Post-2020 Visions and National Plans for Sustainable Transport

A report written for the European Biofuels Technology Platform.

An internship program at the Energy research Centre of the Netherlands

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Summary

The aim

This report is intended to satisfy the queries of the European Biofuels Technology Platform with regards to the sustainable transport policies among Member States for the timeframe 2020-2030. Special attention lays down on finding the main policies for: Alternative Fuels, Means of Transport, Green-House-Gases (GHG) and the Sectorial Objectives related to transport. To do so, this research study reviews, analyses, assesses, and reports the data gathered from National Plans in the field of sustainable transport beyond 2020 of each Member State analysed. In order to give organization in the data gathering, an analytical framework was defined which is also based on the transport-related policy documents issued by the European Commission. Furthermore, this research also aims to provide an overview on differences in visions and discourses by Member States regarding sustainable transport beyond 2020. As well, this research aims to provide a background to explore which policies may be better addressed at national-level or European Union-level.

The queries

In this sense, this research study is guided under the main research question: 'what policies have been defined by the European Member States in terms of *Sustainable Transport* for the timeframe beyond 2020? Moreover, is of the interest of this study to explore the causes of differences in visions, strategies and policies among Members states when it comes to sustainable transport (Chapter 1.1 addressed the research questions).

The method

In order to proceed with the research study the data gathering followed the next methodology. The data regarding the national plans by each Member States was gathered by conducting a literature review of the policy documents issued by each Member State from the study sample. The study sample consists in the following countries (the Member States):

- Finland
- France
- Germany
- Italy
- Netherlands

- Poland
- Spain
- Sweden
- The United Kingdome (UK)
- Greece

Each Member State studied in this research represents a case study. The case study as a study design was the most suitable choice for exploring 'in-depth' the different national plans for sustainable transport.

The limitations

The limits of this research study are described as follows. Regarding the energy carriers this research studied: electricity, hydrogen, biofuels, oil and natural gas. Regarding the means of transport this research only studied road transport, in which the following are included: Passengers Cars, Light-Duty Vehicles (LDV), Heavy-Duty Vehicles (HDV) and Buses. For the aviation and international shipping sectors, (advanced) biofuels will most probably also need to play a role in their decarbonisation strategies. Particularly when this will need to be drop-in biofuels that can be limitlessly blended into the current fuel stock, this brings other dimensions to the development of advanced biofuels.

The main findings

After reviewing the national plans of Member States the following major findings are addressed as follows:

- In all Member States, ambitions beyond 2020 are still in the phase of visions and plans, and have not yet been translated into formal legislation.
- Not all the Member States have issued national plans beyond 2020. Only Finland, Germany, the Netherlands, Poland, and the UK have issued national plans on this.
- Timeframes and horizons regarding the action plans for sustainable transport are diverse among Member States. These vary from 2020 and up to 2050.
- There is a major difference in the availability of data among national plans, which diverges between qualitative and quantitative data. Moreover, a major difference among the national plans is found with regards to the level of in-depth data.
- The status of the policy documents varies from: visions, targets and national strategies.
- The aim of the policy documents varies from one Member States to another, according to their national preferences. For some Member States the aim is to modernize or update the transport system, while for others the aim is to decarbonize the system or lower the emissions related to transport.

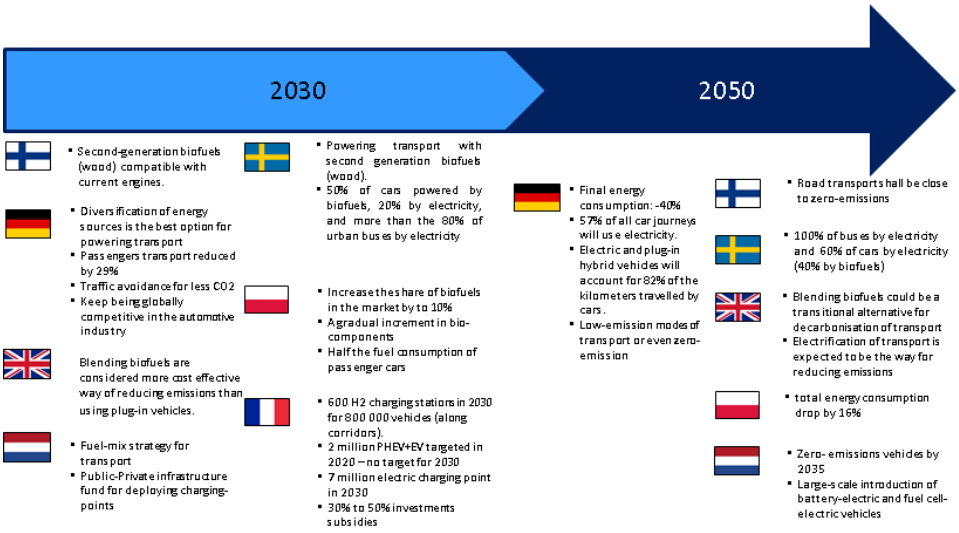


Figure 1. The timeframe of the main goals

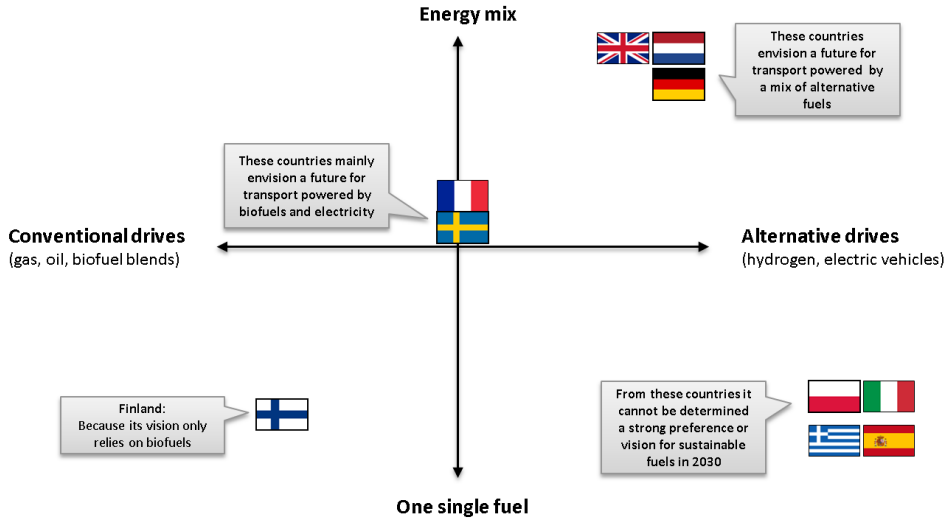


Figure 2. The visions for alternative fuels.

Alternative Fuels:

- Oil-based fuels are expected to inevitably power transport for the short and medium term future, but on the other hand are planned to be phased-out as fuels for transport.
- Most of the Member States consider a fuel-mix strategy that aims to work as a diversification portfolio to warranty the availability of different fuels supply. But also to warranty continuity of transport.
- Second-generation bio-fuels for transport are preferred over first-generation bio-fuels among Member States. No targets were found for third-generation bio-fuels when reviewing the different national plans.
- Electricity is seen as one of the most suitable fuels options for triggering CO2 emissions reductions and it is also one of the most recurrent alternatives mentioned among Member States in their National Plans.
- Hydrogen is also one of the most recurrent options beyond 2020 among Member States. Different visions and strategies vary from supporting projects for hydrogen R&D, but also for warrantying supply of hydrogen and its infrastructural development.
- Drop-in blends for biofuels, electricity, and hydrogen are common options for powering passengers cars. LNG and CNG are options to power HDV. CNG, LNG and hybrids are options to power LDV. And hybrids, natural gas, and electricity are option to power buses from public transport in urban areas.

Means of Transport:

- Passengers cars are seen as both the main cutter of GHG emissions and the main contributor to GHG emissions. Important gains are possible by improving this specific part of the transport sector.
- LDV are planned to play a low-emissions role when these are driven within cities or distances below 200km. Hybrid options of fuel (electricity and hydrogen/gas) can power these vehicles.
- Higher blends of bio-fuels and duel-fuels are the options to power HDV, however R&D, investments, infrastructure and further deployment are needed.

- Hybrid buses, gas buses and modernization of buses for public transport as energy-efficiency measures.
- In summary and aligned with the European Commission's recommendations, 'a seamless door-to-door' approach shall work as key driver for further developments with regards to means of transport.

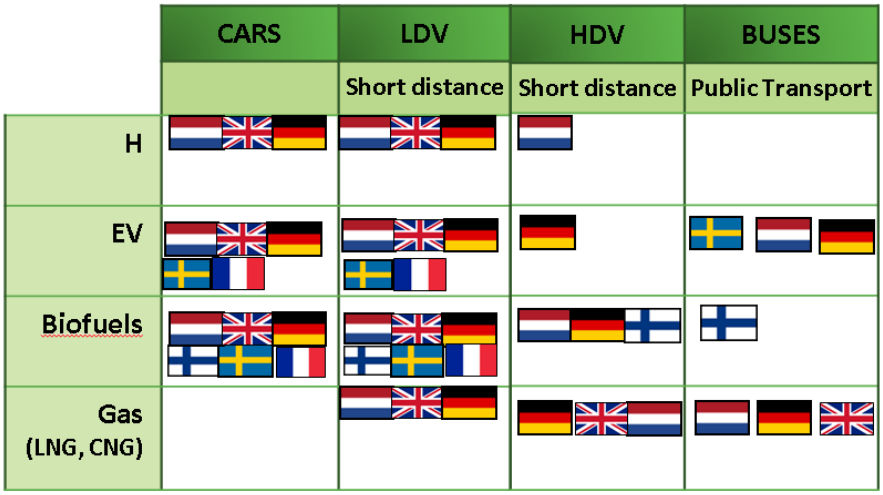


Figure 3. Summary of fuels and transport visions.

Green-House-Gasses emissions reduction targets:

- Electrification, low-emissions standards, and traffic avoidance and management are seen as the major reduction targets of GHG emissions.
- Pollution from transport is the main obstacle for air quality.
- Des-transportation is the major contributor to energy savings and efficiency.
- Diversification of energy sources as an energy saving measure.
- Energy efficiency improvements: enhanced aerodynamics, lightweight construction materials, and regenerative braking and low-friction.

Sectorial Objectives related to transport:

- The external dimension considerations are not broad enough among the national plans reviewed, and do not consider cross-country measures for sustainable transport beyond 2020 in terms of infrastructural or fuels development.
- The effects of bio-fuels production on Indirect Land Use Change are addressed in an enunciatively way rather than by setting clear measures.
- No-ETS in road transport is suggested as a preventive measure for lowering GHG's emissions.

Key findings per country

Finland

- Cutting emissions from the largest contributor sector 'transport' is a key target for Finland.
- Road transport shall be close to zero-emissions by 2050.
- Second-generation biofuels is the preferred fuel option for 2020 and beyond.
- 2nd generation biofuels shall be compatible with the existing vehicles fleet.
- When producing 2nd generation biofuels, two considerations arise: sustainability of its production and sustainable management of wood as input for refineries.
- Finland is expected to become an exporter of refined petroleum products once its national consumption is decreased or phased out.
- Finland aims for no ETS in road traffic, and to spread this idea across Europe.
- A call for fair effort sharing among Member States for non-ETS.

Germany

- Electrification of transport is the most promising alternative fuel for transport. This improvement will reduce potentially CO2 emissions within the timeframe 2020-2030
- Diversification of energy sources in transport may lead to a general reduction of energy consumption. Final energy consumption of energy can be reduced by 40% by 2050.
- Oil-based fuels will continue to be the main fuel for transport in the medium term.
- Support for sales and consumption of natural gas (CNG / LNG) and LPG is needed beyond 2018.
- Clear drop in the sale of petroleum products up to 2025.
- HDV can be powered by LNG or purely electric drives as a transitional measure.
- In 2050, the transport sector is dominated by synthetic liquid fuels, and the adoption of biofuels is expected to come onto the market in the medium term.
- By 2050, the goals of a greenhouse gas-neutral transport sector will be achieved by a 100% of the liquid fuel provided by PtL technology.
- Hydrogen is used in compressed or liquefied form in cars, distances of 400 kilometers and more are possible.
- Target of a network of around 1,000 hydrogen-fuelling stations by 2030.
- Freight traffic is aimed to reduce up to 2050 by 37% compared with the trend final energy

demand in 2050.

- Passenger transport it is envisioned to reduce by 29% due to modal shifts and more fuel-efficient vehicles.
- By 2050 the final energy demand for passenger transport will be 958 PJ, which equates to 59% of the overall final energy demand for the transport sector (excluding shipping).
- By 2050, 20% of transport will be powered with direct use of electricity and an 80% by power-generated fuels (excluding shipping).
- By 2050, 57% of all car journeys will use electricity.
- In 2050 electric and plug-in hybrid vehicles will account for 82% of the kilometers travelled by cars.
- Hybrid buses are on option for the medium term future, bringing energy efficiency improvements up to 20%.
- Traffic avoidance is thus the most fundamental way of reducing greenhouse gas emissions.
- Low-emission modes of transport or even zero-emission by 2050.
- Regulatory measures for reducing CO2 emissions such as: tightening CO 2 emission limits, motorway speed limit of 120km/h, and low-emission zones in city centers from 2025.
- Concern regarding the social acceptance of biofuels and ILUC.
- Germany envisions further reductions of CO2 emissions while maintaining a globally competitive automotive industry.
- No profound changes in the energy sources for transport are expected until at least 2020.

The Netherlands

- The fuel-mix strategy aims to innovate and develop its market leadership on: electric transport, hydrogen, renewable gas, and sustainable biofuels.
- The next step of electric transport is to work on recharging infrastructure, smart grids, and options for energy storage (such as hi-speed recharging batteries). Battery-powered electric drive technology is the most energy-efficient solution.
- Hydrogen needs niche development by conducting pilots and studies on fuel-cell cars and other vehicles. Also, more development is needed regarding the distribution system of sustainable hydrogen fuel.
- Production and distribution of renewable gas for LDV and LNG/bio-LNG for HDV needs more R&D.
- More support on development and distribution of sustainable biofuels.

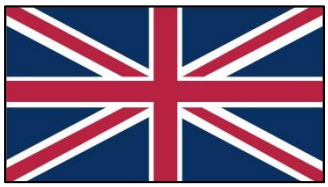
- Zero-emission vehicles by 2035
- Electrification is seen as well as a major contributor for the energy-climate goals achievement.
- Large-scale introduction of battery-electric and fuel cell-electric vehicles is assumed in the period up to 2050.
- Efficiency improvements for the transport sector such as: enhanced aerodynamics, lightweight construction materials, and regenerative braking and low-friction. By applying this measures improvements on efficiency by 65% in the passenger transport sector and 30-40% in freight transport are expected.
- By 2030 the CO2 emissions have to be reduced by 8 Mton.
- By 2050, a reduction of 23 Mton on the reference estimate is required (60% reduction in CO2 emissions).
- Existing policies and autonomous developments involving the use of the fuel-mix and efficiency improvements could bring about a 12 Mton reduction in emissions by 2030 and a 15 Mton reduction by 2050.
- Hydrogen fuel cells represent a valuable supplementary power source, since they increase vehicle range with a shorter refill-time and are also associated with zero emissions.
- To collaborate at the EU level to reduce greenhouse gas emissions within the fuel chain – preferably within the EU Fuel Quality Directive (FQD) – and reformulate the EU Renewable Energy Directive after 2020.
- Develop market introduction for forms of electric propulsion in passenger and freight vehicles, including loading and hydrogen-tank infrastructure and related services.
- Create a public-private infrastructure fund for charging points for battery-powered electric cars, renewable gas and hydrogen fuel stations, and LNG bunker stations.

Poland

- Specific data about energy carriers for sustainable transport and specific means/modes of transport were not found.
- An increase in the share of biofuels in the market of transport fuels is expected by to 10% by 2020 and up to 2030.
- A gradual increment in the share of bio-components in transport fuels**.**
- By 2050, total energy consumption in the transport sector will drop by 16%, and the demand for fuel by 11 million tonnes.
- By 2030 fuel consumption of passenger cars

will decrease by almost a half.

- When envisioning means of transport objectives, these mainly lay down on improvements of the management and efficiency of the whole transport sector. Mainly digitalization, collection and use of Big-data, among others.
- Regarding GHG emissions reductions, different areas for improvements are envisioned. To mention them: space management, financial mechanisms, traffic management and environmental protection.
- Improvement of living conditions and the environment by reducing the negative impacts of transport.
- Mitigation of the impacts of climate change on transport infrastructure in order to contribute to improving the safety of road users (prevent damages by natural disasters on roads).
- Management of efficient transport modes and nurturing behavioral change.
- Des-transportation measures such as public, pedestrian and cycling modes of transport.
- Protecting forests and the agricultural sector against overexploitation in order to obtain biomass.



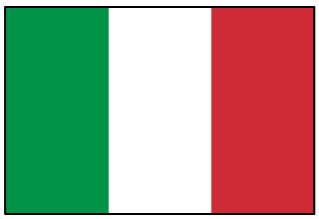
The United Kingdome

- GHG emission reduction target of 80% by 2050, compared to 1990 levels.
- Decarbonisation of road transport, especially cars, is expected to be achieved in the long term with electric plug-in vehicles and hydrogen vehicles, coupled with a decarbonisation of the electricity and hydrogen production
- Integration of the requirements of vehicles, infrastructure and hydrogen in the time period to 2023.
- Hydrogen market is believed to become commercial by 2023.
- Brown and green hydrogen production methods should be supported up to 2020s to avoid market failure and to nurture further green hydrogen development.
- By 2050, biomethane could potentially replace all current fuels for Heavy-Goods-Vehicles (HGV) and buses.
- Deployment on a 2030 timeline will need progressive targets to support investments into gas vehicles for HGV/busses as well as drop-in fuels into passengers cars.
- Support and incentives are needed for the use of advanced biofuels post-2020, one way is by setting a blending mandate for advanced biofuels and by extending a sub-target for

advanced biofuels.

- Biobutanol needs progressive targets to underpin project investments for advanced biofuels for the timeframe 2020-2030.
- Biofuels are an option for both carbon savings up to 2030 and to decarbonise transport.
- Blending biofuels are considered more cost effective way of reducing emissions than using plug-in vehicles in the timeframe to 2030.
- Blending biofuels could be a transitional alternative for decarbonisation of transport in the 2050 horizon.
- High level of biofuels blending can be achieved within supply constraints and achieves significant emission savings (up to 4Mt/year in medium pathway).
- Although advanced biofuels can offer sustainable drop-in fuels in the future, their availability may be limited before 2020.
- Biofuels pathways are complementary to hybrid and plug-in hybrid vehicles, these are expected to dominate low carbon powertrains during the 2020s and can make use of low carbon liquid fuels.
- Further developments for biofuels must warranty: clear demand for these fuels, secure investments in advanced biofuels by fiscal measures to support new fuels in their developmental phase, and to ensure the sustainability of individual feedstock and supply chains of biofuels.
- For the long-term, electrification of transport is expected to be the way for reducing emissions by 2050.
- Increased introduction of ultra-low emission vehicles during the 2020s.
- Road transport is one of the major CO2 contributors in UK by making up over 90% of this, also is a significant contributor to poor air quality and is the main source of air pollution in 92% of areas identified by local authorities as having problematic pollution levels.
- Ultra-low emission vehicles aim to be the major contributors for greenhouse gas emissions reductions. By 50% by 2027 and by 80% by 2050.
- Eight pilot projects installing and trialling recharging infrastructure for plug-in vehicles in the UK to support the Carbon Plan commitment to install up to 8,500 charging points.
- Car fleet powered by internal combustion engines will remain dominant until 2030.

Italy



- It mainly addresses a descriptive and short vision in which gas and electricity as seen as alternative options to power transport in general terms.

Sweden

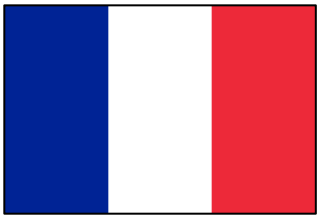
- Powering transport with second generation biofuels is the main target for 2030. The biomass is obtained mainly from the large forestry industry: stem wood, tops and branches, and stumps.
- To increase the use of biofuels by enhancing the quota obligation.
- Sweden 2030 should have a vehicle fleet that is independent of fossil fuels
- 2030 50% of passenger cars are powered by biofuels and 20% by electricity, and more than the 80% of urban buses by electricity.
- For 2050, 100% of buses by electricity and 60% of cars by electricity (40% by biofuels)
- A sustainable and resource efficient energy system without net emissions of greenhouse gases to the atmosphere 2050.
- Slightly envisioned to Electrically power road transport.

Greece

- After searching and reviewing current literature, no policy documents containing national plans for sustainable transport beyond 2020 were found.
- After contacting the national representatives from the EBTP, it was explained that these policy documents do not exist yet.

Spain

- After searching and reviewing current literature, no policy documents containing national plans for sustainable transport beyond 2020 were found.
- Also, after contacting the national representatives from the EBTP, it was explained that these policy documents do not exist yet.



France

- 15% of renewables in transportation 2030
- -20% energy consumption in 2030 (-50% in 2050) (EU=-30%)
- -30% fossil primary energy consumption
- From 75% to 50% power from nuclear source in 2025 (This is partly related to the possible electricity to be consumed by EV).
- Transport will be powered by biofuels, electricity and H2.
- 7 million electric charging point in 2030
- 30% to 50% investments subsidies
- 2 million PHEV+EV targeted in 2020 – no target for 2030
- 600 H2 charging stations in 2030 for 800 000 vehicles (along corridors).

Finally, after conducting this research three main recommendations were addressed for further policy-making:

- To address the minimum levels requirements for infrastructure deployment 'at least along the TET-T network' in order to ensure the availability and continuity of supply of a portfolio of alternative fuels.
- To coordinate deployment in order to warranty green corridors with uninterrupted access to a portfolio of alternative fuels and therefore ensure continuity of any kind of alternative transport.
- To make possible joint-policy-making processes among Member States.

1

Introduction

Sustainable transport development is one of the major opportunities for GHG emissions reduction. By 2050 the European Union needs to reduce its emissions by 80–95% below the 1990 levels. Therefore, a reduction of at least 60% of GHG by 2050 is required from the transport sector[4]. In the medium term, by 2030, the goal for transport in the European Union is to reduce GHG emissions by 20% below their 2008 levels[3]. However, the transport system has not fundamentally changed and it stills depend on oil products for 96% of the fuels consumption[4].

The Directive on the Deployment of Alternative Fuels Infrastructure (Directive 2014/94/EU) establishes that Member States must adopt national policy frameworks for the development of alternative fuels in the transport sector and the deployment of its infrastructure[6]. In this sense, Member States shall consider, when planning the future of transport and in the policy-making process, elements such as: simultaneous and combined use of alternative fuels, fuels infrastructure, cross-border continuity, union-wide policy, and minimum infrastructure requirements for alternative fuels[6]. Moreover, it is important that the compliance of this Directive goes hand-to-hand with the Withe Paper on "Roadmap to a Single European Transport Area' and the 'Clean Power for Transport: A European alternative fuels strategy'. However, this implicates an overarching scheme for sustainable transport among Member States. A scheme that embraces not only transport or mobility means, but also infrastructure and fuels for sustainable transport under an European-wide approach.

Beyond setting the rules of the game for Member States, the European Commission encourages to its members to participate on joint-policy frameworks aiming to achieve coordinated and coherent results among them[6]. Transport is a cross-country phenomenon that needs to be addressed under an integrated approach.

The European Commission states that Member States shall not only adopt national plans (in this case for transport), but it also states that it will assist on this duty to its members by issuing guidelines. As well, it will assist the Members on coordinating joint-policy frameworks[6]. Some of the main issued to be addressed within these guidelines are:

- Legal measures
- Policy measures supporting the implementation of the national policy framework
- Deployment support.
- Research, technological development and demonstration.
- Targets and objectives (by 2020, 2025 and 2030)
- Alternative fuels infrastructure developments.

Then in 2014, 'A policy framework for climate and energy in the period from 2020 to 2030' was issued by the European Commission. This policy document aims for a reduction of 40% of GHG emissions at the European level for 2030, combined with a 27% target for renewable energy in that year[5]. Moreover, these ambitions may be accomplished by the contribution of European countries efforts.

Nevertheless, to which extent Member States contribute for the realization of the ambitions with regards to sustainable transport is an issue that has to deal with the Subsidiarity and Flexibility principles. Under Subsidiarity principle, is yet to be known what actions may be better addressed at European level or at national level regarding sustainable transport beyond 2020.

There is an assumption that visions and national plans for sustainable transport have been set among Member States for 2020. However, little is known about the post-2020 visions and strategies for sustainable transport by Member States. Therefore, the period between 2020-2030 is the timeframe for studying the different national visions or strategies among Member States.

Although the positive perception by the European Commission regarding the energy-related achievements for the 2020, is yet to be found whether or not European Member States have already 'drafted' or 'implemented' or 'achieved' sustainable transport visions, national plans or strategies, as well as whether or not these policies are planned in the long-term perspective. Being more specific for the timeframe 2020-2030. Moreover, it is not known yet which policies are addressed or better addressed at national or European level when it comes to sustainable transport beyond 2020.

This research study attempts to review the sustainable transport visions, plans and strategies within the timeframe 2020-2030 among Member States. As well, this study analyzes what is envisioned by Member States and how these targets are related or not to the European Commission policies. Also, this study aims to understand from the Member States studied what differentiation about national strategies exists and which may be the reasons. Moreover, the following are objectives for this research study:

- To review the national visions and strategies for sustainable transport among Member States.
- To analyze the current policies regarding visions and strategies for sustainable transport among Member States. (In terms of ambitions and measures on both: state and European level).
- To assess the current policies (visions and strategies) for sustainable transport in Member States and to determine whether or not national strategies envision measures for the period after 2020.
- To gain insights about the balance of transport-related measures and the supply-side of alternatives for fuels, transports and infrastructure.
- To have an overview on differences in visions and discourses by the Member States to be analyzed.
- To explore causes of the differentiation of visions and strategies related to sustainable transport among Member States.
- To provide a background for exploring which policies may be better addressed at national-level or EU-level (based on the subsidiarity principle, national flexibility, national preferences and the need of integrated solutions).

In order to conduct this research, this document is organised as follows. Chapter 1 explains and contextualize this research study by introducing its problem definition, objective and research questions. Then, Chapter 2 reports on the national documents reviewed. Thereafter, Chapter 3 concludes with the main remarks and learnings from this research study. Moreover, it addresses recommendations and insights for further policy-making.

1.1 Research Questions

1. Which policies (policies: visions and strategies) have been defined by the European Member States in terms of *Sustainable Transport* for the timeframe beyond 2020?
    a. What is the timeframe of these visions?
    b. What policy measures/visions are considered by European Member States for the timeframe 2020-2030?

2. What may cause differences in visions among European Member states?
    a. To what extent can the national policies be related to typical national assets or country features?
    b. How do targets relate to other sectorial objectives?
    c. What are the key motivations/drivers for 2030 visions?

3. By reflecting the national policies of the European Member States with the Sustainable Transport framework, what do we learn?
    a. What are the implications for European Member States for mainstreaming their national policies regarding sustainable transport with the EC's ones?
    b. What insights can be recommended to EU's members for envisioning strategies for sustainable transport?

2

Transport beyond 2020

This chapter displays and compares the main findings of the research study. It shows the different findings about the national plans for sustainable transport beyond 2020. Four main themes organises the data content under the following headings: Means of transport, Alternative fuels, Green House Gasses, and Other sectorial objectives.

After gathering, reviewing, and analysing the data regarding the national plans for sustainable transport beyond 2020, the different plans are summarized, compared and concluded within this chapter. Moreover, before reading the findings under the four themes mentioned above, the characteristics of the policy documents themselves are analysed.

The data gathering and review:

Not all the Member States have issued national plans beyond 2020. After reviewing several policy documents and consulting experts, no data regarding sustainable transport national plans post-2020 was found for the cases of Spain and Greece. For the cases of Italy and Poland only few data was found, but communication with national representatives was not successful.

Nevertheless, the European Commission establishes that Member States must issue plans and frameworks for alternative fuels infrastructure development and deployment, which so far has not been done by all the Member States.

For some countries it may be the case that infrastructural development is still in a 'grey' status and therefore to provide infrastructure is the main concern for the upcoming years. On the other hand, some other countries have managed to perform better with regards to infrastructure, means of transport and fuels development. Therefore, this may be a reason why the differences in countries that have drafted plans and the ones that have not.

With regards to alternative fuels plans, the Directive (Art. 1) 'sets out minimum requirements for the building-up of alternative fuels infrastructure, including recharging points for electric vehicles and refuelling points for natural gas (LNG and CNG) and hydrogen, to be implemented by means of Member States and considered in their national plans. It also specifies that the scope of further fuels plans' implementation must be at national and Union-wide[6].

However, the European Commission established the 18th of November of 2016 as the deadline for Member States to notify their national policies, and this could be the main reason why not all the countries have issued the mentioned national plans.

The policy documents:

Timeframes and horizons are diverse among Member States. For the Netherlands, Germany, the UK, France, Sweden and Finland, there is a clear distinction about the timeframe of their transport targets between 2020, 2030 and/or 2050. But for Italy and Poland the horizon of their goals is mainly 2050. For the cases of Spain and Greece, no data was found for 2030 neither 2050 visions.

By taking into consideration the policy documents issued by the European Commission with regards to sustainable transport, Member States shall draft national plans for means of transport and alternative fuels. Some of these policy documents establish horizons for actions up to 2030 or 2050. For instance the policy document 'Roadmap for a Single European Transport Area' which states that solving transport problems means meeting very difficult goals by 2050 and challenging ones by 2020/30 to ensure Europe is moving in the right direction[3].

In the national plans reviewed Members States normally establish measures or visions for both 2030 and 2050. Moreover, sometimes plans or visions are thought for the years before 2030. Although the European Commission has set deadlines and defined horizons for further action, flexibility among Member States may be very related to the fact that Member States' horizons are diverse.

There is a major difference in the availability of data among national plans, which diverges between qualitative and quantitative data. The Netherlands and the UK address numeric estimations about the energy supply needs for the future and the alternative fuels for transport in a more quantitative approach than the rest of the study sample. But for Germany, Finland, France, Sweden, Italy, and Poland, these estimations are less regular or in some cases do not exist. Poland, for instance, focuses in a more qualitative vision. While the Netherlands, the UK, Germany, and Finland go for more strategic and targeted plans beyond 2020.

One of the issues related to this point and with the EC's provisions, is that national plans for alternative fuels infrastructure deployment must consider measures, objectives and targets regarding fuels and its infrastructure[3,6].

However, Members' needs and developmental status may vary among each other. Different national characteristics or features are related with the level of infrast4ructural development and also related with the type of priorities. For countries that are already working in efficient and intelligent traffic management systems, perhaps a step forward is envisioned for the future. While for countries that are less developed, more basic needs are still pending and seen as priorities. Under this reasoning, more developed countries are more likely to be able to plan the future with more precise quantitative data than the less developed ones.

The status of the policy documents. Since the policy documents studied in this research are plans and visions for transport beyond 2020, there is not legal binding yet of the considerations within these documents.

***The aim of the policy documents varies from one Member States to another, according to their national preferences*.** For Germany, the Netherlands and the UK, they do have strategic plans for transport's future that address measures, pathways and goals beyond 2020[11,12,15,22-25]. For these countries targets are measurable and time-based. Finland and Sweden also address a strategic plan for transport beyond 2020[8,9,10,27], but the main difference compared to the previous countries mentioned is the scope of fuel and transport options. Finland and Sweden mainly relies on second-generation biofuels that are suitable for the current and future vehicle fleet, while the previous mentioned

countries rely on a diversification portfolio[8]. While the policy documents reviewed from Poland reflect a more vision approach, which mainly addresses how the transport system should look like in the future[16-21]. For the case of Italy, data was more diverse and difficult to gather. Italy's policy documents mainly address a vision of transport rather than a very detailed national strategy. Few targets are found within the reviewed policy documents[13,14]. For the case of France, the vision is to combine the use of alternative fuels such as biofuels, electricity and hydrogen to power transport in general terms for 2030[26].

As established in the 'Roadmap for a Single European Transport Area', national plans should be done in such a way that enable the concept of free travel across Europe. Isolated national plans or one-single-fuel strategies would destroy this concept by hampering the continuity of alternative means of transport traveling and powered by alternative fuels across Europe[3] .

As addressed above, Member States are following one of the next three directions: diversification of fuels options, one-single-fuel strategy, or vague fuel visions.

The National Plans:

The fuels for transport:

The path-dependency and the phasing-out of oil. Although all the countries studied acknowledges that conventionally fuelled vehicles will remain dominant up to 2020 and beyond, only Finland, Sweden, the Netherlands, the UK and Germany envision a phase out of this kind of transport[8,9,11,12,15,25,27]. However, Oil seems to be an important fuel for the period between 2020-2030. Although countries are making efforts for transitioning into a low-carbon transport system, oil will remain consumed. Finland expects to reduce its consumption of oil-based fuels during the 2020's, and it aims to export refined petroleum products once its national consumption is decreased or phased out[8]. Germany states that oil-based fuels will continue to be the main fuel for transport in the medium term, but a clear drop in the sales of petroleum products is assumed up to 2025 falling by 13% to 92 million tonnes[10,11]. As well, the UK prevents that car fleet powered by internal combustion engines will remain dominant until 2030[22,24]. And France aims to reduce by 30% the use of fossil fuels in primary energy consumption[26] (not specified for road transport).

The European Commission states that 'gradually phasing out conventionally-fuelled vehicles from the urban environment could be a major contributor for reduction of oil dependence and greenhouse gas emissions. However, this phasing out must be complemented with the appropriate fuelling/charging infrastructure for new vehicles[3].

As found in the Member States studied, some of them acknowledge the important role that oil-based fuels will play but they also plan to either phase them out or to reduce their consumption during the 2020's. Therefore, the lack of an Union-wide infrastructural interconnection for sustainable transport projects may hamper the phasing out of conventionally fuelled vehicles principally for long-distances transport. This implicates that further collaboration or even interactive-policy-making among Member States shall occur. The phasing-out of oil implies an introduction of new fuels supply, infrastructural development, and drives.

The fuel-mix strategies as a diversification portfolio for availability of fuels supply. While the Netherlands goes for electrification of transport and a fuel-mix as backup[15], Finland relies on 2nd generation biofuels (from wood) considering other fuels options[8] but not as the Netherlands. Germany mainly relies on an electrification future and hydrogen as fuels options, while having a backup of 2nd generation biofuels. For the UK the strategy is similar to the Dutch one, by having a diverse-fuels strategy in which big

efforts are to be done for electrification of transport but also for biofuels and higher blends of biofuels introduction[25]. Poland does not have strategy for future fuels or means of transport, its vision mainly relies on a modernization and digitalization of the whole transport system. While Italy poorly describes an electrification vision up to 2050 besides a target for the wholesale use of a 25% biodiesel mix by 2050[13,14]. France considers biofuels, hydrogen and electricity as options for powering transport (general terms) without providing a detailed plan or strategy as other Member States analyzed[26]. The same goes for Sweden which specifies that biofuels and electricity are the first and second most preferred options for powering transport, a broader strategy[27].

The European Commission states that regarding the future of mobility and its alternative fuel options, there is not a single fuel solution. Therefore, all fuel options must be pursued without giving any preference to any particular fuel. 'Moreover, all transport modes must build on a comprehensive mix of alternative fuels'[4]. Then Commission also states that this comprehensive mix shall be developed in an Union-wide multimodal TEN-T core network basis by 2030. And this shall be complemented with intelligent information services for road users[3].

However, Member States do have preferences for alternative fuel mixes. Meaning that a comprehensive mix of alternative fuels and an Union-wide transport network need to be matched. This implies that continuity and the Union-wide integrative policy-making need to be addressed among Member States. So far the fuel-mixes are present as found in the national plans but Union-wide TEN-T core network considerations are still missing in the plans reviewed.

Second-generation bio-fuels for transport are one of the preferences. Finland targets a second-generation biofuels uptake which will fit the existing fleet of vehicles[8], while the Netherlands targets a mix of new and current fleet suitable for second-generation biofuels[15]. Sweden, similar to Finland, considers second-generation biofuels as a suitable option to power transport[27]. Then, Germany contemplates a diversification measure in which most of the transport means are shifted to more efficient and zero-emission means[11,12]. France, considers second-generation fuels as an alternative to power transport[26]. While the UK contemplates an increasing share of drop-in fuels suitable for the current engines and infrastructure[22,25]. Italy sets a target for the wholesale use of a 25% biodiesel mix by 2050 which is more an objective than a preference[13,14]. Lastly, the rest of the study sample does not contemplate measures, visions or targets regarding this point.

Nowadays, bio-fuels are the most important type of alternative fuels, accounting for 4.4% of transport in Europe[4].

Since bio-fuels already power transport and bio-fuels blends are suitable for most of current engines, there may be a correlation between the current national plans with regards to biofuels and the current development of biofuels.

First Generation Bio-fuels. The aim of the different countries studied is to avoid or limit the production and consumption of first-generation biofuels.

As well the European Commission suggests to 'limit the amount of first generation biofuels that can be counted towards the Renewable Energy Directive targets to 5%.'[4]. Instead, further public support for advanced biofuels is envisioned by the Commission up to 2020[4].

As establishes in the different national plans studied, there is no ambition for further development of 1st generation biofuels. Indirect Land Use Change (ILUC) and food security concerns among Members States and the European Commission have pushed the national plans to move on from this specific fuel. One of the main challenges to be addressed with regards to bio-fuels is the sustainability of production.

***Second Generation Bio-fuels*.** Regarding biofuels there is broad consensus in the way these are to be produced. Finland, Sweden, France, Germany, the Netherlands and the UK agree on second generation or advanced (including third generation) biofuels. All of them concerned about the collateral implication of biofuels production. Finland states that second generation is the preferred option for 2020 and beyond, and shall be compatible with the existing vehicles fleet[8]. Sustainability of production of 2nd generation biofuels and sustainable management of wood as input for refineries[8]. Germany states that by 2050 transport sector will be dominated by synthetic liquid fuels (PtL), and the adoption of biofuels is expected to come onto the market in the medium term[11,12]. The Netherlands aims for more support on development and distribution of sustainable biofuels in the period after 2020[15]. Then, Poland envisions an increase in the share of biofuels in the market of transport fuels to 10% by 2020 (this is also up to 2030), and also an increase in the use of second-generation biofuels by gradually incrementing the share of bio-components in transport fuels[19]**.** The UK establishes that support and incentives are needed for the use of advanced biofuels post-2020, and one way to do so is by setting a blending mandate for advanced biofuels and by extending a sub-target for advanced biofuels[24]. France, plans to subsidize the deployment and development for second-generation biofuels. And Sweden aims for 50% of passengers cars powered by biofuels for 2030 and enhance the quota obligation for biofuels[27].

The UK explains in its national plans more in detail the visions regarding biofuels, which are summarised as follows. Biofuels are an option for both carbon savings up to 2030 and to decarbonise transport[24]. Although advanced biofuels can offer sustainable drop-in fuels in the future, their availability may be limited before 2020[24]. However, biofuels pathways are complementary to hybrid and plug-in hybrid vehicles, and these are expected to dominate low carbon powertrains during the 2020s[22]. Therefore these can make use of low carbon liquid fuels combined with hybrid engines or fuel blends[22].

For the UK, blending biofuels are considered more cost effective way of reducing emissions than using plug-in vehicles in the timeframe to 2030[22,23]. Blending biofuels could be a transitional alternative for decarbonisation of transport in the 2050 horizon[25]. According to the UK visions, high level of biofuels blending can be achieved within supply constraints and it can also achieve significant emission savings (up to 4Mt/year in medium pathway)[22]. For the UK is also important that for further developments for biofuels some key elements must be warranted: clear demand for these fuels, secure investments in advanced biofuels by fiscal measures to support new fuels in their developmental phase, and to ensure the sustainability of individual feedstock and supply chains of biofuels[24].

The UK goes even more precisely when it comes to biofuels visions. Its vision considers biomethane and biobutanol for transport. By 2050 biomethane could potentially replace all current fuels for Heavy-Goods-Vehicles (HGV) and buses. And, biobutanol is seen as niche that needs progressive targets to underpin project investments for advanced biofuels for the timeframe 2020-2030[24].

As acknowledged by the European Commission, bio-fuels can contribute to reductions in CO2 emissions as long as these are sustainably produced. Mainly, by avoiding ILUC. The importance of biofuel also lays down in the fact that these can power all modes of transport. However, 2nd generation biofuels are preferred over 1st generation ones. Moreover, is important to support advanced biofuels only up to 2020. The Commission also states that higher blends of biodiesels may be suitable for current power trains, and these may not require substantial adaptations[4].

Aligned with the European Commission's provisions, Member States' view for bio-fuels shows a clear preference for second-generation ones. This fuel is also seen as a major contributor to CO2 reductions. Countries see biofuels as a suitable alternative for current and future engines without the need of substantial adaptations and with the possibility of upgrading blending mixes. The limitation rules set by the EC for 1st generation bio-fuels may trigger further developments with regards to 2nd generation ones. After reviewing

the national plans it is supported that Member States have a strong preference for 2nd generation biofuels.

Electricity is seen as one of the most suitable fuels options for CO2 emissions reductions and it is also one of the most recurrent alternative among Member States in their National Plans. Regarding electrification for transport, the Netherlands, the UK and Germany are the countries that have more precise targets for the period after 2020. Germany states the most promising alternative fuel for transport is electrification, and it is envisioned that this improvement will reduce potentially CO2 emissions within the timeframe 2020-2030. For the Netherlands electrification is seen as well as a major contributor for the energy-climate goals achievement. In detail, the Netherlands aims to address electrification for transport under a systematically approach of electrification for mobility (WTW)[15]. The Dutch vision states that in order to address the electrification measure for transport it will work on the recharging infrastructure, smart grids, and options for energy storage (such as hi-speed recharging batteries). Battery-powered electric drive technology is seen for the Netherlands as the most energy-efficient solution. Also, a large-scale introduction of battery-electric and fuel cell-electric vehicles is assumed to happen in the period up to 2050[15].

For the Netherlands is essential to develop the market introduction for forms of electric propulsion in passenger and freight vehicles and related infrastructure and services. Thus, one way to achieve this is by making possible a smart mix of electric vehicle use for short-distance transport, and hybrid means of transport[15]. Then for the UK, the decarbonisation of road transport (especially cars) is expected to be achievable in the long term with electric plug-in vehicles and hydrogen vehicles, coupled with a decarbonisation of the electricity and hydrogen production[22,24]. Also and for the long-term, electrification of transport is expected to be the way for reducing emissions by 2050[24].

Also, Sweden states that electricity can power 20% of the passenger cars by 2030, and more than the 80% of urban buses. While for 2050, 100% of buses are powered by electricity and 60% of cars as well by electricity[27]. And France plans to deploy 7 millions of electricity charging-points in 2030[26].

Electric vehicles (EVs), using a highly efficient electric motor for propulsion, can be supplied by electricity from the grid, coming increasingly from low-CO2 energy sources. Hybrid configurations, combining internal combustion engines and electric motors, can save oil and reduce CO2 emissions by improving the overall energy efficiency of propulsion (up to 20%) but are, without external recharging possibilities, not an alternative fuel technology[4]. Then, the Directive on the deployment of alternative fuels infrastructure states that regarding electricity supply for transport (Article 4) MS shall ensure through their NPF that an appropriate number of recharging points accessible to the public are put in place (before 31 December 2025) at least along the TEN-T core network and (sub) urban agglomerations[6].

The different national plans envision major changes regarding infrastructural development for EV during 2020's and up to 2050. The concern that comes more often among MS is the recharging points infrastructure development. For which, the EC states that charging points shall be accessible to the public by the end of 2025 at least along the TEN-T core network and (sub)urban agglomerations. As the MS and the EC address, by systematically improving the sources of electricity for transport, lower CO2 emissions are possible under a WTW perspective. Lastly and as the EC suggests, efforts shall go beyond the urban context and expand within a cross-European network. Meaning that the main implication is the allocation of recharging point in a certain way that enables continuity of transport across Europe. Which is also a point that is not addressed in the national plans review. No considerations were found for collaboration or coordination between Member States for an strategic deployment of recharging points. Therefore, this fact may hamper the Union-wide continuity of supply as long as is not interactively addressed by Member States.

Hydrogen is one of the most recurrent options beyond 2020 among Member States. Different visions and strategies vary from support projects, to warranty of supply and infrastructural development. Germany envisions that by 2050 hydrogen is produced by means of electrolysis obtained by high-temperature electrolysis (HTEL). As well hydrogen is used in compressed or liquefied form in cars, aiming to achieve distances of 400 kilometers traveled by car per tank. As well Germany has a target to create a network of around 1,000 hydrogen-fuelling stations by 2030[11,12]. On the other hand, for the Netherlands hydrogen needs niche management and development by conducting pilots and studies on fuel-cell cars and other vehicles. Also, more development is needed regarding the distribution system of sustainable hydrogen fuel. For the Netherlands, hydrogen fuel cells represent a valuable supplementary power source, since they increase vehicle range with a shorter refill-time and are also associated with zero emissions. It is part of the Dutch vision to develop market introduction for forms of electric propulsion in passenger and freight vehicles, including loading and hydrogen-tank infrastructure and related services[15]. Then, for the UK integration of the requirements of vehicles, infrastructure and hydrogen in the time period to 2023 is essential. In the UK, hydrogen market is believed to become commercial by 2023. Then, brown and green hydrogen production methods should be supported up to 2020s to avoid market failure and to nurture further green hydrogen development[24]. One measure envisioned by the UK to achieve its visions related to hydrogen, is about eight pilot projects installing and trialling recharging infrastructure for plug-in vehicles in the UK to support the Carbon Plan commitment to install up to 8,500 charging points[23]. For France, Hydrogen is seen as the step forward after EV uptake. It is planned to deploy 600 charging-stations for 800,000 vehicles (unspecified) along corridors[26].

The European Commission states that 'the technology for hydrogen fuel cell vehicles is maturing, and is being demonstrated in passenger cars, city buses, and light vans… and for the next years several Member States are planning for hydrogen refueling networks'[4]. Moreover, Member States shall develop a Cross-border link for hydrogen infrastructure by 2025. This infrastructural link shall be developed under the flexibility of each Member State[6]. Nowadays, the main issues regarding hydrogen and its infrastructure are the high cost of fuel cells and the absence of a refueling infrastructure network[4].

Despite of the national plans from the different Member States for further development in hydrogen fuel and its infrastructure, the Union-wide dimension is hardly found in these policy documents. As the European Commission states, cross-border links shall exist in order to warranty the continuity of vehicles powered by hydrogen. For other fuels the European Commission encourages Member States to deploy infrastructure '*at least along the existing TEN-T core networks'.* Which is not the case for Hydrogen deployment. Therefore, national flexibility for hydrogen deployment may apply. Since This fact can either hamper or trigger the cross-border infrastructural link between Member States. Therefore, centralization of infrastructure deployment must be avoided and refueling infrastructure shall be deployed in a European-coordinated way that enables continuity of transport powered by hydrogen. So far, pilot project are supporting the introduction of this alternative fuel but further efforts needed if the 2025 goals established by the European Commission and the Member States plans for the 2020's are to be addressed.

<u>Natural Gas (fossil and bio-based)</u>

The LNG for HDV. The Netherlands will invest in R&D about production and distribution of renewable gas for light vehicles and LNG/bio-LNG for heavy vehicles. Phasing out the use of fossil-based NG and LNG up to 2025, thereafter and up to 2050 introducing and mainstreaming low-carbon NG and LNG[15]. Moreover, the UK will phase out conventional NG and LNG and transit after 2025 into more low-carbon NG/LNG[25].

The EC states that LNG with high energy density offers a cost-efficient alternative to diesel for trucks with lower pollutant and CO2 emissions and higher energy efficiency. LNG is particularly suited for long-distance road freight transport for which alternatives to diesel are extremely limited[4]. In order to support its infrastructural development, refueling points shall be deployed every 400km 'at least along the existing TEN-T core networks' by 2025. This measure aims to give traveling continuity for HDV throughout the Union[6].

In this case, both the European Commission and the Member States plans match with regards to the timeframe of their goals. Although the Union-wide dimension is not included yet in the national plans reviewed, visions about fuel development and deployment are projected under the same timeframe. Meaning that coordinated deployment among Member States may be the main implication to be addressed.

The promising option of CNG for HDV. Germany, the Netherlands, and the UK are the countries from which clear targets post-2020 for CNG were found. The German government wants to promote and stimulate the sales and consumption of natural gas (CNG / LNG) and LPG beyond 2018[11,12]. Then, the UK states that further deployment in gas vehicles for HGV/busses and drop-in fuels into passengers cars on a 2030 timeline will need progressive targets to support investments[24].

According to the EC, natural gas vehicle technology is mature for the broad market. Additional refueling stations could easily be supplied from the existing dense natural gas distribution network in Europe. CNG vehicles have low pollutant emissions and have therefore rapidly gained ground in urban fleets of buses, utility trucks and taxis. Optimized gas-only vehicles can have higher energy efficiency[4]. Further infrastructural development should cover 'at least along the existing TEN-T core networks', but also (sub)urban conglomerations. Efforts shall be done to warranty transport to circulate throughout the Union by deploying refuelling points every 150km for CNG road motor vehicles by 2025[6].

One of the main differences between the EC provisions and the MS national plans for CNG is that the former contemplates CNG as an alternative for all type of road transport rather than only for HDV. In the other hand, as the EC establishes there is already a considerable distribution network for gas. Meaning that the distribution of this fuel may not be an implication and may not hamper its development. One implication is related with determining whether or not distribution of CNG is available across the TEN-T network and agglomerations at least every 150 km, which was not found in the national plans reviewed. One consideration to keep in mind is that although CNG is a low-pollutant fuel, further energy-efficiency and energy-saving measures together with stricter standards for emissions should be followed up in the upcoming years by Member States.

Table 1 illustrates the national preferences regarding the fuels of the future beyond 2020, which were extracted from the national plans reviewed. By comparing this table with the previous graphs it is also possible to argue whether or not countries have national plans, which are related to national preferences or national assets.

Country	Preferred fuel	Transitional Fuel	Fuel-mix	Lock-in fuel
Germany	Electricity for cars and biofuels for goods transport	Biofuels Gas for LDV LNG for HDV, Dual-fuel vehicles (diesel and natural gas) for HDV	Hydrogen Electricity Biofuels Gas Diesel Gasoline	Oil-based fuels

Greece	N/d	N/d	N/d	N/d
Spain	N/d	N/d	N/d	N/d
France	N/d	N/d	Biofuels, electricity and hydrogen.	Nuclear energy (this does not power transport directly).
Italy	Electricity and biofuels	Gas	Biofuel mix of 25%, electricity, and gas	N/d
Netherlands	Electricity	Gas	Biofuels, gas, electricity	Oil-based fuels
Poland	Biofuels (increasing share of bio-components)	N/d	N/d	N/d
Finland	Biofuels (wood)	N/d	N/d	N/d
Sweden	Biofuels (wood)	N/d	Biofuels and electricity.	N/d
United Kingdom	Electrification and biofuels	Biofuels and higher blends of biofuels	Hydrogen, electricity, biofuels,	Oil-based fuels

Table 1. Alternative fuels visions among Member States

Means of Transport in Road Transport

After reviewing the transport-related policy documents issued by the European Commission, specific data about means of transport was found. Most of the data found is very related to alternative fuels and infrastructure deployment as already addressed in the previous section. However, the major visions of the European Commission for the means of road transport are addressed within this section.

The European Commission envisions a transport infrastructure based on a territorial cohesion approach and a core network of strategic European infrastructure. Basically, to strengthen the TEN-T network for better links between means of transport, infrastructure and fuels supply. Specifically, further development of cross-border missing links and intermodal connecting points[3]. Moreover, a 'seamless door-to-door mobility' approach is envisioned for enabling continuity and integrity of different transports in multimodal corridors[3].

The different national plans reviewed provide different targets and visions with regards to passenger cars, LDV, HDV and public transport. The seamless door-to-door mobility approach shall be warranted for all means of transport. Otherwise, whenever the availability of one alternative fuel is missing then probably transports will shift to conventional fuels and this will hamper the 'seamless ambition'. The seamless ambition is clearly a target that goes beyond road transport (including rail, shipping, air). But it can be also translated to the case of a single type of transport in the sense that scarcity of recharging point for this specific vehicle will not allow the seamless door-to-door traveling.

Passenger cars are seen as both the main cutter of GHG emissions and the main contributor to GHG emissions. Important gains are possible by improving this sector. Germany, Poland, the UK, and the Netherlands are the countries that have drafted more clear and precise targets for passenger cars after 2020. Germany aims to reduce by 29% due to modal shifts and more fuel-efficient vehicles 2050. Also by 2050 the final energy demand for passenger transport will be 958 PJ, which equates to 59% of the overall final energy demand for the transport sector (excluding shipping). By 2050, 57% of all car journeys will use electricity in Germany. And in 2050 electric and plug-in hybrid vehicles will account for 82% of the kilometers travelled by cars[11,12]. Then, Poland envisions that by 2030 the fuel consumption of passenger cars will decrease by almost

50%[21]. While the UK states that the deployment on a 2030 timeline for passenger cars will need progressive targets to support investments into drop-in fuels into passengers cars[24]. And the Netherlands aims for scaling up both the use of battery-electric and renewable gases vehicles during 2020's. As well, the Netherlands aims for introducing fuel cell-electric vehicles in to the market and biofuels blending in the period 2020-2030[15].

According to the EU, in 2012 Passenger transport, based on passenger-kilometres, contributed with 72.2% out of the total transportation in Europe[7]. Being the most dominant type of transport. Moreover, road transport sector is responsible for 71.9% of GHG emissions related to transport[7].

As envisioned by both, the European Commission and the Member States, passenger cars are a strategic area of improvement. Without further concern on this type of transport GHG emissions are very likely to increase, but by shifting to alternative fuels strategies passengers transport will trigger further GHG reductions. Among the different national plans reviewed, different approaches are addressed. Heterogeneity of visions and targets are found ranging from energy efficiency measures, to electric vehicles, hybrid vehicles and bio-fuels blending. Moreover, measures such as: decarbonisation, de-transportation, and shift to public transport, are envisioned by the Member States. By adopting these measures, the reduction measures established by the Member States can be met and a reduction in the GHG emissions related to transport as well.

Light Duty Vehicles are planned to play a low-emissions role when these are driven within cities or distances below 200km. Hybrid options of fuel (electricity and hydrogen/gas) can power these vehicles. The Netherlands envisions for LDV further developments for production and distribution of renewable gas for light vehicles. Also, LDV in urban areas with journeys of less than 200 km can be powered by electric batteries. Lastly, it is also considered that LDV can be powered by hydrogen or bio-CNG[15]. For Germany, further gains in efficiency and thus successes in reducing CO2 in road transport will emerge through to 2020 as a result of the legal specifications for LDV, and must then be upheld for the period after 2020. Moreover, LDV will use alternative drive systems alongside conventional vehicles. For LDV new CO2 emissions limits will be introduced and existing ones tightened, combined with the introduction of low-emission zones in inner cities. With regards to LDV Germany assumes (in a scenario study) a maximum potential of 100% for plug-in hybrids by 2050. Furthermore, the introduction of low-emission zones in town centers aims to create the need and development for urban delivery vehicles with electric capabilities[11,12].

Goods transport below 300 km will remain on trucks. Based on this it is important to work on this constrain by improving efficiency, the uptake of new engines and cleaner fuels, and the use of intelligent transport systems[3].

For both, the European Commission and the Member States energy efficiency, cleaner fuels uptake, and the adoption of intelligent transport systems are key areas of development with regards to LDV or short distance transports. Both sources of data agree on establishing a distance-limit, and based on this limit to plan further strategies. Moreover, these measures are seen as low-emissions since short distances enable more flexible solutions for alternative fuels and proximity of refueling points. What is not clear yet is the extent of compatibility of current engines and the envisioned fuels to power them.

Higher blends of bio-fuels and duel-fuels are the options to power Heavy Duty Vehicles, however R&D, investments, infrastructure and further deployment are needed. Regarding HDV, Germany envisions that LNG or purely electric drives can power these vehicles as a transitional measure. Moreover, freight traffic is aimed to reduce up to 2050 by 37% compared with the trend final energy demand in 2050. Heavy trucks (7.5 t and over) can be powered with high energy density blends of biofuels or CNG or LNG in the long-term perspective. Dual-fuel vehicles (combination of diesel and

natural gas or liquefied petroleum gas) are another option that can work as a transitional solution. Lastly, according to a GHG-neutral transport scenario, Germany estimates that by 2050 the HGV (over 12 t) will be entirely conventional vehicles running on synthetic liquid fuels. Then, the Netherlands aims for more R&D in the production and distribution of LNG/bio-LNG for heavy vehicles after 2020. As well hydrogen can power HDV at urban and national scale[11,12]. The UK states that more deployment on a 2030 timeline will need progressive targets to support investments into gas vehicles for HDV.

The European Commission encourages the creation of multimodal freight corridors for sustainable transport networks for optimising the performance of multimodal logistic chains. In this sense it is recommended that 30% of road freight over 300 km is shifted to other modes transport by 2030 (e.g. rail or waterborne)[3]. To meet this goal will also require appropriate infrastructure to be developed[3].

The latest Commission's recommendation implies that integrative plans among Member States for transport infrastructure and fuels are to be done. Also, implies that different modes of transport are connected providing continuity for enabling the shift from HDV to rail or waterborne transport. As well, transport nodes shall be available if a seamless door-to-door mobility is to be addressed. Moreover, if higher blend for biofuels are planned, then more considerations with regards to ILUC and its effects may be addressed beforehand.

Hybrid buses, gas buses and modernization of buses for public transport as energy-efficiency measures. In the field of public transport data was scarce when reviewing different policy documents from the sample of Member States. Poland aims for a modernization of the public transport sector, which mainly lays down on measures such as: traveling data, duration of traveling, traveling planning and traffic management[20]. But Germany, aims for supporting hybrid buses, as a medium term measure, bringing energy efficiency improvements up to 20%. Also, natural gas, hybrid applications and the electrification of the bus drive system through battery and fuel cell are potential solutions for low-emission urban mobility[11,12]. The Netherlands aims for scaling up the use of battery-electric, fuel cell-electric drivetrain systems, and renewable gas, specifically for inter-urban and intra-urban public transport. Also, the Netherlands aims for introducing renewable LNG to the market[15].

According to the EU, in 2012 public transport, based on passenger-kilometres, contributed with 9.7% out of the total transportation in Europe[7].

A higher share of travel by collective transport, combined with minimum service obligations, will allow increasing the density and frequency of service, thereby generating a virtuous circle for public transport modes. Demand management and land-use planning can lower traffic volumes. Facilitating walking and cycling should become an integral part of urban mobility and infrastructure design[3].

The quality, accessibility and reliability of transport services will gain increasing importance in the coming years, inter alia due to the ageing of the population and the need to promote public transport. Attractive frequencies, comfort, easy access, reliability of services, and intermodal integration are the main characteristics of service quality. The availability of information over travelling time and routing alternatives is equally relevant to ensure seamless door-to-door mobility, both for passengers and for freight[3].

As envisioned by the European Commission and some Member States, the are different levels to approach improvement in the public sector area. For some countries is a priority to work in the standardization and update of the public transport system by implementing measures such as: service quality, reliability, time schedules, or traveling information. While for other countries it is assumed that these last features are already addressed and as a second step for further improvements another targets are planned. Also, de-transportation, decarbonisation and a rise in the share of collective transport are measures

to improve road transport and the related emissions. The Commission and the Member States are planning the future beyond 2020 by avoiding motorised traffic, enabling walking distances, and getting more passengers in public transport buses.

Table 2 summarizes the main findings from the national plans of the Member States studied with regards to means of transport.

MS	Cars	LDV	HDV	Bus
DE	-Reduce car-use by 29% due to modal shifts by 2050. -More fuel-efficient vehicles 2050 -Final energy demand will be 59% of the demand for the whole transport sector, by 2050. -57% of all car journeys will use electricity by 2050. - Electric and plug-in hybrid vehicles will account for 82% of the kilometers travelled by cars.	-LDV will use alternative drive systems alongside conventional vehicles. - With regards to LDV Germany assumes a maximum potential of 100% for plug-in hybrids by 2050. - For LDV new CO2 emissions limits will be introduced and existing ones tightened, combined with the introduction of low-emission zones in inner cities.	-Powered by LNG or purely electric drives as a transitional measure. - Freight traffic is aimed to reduce up to 2050 by 37% compared with the trend final energy demand in 2050. - Heavy trucks can be powered with high energy density blends of biofuels or CNG or LNG in the long term perspective - Duel-fuel vehicles as a transitional solution. - By 2050 the HGV (over 12 t) will be entirely conventional vehicles running on synthetic liquid fuels	-Support for hybrid buses, as a medium term measure, bringing energy efficiency improvements up to 20%. - Natural gas, hybrid applications and the electrification of the bus drive system through battery and fuel cell are potential solutions for low-emission urban mobility
GR	N/d	N/d	N/d	N/d
SW	50% powered by biofuels by 2030	N/d	N/d	80% powered by electricity by 2030
F	N/d	N/d	N/d	N/d
I	N/d	N/d	N/d	N/d
NL	-Scaling up the use of battery-electric and renewable gases vehicles during 2020's - Introducing fuel cell-electric vehicles in to the market and biofuels blending in the period 2020-2030.	-Further developments for production and distribution of renewable gas for LDV. -LDV in urban areas with journeys of less than 200 km can be powered by electric batteries. - LDV can be powered by hydrogen or bio-CNG	-More R&D in the production and distribution of LNG/bio-LNG for heavy vehicles after 2020. - Hydrogen can power HDV at urban and national scale	-Scaling up the use of battery-electric, fuel cell-electric drivetrain systems, and renewable gas, specifically for inter-urban and intra-urban public transport. -Support for the introduction of renewable LNG to the market for buses.
PL	-Fuel consumption will decrease by almost 50% by 2050.	N/d	N/d	Modernization of the public transport sector using and implementing: traveling data, duration of traveling, traveling planning and traffic management.
FL	2nd generation biofuels (wood)	N/d	N/d	N/d
SW	N/d	N/d	N/d	N/d

UK	-Support for investments into drop-in fuels into passengers cars by 2030.	N/d	-More deployment on a 2030 timeline and investments support into gas vehicles for HGV.	-More deployment on a 2030 timeline and investments support into gas vehicles for buses.

Table 2. Visions and plans with regards to means of transport.

GHG emissions

Regarding GHG emissions targets and visions, differences in timeframes and quantity reductions were found. But there is a consensus that cutting emissions from transport means cutting emissions from the major contributor. Similarities are found under the vision of zero-emission vehicles (or low-emission) as major cutter of GHG emissions. On the other hand, differences in the topics, timeframes and level of detail on the different national plans were found.

In the Commission's view transport needs a transition under a system approach. Not only transport modes or fuels need to be shifted. But the complete transport system must go into a transition, in which infrastructures, alternative fuels, traffic management, transports, and all the development needed are planned hand-to-hand[3]. If this transformation happens further GHG emissions reductions can move on the transport sector from being responsible for 71.9% of the GHG emissions from transport[7]. Moreover, the Commission's vision looks for achieving a 60% GHG emission reduction target by 2050. Furthermore, the European Commission suggests to halve the use of 'conventionally-fuelled' cars in urban transport by 2030 and to phase them out in cities by 2050[3]. Also by 2030, the goal for transport will be to reduce GHG emissions to around 20% below their 2008 level[3].

The member States studied have approached the Commission's goals in different way. By reviewing the national plans differences in the levels of GHG abatement and timeframes are present. However, all agree on lowering the emissions from transport the closest to zero possible.

Electrification, low-emissions standards, and traffic avoidance and management are seen as the major reduction targets of GHG emissions. Germany expects that electrification will reduce potentially CO2 emissions within the timeframe 2020-2030, and then low-emission modes of transport or even zero-emission may be achievable by 2050[11,12]. For the Netherlands the goals and achievement of zero-emission vehicles by 2035 will be the major contributor for the emissions goals[15]. Finland argues that road transport is to become close to zero-emissions by 2050, and supports the position of 'no ETS in road traffic'[8,9]. On the other hand, Poland goes for more general targets regarding GHG emissions reductions, some of the measures are related to: space management, financial mechanisms, traffic management and environmental protection[20]. For the UK, ultra-low emission vehicles aim to be the major contributors for greenhouse gas emissions reductions by achieving a 50% reduction by 2027 and 80% by 2050[22,23]. Moreover, and increased introduction of ultra-low emission vehicles will take place during the 2020s[23].

Another difference among the studied national plans is the level of detail in the way strategies and visions are drafted. Regarding GHG emissions countries such as Germany and Netherlands have more detailed plans for future emissions reductions. Germany envisions some detailed strategies such as:

- By 2050, the goals of a greenhouse gas-neutral transport sector will be achieved by a 100% of the liquid fuel provided by PtL (Power to Liquid) technology[11].
- Regulatory measures for reducing CO2 emissions such as: tightening CO 2 emission limits, motorway speed limit of 120km/h, and low-emission zones in city centers from 2025[11].

- For the period beyond 2020, Germany envisions further reductions of CO2 emissions while maintaining a globally competitive automotive industry[11].
- Traffic avoidance is thus the most fundamental way of reducing greenhouse gas emissions[11].

The Netherlands establishes detailed plans for further GHG emissions reduction for the timeframe between 2030 up to 2050[15]. Some of the measures and expected outcomes are the following:

- By 2030 the CO2 emissions have to be reduced by 8 Mton[15].
- By 2050, a reduction of 23 Mton on the reference estimate is required (60% reduction in CO2 emissions)[15].
- Existing policies and autonomous developments involving the use fuelmix and efficiency improvements could bring about a 12 Mton reduction in emissions by 2030 and a 15 Mton reduction by 2050[15].
- The TTW CO2 emissions associated with battery-powered electric drive technology are by definition zero, and the WTW CO2 emissions are potentially very low as well, if the batteries are charged using electricity produced from wind or solar energy[15].
- To collaborate at the EU level to reduce greenhouse gas emissions within the fuel chain – preferably within the EU Fuel Quality Directive (FQD) – and reformulate the EU Renewable Energy Directive after 2020[15].

Pollution from transport is the main obstacle for air quality. Poland aims to improve living conditions and the environment by reducing the negative impacts of transport[20]. The UK states that road transport is one of the major CO2 contributors in UK by making up over 90% of this, also is a significant contributor to poor air quality and is the main source of air pollution in 92% of areas identified by local authorities as having problematic pollution levels[23]. Therefore, the UK aims to reduce CO2 and improve air quality.

The European Commission states that cities are exposed to poor air quality and only urban transport is responsible for about a quarter of CO2 emissions from transport. By phasing out conventionally fuelled vehicles, air pollution can be abated. Moreover, there more different strategies for improving air quality, for instance: 'traffic monitoring and communication services to allow for the integration of information flows, management systems and mobility services based on a European integrated multimodal information and management plan'[3].

From the policy documents reviewed it can be observed that Member States envision to improve air quality by implementing the measures related to energy efficiency, energy savings, and alternative fuels consumption in transport.

Table 3 shows the main targets that Member States have with regards to GHG in general terms. It divides the data in timeframes according to what each country envisions.

MS	Targets up to 2025	Targets up to 2030	Targets up to 2050
DE	-Electrification will reduce potentially CO2 emissions	-Electrification will reduce potentially CO2 emissions - Motorway speed limit of 120km/h, and low-emission zones in city centers from 2025.	-Deployment of zero/low emissions vehicles -Traffic avoidance
GR	N/d	N/d	N/d
SP	N/d	N/d	N/d

F	N/d	-40% GHG reduction in 2030.	N/d
I	N/d	N/d	N/d
NL	-Aim for charging batteries using electricity produced from wind or solar energy. -To collaborate at the EU level to reduce greenhouse gas emissions within the fuel chain – preferably within the EU Fuel Quality Directive (FQD) – and reformulate the EU Renewable Energy Directive after 2020.	-By 2030 the CO2 emissions have to be reduced by 8 Mton -The use of the fuelmix and efficiency improvements could bring about a 12 Mton reduction in emissions by 2030	-Deployment of zero/low emissions vehicles by 2035 - A greenhouse gas-neutral transport sector will be achieved by a 100% of the liquid fuel provided by PtL technology - By 2050, a reduction of 23 Mton on the reference estimate is required (60% reduction in CO2 emissions). - The use of the fuelmix and efficiency improvements could bring about a 15 Mton reduction by 2050.
PL	N/d	-Measures for GHG reductions: space management, financial mechanisms, traffic management and environmental protection.	-Traffic avoidance -Traffic Management
FL	-No ETS in road transport	-No ETS in road transport	-Become close to zero/low emissions vehicles. -No ETS in road transport
SW	N/d	N/d	A sustainable and resource efficient energy system without net emissions of greenhouse gases to the atmosphere 2050.
UK	- An increased introduction of ultra-low emission vehicles	- Ultra- low emissions vehicles aim to achieve GHG emissions reductions by 50% by 2027	- Ultra- low emissions vehicles aim to achieve GHG emissions reductions by 80% by 2050

Table 3. GHG emissions reduction targets

Energy Savings and Energy Efficiency

Regarding energy efficiency and energy saving envisioned for the road transport sector, differences are found in the level of detail in which these are drafter. Germany, the Netherlands, and Poland are the countries that go more in detail with their national plans.

Des-transportation is the major contributor to energy savings and efficiency. Poland and Germany envision des-transportation measures such as public, pedestrian and cycling modes of transport aiming to reduce and avoid road traffic[11,12,17,20].

Diversification of energy sources as an energy saving measure. Germany states that diversification of energy sources in transport may lead to a general reduction of energy consumption[11]. It is targeted to reduce final energy consumption of energy by 10% by 2020, and 40% by 2050[12]. The expected final energy demand for the transport sector by 2050 may be 1623 PJ or 451 TWh (excluding shipping), which is 33% below the final energy demand for the trend, this is partly because of a higher proportion of electric vehicles on the roads[12]. And, by 2050 20% of transport will be powered with direct use of electricity and an 80% by power-generated fuels (excluding shipping)[12].

Efficiency measures. The Netherlands envisions energy efficiency improvements for the transport sector related to: enhanced aerodynamics, lightweight construction materials, and regenerative braking and low-friction. It is expected that by applying this measures, improvements on efficiency by 65% is possible in the passenger transport sector and 30-40% for freight transport[15]. Poland envisions for 2050 that total energy consumption in the transport sector will drop by 16%, and the demand for fuel by 11 million tonnes. When envisioning means of transport objectives, these mainly lay down on improvements of the management and efficiency of the whole transport sector[22] (Mainly digitalization, collection and use of Big-data, among others).

Table 4 summarizes the measures taken by the Member States studied regarding energy savings and energy efficiency goals.

Country	Measures up to 2025	Measures up to 2030	Measures up to 2050
Germany	-To reduce the final energy consumption of energy in transport by 10% by 2020	-Further gains in efficiency and thus successes in reducing CO2 in road transport will emerge through to 2020 as a result of the legal specifications for passenger cars and LDVs, and must then be upheld for the period after 2020.	-To reduce the final energy consumption of energy in transport by 40% by 2050. -Road de-transportation -By 2050 20% of transport will be powered with direct use of electricity and an 80% by power-generated fuels.
Greece	N/d	N/d	N/d
Spain	N/d	N/d	N/d
France	N/d	-The 32% target for renewable energy is developed in detail.	N/d
Italy	N/d	N/d	N/d
Netherlands		-Energy efficiency improvements: enhanced aerodynamics, lightweight construction materials, and regenerative braking and low-friction. -Improvements on efficiency by 65% is possible in the passenger transport sector and 30-40% for freight transport	
Poland	N/d	N/d	-Road de-transportation - Total energy consumption in the transport sector will drop by 16%, and the demand for fuel by 11 million tonnes
Finland	N/d	Biofuels (wood) are considered the most energy efficient fuel	N/d
Sweden	N/d	N/d	N/d
United Kingdom	N/d	N/d	N/d

Table 4. Energy savings and efficiency measures.

Other sectorial objectives related to transport

The external dimension considerations are not broad enough, and do not consider cross-country measures for sustainable transport beyond 2020 in terms of infrastructural or fuels development. None of the countries studied consider joint-policy-making or efforts for cross-border infrastructural plans, or inter-state projects for continuity of fuel supply across borders. Moreover, among the countries studied there is not a single-transport-area vision neither a united infrastructural approach yet. The German national plan is the only one that mentions about a European dimension for transport, but this is mentioned as a single idea and as vision rather than a clear strategy or plan. It mainly addressed the idea of taking into account the European and international context when drafting policies[11]. Then, Finland considers aligning efforts equally among Member States regarding GHG emissions targets related to transport and support the exclusion of GHG emissions related to transport from the ETS[8,9].

The commission recommends to Member states to work on the homologation and harmonization of policy-making with the neighbors[1]. Also, it states that further transport developments need to be done under an Union- wide transport system approach[3]. Two different ways of approaching these recommendations are: European Governance Structure and integrative policy-making[5]. The former is based on guidance and assessment of national plans by the European Commission and the latest is based on the Member States commitment for interacting among them when making policies.

The effects of bio-fuels production on Indirect Land Use Change are addressed in an enunciatively way rather than by setting clear measures. No consumer acceptance clause regarding this point is addressed in the policy documents reviewed for the cases of the Netherlands, Finland, Poland, Italy, Sweden, France and the UK. On the other hand, only Germany contemplates issues regarding the consumer acceptance for the uptake of biofuels and the related consequences with ILUC. Finland, Germany, the Netherlands and Poland consider the possibility of ILUC related to biofuels production, and all of them agree on considering sustainability of biofuels production by preferring second-generation biofuels[8,11,15,18,19].

In this sense the European Commission establishes that the consumer acceptance of biofuels has been hampered by the lack of coordination between Member States. The Commission says that the main hampers for consumer acceptance are: lack of common technical specifications, lack of information on the compatibility of new fuels with current or future vehicles[4]. The Commission suggests to Member States to 'Harmonize consumer information on fuel quality and vehicle compatibility and on the availability of recharging/refueling points'[4].

In fact the sustainability and ILUC effect are important problems for both the European Commission and the Member States. However, these two issued have been the only concerns for Member States so far. Therefore, measures to overcome the lack of coordination, technical specifications and information have not been addressed at all by the national plans as the European Commission states.

3

Conclusions and Recommendations

After reviewing each country and their national plans for sustainable transport beyond 2020, the following learning outcomes are concluded as follows.

- **Not all the Member States have issued national plans beyond 2020 for alternative fuels infrastructure development and deployment.** Nevertheless this is an obligation that Member States have by establishing the minimum requirements for the building-up of alternative fuels infrastructure. However, it may be understandable that some national plans have not been issued since the European Commission established as deadline for notifying the national plans the 18th of November of 2016.

- **The national plans already issued vary in terms of the horizons for further developments between the timeframes 2030 or 2050**. This point may be very related to the flexibility among Member on planning fuels alternatives for transport.

- **There is a major difference in the availability of data among the national plans reviewed, which diverges between qualitative and quantitative data.** Some countries showed to be able to plan the future of transport and its fuels with more precise quantitative data. On the other hand some of the countries reviewed have a preference on providing systematic transport system as a first and basic steps. Countries that already addressed the provision of transport under a systematic approach are focusing the future's efforts on greening the system rather than providing the basics of the system. Meaning that there is a difference on the level of system provision already achieved by the different Member States studied.

- **The aim of the policy documents varies from one Member States to another, according to their national preferences.** As addressed in the policies analysis the Member States showed to have different plans beyond 2020. However, one of the implications of the flexibility related to national preferences, is that isolated national plans considering one-single-fuel strategies would hamper the continuity of alternative means of transport traveling and powered by alternative fuels across Europe.

- **The fuel-mix strategies as a diversification portfolio ensures availability of fuels supply for transport.** As Commission mandates for 2030 this comprehensive mix shall be developed in an Union-wide multimodal TEN-T core network basis. However, the national plans reviewed do not consider considerations regarding this point.

- **Oil is still on a path-dependency but also under a phasing-out transition.** Among the national plans studies oil-based fuels are still envisioned as ways to power transport. However, some countries based oil consumption in a step further that simply path-dependency and plan the phasing-out of oil under in a transitional planning. Nevertheless, as long as Union-wide infrastructural interconnection does not exist it may be difficult to phase oil-based fuels consumptions especially for long-distances transport. The major implication for achieving the phasing-out ambitions is to collaborate in interactive-policy-making processes among Member States.

- **Second-generation bio-fuels for transport are one of the most recurrent preferences among Member States.** Beyond the visions reviewed bio-fuels blends already power transport and these are suitable for most of current engines. Therefore, this may be a reason why this fuel comes more often in the national plans reviewed. Moreover, second generation biofuels are seen as a potential option for reducing CO2 emissions as long as these are sustainably produced.

- **Electric Vehicles are seen as one of the most suitable options for CO2 emissions reductions and are also one of the most recurrent alternative among Member States in their National Plans.** However, the success of this alternative is very related to the supply of energy from the grid. Electricity as fuel can bring important emission reductions as long as its supply chain is addressed under a well-to-wheel approach (avoiding electricity with detrimental WTW balance). Moreover, other major implications are very related with the deployment of refueling points and the extension of the grid at least along the TEN-T core network and (sub) urban agglomerations.

- **Hydrogen is a recurrent fuel option beyond 2020 among Member States. Different visions and strategies vary from support projects, to warranty of supply and infrastructural development.** The European Commission's view is that technology for hydrogen fuel cell vehicles is maturing. Also, Member States are expected to develop a cross-border link for hydrogen infrastructure by 2025. However, one of the main current limitations for this technology is the absence of a refueling infrastructure network.

- **LNG and CNG are alternative options for powering HDV, which can bring both more cost-efficient and less C02 emissions than diesel.** The Commission states that the availability of these fuels shall exist at least along the existing TEN-T core networks' by 2025. However, additional refueling stations could easily be supplied from the existing dense natural gas distribution network in Europe.

- **Passenger cars are seen as both the main cutter of GHG emissions and the main contributor to GHG emissions. Important gains are possible by improving this sector.** Passenger transport, based on passenger-kilometres, contributed with 72.2% out of the total transportation in Europe and it is responsible for 71.9% of GHG emissions related to transport. By addressing the deployment and availability of a portfolio of alternative fuels, the most important mean of transport can be benefited in terms of emissions reductions.

- **Light Duty Vehicles are planned to play a low-emissions role when these are driven within cities or distances below 200km, due to hybrid options for powering these vehicles.** Moreover, the uptake of new engines and cleaner fuels, and the use of intelligent transport systems may improve this specific sector of road transport.

- **Higher blends of bio-fuels and duel-fuels are options to power Heavy Duty Vehicles, however R&D, investments, infrastructure and further deployment are needed.** However as a complementary measure, the European Commission suggests that 30% of road freight over 300 km is shifted to other modes transport by 2030 (e.g. rail or waterborne).

- **Hybrid buses, gas buses and modernization of buses for public transport as energy-efficiency measures.** Public transport represents an opportunity for niche management of alternative fuels and drives due to the fact that it can be publically funded and supported.

- In general, in terms of infrastructure development, by addressing one mode of transport other modes can benefit from the first one. For instance, since passengers transport is the most dominant and it can be powered mainly by any fuel. Therefore improvements on the fuels infrastructure and technology development for this type of transport can be seen as a starting point for further developments in other means of transport.

- **Different ways of addressing GHG emissions related to transport, by Member States, contemplate: electrification, low-emissions standards for vehicles, zero emissions vehicles, traffic avoidance and traffic management.**

- **Pollution from transport is the main obstacle for air quality, specially urban transport.** Therefore, Member States and European Commission envision to phase out conventionally fuelled vehicles from urban centers, air pollution can be abated.

- **Des-transportation is the major contributor to energy savings and efficiency.**

- **Member States barely consider an external dimension when envisioning transport beyond 2020. They neither consider cross-country measures for sustainable transport in terms of infrastructure or fuels deployment.** However, the European Commission suggests that this issued shall be addressed by implementing an European Governance Structure and an integrative policy-making process among Member States.

Recommendations for the Member States:

- To address the minimum levels requirements for infrastructure deployment ‘at least along the TET-T network’ in order to ensure the availability and continuity of supply of a portfolio of alternative fuels.
- To coordinate deployment in order to warranty green corridors with uninterrupted access to a portfolio of alternative fuels and therefore ensure continuity of any kind of alternative transport.
- To make possible joint-policy-making processes among States.

4

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