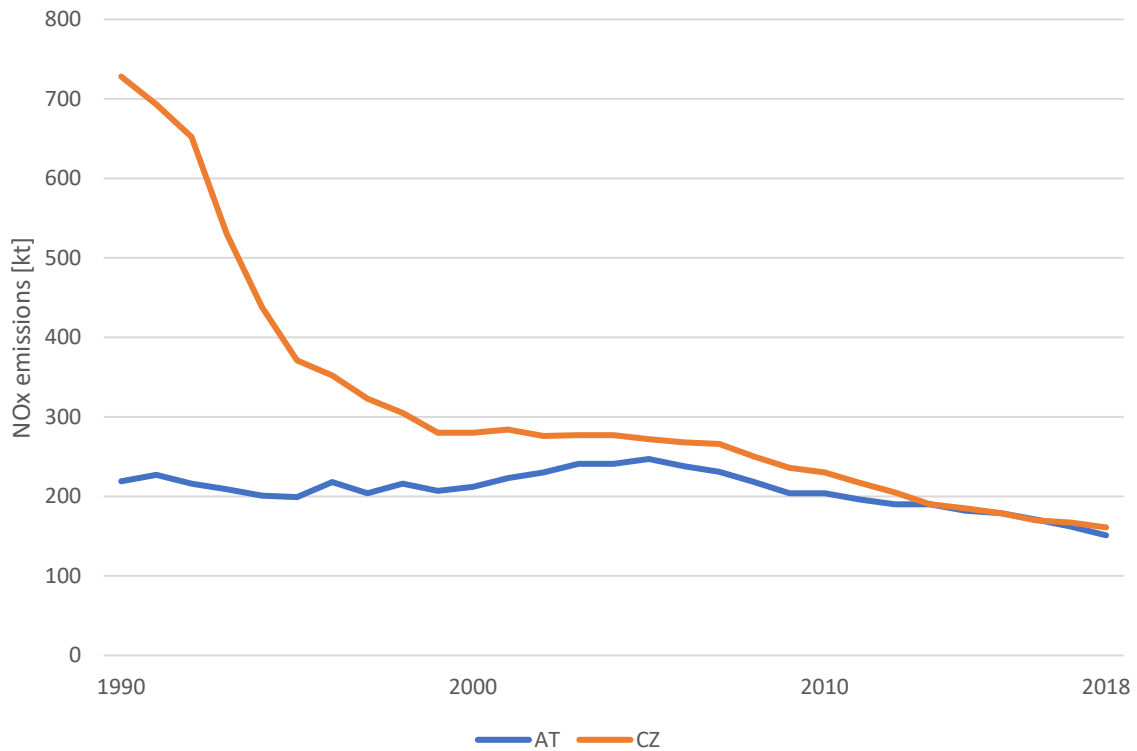


Figure 3 NOx emissions for Austria and the Czech Republic in kt/ year, sources: Environment Agency Austria (Anderl et al., 2020) and National GHG inventory of the Czech Republic (Krtkova et al., 2020)

4. Outlook

The travel restrictions during lockdowns showed also some possibilities to progress towards a sustainable transport system post COVID. Figure 4 shows aspects that can be considered for this purpose. Instead of a top-down approach which was the common practice before COVID, the authors suppose the increasing consideration of individual responsibility for making their transport choices. The authors argue that millions of people around the world took responsible choices when protecting their families during the times of high number of COVID cases.

Responsible transport and lower emissions can be achieved by following examples:

- Alternative online meeting instead of in-person
- Active mobility if possible or transportation with lowest environmental impact
- Offsetting flight emissions
- Awareness that many purchased items are transported by air

(Budd and Ison, 2020)

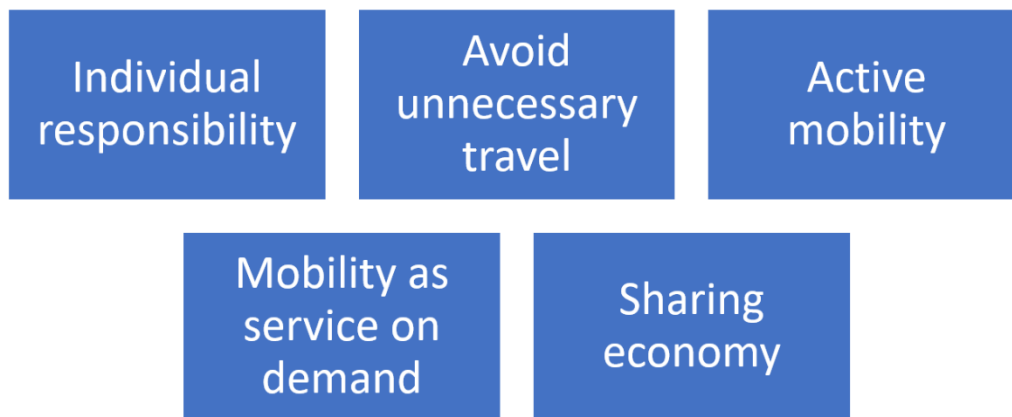


Figure 4 Possible contributions of a more sustainable transport system

A question is also if it is possible to replace all combustion engines with battery electric vehicles. There is a broad opinion that a change of behavior will be inevitable and that unnecessary travels should be avoided.

A new type of business in the last twenty years is the sharing economy. The growth of this business model is predicted to be significant in the short to mid-term. Sharing concepts like car sharing can contribute to traffic reduction in urban areas when people don't buy their own car, use public transport regularly and use cars only for special occasions. For people who are reliant on their car every day, car-pooling might be an option. In this case, the vehicle usually belongs to the driver, but more people use the car. The positive aspects are reduced costs and lower emissions for the individuals, but also less congestion and less demand for parking on urban levels. However, there are still concerns if this concept will succeed on a large scale.

A less well-known concept is load sharing. The idea is to use apps for increasing the visibility and transparency of involved persons. Small businesses should get more access to on-demand capacity. The overall goal is to increase the efficiency and big logistic companies could reduce their fleet or provide excess capacities on the market.

Regulations by governments can also become barriers for the sharing economy. In some countries there are strict rules for car-sharing drivers. The regulations depend on the commercial activities at the considered time frame. Over-regulation can be a threat for people to start a new sharing business and a new legal framework is probably required because the current law is designed for already established business models. Regulations that support car-sharing are for example road lane restrictions for less than two passengers (Standing et al., 2019).

5. Conclusions

The transition to a sustainable transport system will be a major challenge for European countries. The policies of the last three decades could not manage to reach CO₂ emission reductions compared to 1990. However, some progress was achieved by reducing the NO_x emissions significantly.

It will not be a simple solution and the focus on only one technology is probably not enough. Regulations can work to reduce emissions in cities and bring people to use other modes of transport. However, it is important to ensure reliability and to reflect the environmental impact in the different transport modes.

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