-Draft-

National Policy Framework for the Development of the Market in Alternative Fuels

CONTENTS

INTRODUCTION

The *Draft National Policy Framework for the Development of the Market in Alternative Fuels* is submitted by the Ministry of Economy in collaboration with the Ministry of Transport, Construction and Regional Development further to Article 3 of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure and further to the Government Resolution of 1 April 2015 and Government Resolution 2015/504/B/1 of 9 September 2015.

This document aims, by means of established measures, to promote the development of the market in alternative fuels in the transport sector and the development of the corresponding infrastructure, with a focus on:

- an assessment of the current state and future development of the market as regards alternative fuels in the transport sector, including in light of their possible simultaneous and combined use, and of the development of alternative fuels infrastructure, considering, where relevant, cross-border continuity;
- national targets and objectives for biofuels, supplies of electricity for transport, supplies of natural gas for transport and, where applicable, supplies of hydrogen for road transport, including the deployment of alternative fuels infrastructure; those national targets and objectives shall be established and may be revised on the basis of an assessment of national, regional or Union-wide demand, while ensuring compliance with the minimum infrastructure requirements;
- measures necessary to ensure that the national targets and objectives are reached and that **can promote the deployment of alternative fuels infrastructure in public transport services;**
- the designation of the urban/suburban agglomerations, of other densely populated areas and of networks **which, subject to market needs, are to be equipped with recharging points accessible to the public in accordance with requirements regarding the supply of electricity for transport;**
- the designation of the urban/suburban agglomerations, of other densely populated areas and of networks which, subject to market needs, are to be equipped with compressed natural gas refuelling points accessible to the public in accordance with requirements regarding the deployment of an appropriate number of compressed natural gas refuelling points accessible to the public;
- an assessment of the need to install refuelling points for liquefied natural gas in ports outside the TEN-T Core Network;
- consideration of the need to install electricity supply at airports for use by stationary aircraft.

Under Article 3(1) of Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, each Member State shall ensure that the share of energy from renewable sources, calculated in accordance with that Directive, in gross final consumption of energy in 2020 is at least its national overall target for the share of energy from renewable sources; the national target set for Slovakia is 14%. Furthermore, under Article 3(4) of Directive 2009/28/EC, Slovakia shall ensure that the share of energy from renewable sources in all forms of transport in 2020 is at least 10% of the final consumption of energy in transport.

Support for the development of alternative fuels in Slovakia is not just a matter of complying with the Directive. In addition, it also provides the State and citizens with numerous benefits, including:

- reduced greenhouse gas emissions, pollution and dependence on oil and petroleum products;
- reduced noise emissions;
- a reduction in the incidence of carcinogenic, cardiovascular and pulmonary diseases, and the related treatment costs;
- increased investment in innovative technologies, infrastructure and cutting-edge vehicles;
- more jobs;

- increased self-sufficiency and reduced energy dependence.

The document's partial objectives take into account the needs of the different transport modes existing in Slovakia, including those for which only limited alternatives to fossil fuels are available.
Measures to promote alternative fuels infrastructure will be implemented in accordance with State aid rules under special regulations, with a focus on the promotion of alternative fuels that are not only sustainable but also pursue environmental objectives aimed at reducing greenhouse gas emissions in the transport sector.
The draft *National Policy Framework for the Development of the Market in Alternative Fuels* includes measures that are important instruments for the development of the market in alternative fuels in the transport sector and for the development of the corresponding national infrastructure requiring fulfilment by the individual State administration stakeholders.
It is impossible – not least in view of the major investment needed – to promote all types of alternative fuel in equal measure.

The individual chapters defining the various fuels have been structured in accordance with Article 2 of the above Directive, which, under paragraph (1) of its '*Definitions*' article, provides that '*alternative fuels*' means fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia:

- electricity;
- hydrogen;
- biofuels as defined in point (i) of Article 2 of Directive 2009/28/EC;
- natural gas, including biomethane, in gaseous form (compressed natural gas – CNG) and liquefied form (liquefied natural gas – LNG), and liquefied petroleum gas (LPG).

The National Policy Framework responds to the transposition document '**National Policy for the Deployment of Alternative Fuels Infrastructure in the Slovak Republic**', implying the need to determine:

- ***electricity supply for transport:***

The National Policy Framework establishes the number and distribution of publicly accessible recharging points enabling, by 31 December 2020, electric vehicles to circulate at least in urban and suburban agglomerations and other densely populated areas, and, where appropriate, within networks.
The National Policy Framework establishes measures to promote and facilitate the deployment of publicly inaccessible [*sic*] recharging points and to assess the need for shore-side electricity supply for inland waterway vessels and seagoing ships as a matter of priority at inland ports of the TEN-T Core Network by 31 December 2025. The targets for the share of energy from renewable energy sources (RES) and the fact that only electricity made from RES is counted towards greenhouse gas emission reduction targets must be fully taken into account here.

- ***hydrogen supply for road transport***

The National Policy Framework assesses the number and distribution of publicly accessible hydrogen refuelling points to ensure, by 31 December 2025, the circulation of hydrogen-powered motor vehicles, including fuel cell vehicles, within networks, including, where appropriate, cross-border links.

- ***biofuel supply for transport***

Biofuels can be used for road transport (for motorcycles, cars and trucks) for all ranges of distances. They can also be used for inland waterway transport.
Second-generation biofuel technology is also being developed. It is not yet in commercial production in Slovakia. This technology could be distributed in the same way as commercially deployed biofuels. In terms of cost, the marketing of biofuels is the most economically advantageous for the State because they are already deployed via the developed distribution system intended for motor fuel distribution across the country.

- ***natural gas supply for transport***

In keeping with the relevant Directive, the National Policy Framework establishes the number and distribution of publicly accessible compressed natural gas refuelling points to ensure, by December 2020, the circulation of CNG-powered motor vehicles in urban and suburban agglomerations and other densely populated areas and within networks, and to enable, by 31 December 2025, the circulation of CNG-powered motor vehicles in the implemented TEN-T Core Network in all EU Member States.

The National Policy Framework also establishes the number and distribution of liquefied natural gas refuelling points to enable, by 31 December 2013, LNG inland waterway vessels to circulate throughout the TEN-T Core Network. Where necessary, Slovakia cooperates with neighbouring EU Member States to ensure coverage of the TEN-T Core Network. The National Policy Framework also establishes the number and distribution of publicly accessible liquefied natural gas refuelling points to enable, by 31 December 2025, in the existing TEN-T Core Network, the circulation of LNG-powered heavy-duty commercial vehicles throughout all EU Member States, where there is demand, unless the costs are disproportionate to the benefits, including environmental benefits.

- ***consumer information***

Comprehensible information as regards those motor vehicles which are regularly fuelled with fuels placed on the market, or which can be charged at recharging points, must be made available in motor vehicle manuals, at refuelling and recharging points, on motor vehicles and in motor vehicle dealerships.

Process of document preparation

This document was drawn up in collaboration with the Ministry of Economy's Working Party on Electro-mobility, the members of which (in addition to representatives of State administration) are representatives of the Automotive Industry Association, the Slovak Electric Vehicle Association, energy companies, automotive industry companies, and civic associations active in the field of electro-mobility, representatives of science and research (universities and research institutions), the National Union of Employers, Klub 500, and professional organisations, and representatives of the Association for the Production and Use of Biofuels.

Follow-up on other strategy papers

In the production of this document, we drew on statistical data from the Statistical Office, analytical observations of the International Energy Agency, the Ministry of Economy, the Ministry of Economy's Working Party on Electro-mobility and Alternative Fuels, CARS 2020, studies and surveys, as well as the documentation of international institutions from 2010-2015 in areas related to alternative fuels. The document builds on these international commitments, strategy papers and initiatives:

- Strategy for the Development of Electro-mobility in the Slovak Republic and its Impact on the National Economy of the Slovak Republic;
- Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure;
- National Policy for the Deployment of Alternative Fuels Infrastructure in the Slovak Republic;
- Lessons for Prosperity – Slovak Strategy of Research and Innovation for Smart Specialisation;
- Europe 2020 - A Strategy for Smart, Sustainable and Inclusive Growth;
- Horizon 2020 initiative for science and research;
- National Strategy for the Development of Cycling in the Slovak Republic;
- National Renewable Energy Action Plan of the Slovak Republic;
- Energy Policy of the Slovak Republic;
- National Energy Efficiency Action Plan 2014-2016, with an Outlook up to 2020;
- Framework Strategy for a resilient Energy Union with a forward-looking climate change policy;
- SET Plan – European Strategic Energy Technology Plan;
- Strategic Plan for the Development of Transport Infrastructure in the Slovak Republic up to 2020;
- Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the

use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC;

- Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC;
- Directive 2015/652 of the European Parliament and of the Council [*sic*] of 20 April 2015 laying down calculation methods and reporting requirements pursuant to Directive 98/71/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.

1 NUMBERS OF VEHICLES IN SLOVAKIA

In the 1990s, the use of motor vehicles became more widespread in Slovakia, kickstarted primarily by rising living standards.
Between 1995 and 2014, the number of passenger cars all but doubled, rising from approximately one million to 1.95 million. The table below tracks the number of vehicles over that period.

Table 1 Numbers of vehicles in Slovakia

	1995	2000	2005	2009	2010	2011	2012	2013	2014
Total vehicles registered in Slovakia	1,498,160	1,751,840	1,801,117	2,236,608	2,339,358	2,442,231	2,537,976	2,622,939	2,725,538
of which									
Passenger cars	1,015,794	1,274,244	1,303,704	1,589,044	1,669,055	1,749,271	1,824,190	1,879,759	1,949,055
Trucks	102,634	110,714	160,089	246,667	252,886	256,869	259,839	261,840	265,424
Buses	11,812	10,920	9,113	9,400	9,350	9,074	8,957	8,821	8,876
Tractors	-	3,281	14,141	22,655	23,183	24,942	26,139	27,561	28,429
Semi-trailers and trailers (including those of buses)	175,740	201,269	188,411	218,724	226,333	234,502	241,823	251,217	262,781
Motorcycles	81,847	45,647	56,366	55,513	59,649	63,952	68,175	74,228	80,932
Quadricycles				**3,269**	**3,935**	**4,754**	**5,435**	**6,189**	**7,022**

Source: Ministry of the Interior, Presidium of the Police Force, 2015

The average age of vehicles in Slovakia is approximately 13 years. It seems likely that we will see gradual convergence with the EU average of approximately 10 years. New-vehicle purchases should also be reflected in the proliferation of low-emission vehicles. When it comes to emission abatement in the transport sector, the introduction of new vehicles meeting stricter emission limits into the national vehicle stock has a major effect. The table below documents the numbers of vehicles in Slovakia by fuel type.

Table 2 Numbers of vehicles in Slovakia by fuel type (as at 30 June 2015)

FUEL TYPE	M1	M2	M3	N1	N2	N3
Petrol + electricity	316					
Petrol + CNG	1,168		30	143	1	
Petrol + LPG	42,973			2,635	5	
Petrol	1,108,572	38	6	41,651	123	19
CNG*	47	0	244	41	27	4
Electricity	157		5	16		
LPG	9	4				
Diesel	780,031	794	4,993	178,580	25,508	37,832
Diesel + CNG						1
Diesel + electricity	13					1
Diesel + urea	514		2,406	9	1,838	16,755

Source: Automotive Industry Association, 2016; *Slovak Association of Petroleum Industry and Trade, 2016

Vehicles running on a combination of petrol and LPG account for the largest proportion of alternative fuel vehicles. As at 30 June 2015, there were 1,342 vehicles running on petrol + CNG, and 363 powered purely by CNG. There were 178 electrically powered vehicles (the majority in group M1[1]) and 318 hybrids (petrol + electricity, and diesel + electricity).
In Slovakia's public passenger transport sector, electric buses are currently only operated in Košice (5 x SOR EBN 10.5). There are no hybrid buses at all. According to information from carriers, there are 228 buses running on CNG, with an average age of seven years, which are operated in Bratislava, Trnava, Nitra, Banská Bystrica, Košice, Prievidza and Zvolen.

[1] **Category M1** – vehicles designed and constructed for the carriage of passengers and comprising not more than eight seats in addition to the driver's seat.

1.1 Evaluation of transport developments

The Ministry of Transport, Construction and Regional Development is currently preparing an information update as part of the Transport Development Strategy up to 2030. Forecasts for each mode of transport are being drawn up under the Transport Model.

- **Developments in private motorised transport**

Private motorised transport dominates passenger transport figures in Slovakia. Since 2000, the rate of private motoring has risen by an eighth, recording average annual growth momentum of 1.2%. In 2014, private motoring accounted for more than 27 million pkm. The volume of private motorised transport in the last year was nearly 7 times higher than the volume of public road transport and almost 11 times higher than the volume of public rail transport. Passenger air transport stood at just 3% of the level of private motorised transport. There is every reason to believe that private motorised transport's supremacy in overall passenger transport, and its upward trend, will continue in the near future. It is underpinned primarily by the effects of improving living standards among the population and the constantly eroding appeal of public modes of transport.

- **Developments in public road transport**

The annual numbers of passengers making use of public means of road passenger transport in Slovakia have exhibited statistically significant dependence on a host of economic and transport indicators. The indirect dependence of the number of passengers carried on the export and import of products and services and, where appropriate, the number of road freight transport vehicles may be linked to the overall performance of the economy. This synergy, derived from higher employment and the associated rise in the need to commute and growing consumption within the private sector, however, is not corroborated by the population's spending on transport. This may be due to the use of private motorised transport.

Developments in the past decade, in which the number of passengers carried has almost halved, suggest that this trend is set to continue, albeit not so acutely. The main factors here are the country's economic development and the population's improved living standards. This has been reflected in the steadfastly growing number of passenger cars and the degree of motorisation, which has tended to be counter-productive from the perspective of passenger numbers. In the next 20 years, we can expect the downturn in the numbers using public passenger transport in towns and urban agglomerations to be cushioned somewhat, mainly by a better quality travel experience thanks to the gradual introduction of integrated transport systems, the promotion of non-motorised transport (in particular cycling), and a major hike in the cost of allowing passenger cars to enter urban zones or high parking charges in city centres.

- **Developments in public rail transport**

In terms of overall performance, measured in passenger-kilometres, it seems likely that, if anything, there will be stagnation or just a slight rise. As far as the modal split is concerned, we can expect to see private motorised transport eat into the share of public transport.

As concerns individual transport axes and links, the railways could capitalise on forecasts of increased demand along the long-distance Košice - Žilina - Bratislava axis. Nevertheless, in the longer run this potential could be stifled by the completion of the D1 motorway. With this in mind, in this area the railways should offer greater travel comfort and convenience (vehicles, station facilities, and intermodal services).

- **Developments in passenger air transport**

According to *Current Market Outlook 2012-2031*, an air transport demand forecast drawn up by Boeing Commercial Airplanes, annual 4.1% growth can be expected up to 2031, subject to economic growth in the EU. In Slovakia, in 2020 this means a 0.8 multiple of the volumes reported in the pre-crisis year of 2008, or – expressed in absolute terms – slightly more than 2.36 million transport passengers annually. The lion's share of traffic volumes is projected in international air transport,

accounting for 90-95%, and in the next 10 years this will almost entirely inhibit growth in national passenger air transport similar to that prior to the crisis.

- **Developments in passenger shipping**

In the past six years of monitoring, numbers have been in the range of 110-134,000 passengers. According to an expert estimate, the trend up to 2030 will see passenger numbers range from 100,000 to 200,000.
Under the Strategic Plan for the Development of Transport Infrastructure up to 2020, passenger shipping volumes are put at 3-5 million pkm up to 2030.

- **Developments in freight transport**

In the past decade, the domestic output of Slovak carriers in road freight transport has virtually doubled. It seems likely that the trend observed thus far, assuming stagnation in the haulage distances covered, will continue, especially considering Slovakia's position and importance as a transit country. However, the current statistical survey methodology does not include the performance of foreign carriers who transit Slovakia or provide exports of vehicles from Slovak carmakers' production plants. This is despite the fact that passenger car exports account for a large slice of total exports.
Performance in freight rail transport plunged by almost 40% between 1995 and 2014. The upward trend in globalisation indicates that intermodal transport will see further growth. The share of container transport on the railways has already far outstripped the growth forecasts made in 2000.
It can be concluded that, with respect to 2020, Slovakia has enough potential for combined transport amounting to 10-12 million gross tonnes per year (*Strategic Plan for the Development of the Transport Infrastructure of the Slovak Republic up to 2020*, 2010). The existing inland port service, as part of the chains of overseas combined transport, handles approximately 3.6 million gross tonnes per year. These studies also anticipated that Slovakia would open up to the continental road-railway combined transport system. They envisage manifold increases in current performance, consistent with the forecast that combined transport – with the right infrastructure – could take up a 20-25% share of railway transport (2011: approximately 9%).
In the past 10 years, commodities transported by freight shipping in Slovakia have hovered around 1.5 million tonnes annually. Exceptions were 2009 and 2010; in the last reporting period, the average volume had arisen to almost double that of the year 2000. This indicates positive trends in the use of Slovakia's inland waterways, of which approximately 250 km are currently in operation. The transshipment capacity of the two Danube ports in Bratislava and Komárno stands at around 5 million tonnes per year.

1.2 Road transport infrastructure relevant to the introduction of support for alternative fuels

- **Slovakia's road corridors incorporated into the TEN-T network**

The appearance of the TEN-T network is currently defined by Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU. In keeping with the Green Paper published by the Commission in early 2009 in order to examine existing TEN-T policy and the results achieved, a European-wide review of the TEN-T network was launched in 2009. This process was rounded off in 2013 by the adoption of the aforementioned regulation on the appearance of the network.
The TEN-T network, approved under Regulation (EU) No 1315/2013 of the European Parliament and of the Council, is a network of road and railway, inland and sea multimodal corridors within the TEN-T Core Network, international airports, sea and inland ports and waterways. The underlying rationale for establishing the network was to improve transport infrastructure internationally for the smooth functioning of the internal market and the reinforcement of economic, social and territorial cohesion. The corridors defined by the above regulation (including from the aspect of the implementation of the TEN-T network for the 2014-2020 period in the form of Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and

(EC) No 67/2010), as incorporated into the TEN-T network, have been planned and projected to cover the European continent in its entirety in order to connect national networks, interlink the Union's peripheral regions with its centre, and improve the quality, safety and efficiency of the transport networks.
The TEN-T network has two layers: a core network and a comprehensive network. The core network, comprising the major transnational transport axes, significant nodes and intermodal connecting points (ports, airports and terminals), should be completed by 2030, while the comprehensive network should be finished in 2050.

The TEN-T network's road infrastructure in Slovakia consists of:

- **Core network**

D1 Bratislava – Žilina – Prešov – Košice – Slovak/Ukrainian state border (Vyšné Nemecké)
D2 Slovak/Czech state border (Brodské/Lanžhot) – Bratislava – Slovak/Hungarian state border (Rajka)
D3 Žilina (from the junction with the D1) – Slovak/Polish state border (Skalité/Zwardoń)
D4 Jarovce (from the junction with the D2) – Slovak/Austrian state border (Jarovce/Kittsee)
R3 Martin – Žiar nad Hronom – Zvolen – Slovak/Hungarian state border (Šahy/Parassapuszta)
R6 Púchov (from the junction with the D1/Beluša) – Slovak/Czech state border (Lysá pod Makytou/Horní Lideč).

- **Comprehensive network (excluding the core network components)**

D4 Bratislava, Jarovce – Ivanka pri Dunaji – Bratislava, Rača – Bratislava, Záhorská Bystrica
R1 Trnava – Nitra – Žiar nad Hronom – Zvolen – Banská Bystrica – Ružomberok
R2 Trenčín – Prievidza – Žiar nad Hronom – Zvolen – Lučenec – Košice
R3 junction with the D1 – Dolný Kubín – Trstená – Slovak/Polish state border
R4 Slovak/Polish state border (Vyšný Komárnik/Barwinek) – Prešov – Košice – Slovak/Hungarian state border (Milhosť)
R5 Svrčinovec (from the junction with the D3) – Slovak/Czech state border (Svrčinovec/Mosty u Jablunkova).

- **Motorway/expressway service areas and service stations on motorways and expressways**

Basic requirements concerning the location and facilities of motorway/expressway service areas are laid down the *Policy for the Distribution and Facilities of Motorway/Expressway Service Areas on Motorways and Expressways in the Slovak Republic*, as amended by Appendix 2, which (in accordance with applicable legislation, standards, technical regulations and requirements in development documents) serves as documentation underlying the siting of motorway/expressway service areas.
There are both small and large motorway/expressway service area designs. On motorways and expressways, small motorway/expressway service areas are spaced at distances of 15 to 25 km, while large motorway/expressway service areas are set up at intervals of 30 to 70 km.[2]
A motorway/expressway service area is a service facility providing road users with a place to park their motor vehicle and take this opportunity to have a short or long rest associated with the use of the services available. The services on offer comprise parking zones for passenger cars, buses and trucks, rest zones with the possibility of individual passive or active rest, the opportunity to refuel at a service station, and the option of making use of catering or accommodation facilities for longer stays. The motorway/expressway service area design should aim for the optimal sequencing of the various

[2] Under the applicable regulation on the TEN-T and the TEN-T Core Network, the TEN-T Core Network's road infrastructure may comprise only motorways or expressways with criteria for the TEN-T Comprehensive Network. At the same time, Member States must ensure that their road infrastructure includes the construction of service areas on motorways approximately every 100 km in line with the requirements of society, the market and the environment, with a view to providing, among other things, reasonable parking capacity for commercial road users that offers appropriate safety and security, and ensure the availability of alternative environmentally friendly fuels.

services in dedicated parts of the motorway/expressway service area, taking into account the structuring of vehicles' transport routes and the priority safety of pedestrian ways at the motorway/expressway service area.

Large motorway/expressway service areas
Passenger cars are separated from trucks upon entering the service area. The truck zones are located nearer to the motorway/expressway than passenger car zones. The motorway/expressway service area entrance segues into the part earmarked for the zoning of a service station. Beyond the service station, the motorway/expressway service area has parking zones for passenger cars, which are separate from the zones for trucks and buses. The parking zones for buses and trucks are just off the road parallel to the motorway/expressway, while the passenger car parking zones are situated further away from the motorway/expressway. They are separated by a rest zone, equipped with small-scale architecture accessible to drivers and passengers from the cars, buses and trucks. The rest zones, located on the side of the motorway/expressway service area facing away from the motorway/expressway, are suitable as a hygienic setting designed for relaxation. Near to the passenger car parking zones, there is a part earmarked for the zoning of catering and accommodation facilities.
Small motorway/expressway service areas
Passenger cars are separated from trucks after entering the service area. The truck zones are located nearer to the motorway/expressway than passenger car zones. Parking zones for passenger cars are separate from the zones for trucks and buses. Alongside the parking for passenger cars, there are relaxation zones equipped with small-scale architecture accessible to drivers and passengers from the cars, buses and trucks. Near to the passenger car parking zones, there is a structure housing sanitary and catering facilities. Motorway/expressway service areas are broken down into several types depending on the scope of services on offer. Small motorway/expressway service areas occupy 1.5-2.5 ha, while large service areas cover 2.5-4.5 ha.
As at 31 December 2015, there were 75 service areas (of which 40 with a service station) on motorways and expressways. Since 15 December 2015, the Zeleneč and Sekule service areas have had recharging points for electric vehicles.
Park-and-ride car parks
The Government will promote the building of park-and-ride car parks on main access routes. These facilities, combined with follow-up measures, will seek to ease the strain on inner-city roads by eliminating terminating and static traffic within the scope of the following projects:

- P&R Pezinok, dates: 09/2016-11/2018
- P&R Ivanka pri Dunaji, dates: 09/2016-11/2018
- P&R Nové Košariská, dates: 01/2017-03/2019

- **Toll sections of roads**

Highway tolling is governed by the '*user pays*' principle under Act No 474/2013 on toll collection for the use of designated sections of highways and amending certain laws, as amended, and under Act No 488/2013 on motorway vignettes and amending certain laws, as amended. Funds generated by tolls and motorway vignettes are spent on the maintenance, repair and construction of the network of motorways and expressways. The toll rates favour greener vehicles on the strength of their emission classes (EURO I-VI and EEV) and reflect the 'polluter pays' principle, i.e. higher rates apply to the least environmentally friendly vehicles, whereas lower rates are paid by those vehicles placing the least strain on the environment.

1.2.1 Use of electricity in inland waterway transport

In the use of electricity to power vehicles in water transport, the level at which electricity is used as a fuel in freight shipping is currently very low in Slovakia and across the EU. Developmental trends indicate that there is unlikely to be any significant increase in the near future. Electric motors tend to be used more often for passenger boat use on endorheic bodies of water (reservoirs, lakes, etc.).
Vessels used in passenger and freight shipping, upon arriving in a port, should be able to connect to a shore-side electricity supply while parked and moored in the port. This significantly reduces

emissions in this area, which is also in line with the Strategic Plan for the Development of Transport Infrastructure up to 2020, a document defining Strategic Objective SV4 '*Reducing the environmental impacts of water transport*' and Priority SV4.1 '*Reducing emissions from the operation of vessels*'.
In view of the above, it does not seem efficient to consider the installation, in the near future, of recharging points in public ports in Slovakia, or to set objectives aimed at the promotion of electricity use in inland ports in this document. Nevertheless, the requirement under Directive 2014/94/EU means that this matter needs to be addressed when the strategy is updated, and the opportunities available in relation to this issue need to be reassessed. Under Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, Member States must ensure that alternative environmentally friendly fuels are available for inland navigation in the TEN-T Core Network (unlike the TEN-T Comprehensive Network).

The TEN-T network's inland waterway transport infrastructure in Slovakia consists of:

- **Core network**
  The Slovak section of the River Danube.
  The River Váh from its mouth at the Danube (Komárno) via Sereď to Žilina.

The TEN-T network's ports in Slovakia consist of:

- **Core network**
  Bratislava Port (also being considered as a tri-modal terminal).
  Komárno Port.

1.2.2 Use of electricity at airports and use of aviation fuel from renewables

MR Štefánik Airport currently uses Houchin mobile ground power units to connect aircraft. These electricity generators are powered by six-cylinder diesel units. We are considering a project for the installation and use of ground-based aviation units that would be powered exclusively by electricity from the grid and mounted directly on the stands; in the future we expect to purchase mobile units using new engines that are smaller, more powerful and more efficient.
Under Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, Member States must ensure that airports have the capacity to make alternative environmentally friendly fuels available in the TEN-T Core Network (unlike the TEN-T Comprehensive Network). The TEN-T network's air transport infrastructure in Slovakia consists of:

- **Core network**
  MR Štefánik Airport Bratislava.
- **Comprehensive network**
  Košice Airport.
  Poprad Airport.

1.2.3 Use of electricity in cycling

The *National Strategy for the Development of Cycling in the Slovak Republic* identifies, for example, the establishment of public bike schemes or bike rentals as one of its measures. The burgeoning market in electric bicycles is a source of potential in this area. In the EU, sales of electric bicycles shot up nearly twelvefold between 2006 (98 000) and 2014 (1 139 000). Electric bicycles increase the average length of journeys, make negotiating more rugged terrain easier, reduce the energy expended by the rider, and are an appealing sort of motivation for the non-cycling public to use this alternative mode of transport, and they may make a considerable contribution to the greening of transport.

2 ENVIRONMENTAL IMPACT OF TRANSPORT

Projected road transport emissions should and need to be assessed in terms of air protection (pollutant emissions) and climate protection (CO_2/greenhouse gas emissions).[3]
Since 1990, Slovakia has conducted a regular annual comprehensive inventory of emissions of selected pollutants. This includes an **annual inventory of road, rail, water and air traffic**. To determine what quantities are being produced of the various pollutants monitored, CORINAIR methodology is used. This methodology is applied in the Member States of the EU, whose special COPERT software product is designed for inventories of the annual production of road transport emissions. In 2008, COPERT IV started to be used in the processing of road transport emissions, and all emission values from 2000 were recalculated according to that software. Trends in the vehicle mix and traffic volumes influence emission developments (projections).

2.1 Emissions in road transport

- ***Description of the methodology to project emissions in road transport (Copert)***

Road transport emissions have been calculated using the latest version of COPERT (Version 9.0). The inputs for this model are 'activity data', i.e. the numbers of vehicles in each vehicle category:

- passenger cars
- light commercial vehicles
- heavy goods vehicles
- buses
- mopeds
- motorcycles

The emission results for the categories are reported not only by the mode of transport, but also by fuel. Under COPERT methodology, these six core categories are broken down into subcategories according to vehicle weight and emission standards that need to be met by a vehicle in the given category. In Slovakia detailed information is not available for a more meticulous breakdown that could be used when projecting road transport emissions. By quantifying vehicles in Slovakia (using data obtained from the Police Force), we arrived at a basic breakdown of vehicles by fuel, engine capacity, and weight, with a further breakdown into the aforementioned COPERT categories.
Average annual mileage was estimated according to COPERT methodology, which recommends setting average annual mileage in a range reflecting the vehicle's age and the emission standard it is required to meet. It takes account of the fact that older vehicles travel fewer kilometres than new vehicles, which must abide by stricter emission limits. In projections, an emphasis is also placed on the minimal difference between consumption calculated from the mileage and consumption derived from statistics.

- ***Greenhouse gas emissions***

The results of greenhouse gas emissions in 2013 are presented in the tables below:

Table 3 Greenhouse gas emissions from road transport, by vehicle type

	CO_2 eq. (kt)
passenger cars	2,611.826
light commercial vehicles	596.267
heavy goods vehicles	2,565.023
buses	408.643
motorcycles	8.010
Total	**6,189.770**

Note: The figures exclude quantities of CO_2 from bio-components.
Source: Slovak Hydrometeorological Institute, Emission Inventory 2016

[3] Emission Inventory 2014 (for 2013).

Table 4 Greenhouse gas emissions from road transport, by fuel

1A3 – Road Transportation	CO_2 eq. (kt)	CO_2 (kt)	CH_4 (kt)	N_2O (kt)
petrol containing bio-components	1,674.927	1,651.805	0.294	0.053
fossil-based petrol	1,602.293	1,580.173	0.281	0.051
bio-component in petrol (bioethanol, ETBE[4])	72.634	71.632	0.013	0.002
diesel containing a bio-component	4,741.926	4,698.080	0.237	0.127
fossil-based diesel	4,457.213	4,415.999	0.223	0.120
bio-component in diesel (FAME[5])	284.713	282.080	0.014	0.008
LPG	102.669	100.873	0.024	0.004
CNG	23.959	22.330	0.065	0.000
bio-components – TOTAL	357.347	353.712	0.027	0.010
Total	6,543.482	6,473.088	0.621	0.184

Source: Slovak Hydrometeorological Institute, Emission Inventory 2016

- ***Particular matter emissions, not calculated via COPERT***

COPERT calculates all exhaust particulate matter emissions and emissions of PM2.5 and PM10 from the abrasive wear of tyres and brakes. Exhaust particles are very fine and therefore they all fall within the category of PM2.5 (PM2.5 = PM10 = TSP). COPERT does not calculate total particulate matter from the wear of tyres and brakes or particulate matter from road abrasion. To take complete stock of emissions, these emissions were calculated mainly from transport operations in vehicle-kilometres and by means of the TIER 1 emission factors referred to in the manual of the European Environment Agency.

Table 5 Non-combusted emissions of particulate matter calculated ex-COPERT for the 2013 emission inventory

	Emissions from the wear of tyres and brakes (t/year)			**Emissions from road abrasion (t/year)**		
	PM2.5	**PM10**	**TSP**	**PM2.5**	**PM10**	**TSP**
passenger cars	125.97	230.20	274.52	61.84	113.13	226.25
light commercial vehicles	32.82	60.32	68.25	9.78	17.90	35.80
heavy goods vehicles	136.23	262.82	399.04	105.28	195.15	390.31
buses	15.92	32.91	37.65	9.93	18.41	36.82
mopeds	0.08	0.14	0.15	0.03	0.06	0.11
motorcycles	0.32	0.60	0.65	0.12	0.23	0.47
Total	**311.34**	**587.00**	**780.25**	**186.99**	**344.88**	**689.76**

Source: Slovak Hydrometeorological Institute, Emission Inventory 2016

2.2 EU transport sector legislation

The following directives are taken into consideration in the preparation of the *Draft National Policy Framework for the Development of the Market in Alternative Fuels*:

- Council Directive (EU) 2015/652 of 20 April 2015 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.

This Directive lays down calculation methods and reporting requirements pursuant to Directive

[4] Ethyl tertiary butyl ether.
[5] Fatty acid methyl ester.

98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels. Directive 2015/652/EU applies to fuels used to propel road vehicles, non-road mobile machinery (including inland waterway vessels when not at sea), agricultural and forestry tractors, recreational craft when not at sea and electricity for use in road vehicles. The Directive also lays down methodology for calculating emissions from the combustion of fuel and the weighted intensity of greenhouse gas emissions[6] during the life cycle (gCO_2eq/MJ), i.e. 93.3 g CO_2eq/MJ for petrol and 95.1 g for diesel fuel, and allows emissions from the combustion of LPG, CNG and electricity from RES consumed in electric vehicles to count towards emission reductions. Average life cycle greenhouse gas intensity default values for fuels other than biofuels and electricity are presented in Annex 2.

Electricity

For the reporting by energy suppliers of electricity consumed by electric vehicles and motorcycles, Member States should calculate national average life cycle default values in accordance with appropriate International Standards.

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, as amended by Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

- Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC, as amended by Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

[6] Average greenhouse gas default values representing the crude oils consumed in the EU.

3 ELECTRICITY

This chapter builds on the *Strategy for the Development of Electro-mobility in the Slovak Republic and its Impact on the National Economy of the Slovak Republic*, approved under Government Resolution No 504/2015 of 9 September 2015.

The main global factors in the development of electro-mobility are:

- the regulation of CO_2 emissions.
- improvements in air quality, especially in towns and cities.
- security of supply: Dependence on supplies of oil, especially from politically unstable regions, stands out as a particularly significant geopolitical challenge, and scaling down this dependence is one of the EU's primary objectives. Risks of constraints in supply and wild price fluctuations are perceived as a significant threat. The use of electricity – which, furthermore, is increasingly generated locally – helps to reduce this exposure.

These factors should be fleshed out with the following effects, which also promote the trend of electro-mobility development:

- Customer perception: There has also been a paradigm shift among customers. Surveys and field observations alike show that, in the past few years, the public has become increasingly interested in solutions and products that have less of an environmental impact. The drivers here are not just price rises or regulatory restrictions, but also concerted efforts among people who are more and more willing to pay a premium for cleaner solutions. A socially more responsible mindset has also emerged among companies, which are major fleet operators.
- Supplier alertness: Technological advances have gradually reached a stage where electric vehicles can travel an acceptable distance on a single charge, and the range can be extended efficiently by using rapid charging facilities. Over time, electric vehicles have come down in price and the assortment on offer has broadened. Essentially all of the major automobile players are actively pursuing electro-mobility and are poised to respond to the mounting demand.

According to a final report published by the Automotive Industry Association, *Measures to Develop Alternative Fuel Vehicles in Selected Countries* (Automotive Industry Association, 2016), which tracks how the market in alternative fuel vehicles has developed and correlates this with market stimulating support measures while comparing alternative fuel vehicles with developments in the infrastructure of alternative fuel service stations and recharging points, the share of alternative fuel vehicles registered in Europe is set to rise to 28-31% of all vehicles by 2020. In the past few years, there has been a steadfast rise in the share of new alternative fuel vehicles registered. In the last five years, this share has more than doubled (2.0% in 2011, and estimated to be in excess of 4.5% in 2015).

To illustrate the availability and range of alternative fuel vehicles, we can point to the surging numbers of new hybrid and electric models, with carmakers nearly tripling the choice on offer in recent years.

Electric propulsion has established a presence in passenger transport, freight transport (mainly small vans) and even public transport. Away from the classic concept of transport, electro-mobility is gradually also making a name for itself in the commercial electric vehicle, cycling and leisure sectors. International Energy Agency (IEA) data published in Energy Technology Perspectives 2010 as the BLUE Map Scenario project the following trends in sales of new passenger and light commercial vehicles, by propulsion technology, up to 2050, with a fair share taken up by battery electric vehicles and plug-in hybrid vehicles.

The IEA forecasts global sales of 2 million battery electric vehicles (BEVs) and 4.9 million plug-in hybrid electric vehicles (PHEVs) in 2020. This accounts for a 7.1% share of total vehicle sales. The table below documents the trends envisaged in the regions that are economically most relevant to the Slovak economy. It presents the aggregate numbers of electric and plug-in vehicles (PEVs).

Table 6 Projected trends in the development of electro-mobility in selected countries

	Source	Region	Market share/number of vehicles
National targets	strategic objective for 2020[7]	France	2,000,000
	strategic objective for 2020[8]	Germany	1,000,000
	strategic objective for 2020[9]	Austria	250,000
Expert estimates	Roland Berger Strategy Consultants	Europe (2025)	50%
		CEE[10] (2025)	23%
	Boston Consulting Group	Europe (2020)	12%

Source: [The source for each forecast is indicated in the footnotes]

Plans for the active and systematic expansion of electro-mobility in the V4 region are being steadily implemented. For example, the Czech Republic and Hungary have recently announced relatively ambitious plans to build charging infrastructure and, generally, to promote electro-mobility. This includes incentives to develop the market in alternative fuel vehicles. Here, besides the current activities, which are primarily in the hands of the private sector, the State is also making an active entry, paving the way for the electro-mobility expansion process to progress in leaps and bounds.

- **Prediction baselines – situation in Slovakia**

Electro-mobility offers a host of unique opportunities relating to:

- the performance of the Slovak economy: Concentrating on the manufacture of alternative fuel vehicles, especially electric vehicles, and the attendant services will help to safeguard sustainable economic growth.
- the environment and public health, especially as the recharging of electric vehicles will draw primarily on electricity from renewable energy sources: By ushering in electro-mobility we can diminish the adverse effects on human health and the environment because there will be fewer emissions of harmful pollutants and greenhouse gases and lower noise levels from traffic. The development of electro-mobility will have positive repercussions for the environment and public health only if the charging of electric vehicles draws primarily on electricity from renewable energy sources.
- science and research: Electro-mobility is a sector that needs to rely on the results of the latest scientific research. Involving domestic research capacities in the electro-mobility R&D process builds innovation potential that can be deployed in numerous sectors, meaning that we will be taking a major step forwards towards a knowledge-based economy.
- road infrastructure as a prerequisite for efficient implementation: Electro-mobility does not place new demands on road infrastructure, though it does require the building of charging infrastructure over time as the number of electric vehicles increases.

The SWOT analysis below illustrates the opportunity to develop electro-mobility in Slovakia:

Strengths

- The automotive industry's powerful position in the national economy, and a developed network of suppliers for car companies.
- The electrical engineering industry's powerful position in the national economy.
- The availability of experts in technical sectors, including IT.
- The relatively low price of labour compared with key markets for electro-mobility.
- A functioning platform and expert dialogue dedicated to the furtherance of electro-mobility in

[7] Source: http://www.ieahev.org/by-country.
[8] Source: http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Brochures/Industries/electromobility- in-germany-vision-2020-and-beyond.pdf.
[9] Source: http://europa.eu/rapid/press-release_IP-13-40_en.htm.
[10] Central and Eastern Europe

Slovakia.
- A suitable energy mix.

Weaknesses
- Low spending on research and development.
- The automotive industry's underdeveloped research base in Slovakia.
- Slovakia lags behind neighbouring countries. Neighbouring countries, particularly Austria and the Czech Republic, have several years' head start in their systematic support of electro-mobility.
- Harmonisation of standards.
- The current scant infrastructure for electric vehicle charging.
- Companies' reduced sensitivity to the acceptance of environmentally friendly and/or '*innovative*' solutions.
- The continuing paucity of user convenience in terms of the need for frequent recharging.
- The cost to the final consumer from the point of view of the initial investment in a vehicle.

Opportunities
- Reduced oil dependence.
- Emission and pollution abatement where traffic is highly concentrated.
- The creation of new skilled jobs.
- The development of a research base in several electro-mobility-related areas.
- The impetus for car companies and their suppliers to be innovative.
- The creation of new innovative business models and services.
- The use of electric vehicles in smart grids.

Threats
- Slower GDP growth momentum.
- Reduced purchasing power among the population and companies.
- Inefficient investments in the development of electro-mobility.
- Belated reductions in the prices of inputs due to the slow introduction of economies of scale stemming from mass production.
- Lagging behind competing countries, failure to stimulate investment and employment.

Source: [Ministry of Economy's Working Party, 2013]

Electro-mobility in Slovakia is on the rise in terms of the numbers of electric vehicles that have been registered and the current charging infrastructure. Despite the relatively low absolute numbers of registered electric vehicles, there were palpable year-on-year rises in electric vehicles and plug-in hybrids between 2011 and 2015. This is indicative of future developments amid the global trend. *Nevertheless, the methodology established for the registration of motor vehicles has no means of clearly identifying the category of plug-in hybrids, hence figures for this category will have to be derived from international statistics and forecasts for the Slovak market, according to which there is a 60:40 split in the distribution of electric vehicles between battery electric vehicles (BEVs) and plug-in hybrids (PHEVs).*

The rise in electric vehicles from the perspective of electric vehicles newly registered in Slovakia in 2015 is illustrated by the tables below:

Table 7 Number of electric vehicles from the perspective of electric vehicles newly registered in Slovakia in 2015

	Type of fuel:	*ELECTRIC*	*ELECTRIC*	*ELECTRIC*	*ELECTRIC*	*ELECTRIC*	*TOTAL*
Make/model		**Golf 7**	**Leaf**	**NV200**	**Soul**	**Up**	
KIA					8		**8**
NISSAN			22	2			**24**

VOLKSWAGEN		5				15	**20**
TOTAL		**5**	**22**	**2**	**8**	**15**	**52**

Source: Automotive Industry Association, 2016

Table 8 Vehicle numbers in categories M1, N1 in 2011-2015

	2011	**2012**	**2013**	**2014**	**2015**
Number of vehicles	2,019,417	2,045,599	2,105,510	2,179,802	2,373,744
BEVs (60%)	25	28	46	119	223
PHEVs (40%)	17	18	30	79	147
Total PEVs	**42**	**46**	**76**	**198**	**370**
Increase	-	+12%	+64%	+159%	+87%

Source: Automotive Industry Association, 2016

Slovakia has been building up a core network of rapid recharging points. This network seamlessly connects the cities of Bratislava and Košice along the main roads – the D1 motorway and the R1 expressway. Since 2015, this network has also incorporated multiple charging standards, considerably improving recharging conditions for the end user.
Even so, in the infrastructure as it stands the individual points need to be broken down into several categories that narrow their use to selected types of electric vehicles. In the majority of cases, this is dictated by the connection available on the side of the vehicle (the most frequent standards are Mennekes Type 2 and CHAdeMO) or by the individual makes (the Tesla Supercharger standard, which, from the aspect of both hardware and software, is limited solely to Tesla vehicles). Larger cities have also introduced basic charging infrastructure coverage, which tends to offer medium-fast charging. Some of the larger regions are partially covered as well.

Table 9 Current distribution of recharging points in Slovakia by charging standard in 2016

	T1	T2 (*rapid)	CHAdeMO	CCS Combo 2	Tesla	230 V household socket	380 V household socket
Recharging points	3	57 (*23)	28	24	4	38	50
Of which public	3	56 (*23)	28	24	4	28	33
Share of public points	100%	98% (*100%)	100%	100%	100%	74%	66%

Source: Slovak Electric Vehicle Association; as at 31 January 2016

When assessing the existing infrastructure, several categories of recharging points need to be distinguished. For infrastructure construction, it was decided to categorise recharging points by capacity because, in theory, the time it takes to charge can be derived from the point's capacity, provided that the vehicle is capable of handling that capacity. However, in practice, even though points offer rapid charging, vehicles' own limitations mean they can only draw on much lower capacity than that which the point is capable of. Consequently, the actual charging time becomes protracted on account of a vehicle's technical equipment. The charging time also depends on other vehicle-side factors and further factors such as the outside temperature.

Table 10 Distribution of recharging points in Slovakia by available charging speed

	All points (total)	**Public points**	**Share of public points**
Slow charging	5	2	40%
Medium-fast charging	65	47	72%
Rapid charging	30	30	100%

Source: Slovak Electric Vehicle Association; as at 31 January 2016

The above table presents the total number of recharging stations with their highest available charging speeds. At many existing recharging points, however, there are also connections offering other standards and lower categories of charging speeds. At each recharging point, only the fastest available recharging speed was taken into account. There was no further specification of the standard offered or the recharging technology used. Numerous recharging points also offer 'multistandard charging'. This is a combination of the most common types of charging standards around today. In particular, a lot of the current rapid-charging infrastructure in Slovakia incorporates the Mennekes T2 (rapid charging), CHAdeMO and CCS Combo 2 standards.

Standard recharging points are often expanded to include complementary 380 V or 230 V household sockets. That is not to say that this is the rule or should be accepted as a given production factor of recharging points. Rather, it shows that recharging point operators have use their own initiative in an effort to accommodate electric vehicle users. Having said that, a few registered recharging points consist solely of household sockets.

Rapid-charging points are quite evenly spaced throughout Slovakia, with decent coverage along the main D1 and R1 roads and in the largest cities. The greatest distance between any two directly neighbouring rapid-charging points is approximately 80 km, which means that drivers still have to plan their trip when embarking on longer journeys.
South Slovakia is poorly – perhaps even inadequately – covered in terms of all types of charging.
Even so, the prospects for electro-mobility in Slovakia look relatively bright. Across the world, electro-mobility provides a great impetus to those industries that are well established in Slovakia (the automotive industry, electrical engineering, and information technology), indicating that there is quite a good chance that they will find a home in this country. The well-suited topology of the existing road infrastructure, with two key roads, means that building up comprehensive charging infrastructure in support of electro-mobility is relatively easy and cost-effective in Slovakia.

Several of the largest cities, specifically Bratislava, Košice, Prešov and Trebišov, have recently subscribed to the promotion of electro-mobility in Slovakia by signing a *Memorandum on the Support of Electro-mobility*.

Scenarios for the development of electro-mobility in Slovakia
The growth scenarios defined with respect to conditions in Slovakia can be viewed as boundaries within which the country may find itself in the future, depending on how active an approach is taken and what resources are deployed, and on external factors that will affect the rate at which the electric vehicle market grows. The technical and standard scenarios draw on expert assumptions approved by the Slovak Government in the form of the *Strategy for the Development of Electro-mobility in the Slovak Republic and its Impact on the National Economy of the Slovak Republic*. As this national strategy only presented baseline projections for the number of electric vehicles in 2020 under both scenarios, the forecasts were additionally modelled by reference to current trends for the period up to 2030. These considerations are based on assumptions that support for the development of infrastructure-building will be harmonised with the stimulation of the market in alternative fuel vehicles.

Table 11 Share of PEVs in new vehicles

	2020	2025	2030
Standard scenario	5.35%	9.43%	16.63%
Technical scenario	11.36%	19.14%	30.83%

Source: Slovak Electric Vehicle Association, 2016[11]

[11] Source: These data were drawn up by the Slovak Electric Vehicle Association in cooperation with the consultancy company Cap Gemini, and were published in 2014 in the expert study *Slovakia in the Context of European Electro-mobility*.

By adding annual increases to the total number of vehicles, their overall share in registered vehicles can be derived, assuming that the number of vehicles in Slovakia remains constant.

Table 12 Share of PEVs in the total number of vehicles

	2020	2025	2030
Standard scenario	0.42%	2.18%	5.27%
Technical scenario	0.96%	4.58%	10.50%

Source: Slovak Electric Vehicle Association, 2016

However, long-term trends depend on a host of factors and variables that are currently unknown, and it is extremely complicated to come up with forecasts for such a long period of time. Despite this, the scenarios presented can be treated as an expert estimate of the situation up to 2030.
As part of the efforts to build infrastructure systematically in line with Slovakia's requirements, it makes sense to split the charging infrastructure into two parts with different usage and priorities. These are:

Principal transport network – national network of recharging points

- Located along the route followed by the main roads, with priority initially given to motorways and expressways and larger cities (with populations of more than 30 000) that connect to those roads, to be followed at a later date by class 1 roads.
- Most recharging points should satisfy the requirement of rapid charging and the requirement for the recharging point to be fitted with multiple charging standards, with both AC and DC standards present.

Local charging infrastructure

- Mainly located where the public is likely to congregate – shopping centres, universities, public car parks, hospitals, government and public administration authorities, in and around housing estates, etc.
- The recharging points should mainly offer medium-fast charging technology, with rapid recharging points clustered primarily in places where larger numbers of people are concentrated.

Conclusion

Table 13 Estimated numbers of electric vehicles and plug-in hybrids in Slovakia

Year	2016	2017	2018	2019	2020	2025	2030
Numbers of electric vehicles and plug-in hybrids	500	1,200	2,500	5,500	10,000	20,000	35,000

Source: Automotive Industry Association, 2016

On the strength of the above breakdown of the charging infrastructure into a national network of recharging points and local charging infrastructure, the structure projected for the different charging infrastructure categories can be identified from the plan. Working on this assumption, the national network of recharging points will mainly comprise recharging points with a rapid charging standard, so that users are held up as little as possible in the everyday use of these traffic flows. It seems likely that the principal charging network will account for up to 90% of the total number of rapid recharging points, and only approximately 10% of medium-fast recharging points, which will just play a supporting role in this part of the infrastructure. The overall share of the national network of recharging points in Slovakia's charging infrastructure, assuming the ratio above is maintained, will be in the region of 22%. The remainder of the charging infrastructure can be regarded as local

charging infrastructure, and its location and the internal structure of various charging standards will reflect this.

Table 14 Estimated numbers of medium-fast and rapid recharging points

Year	Plan		
	Medium-fast charging	Rapid charging	Total recharging points
2016	50	30	80
2017	100	40	140
2018	200	80	280
2019	400	120	520
2020	600	150	750
2025 – indicative	1,200	300	1,500

Source: Ministry of Economy, Energy Section, 2016

4 HYDROGEN

Hydrogen can be used as an energy carrier not only in various fields of energy, but also in transport, where it can help to diversify fuel sources. Hydrogen itself is not a source of energy. Rather, just like electricity, it is a carrier of energy. Hydrogen offers a whole raft of benefits as a clean energy carrier. Its potential cannot yet to be harnessed in the energy sector on account of open research issues surrounding the storage and safety of hydrogen.
To develop forward-looking hydrogen technologies in Member States, an institution called ***Fuel Cells and Hydrogen Joint Undertaking*** has been set up at the EU Council.

Description of the current state of the hydrogen market
As hydrogen is not used in transport in Slovakia and remains a little-known energy carrier, when determining how it will be developed in the transport sector in the next few years we need to briefly analyse its production, use, transportation and storage.

- ***Hydrogen production and use***

Hydrogen can be made from fossil fuels, biogas or water. It is currently commercially viable to obtain hydrogen from natural gas or biogas by means of three different chemical processes, namely steam reforming, partial oxidation or autothermal reforming.
Hydrogen can also be obtained from water splitting by processes such as hydrolysis, photoelectrolysis, photobiological production and the high-temperature decomposition of water. Approximately 50 kWh of electricity is required to make 1 kg of hydrogen by electrolysis.
If renewable energy sources with an interrupted electricity supply (solar and wind energy) are used to make hydrogen, the storage of electricity in hydrogen and the recovery of that electricity could remedy their deleterious effect on the electricity grid. At the heart of power-to-gas technology is electrolysis, transforming electricity into energy in the form of a gas, namely hydrogen; a by-product of this process is pure oxygen. This method can be used for the long-term 'storage' of electricity or energy from renewable sources, thereby increasing the security of supply of various forms of energy (gas, electricity, heat), enhancing the balancing of the network and improving the diversification of energy sources. Hydrogen production by means of nuclear energy can help to increase the efficiency of nuclear power plants. The continuous full output of such a power plant, in situations where demand for electricity is low, could be used to make hydrogen. A high-temperature (950 °C to 1 000 °C) gas-cooled nuclear reactor can separate hydrogen from water by a thermal-chemical process using heat from the core (i.e. without electrolysis). Approximately 90% of hydrogen is used in the manufacture of chemicals and in hydrogenation-refining processes at refineries. The increased production of fuels with a smaller carbon footprint (second-generation bio-components) and the processing of heavier sulphurous oils have pushed up demand for hydrogen. It is anticipated that, in 2030, the need for hydrogen at refineries will be triple what it was in 2005.

- ***Transportation of hydrogen***

Most of the world's production of hydrogen is concentrated at major industrial complexes, which is where it is also used, and this minimises the need for transportation. If hydrogen is to be used as an alternative fuel, broad, cost-effective and energy-efficient infrastructure needs to be built that is capable of transporting large quantities over long distances. Currently, pure hydrogen is transported by pipeline, tube trailers, cryogenic tankers or ordinary tankers in the form of ethanol or ammonia. Pipeline distribution is the cheapest way to deliver large volumes of hydrogen, but distribution networks are only found in close proximity to major oil refineries or chemical plants. One exception is the longest hydrogen pipeline in Europe, owned by Air Liquide, which connects France with Belgium and runs for approximately 400 kilometres. Theoretically, it may be possible to transport up to a 20% mixture of hydrogen in natural gas (HCNG) without having to modify natural gas pipelines.
The road transportation of compressed hydrogen gas in high-pressure tube trailers is very expensive and is therefore only used for supplies within a 300-kilometre radius. On the other hand, liquid hydrogen (cooled to -253 °C) is denser than hydrogen gas, and therefore is preferred for supplies over longer distances. Liquefaction is costly and energy intensive. However, the scarcity of distribution

pipelines increases the need to transport hydrogen in liquefied form in special cryogenic super-insulated trucks or tanker vessels.

- ***Storage of hydrogen***

Hydrogen storage is thought to be one of the biggest technological challenges. In the absence of effective storage systems, it will be difficult to achieve positive values for the hydrogen economy. As hydrogen has low bulk density, it contains less energy than natural gas or oil. There are three basic methods of hydrogen storage:

Hydrogen (gaseous phase): In its gaseous phase, hydrogen is stored at higher pressures on account of its lower bulk density. Currently, hydrogen is predominantly stored in its pure form in cylinders at a pressure from 200 bar to 700 bar. In the development process, the cylinders are at pressures of up to 1 000 bar. **Besides storage in cylinders, enormous potential for hydrogen storage is offered by underground natural gas storage facilities, where hydrogen could be stored, for example, in a mixture with natural gas**. If hydrogen is blended into natural gas, the resultant mixture of gases can then be stored in underground natural gas storage facilities. Besides the direct storage of hydrogen in underground storage facilities, pure hydrogen can be used in the transport sector as a fuel for vehicles with fuel cells. More than 20 power-to-gas pilot projects are currently running in Europe. In some of these projects, the hydrogen is blended into local distribution networks so that the hydrogen concentration stands at several per cent. As the European gas infrastructure has been built to a high level, large quantities of energy can be stored here in the form of hydrogen. Furthermore, energy can be distributed over long distances with minimum losses in this way. Hydrogen made with power-to-gas technology, together with CO_2, can be used in the production, for example, of synthetic methane, as borne out by the pilot projects currently in progress. This technology has the potential to close the CO_2 loop, or to reduce CO_2 emissions.

Hydrogen (liquid phase): If hydrogen is to be condensed, it needs energy, a highly volatile environment and a cryogenic temperature (because the boiling point of hydrogen is -253 °C), which places high demands on tank insulation and on gas liquefaction. The energy needed to liquefy hydrogen stands at approximately 40% of the fuel energy value. Hydrogen can also be stored in suitable liquid compounds with a high number of hydrogen atoms. Liquid hydrogen theoretically has a very high energy (gravimetric) density, so further research will be crucial for the entire hydrogen economy and, in particular, for its safe use in aviation and space, and perhaps in road transport due to its long range.

Hydrogen (solid phase): Metal hybrids store hydrogen compactly and safely in solutions at room temperature. Hydrogen atoms are incorporated into the grid of the metal or alloy during the production process. Solid-phase hydrogen could potentially become a safe and efficient way of storing energy for later use (storage capability comparable to its liquid state can be achieved). There are high hopes for rechargeable hybrids, such as borohydrides, alanates, amides, and other organic liquids, and hydrates thereof.

Hydrogen can be viewed as a medium for the convenient storage of electricity. However, hydrogen storage facilities lose a lot of energy in the cycle of hydrogen liquefaction or compression and reverse conversion into electricity. The overall efficiency of hydrogen storage is usually 50-60%, which is lower than pumped storage or batteries.

Hydrogen liquefaction is energy intensive and appears to be a significant factor in the storage process. Consequently, the storage of hydrogen together with natural gas in underground geological structures comes across as an alternative worthy of further research.

- ***Development of hydrogen use in road transport across the world***

Hydrogen use in the transport sector is one of the ways in which transport can be developed, and is also an opportunity to decarbonise this sector. Hydrogen is now at the development stage as a vehicle fuel. Nevertheless, there are numerous hurdles that need to be overcome before these vehicles can be marketed. One of them is the high cost of hydrogen distribution. Elsewhere in the world, such as in the US, Japan, and even Europe (Germany, Belgium, the UK, Spain, France, Italy, Switzerland and Austria), projects are emerging for the construction of hydrogen refuelling points (e.g. the HyFIVE

project).[12] In many of these projects, hydrogen is made by the electrolysis of water, so no emissions are generated. As the infrastructure emerges, it is joined by the development of the automotive industry in this segment. Fuel cell vehicles are being made by numerous car companies. Besides car and bus transport, projects are also in the pipeline for ship and train transport. Hydrogen production from the electrolysis of water is also evolving to the extent that current efficiency stands at 60-80%.

Table 15 Number of public hydrogen refuelling points and indicative targets up to 2020

Region	Current number of refuelling points		Planned number
		2015	2020
Europe	36	82	~430
Japan	21	100	>100
Korea	13	43	200
USA	9	64	>100

Source: Slovak Association of Petroleum Industry and Trade, 2016

Another important factor in the development of these vehicles is their safety. Although hydrogen is 'safer' than LPG in an open space because it is instantly dispersed upwards in the air, it can be very dangerous in closed spaces, such as vehicles or indoor parking areas. Special safety arrangements are needed for such storage. This is because much less energy is required to ignite hydrogen than natural gas.

Conclusion

Member States have the discretion, but not the obligation, to set up publicly accessible hydrogen infrastructure. They may consequently opt not to promote such infrastructure, but to channel their support into other alternative fuels instead. Slovakia will analyse opportunities to further the advancement of hydrogen infrastructure by reference to current hydrogen use and existing storage-related challenges. However, from the medium- and long-term aspect of the further development and unlocking of the potential offered by hydrogen, especially in the transport and energy sectors, it will be necessary to support further research for the commercial use of hydrogen in transport, the seeking of potential natural geological structures for hydrogen storage, and the applicability of such fuel.

[12] Source: http://www.hyfive.eu/.

5 LIQUID BIOFUELS

Biofuels are mainly assessed in terms of their greenhouse gas emissions. From this point of view, they are the most strictly regulated alternative fuels.

Current state of play
Biofuels are currently the only alternative fuel used by the general public in Slovakia. Biofuels are supplied to the market by blending them into fossil motor fuels via the existing network of service stations. As a result of technological advances, most vehicles in the European Union are capable of using a low biofuel blend without any problem. Today, the modern automotive industry guarantees the capacity to use blends of up to 5% biofuel and up to 7% of the volume of final energy consumption in the transport sector without affecting the technical condition of the vehicle or the performance and life of vehicle components.

Reducing greenhouse gas emissions
Biofuels must abide by sustainability criteria if they are to contribute to the environmental targets above. These criteria include a greenhouse gas emission saving from the total carbon footprint when they are used, such being by at least 35% for biofuels made at installations in operation as at 5 October 2015, and by at least 60% for biofuels made at installations starting operation after 5 October 2015 (as set forth in Directive 2015/1513). Biofuels made by biofuel manufacturers in Slovakia will achieve a much higher greenhouse gas emission saving than the present values of biofuels supplied.
They are one of the most important alternative fuels when it comes to the abatement of greenhouse gas emissions. In view of this greenhouse gas saving (the total carbon footprint) and the domestic provenance of the raw materials, continued use of liquid biofuels in selected transport modes is warranted. In the future, it will be necessary to consider the starting materials for biofuel production and to focus support primarily on the use and development of advanced biofuels, the production of which will not push up demand for food crops. On the other hand, we need to take a sensitive look at Slovak farmers' dependence on biofuel manufacturers' demand for such crops, devise an appropriate legislative landscape for further development, and assess biofuel issues comprehensively.

Legal basis and targets for biofuels
The legal basis for biofuels is provided by two basic directives:

- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC;
- Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 amending Directive 93/12/EC relating to the quality of petrol and diesel fuels, and amending Council Directive 93/12/EC.

According to Directive 2009/28/EC, each Member State shall ensure that the share of energy from renewable sources in 2020 is at least 10% of the final consumption of energy in transport in that Member State. According to Directive 98/70/EC, fuel suppliers must ensure that there is a gradual reduction in greenhouse gas emissions throughout the life-cycle of the fuel they supply by 6% by 31 December 2020 compared to the baseline standard for fossil fuels, the calculation methodology for which was established by Directive 2015/652. These targets can be reached by blending biofuels into fossil fuels. At the same time, the adoption of Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources revised the opportunities for Member States to achieve the above targets. The use of first-generation biofuels, referred to as conventional biofuels, was limited to no more than 7% of the final consumption of energy in transport for the purposes of fulfilment in 2020. Under this Directive, each Member State should strive for a minimum target use of second-generation biofuels, referred to as advanced biofuels, i.e. at least 0.5% of the energy content of the share of energy from renewable sources in all forms of transport.

In Slovakia, first-generation biofuels, such as bioethanol, bioethyl tertiary butyl ether (bioETBE) and vegetable oil methyl ester (VOME), or other fatty acids of biological origin, are used almost exclusively in the pursuit of the set targets.
The revision of the directives governing biofuel production, use and quality places further demands on biofuel production and requires the production of advanced biofuels – that will meet environmental requirements, and be competitive and sustainable – to be built on the basis of first-generation biofuels. Although advanced biofuel production operations already exist elsewhere in the world, such production by the same means is not applicable in Slovakia. Further research is necessary into the raw materials for the production of these biofuels, as well as into the effective configuration of the manufacturing process and systems.

Conclusion

In keeping with the requirement stemming from Directive 2009/28/EC, Slovakia has set itself the target of achieving at least 0.5% of biofuels corresponding to second-generation biofuels (i.e. biofuels made from raw materials and other fuels listed in Annex IX, Part A, in its territory within the scope of this Directive). As there is currently no production of advanced biofuels in Slovakia, conditions will have to be fostered for the development of such production in order to reach the 0.5% target in 2020.
We need to create a legislatively befitting environment that will provide sufficient incentives for the further development and use of advanced biofuels.
Accordingly, in support for the development of advanced biofuels, it is also necessary to focus on the sector of biomass, i.e. the raw materials that are used in the production of biofuels. In its research and development, Slovakia should pay attention to biomass as it plays a key role in reducing greenhouse gas emissions and in the further development of energy from renewable sources. It is important to identify which biomass can be cultivated in Slovakia sustainably and on a scale sufficient for commercialisation, while respecting land stocks and climate conditions.
Parallel to this, in Slovakia we need to guide research towards the abatement of emissions from land utilisation so that the carbon footprint is reduced not only for the production of raw materials used in the manufacture of biofuels, but also with regard to emissions as a whole.
Support for the development of – and a future focus on – biomass will lead to the further growth and development of the agricultural sector, thereby creating new jobs, especially in rural areas. The development and growth of the biofuel sector will create both direct and indirect jobs. This translates into 1.2 million jobs in the EU and at least 1 500 jobs in Slovakia. Achieving a target of 10% renewables in transport seems to be a challenge in the EU, and the measures mentioned could help Slovakia to meet its RES target in the transport sector.

6 COMPRESSED NATURAL GAS (CNG) AND LIQUEFIED NATURAL GAS (LNG)

We understand from a European Commission document[13] that natural gas in CNG or LNG form is the best alternative fuel prepared for the transport sector (at least in the medium term). The main component of natural gas is methane and it is increasingly being used as a motor fuel in the transport sector. The combustion of methane, as the simplest hydrocarbon, generates the least pollutant emissions of any fossil fuels. How widespread the use of CNG/LNG becomes as a propellant will depend, to some degree, on the alignment of standards harmonising requirements for the quality and composition of gases across the EU.

Current state of play

Slovakia's target to have 1% of vehicles running on natural gas in 2025 and 2% in 2030 is feasible if the corresponding support measures are in place.

CNG *(Compressed Natural Gas)* – for use as a motor fuel, compressed natural gas is compressed by a compressor at a CNG refuelling point to a pressure of 20-22 MPa, and it is in this compressed form – by now CNG – that it is transferred to vehicles' pressure tanks.

Biomethane is a gas made from biomass. It is an alternative fuel to CNG within the meaning of Article 2(1) of Directive 2014/90/EU. It is also a renewable energy source, the energy potential of which is constantly renewed by natural processes or by human intervention. Biomethane's main advantage is that it can be added to conventional fossil-based natural gas at any ratio. Biomethane used as a fuel must comply with quality parameters (especially purity) regulated by relevant technical standards. Biomethane's marketing as a fuel in the transport sector will be speeded up by a technical standard (natural gas and biomethane for use in the transport sector) that is being prepared by the European standards committee CEN/TC 408. It is scheduled for approval in late 2016 or early 2017.

LNG *(Liquefied Natural Gas)* – from a chemical perspective, liquefied natural gas is natural gas liquefied at atmospheric pressure and a temperature of -162 °C, which shrinks it to 1/600 of its original volume. LNG is a colourless, odourless, non-corrosive and non-toxic liquid.

The CNG/LNG market can only be kickstarted with fossil-based natural gas (which will result in an initial greenhouse gas emissions saving, especially compared to diesel and conventional petrol). Subsequently, further necessary savings in particulate matter and greenhouse gas emissions will be achieved by upping the share of the biomethane component. The development of this use will contribute to the Transport White Paper's target of a reduction of 60% in greenhouse gas emissions from transport by 2050, as measured against the 1990 levels.

Table 16 Comparison of the characteristics of CNG and LNG

	CNG	LNG
Characteristics	Natural gas compressed to a pressure of 20-22 MPa is transferred to a vehicle's pressure tank in that compressed form.	Natural gas liquefied at atmospheric pressure and a temperature of -162 °C. Liquefaction compacts natural gas to 1/600 of its original volume.
Volume per kilogram	6.471	2.41
Use in the transport sector	In cars, vans, buses, logistics and rail transport.	In heavy-duty long-haul freight, inland waterway and rail transport.
Pros	A broader spectrum of use in transport from small vehicles to trucks.	In view of its smaller volume per mass unit, it offers greater vehicle range. The vehicle refuelling time is on a par with conventional fuels.
Cons	Vehicles have less range and are heavier.	More complex storage – storage unit cooling.

[13] State of the Art on Alternative Fuels Transport Systems in the European Union – Final Report. European Commission, 2015. Source: http://ec.europa.eu/transport/themes/urban/studies/doc/2015-07-alter-fuels-transport-syst-in-eu.pdf

Source: SPP, 2016

- ***Use of CNG and LNG in individual modes of transport***

Passenger cars: The current range of passenger cars running on CNG is very broad, featuring in the product portfolios of VW, Škoda, Fiat, Mercedes-Benz, Audi, Opel, Seat, and others. In Europe, companies and individuals use approximately a million CNG passenger cars, and there is also a reasonably well established secondary market in used vehicles. In Slovakia, there are currently more than 1 200 registered passenger cars running on a combination of CNG and petrol and 47 running on CNG alone.

Light commercial vehicles: Category N1 vehicles tend to be used by businesses for urban and local goods deliveries. ***(These vehicles are offered by Iveco, Mercedes-Benz, Fiat, VW and others.)***

Freight logistics transport and municipal vehicles: In the logistics transport sector, the range offered by CNG heavy goods vehicles is sufficient for daily use. Another major segment where CNG propulsion is widely used comprises various municipal waste collection vehicles, spraying vehicles, snowploughs, gritters, etc.

Long-distance freight transport: CNG and LNG can also be used in heavy-duty freight transport. CNG tractors with a range of approximately 300 km can be used for logistics transport. LNG tractors with a range of approximately 750 km, and which take approximately 3-5 minutes to refuel, are ideal for use by carriers on long-distance and international routes.

Bus transport: The replacement of buses with models running on CNG or LNG is preferred as part of the rejuvenation of stock and the greening of public passenger transport up to 2020 and the next update of the National Policy Framework. The current range of CNG vehicles is illustrated by Annex 5.

Use of LNG in inland waterway transport: Every year, 8-10 million tonnes of goods are transported along the Slovak section of the River Danube. Approximately 60% of the goods transported are for transit, approximately 35% are exports from Slovakia, and the remaining 5% are imports and shipping between the ports in Bratislava and Komárno.

Table 17 Forecast of the shipping of commodities along the Danube axis

millions of tkm	2007	2020	2040
Danube axis	19,940	25,683	37,966

Source: The Danube Axis – Case Study of the Port Cities of Bratislava, Komárno and Štúrovo, 2013

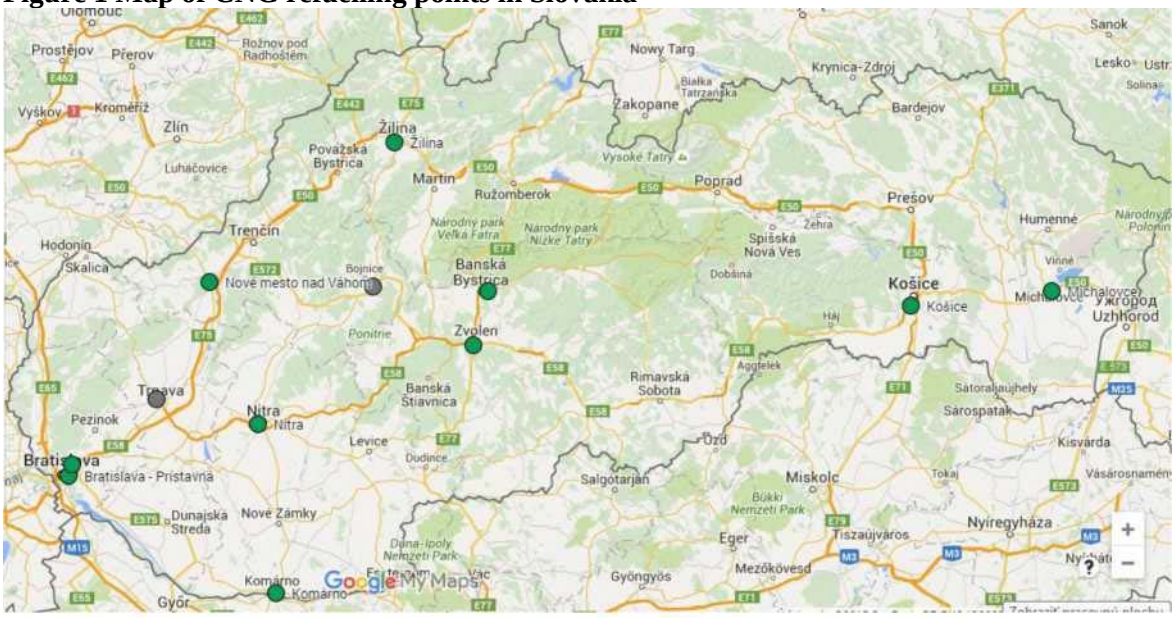
This forecast indicates that there is set to be a long-term rise in the shipping of goods along the River Danube. In terms of incorporation into the TEN-T Core Network, the ports of Bratislava and Komárno are important for Slovakia. The third port, Štúrovo, is too small. It specialises in passenger shipping, and it would not be economically viable to make LNG infrastructure available at this port, as well. At the same time, the port in Bratislava far outstrips the port in Komárno in terms of the volumes of goods handled.

Through the TEN-T programme, the EU has co-financed the project '*LNG Masterplan for Rhine-Main-Danube (2012-EU-18067-S)'*, which centres on the use of LNG for inland navigation and sets out to interlink the North Sea (Atlantic Ocean), via the Rhine, Main and Danube, with the Black Sea, and to green water transport with inland vessels running on LNG. At both ends of the inland waterway, there would be large LNG terminals. Inland ports would be supplied by river tankers or would draw on locally produced LNG. *It is thought that the navigability of the Danube would prove problematic if the above plans were put into action because there are several spots that are prone to freezing over in the winter, while in the summer the river has to grapple with low water levels.*

- ***Current situation of the CNG market in Slovakia***

In Slovakia, **10 public** CNG refuelling points are available to motorists. SPP CNG s. r. o. operates eight of them; these are self-service facilities available to customers 24 hours a day, 365 days a year. Two refuelling points are operated by SAD Zvolen a.s., one in Zvolen and the other in Banská Bystrica. In addition, there are **two private** CNG refuelling points in Prievidza and Trnava. After they cease to be tied to specific projects in the coming years, they may become public facilities.[14] **Considering user numbers and how sales of CNG are developing, this is too meagre a number of stations.**

Figure 1 Map of CNG refuelling points in Slovakia



Legenda: • – existujúce verejné • – existujúce neverejné
Key: • - existing public • - existing private

As at 30 June 2015, there were 1 706 registered vehicles in Slovakia that ran on a combination of CNG and petrol, of which 363 were powered by pure CNG. Of that number, 274 were buses, 217 were vans and freight vehicles, and 1 215 were passenger cars and small commercial vehicles. Businesses operate approximately 900 CNG vehicles. CNG vehicles account for **0.074%** of the total number of vehicles registered in Slovakia.

The development of CNG in Slovakia has been closely linked to public bus transport. In 2006-2008, 220 Karosa buses were converted to run on for DPB Bratislava, DPMK Košice and SAD Michalovce. Between 2006 and 2010, DPB Bratislava also purchased several dozen new CNG buses. Under Operational Programme Environment 2007-2013, the public transport greening scheme granted subsidies totalling EUR 34.2 million for the purchase of 120 CNG buses by the SAD (Slovak Bus Transport) companies in Prievidza, Zvolen, Trnava, and Banská Bystrica, and by DPMK Košice. All of these buses triggered CNG market growth until 2011. In parallel, the market in CNG passenger cars and vans also expanded. New CNG refuelling points were built, admittedly at a slow rate, either for bus companies alone or for the public as well (Komárno, Bratislava – Mlynské Nivy).
With effect from 1 January 2011, natural gas intended for the production of compressed natural gas to be used as fuel became subject to excise duty under Act No 609/2007 on excise duty on electricity, coal and natural gas. The duty rate on CNG supplied or used as a fuel is EUR 0.141 per kilogram *(this CNG excise duty rate has been set at a minimal level).*

[14] *Besides the CNG refuelling points mentioned above, there are another two private company stations in Slovakia, but these will not be opening to the public in the future.*

To promote CNG, SPP - distribúcia, a.s. set a zero annual rate for daily distribution capacity at the supply points of CNG refuelling points where the contractually agreed annual quantity of distributed gas was in excess of 633 MWh (more than 60 000 m³).

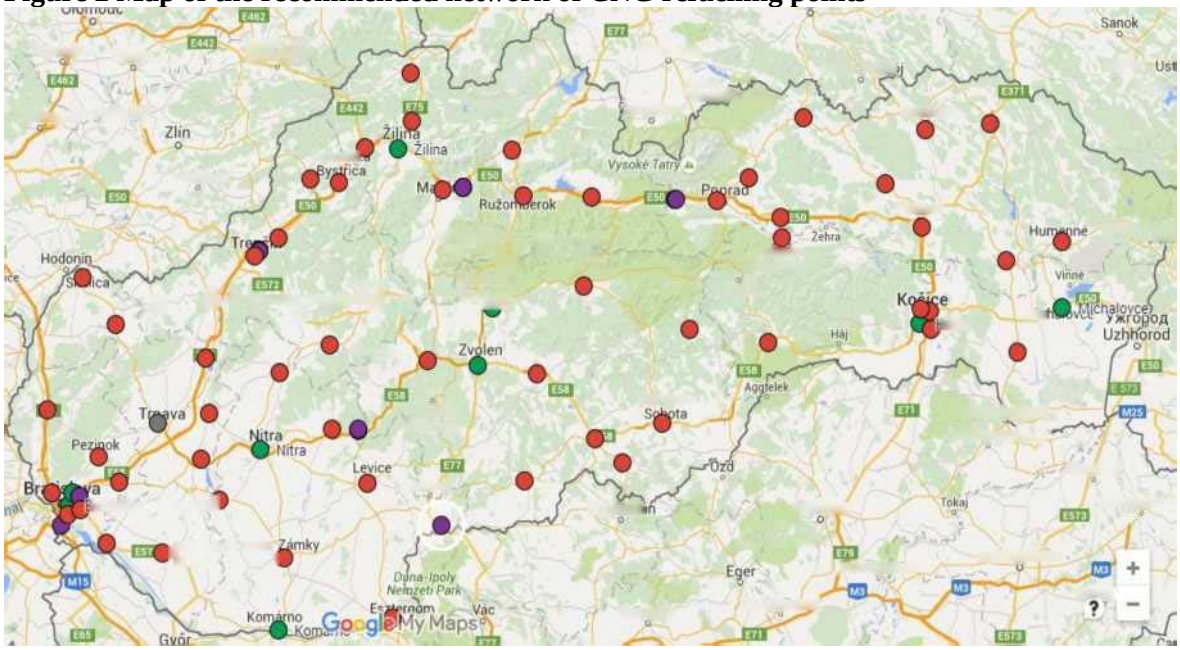
Planning permission for the construction of compressed natural gas refuelling points (CNG stations) **is coordinated by** the Ministry of Transport, Construction and Regional Development under Act No 50/1976 on spatial planning and building rules (the Building Act), as amended. The location and construction of a CNG/LNG station, defined as a structure under Section 43 of the Building Act, requires a separate zoning decision for the siting of the structure and a separate building permit. This obligation significantly protracts the process of constructing a CNG/LNG refuelling point, making it necessary to look for a more flexible set-up to grant permission for refuelling points, e.g. by a reduction in the number of statements and a shortening of the authorisation process and, in relation to mobile CNG refuelling points, by the simplification of building permit proceedings.
The commercial development of the LNG market is still in its infancy, with most EU Member States at a stage where they are deploying pilot projects. In Slovakia, LNG has not yet come into commercial use.

- ***Prediction of CNG and LNG developments in Slovakia***

Prediction of CNG developments in Slovakia: The first step, up to 2020, will necessitate the construction of CNG refuelling points in all towns and cities with more than 25,000 inhabitants and on the main roads in the TEN-T Core Network, i.e. 31 stations in all, followed by the establishment of stations in towns with more than 10,000 inhabitants by 2025 (i.e. a further 37 CNG refuelling points). It will be necessary to build one refuelling point in both the Bratislava Region and the Košice Region, plus a further approximately 10 stations in the districts of Bratislava I - Bratislava V and Košice I - Košice IV, as well as on main roads in the TEN-T Core Network.

Altogether, then, the network of public CNG refuelling points in Slovakia should comprise 80 facilities. This is consistent with the opinion voiced by the European Commission's Expert Group on Future Transport Fuels, presented in its *State of the Art on Alternative Fuels Transport Systems* of July 2015, stressing that EU Member States should allow access to CNG refuelling points for passenger cars and vans not only in certain cities or parts of Europe, as the more widespread use on the market can be secured only if at least 10% of the existing infrastructure of service stations for conventional fuels also includes the option of refuelling with CNG (at least along the TEN-T Core Network).
The following figure is a map of the recommended network of CNG refuelling points.

Figure 2 Map of the recommended network of CNG refuelling points



Key: • - existing public • - existing private • - new (cities) • new (TEN-T)
Source: SPP, 2016

It is projected that the target of 1% of CNG vehicles in the total number of vehicles in Slovakia will be reached in 2025 and that the target of 2% of CNG vehicles will be reached in 2030. Slovakia will continue to promote CNG-driven urban and suburban bus services in the public interest. The first application of CNG in rail transport will take place via the support of research and develop and in this area.

Prediction of LNG developments in Slovakia

The prediction of LNG developments in Slovakia depends, in part, on the gradual deployment of LNG infrastructure in other EU Member States. Article 6(4) of the Directive provides that:
'*Member States shall ensure, by means of their national policy frameworks, that an appropriate number of refuelling points for LNG accessible to the public are put in place by 31 December 2025, at least along the existing TEN-T Core Network, in order to ensure that LNG heavy-duty motor vehicles can circulate throughout the Union, where there is demand, unless the costs are disproportionate to the benefits, including environmental benefits*.'
The commitment to enable LNG vehicles to operate across the EU paves the way for Slovak carriers to introduce LNG vehicles in their own fleets.
The construction of LNG refuelling points should mainly be coordinated with neighbouring countries in order to maximise synergies and the efficiency of the entire network of LNG refuelling points for international heavy-duty freight and bus transport.
Besides LNG infrastructure for heavy goods vehicles, the Directive also lays down the obligation to make LNG available as a fuel at inland ports in the TEN-T Core Network by 31 December 2030.

The following belong to the TEN-T Core Network in Slovakia:

- urban nodes – Bratislava
- ports – Bratislava, Komárno
- intermodal terminals – Bratislava, Žilina.

Compliance with obligations deriving from the Directive would require the establishment of at least two LNG refuelling points for heavy goods vehicles, plus the construction of LNG bunkering facilities in the ports at Bratislava and Komárno.

Figure 3 Map of main roads and transport nodes in Slovakia

Source: http://www.ndsas.sk/dialmcna-siet/44346s , SPP, 2016

Considering the network of motorways and expressways in Slovakia and the levels of traffic, the construction of LNG refuelling points appears to be most appropriate in the vicinity of the following junctions:

- D1, D2 and D4 – Bratislava area
- D1 and D3 – Žilina area
- D1, R2 and R4 – Košice/Prešov area
- R1, R2 and R3 – Zvolen area

Conclusion

- **CNG**

Slovakia aims to build new CNG refuelling points in Slovakia by 2025, targeting a minimum of 50 and ideally 80 such facilities.

Table 18 Forecast of the number of CNG vehicles

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2025**	**2030**
CNG vehicles	2,000	2,400	2,900	3,500	5,000	15,000	30,000

Source: Automotive Industry Association, 2016

- **LNG**

To make the most efficient possible use of capacity, all LNG refuelling points for trucks and buses should be in L-CNG format as this would facilitate the pumping of natural gas – as a fuel – in both of the forms available (CNG and LNG).
For Slovakia, the ideal situation appears to be 3-5 public LNG refuelling points for road transport by 2025 and one LNG refuelling point for water transport by 2030.

7 LIQUEFIED PETROLEUM GAS (LPG)

LPG (liquefied petroleum gas) is a gas obtained as a by-product in the processing of crude oil and refineries. It is liquefied by compression and cooling, which makes its volume 260 times smaller.
LPG characteristics are very similar to petrol, which is the main reason this fuel is used to power cars. LPG is a fuel with very good qualities; its octane rating is approximately 101-111. Combining the octane rating and homogeneity results in combustion. An accompanying phenomenon is the more refined running of the engine across its entire dynamic range. In the Slovak climate, summer and winter blends are used, depending on the season and average temperatures. The summer blend is 40% propane and 60% butane; the winter blend is 60% propane and 40% butane. The use of LPG as a popular alternative to petrol is commonplace across the world. In developed countries (including Italy, the Netherlands and Belgium), more than 30% of vehicles have been configured to run on it. Similarly, in neighbouring countries LPG is a common and much appreciated fuel. How widespread the use of LPG becomes as a propellant will depend, to some degree, on the alignment of standards harmonising requirements for the quality and composition of gases across the EU.

Table 19 Pros and cons of LPG

Pros	Cons
Low price per litre of fuel	Higher consumption of LPG versus petrol
Lower running costs	Shorter range if vehicles are run exclusively on LPG
Long range when combined with petrol	Initial investment in conversion
Widespread network of refuelling points across the country	Ban on parking in underground parking facilities
Possibility of locating a tank in the area designed for a spare wheel	The pressure vessel takes up extra space (usually in the shape of a spare wheel)

Source: Slovak Association of Petroleum Industry and Trade, 2016

Figure 4 Map of LPG refuelling points in Slovakia
Obrázok 4 Mapa čerpacích staníc LPG na Slovensku

Source: http://www.autolpg.sk/, 2016

Conclusion

Unlike other alternative fuels, LPG is covered by a relatively large nationwide network of refuelling points genuinely meeting the requirements of motor vehicle operators. Despite this, the take-up of this alternative fuel among motorists remains low. There are approximately 1 000 service stations in Slovakia; the share of LPG refuelling points is approximately 38%. It is estimated that the share of refuelling points where exclusively LPG is pumped stands at approximately 37%. Most LPG refuelling points are distributed along and in the vicinity of the main roads. Broken down regionally, most coverage can be found in the west and east of Slovakia. The range of passenger cars adjusted to run on LPG directly by the manufacturer is sufficient, and car companies are constantly adding new models to their portfolios. The infrastructure of LPG refuelling points is constantly expanding, and we expect it to develop in parallel with the development of service stations for conventional fuels.
One of the main barriers preventing the development of LPG vehicles is the restriction on parking in underground parking facilities.

8 OPERATIONAL PROGRAMMES AND INSTRUMENTS IN THE EU AND SLOVAKIA FACILITATING SUPPORT FOR THE DEVELOPMENT OF ALTERNATIVE FUELS IN TRANSPORT

Connecting Europe Facility

Opportunities for the financial support of alternative fuels under the TEN-T Regulation are offered by the ***Connecting Europe Facility*** (**CEF**), a financial instrument for the implementation of the TEN-T network in the 2014-2020 period, approved by the European Parliament in the form of Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010. The CEF is controlled directly by the European Commission, and specifically – from the point of view of transport and transport infrastructure – by DG MOVE. The implementation of this facility was delegated to the Innovation and Networks Executive Agency (INEA). The issue of promoting alternative fuels and clean mobility is addressed as part of the Horizontal Priorities – New technologies and innovation.

As part of the Commission's first call for projects under the CEF, in 2015 support was provided for a Slovak-Czech cooperation project implemented by Západoslovenská energetika, a.s., and E.ON Česká republika. This project includes studies and the pilot distribution of 29 rapid recharging points in Slovakia and the Czech Republic. The main output will be the ***Electric Vehicle Roll-Out Masterplan*** for Slovakia and the Czech Republic, which should form a basis for further policy-making and attract private investment.

Integrated Regional Operational Programme 2014-2020

Under the Integrated Regional Operational Programme 2014-2020, the promotion of sustainable mobility is covered by Priority Access 1 (Safe and environmentally friendly transport and the regions), and specifically by Investment Priority 1.2 – Developing and improving environmentally-friendly (including low-noise) transport systems, including inland waterways and maritime transport, ports, multimodal links and airport infrastructure, in order to promote sustainable regional and local mobility.

The main aim of the aid under Priority Axis 1 is to promote a sustainable local/regional transport system that guarantees mobility and access to key services for all categories of citizens, in particular by means of public passenger transport and other sustainable transport modes. The activities supported as part of the improvement in the quality of vehicles used in bus transport include the purchase of buses for urban mass transport and/or suburban bus services, highly environmental low-floor buses, combined with the construction of the corresponding supply infrastructure. One of the basic conditions for the financing of activities to develop regional and urban public passenger transport is the production of sustainable urban mobility plans. Interventions in regional bus transport will be contingent on the production of regional transport service plans and on the existence of integrated transport systems in the areas covered by the project. Support for the renewal of rolling stock in urban mass transport will also be conditional on the implementation of measures to safeguard a preference for these urban mass transport vehicles on the routes for which they are intended. Under the IROP, an indicative allocation of EUR 99 million has been earmarked to promote public passenger transport.

Operational Programme Integrated Infrastructure 2014-2020

Investments up to 2020 should be used to plug gaps and fill in missing connections in the basic infrastructure nationally and across borders, with an emphasis on sustainable, more environmentally friendly and more cost-effective transport infrastructure. In public passenger transport and sustainable urban mobility, large urban agglomerations with high concentrations of housing estates will be a focus of support, involving the promotion of the integration of transport systems and the renewal of rolling stock for the rail, passenger and urban mass (track and rail) transportation of passengers.

The current version of the Operational Programme Integrated Infrastructure does not pay particular attention to the deployment of alternative fuels in road transport because the Strategic Transport Infrastructure Development Plan up to 2020 did not identify priority projects in this area, due to the

restricted allocation compared to the requirements of the road sector, which are primarily focused on the construction of TEN-T networks and the modernisation and increased safety of class I roads. In public passenger transport, Operational Programme resources will be used to support rail and track transport (trains and trams) and trolleybus transport. This will also include the expansion of the network of electric railways. Under the Operational Programme, a separate priority axis has been created and an indicative allocation of EUR 332 million (including national co-financing) has been earmarked to promote public passenger transport.

Operational Programme Research and Innovation

Aid under the Operational Programme Research and Innovation is not sectorally defined in the part concerning the Ministry of Economy. It deals with the horizontal support of industry; specific conditions or restrictions will be defined in calls relating to the following themes:

Improvements in the quality and efficiency of production and technology processes by increasing the standard of technology and innovation at undertakings, with a focus on:

- reducing the technology gap so that product and process innovations can be made;
- priority support for the promotion of technology transfers from scientific and research organisations in Slovakia (in combination with contracted research) in order to minimise the drain of resources to other countries.

Support for research, development and innovation activities:

- the implementation of industrial R&D projects at undertakings and cluster organisations.

The introduction of innovative products and services onto the market:

- support for the emergence, for example, of intermediate operations, the production of prototypes, pilot activities, pilot testing and expansion on markets

The networking of undertakings, including clusters and technology platforms, involved in research and innovation activities:

- support of cluster cooperation and the development of cluster organisations that provide activities to the benefit of their members, including by the implementation of joint projects (especially research and innovation projects) with a view to increasing the competitiveness of individual members;
- the formation and development of clusters in new forward-looking sectors, motivation for clusters in the search for new strategic segments and the implementation of development strategies.

Horizon 2020

All schemes to promote science, research and innovation in Slovakia draw on strategic objectives defined by the EU under 'Horizon 2020 – Framework Programme for Research and Innovation'. Horizon 2020 is a strategic programme used by the EU to finance science, research and innovation between 2014 and 2020. It is a follow-up to the Seventh Framework Programme for research, technological development and demonstration (2007-2013). Horizon 2020's main target groups are researchers (at universities and research institutes or in industry), undertakings and firms. Under Horizon 2020, EUR 77 028.3 million has been earmarked for the financing of research and innovation projects between 2014 and 2020.

In Horizon 2020, the theme of alternative fuels comes under 'Secure, Clean and Efficient Energy' (biofuels) and JTI Fuel Cells Hydrogen2 (hydrogen technology). Electro-mobility and infrastructure are covered by 'Smart, Green and Integrated Transport'. Numerous calls are notified here that may also deal with this theme (some calls specifically mention alternative fuels and the projects are to tackle those problems; in other cases the project topic is up to the researchers).

Small and medium-sized enterprises established in the EU or in a country affiliated with Horizon 2020 may be awarded funds for innovation projects under the *SME Instrument*. The total allocation for this programme is EUR 3 billion.

Under Horizon 2020, Fast Track to Innovation (FTI) provides funds for innovation activities in any area of technology or the application thereof and has an overall allocation of EUR 200 million.

The support of biofuel-related research is also addressed by the partnership called Joint Technology Initiative Bio-Based Industry, operated under Horizon 2020 with an allocation of EUR 3.7 billion.

9 MEASURES PROPOSED

Fuels included in the national policy framework are eligible for Union and national support measures for alternative fuels infrastructure, in order to focus support on coordinated internal market development towards mobility using alternative fuels vehicles and vessels and the full range of regulatory and non-regulatory incentives in close cooperation with private sector actors, who should play a key role in supporting the development of alternative fuels infrastructure. The measures proposed are important instruments for the development of the market in alternative fuels in the transport sector and for the development of the corresponding national infrastructure, and they require implementation by the individual State administration stakeholders.

1. Stimulation to support sales of low-emission vehicles for all types of use (for the private sector, for the fleets of municipal undertakings operating municipal waste distribution vehicles, for the fleets of postal undertakings, and for the fleets of carriers responsible for urban mass transport and public passenger services)

Link to strategic objective	- Stimulation of demand for electric vehicles - Creation of conditions for the improved perception of electro-mobility among potential customers.
Objective of the measure	The objective of the measure is to promote sales of vehicles running exclusively on batteries and electric motors, i.e. battery electric vehicles (BEVs) or vehicles with a battery chargeable via an external power source and with a supplementary combustion engine – plug-in hybrid electric vehicles (PHEVs), from the perspective of Slovakia's potential opportunities and needs, and further to the national reference framework in the implementation of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.
Description of measure	This measure aims to stimulate growth in sales of low-emission vehicles and to provide direct support for the purchase of vehicles for all types of use (the private sector, the fleets of municipal undertakings operating municipal waste distribution vehicles, the fleets of postal undertakings, and the fleets of carriers responsible for urban mass transport and public passenger services). Taking into account experience and practices in other European countries, and bearing in mind the high price sensitivity prevailing on the Slovak market, alternative fuel vehicles are unlikely to penetrate the market without financial incentives. Direct financial incentives will focus on a motivational mechanism for the purchase of low-emission vehicles and on the testing of processes in their subsequent processing. The support mechanism will be defined in detail in the Ministry of Economy's document entitled *Specific Models to Promote Sales of Electric Vehicles and Modes of Transport Running on Alternative Fuels*. The mechanism to increase sales of vehicles running exclusively on batteries and electric motors, i.e. battery electric vehicles (BEVs) or vehicles with a battery chargeable via an external power source and with a supplementary combustion engine – plug-in hybrid electric vehicles (PHEVs), determines the follow-up technical criteria for vehicles to which the support mechanism applies: - Vehicle categories M1 and N1; - Vehicles running exclusively on batteries and electric motors, i.e. battery electric vehicles (BEVs) or vehicles with a battery chargeable via an external power source and with a supplementary combustion engine – plug-in hybrid electric vehicles (PHEVs).
Responsibility	Automotive Industry Association, Ministry of Economy
Dates	Call to register subsidy applications: by 31 December 2017, or until the overall volume of funds has been exhausted, whichever is earlier. Project completion: the month following the payment of the final subsidy (no later than 31 January 2020).

2. Support of alternative fuels infrastructure

Link to strategic objective	- Support for the construction of alternative fuels infrastructure.
Description of measure	The provision of cooperation to relevant partners in the production of grant applications under the third call of the Connecting Europe Facility, focusing on the promotion of electro-mobility, CNG/LNG refuelling points and related infrastructure, and technology for the efficient use of hydrogen as an alternative fuel. The Ministry of Transport, Construction and Regional Development works with beneficiaries by contributing to the preparation and submission of grant applications under the third call of the Connecting Europe Facility, or other calls that may be notified, focusing on the promotion of electro-mobility, CNG/LNG refuelling points and related infrastructure, and technology for the efficient use of hydrogen as an alternative fuel in Slovakia. Where necessary, the Ministry, in cooperation with Národná diaľničná spoločnosť, a.s., creates conditions and provides cooperation for the construction of recharging points for electric vehicles and hydrogen vehicles and CNG/LNG refuelling points for selected roadside service areas on motorways and expressways along TEN-T routes. Within the scope of its competence, the Ministry will also incorporate the promotion of alternative fuels and the development of relevant infrastructure into the update of the sectoral strategy (Strategic Plan for the Development of Transport up to 2030), which is to be drawn up by the end of 2016.
Responsibility	Ministry of Transport, Construction and Regional Development
Dates	2016-2030

3. Support for the deployment of alternative fuels in water transport

Link to strategic objective	- Stimulation of demand for alternative fuel vehicles - Support for the construction of alternative fuels infrastructure - Research and development relating to alternative fuels
Description of measure	To analyse opportunities for the use of alternative fuels (electricity, CNG/LNG in water transport). This measure is consistent with Directive 2014/94/EU on the deployment of alternative fuels infrastructure and with the Strategic Plan for the Development of Transport Infrastructure up to 2020, which defines Strategic Objective SV4 *Reducing the environmental impacts of water transport* and Priority SV4.1 *Reducing emissions from the operation of vessels*. In the pursuit of Priority SV4.1, the main emphasis should be on: 1. the creation of conditions for the remotoring/repowering of vessels; 2. the development and support of the deployment of new (alternative) fuels; 3. the monitoring of factors associated with the potential occurrence of negative impacts on the environment and the population (commissions, water quality); 4. the establishment of basic recharging and refuelling infrastructure for alternative fuel vessels.
Responsibility	Ministry of Transport, Construction and Regional Development
Dates	2016-2020

4. Support for the deployment of LNG refuelling points at inland ports

Link to strategic objective	- Support for the construction of alternative fuels infrastructure
Description of measure	Directive 2014/94/EU on the deployment of alternative fuels infrastructure (Article 6 (2)) provides that Member States shall ensure that an appropriate number of refuelling points for LNG are put in place at inland ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network by 31 December 2030. Member States shall cooperate with neighbouring Member States where necessary to ensure adequate coverage of the TEN-T Core Network. The Ministry of Transport, Construction and Regional Development, in accordance with measures associated with impacts on the environment and the population that are related to water transport, drew up Measure 4.6.4.3 *Construction of LNG refuelling points at Slovak Republic ports* as part of the Strategic Plan for the Development of Transport Infrastructure up to 2020. Upon the adoption of the forthcoming new European legislation on the use of alternative fuels in water transport, Member States will be required to build a network of refuelling points to supply vessels with this type of fuel. In Slovakia, there are plans to set up supply points at the public ports in Bratislava and Komárno.

	The Ministry has assisted with this initiative since 2013, when it supported the handling of the TEN-T project *LNG Masterplan for Rhine-Main-Danube* via the participation of Slovak partners in project implementation. The outputs from the LNG Masterplan, including the proposed solution to set up supply points at the public ports in Bratislava and Komárno, are supported by the Ministry. In the implementation of Directive 2014/94/EU, the main emphasis should be on: 1. the establishment of a core network of refuelling points for LNG at inland ports by the end of 2025 and 2030 (for inland waterway vessels). 2. the production of cost-benefit analyses relating to the establishment of LNG refuelling points at ports outside the TEN-T Core Network; especially at ports important for vessels not engaging in transport services, LNG refuelling points should include, inter alia, LNG terminals, tanks, mobile containers, bunker vessels and barges.
Responsibility	Ministry of Transport, Construction and Regional Development
Dates	2018-2025

5. Tax rate on motor vehicles running on compressed natural gas

Link to strategic objective	- Stimulation of demand for alternative fuel vehicles - Improved conditions for engaging in business in areas related to alternative fuels.
Description of measure	Preserve the 50% reduced annual tax rate for vehicles running on compressed natural gas (CNG).
Responsibility	Ministry of Finance
Dates	2016-2025

6. Minimum excise duty rate on natural gas supplied for the production of compressed natural gas intended for use as a fuel

Link to strategic objective	- Stimulation of demand for alternative fuel vehicles.
Description of measure	No increase in the excise duty on rate on natural gas supplied for the production of compressed natural gas intended for use as a fuel, under Act No 609/2007 on excise duty on electricity, coal and natural gas and amending Act No 98/2004 on excise duty on mineral oils, as amended, beyond the current level of EUR 0.141 per kilogram, at least until 2025. This will not apply if there is a change in European legislation governing the taxation of energy-related products.
Responsibility	Ministry of Finance
Dates	2016-2025

7. 50% reduction in the fee for registration in the vehicles register in Slovakia for motor vehicles running on alternative fuels

Link to strategic objective	- Stimulation of demand for alternative fuel vehicles.
Description of measure	A reduction in the fee for initial registration in the vehicles register in Slovakia for holders of motor vehicles in categories M1 and N1 if those vehicles run on alternative fuel (CNG, LNG, hydrogen and hybrids). The fee will be reduced by 50% (up to a maximum of EUR 33) when a holder registers a hybrid motor vehicle; a hybrid electric vehicle; a motor vehicle running on compressed natural gas (CNG); a motor vehicle running on liquefied natural gas (LNG); or a motor vehicle running on hydrogen. The measure '*Reduction in the fee for registration in the vehicles register in Slovakia for motor vehicles running on alternative fuels*' in 2017-2020 (with no year-on-year rise in registered vehicles) does not require funds directly from the central government budget. However, the waiving of this fee will reduce non-tax revenue in the central government budget by an estimated EUR 788 000 per year.
Responsibility	Ministry of Finance
Dates	from 1 February 2017

8. Introduction of low-emission zones

Link to strategic objective	- Stimulation of demand for alternative fuel vehicles.
Objective of the measure	To create legislation and establish rules so that local government bodies can establish low-emission zones in their jurisdiction that limit entry by motor vehicles.
Description of measure	Low-emission zones can be established on several levels linked to the emission limits of motor vehicles. Introducing EURO emission standards for the registration of new motor vehicles was an effective way of cutting the emissions of newly registered vehicles. According to the Czech Car Importers Association, approximately 4% of the total number of kilometres travelled by all registered vehicles in the Czech Republic are clocked up by vehicles without a catalytic converter (i.e. vehicles made before 1990), yet these vehicles are responsible for some 40% of the total emissions produced. The situation is thought to be much the same in Slovakia, so a solution needs to be found that efficiently regulates the entry of vehicles into urban areas based on the extent to which they pollute the air. The introduction of low-emission zones, which can now be found in more than 50 German towns and cities, has proved to be the most effective means for local government bodies to reduce particulate matter from traffic. *For example, in Berlin the introduction of a low-emission zone slashed dangerous dust particles from traffic by 50% over the course of three years.*
Responsibility	Ministry of the Environment, towns and municipalities
Dates	2017

9. Road user awareness of the location, type and equipment of charging and refuelling points via integrated transport systems

Link to strategic objective	- Creation of conditions for the improved perception of alternative fuels among potential customers.
Description of measure	Further to the development of smart grids and the supplementation of infrastructure with charging and refuelling points, it will be necessary to ensure that road users are aware, in particular, of the location, type and equipment of charging and refuelling points, and to create a platform for the further development of the infrastructure. The building-up of a uniform database/map of charging and refuelling points, which will have three basic functions in particular: - to inform the public of the opportunities and conditions for charging and refuelling with alternative fuels; - to provide a basis for the monitoring and further planning of infrastructure (demand, coverage, capacity, charging standards, conditions of use, etc.); - to serve as a facility for the allocation of station ID names for electric roaming purposes (only EV) in the fulfilment of the requirements of the Directive relating to interoperability and recharging points; - the publication of data indicating the geographic location of publicly accessible refuelling points and recharging points for alternative fuels. Measures conceived in this way are consistent with the Action Plan for the Development of Intelligent Transport Systems in the Slovak Republic up to 2020, with an Outlook up to 2050 (Government Resolution No 268 of 15 April 2015).
Application of the measure in Europe/the world	There are a host of such maps elsewhere in the world. They mainly cover electro-mobility and CNG/LNG and are a handy tool for the public in particular. In practice, they are also a practical tool for the further development of infrastructure.
Responsibility	Ministry of Transport, Construction and Regional Development
Dates	2016-2020

10. Awareness at schools; information on new skills and knowledge in the education system

Link to strategic objective	- Creation of conditions for the improved perception of alternative fuels among potential customers
Objective of the measure	This measure aims to promote the education of the work force for the alternative fuels sector (in particular electro-mobility, CNG/LNG), primarily in the fields of electrical engineering, electrical mechanics, transport machinery and equipment, motor vehicles, rolling stock, vessels, and machinery and equipment maintenance. The goal is to ensure the development of knowledge in these areas,

	especially in secondary and higher education, including specialised training. For this reason, a proposal has been made to supplement the education programmes and study plans at the relevant educational institutions, to include basic environmental knowledge about alternative fuels in transport in the curricula of primary schools, and to include specialist knowledge on alternative fuels in the curricula of secondary schools. Support for existing and forthcoming study fields dedicated to electric traction and electro-mobility at universities. - Address all levels of education concerned, starting with secondary vocational schools and ending with colleges and universities. - Draw up education programmes and start organising courses and training for all emergency rescue components and the police. - Expand and adapt existing study programmes and teacher training at schools of all levels of education on the theme of electro-mobility (organise this on a national scale). - Organise research internships for young researchers and students in fields related to electro-mobility. - State-declared support for international educational and research cooperation with leading world universities and research institutions. - Encourage cooperation between the business sector and the academic community (universities and the Slovak Academy of Sciences) in research and development, scale up the transfer of R&D results into practice, especially by innovating technology processes and products, and intensify the involvement of the business sector in international scientific and technical cooperation.
Description of measure	The inclusion of support for research and development in electro-mobility, hydrogen and other alternative fuels, application testing and verification among the priorities of the Slovak Republic's Smart Specialisation Strategy. The creation of conditions for cooperation between academic and industrial partners in order to put research results into practical use, and cooperation with reputable foreign research institutions. The conditions under which taxpayers can qualify for income tax concessions as one of the forms of R&D incentives. The granting of subsidies within the meaning of Section 3(1)(a) (from the central government budget) or (b) (as an income tax concession) of Act No 185/2009, on the basis of a decision to approve incentives under Section 7(7) or (8) or (10) of that Act. The entity providing incentives under Section 3(1)(b) in the form of an income tax concession is the Ministry of Finance, represented by the tax authority with due subject-matter and territorial jurisdiction. The Ministry of Education, Science, Research and Sport provides direct incentives – subsidies from the central government budget. The Ministry of Finance provides indirect incentives in the form of an income tax concession. Indirect incentives in the form of income tax concessions are tied to the provision of direct incentives, i.e. subsidies from the central government budget to tackle a specific R&D project. A decision to approve the granting of direct and indirect incentives, after the Ministry of Finance has responded to an application for incentives in accordance with Section 3(1)(b) of Act No 185/2009 on research and development incentives…, is issued by the Ministry of Education, Science, Research and Sport in accordance with Section 7(7), (8) or (10). The aims of incentives are to initiate increases in research and development spending by the business sector out of its own resources, to encourage cooperation between the business sector and the academic community (universities and the Slovak Academy of Sciences) in research and development, to scale up the transfer of R&D results into practice, especially by innovating technology processes and products, and to intensify the involvement of the business sector in international scientific and technical cooperation.
Responsibility	Ministry of Education, Science, Research and Sport, Ministry of Economy, Slovak Innovation and Energy Agency
Dates	2017-2025

SUMMARY

Alternative fuels are used as a partial replacement for the most commonly used fuels in the transport sector – petrol and diesel. They are being gradually scaled up in the transport sector in order to help to diversify fuel resources (as an alternative to petroleum fuels), to eliminate greenhouse gas emissions and to enhance the environmental impacts of this sector.

The lack of harmonised development of support for means of transport (vehicles, vessels, etc.) and alternative fuels infrastructure prevents the development of economies of scale on the supply side and mobility on the demand side. New infrastructure networks need to be built up, such as for electricity, liquefied natural gas (LNG) and compressed natural gas (CNG), and networks need to be completed for liquefied petroleum gas (LPG) and, where appropriate, hydrogen. Technological neutrality should be ensured and due account should be taken of the requirement to support the commercial development of alternative fuels. However, the building of infrastructure must not be autotelic, but needs to be harmonised with the development of the market in low-emission vehicles. In the preparation of support measures for the development of alternative fuel use, the development of infrastructure and the vehicles market should be viewed as a single integral whole because neither of these aspects would be able to function successfully on its own.

Electricity has the potential to increase the energy efficiency of road vehicles and to contribute to a CO_2 reduction in transport. It is a power source that is indispensable for the deployment of electric vehicles, including L-category vehicles, which can contribute to improving air quality and reducing noise in urban agglomerations and other densely populated areas. Another important requirement is to ensure that recharging points accessible to the public are built up with adequate coverage, in order to enable electric vehicles to circulate at least in urban/suburban agglomerations and other densely populated areas. Electro-mobility is a fast developing area. Current recharging interface technologies include cable connectors, but future interface technologies such as wireless charging or battery swapping need to be considered as well.

The recharging of electric vehicles at recharging points should, if technically and financially reasonable, make use of intelligent metering systems in order to contribute to the stability of the electricity system by recharging batteries from the grid at times of low general electricity demand and to allow secure and flexible data handling. The interface to charge electric vehicles could include several socket outlets or vehicle connectors as long as one of them complies with the technical specifications set out in the Directive, so as to allow multistandard recharging.

Vessels used in passenger and freight shipping, upon arriving in a port, should be able to connect to a shore-side electricity supply while parked and moored in the port. This significantly reduces emissions in this area, which is also in line with the Strategic Plan for the Development of Transport Infrastructure up to 2020, a document defining Strategic Objective SV4 '*Reducing the environmental impacts of water transport*' and Priority SV4.1 '*Reducing emissions from the operation of vessels*'.

As far as vehicles running on natural gas are concerned, refuelling points could be put in place and supplied from an existing well-developed area covering natural gas distribution networks, provided that the quality of the gas is suitable for use in current and advanced technology gas vehicles. The current distribution network for natural gas could be supplemented with refuelling points utilising locally produced biomethane.

The Slovak Government is striving to ensure that an appropriate number of refuelling points accessible to the public for the supply of CNG or compressed biomethane to motor vehicles is built up, in order to ensure that CNG motor vehicles can circulate in towns and other densely populated areas. An important role is played by the deployment of refuelling points accessible to the public that takes into account the minimum range of CNG motor vehicles. As an indication, the necessary average distance between refuelling points should be no more than 150 km.

The LNG distribution chain includes, inter alia, NG production, LNG terminals, tanks, LNG or L-CNG refuelling points for road traffic, mobile containers, bunker vessels and barges. The initial focus on the core network of ports should not rule out the possibility of LNG also being made available in the longer term at ports outside the core network, in particular those ports that are important for vessels not engaged in transport operations. The decision on the location of the LNG refuelling points at ports should be based on a cost-benefit analysis, including an examination of the environmental benefits. Applicable safety-related provisions should also be taken into account. The necessary

average distance between refuelling points should be no more than 400 km for road transport, where LNG is an attractive fuel for heavy goods vehicles and buses.
In light of the increasing diversity in the type of fuels for motorised vehicles coupled with on-going growth in the road mobility of citizens across the Union, it is necessary to provide vehicle users with clear and easy-to-understand information on the fuels available at refuelling stations and on the compatibility of their vehicle with different fuels or recharging points on the EU market. Simple and easy-to-compare information on the prices of different fuels could play an important role in enabling vehicle users to better evaluate the relative cost of individual fuels available on the market. Therefore, when fuel prices are displayed at a fuel station, in particular for natural gas and hydrogen, it should be possible for unit price comparison to conventional fuels to be displayed for information purposes. A suitable backdrop needs to be created for the use and development of advanced biofuels in Slovakia in order to secure investment in the development and production thereof, such being by establishing binding targets for the use of advanced biofuels in Slovakia at least up to 2030. The attractive pricing of advanced biofuels could be encouraged by means of the following incentives: the support of research into advanced biofuels, the establishment of a binding national target for advanced biofuels, and the establishment of the obligation to blend advanced biofuels into motor fuels, accompanied by penalties for non-compliance with this obligation. This document defines measures to comply with national objectives and plans under the national policy framework, measures to promote the deployment of alternative fuels infrastructure in public transport services, an assessment of the location of liquefied natural gas refuelling points at ports that do not belong to the TEN-T Core Network, and an assessment of the need to install facilities at airports for the supply of electricity to meet the needs of aircraft at stands.
Fuels included in the national policy framework are eligible for Union and national support measures for alternative fuels infrastructure, in order to focus support on coordinated internal market development towards mobility using alternative fuels vehicles and vessels and the full range of regulatory and non-regulatory incentives in close cooperation with private sector actors, who should play a key role in supporting the development of alternative fuels infrastructure.
In view of the need to promote energy sources with the lowest possible greenhouse gas emission ceiling (CO_2 equivalent), the tax burden system needs to be revised because it is currently configured severely to the detriment of fuels with the best emission values. This tax burden system is a major impediment to the further development of alternative fuels with the best emission ceilings, and hence needs to be revised to accommodate those fuels.
This document contains measures that are important instruments for the development of the market in alternative fuels in the transport sector and for the development of the corresponding national infrastructure, and they require implementation by the individual State administration stakeholders.

LIST OF TABLES

LIST OF FIGURES AND GRAPHS

LIST OF ANNEXES

Annex 1 List of abbreviations

B(a)P	Benzo(a)pyrene
BEV	Battery electric vehicle
BEV	Battery electric vehicle
CEF	Connecting Europe Facility
CNG	Compressed natural gas
CO2	Carbon dioxide
VAT	Value added tax
DS	Distribution system
Commission	European Commission
EU	European Union
FEI STU	Faculty of Electrical Engineering and Information Technology, Slovak University of Technology
H2	Hydrogen
HC	Hydrocarbons
HEV	Hybrid electric vehicles
HEV	Hybrid electric vehicles
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
LUV	Light commercial vehicle
MDVRR SR	Ministry of Transport, Construction and Regional Development of the Slovak Republic
MF SR	Ministry of Finance of the Slovak Republic
MH SR	Ministry of Economy of the Slovak Republic
MHD	Urban Mass Transport
MPO ČR	Ministry of Industry and Trade of the Czech Republic
MŠVVaŠ SR	Ministry of Education, Science, Research and Sport of the Slovak Republic
MV SR	Ministry of the Interior of the Slovak Republic
MV SR	Ministry of the Interior of the Slovak Republic
NO2	Nitrogen dioxide
NOx	Nitrogen oxides
OA	Passenger car
OM	Delivery point
RES	Renewable energy sources
DSO	Electricity distribution system operator(s)
PEV	Plug-in electric vehicles
PHEV	Plug-in hybrid electric vehicles
PHM	Fuel
PM10	Solid dust particles (particles smaller than 10 μm)
PM2,5	Solid dust particles (particles smaller than 2.5 μm)
PS	Refuelling points
SAV	Slovak Academy of Sciences
SEVA	Slovak Electric Vehicle Association
SIEA	Slovak Innovation and Energy Agency
SjF STU	Slovak University of Technology in Bratislava, Faculty of Mechanical Engineering
SPRDI	Strategic Plan for the Development of Transport Infrastructure in the Slovak Republic up to 2020
SR	Slovak Republic
TEN-T	Trans-European Transport Networks
UPJŠ	Pavol Jozef Šafárik University
URSO	Regulatory Office for Network Industries
VÚC	Higher territorial unit
ZAP SR	Automotive Industry Association of the Slovak Republic

Annex 2 Average life cycle greenhouse gas intensity default values for fuels other than biofuels and electricity

Table 20 Average life cycle greenhouse gas intensity default values for fuels other than biofuels and electricity

Raw material source and process	Fuel placed on the market	Life cycle GHG intensity (gCO2eq/MJ)	Weighted life cycle GHG intensity (gCO2eq/MJ)
Conventional crude	Petrol	93.2	93.3
Liquefied natural gas		94.3	
Coal-to-Liquid		172	
Natural bitumen		107	
Oil shale		131.3	
Conventional crude	diesel fuel or gasoil	95	95.1
Liquefied natural gas		94.3	
Coal-to-Liquid		172	
Natural bitumen		108.5	
Any fossil sources	Liquefied Petroleum Gas in a spark ignition engine	73.6	73.6
Natural Gas, EU mix	Compressed Natural Gas in a spark ignition engine	69.3	69.3
Natural Gas, EU mix	Liquefied Natural Gas in a spark ignition engine	74.5	74.5
Sabatier reaction of hydrogen from non-biological renewable energy electrolysis	compressed synthetic methane in a spark ignition engine	3.3	3.3
Natural gas using steam reforming	Compressed Hydrogen in a fuel cell	104.3	104.3
Electrolysis fully powered by non-biological renewable energy	Compressed Hydrogen in a fuel cell	9.1	9.1
Coal	Compressed Hydrogen in a fuel cell	234.4	234.4
Coal with Carbon Capture and Storage of process emissions	Compressed Hydrogen in a fuel cell	52.7	52.7
Waste plastic derived from fossil feedstocks	Petrol, diesel or gasoil	86	86

Source: Council Directive (EU) 2015/652 of 20 April 2015 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.

Annex 3 Current number of public CNG and LNG/LCNG refuelling points and number of vehicles running on natural gas in EU and EFTA countries

Table 21 Current number of public CNG and LNG/LCNG refuelling points and number of vehicles running on natural gas in EU and EFTA countries[14]

Country	CNG point	LNG/LCNG point	Number of vehicles
Austria	175	0	8,323
Belgium	20	3	1,033
Bulgaria	108	0	61,320
Croatia	3	0	329
Czech Republic	81	0	7,488
Denmark	7	0	104
Estonia	5	0	340
Finland	23	1	1,689
France	37	3	13,550
Germany	919	1	98,172
Greece	10	0	1,000
Hungary	5	0	340
Iceland	5	0	1,371
Ireland	0	0	3
Italy	1,010	2	885,300
Latvia	1	0	29
Liechtenstein	3	0	143
Lithuania	1	0	380
Luxembourg	7	0	270
Netherlands	133	7	7,573
Norway	17	0	667
Poland	25	0	3,600
Portugal	3	3	586
Romania	0	0	0
Slovakia	10	0	1,426
Slovenia	3	1	58
Spain	45	15	3,990
Sweden	161	11	46,715
Switzerland	134	0	11,640
UK	7	13	718
TOTAL	2,958	60	1,162,935

Source: SPP, 2016

Annex 4 Overview of alternative fuel support mechanisms abroad[15]

The deployment of alternative fuels infrastructure is a relatively new and innovative area abroad, too, hence attention is devoted first and foremost to the support of research and development. As the market in alternative fuels is taking off in each country in different directions, it would be fair to say that many countries are striving to stimulate the market in this area by means of measures devoted to tax concessions, depreciation, vehicle purchase subsidies, and subsidies for the establishment of recharging and refuelling points.
Below is a list of inspirational measures to promote alternative fuels that have been deployed in other countries:

- Direct subsidies for the purchase of vehicles running on alternative fuels (France – the purchase of a passenger car generating CO_2 of up to 120 g/km is eligible for support amounting to EUR 1 000; 20-60 g CO_2/km = EUR 4 000; up to 20 g CO_2/km = EUR 6 300; companies are given VAT refunds for a set quantity of CNG purchased; 12-month depreciation of investments relating to CNG refuelling points);
- Support for the establishment of recharging and refuelling points (subsidies or tax concessions – USA, Belgium);
- Financing of pilot projects;
- Reduced excise duty (Estonia, Spain, Sweden, France, Portugal, Austria, Slovenia, Germany, UK and Italy), or zero excise duty (Latvia, Luxembourg, Belgium, Hungary, Malta, Bulgaria, Ireland, France);
- Tax advantage
  - all low-emission vehicles (below 100 g CO_2/km in the UK) are exempt from road tax
  - for electric vehicles:
    - exemption from the payment of road tax (monthly in Austria, annually in Portugal);
    - significantly reduced road tax rate (Belgium);
    - exemption from road tax for a certain period from initial registration (10 years in Germany, five years in Italy);
    - exemption from road tax and motorway vignettes or tolls (Norway).
- Support of research and development (e.g. national studies on the promotion of the deployment of alternative fuels and other forms of clean mobility – Luxembourg, Germany, Netherlands);
- The creation of low-emission zones in city centres (Norway – Oslo, UK – London, Spain – Madrid);
- Dedicated parking spaces and dedicated lanes (Germany, Netherlands, Norway);
- In May 2016, the German government approved a new scheme of incentives worth EUR 1 billion to promote demand for electric cars. These vehicles will be exempt from tax for 10 years, which should also help to push up sales;
- Awareness and campaigns related to alternative modes of transport (UK – the national campaign Go Ultra Low, Germany);
- Multi-sector cooperation in the pursuit of national policies promoting alternative fuels and clean mobility, especially the economic, transport, environmental and education sectors.

Support of CNG in selected European countries:

- **Czech Republic**

The Czech Republic has approved two significant resolutions in the past:

- A scheme to replace the fleet of vehicles used by public administration with '*environmentally friendly vehicles*' – Resolution of the Government of the Czech Republic No 1595 of 16 December 2008.

[15] Forms of electro-mobility support elsewhere in the world are defined in more detail in the document *Strategy for the Development of Electro-mobility in the Slovak Republic and its Impact on the National Economy of the Slovak Republic*

- A scheme to promote alternative fuels in the transport sector – natural gas – Resolution of the Government of the Czech Republic No 563 of 11 May 2005.
- The Czech Ministry of Industry and Trade entered into an agreement with gas companies on the expansion of natural gas as an alternative fuel in the transport sector. Basic tools incorporated into the agreement include:
- the construction of one refuelling point per gas company in their territory within one year;
- the construction of a refuelling point in regions where the self-governing region decides to switch the fuel base of buses to natural gas (at least four buses);
- the construction of CNG refuelling points along the main transit roads by 2013;
- the gas companies will arrange for the construction of a network of 100 CNG refuelling points by 2020;
- the gas companies will arrange for the standardisation of the construction and operation of their refuelling points;
- the gas companies, for the marketing support of scheduled passenger services and urban mass transport, will provide a subsidy of CZK 200,000 per newly purchased bus (up to a total amount of CZK 10 million);
- the gas companies will arrange for a communication policy for public awareness and will organise practical demonstrations demonstrating the safety of gas vehicles;
- the State will take part in the communication campaign as a partner;
- the State will promote the use of natural gas in the transport sector as one of the priorities of the National Programme of Efficient Energy Management 2006-2009;
- the State will commission an economic analysis of the potential for the gradual replacement of the vehicles of State bodies and State-controlled organisations.

Support mechanisms:

- a temporary reduction in excise duty (translated into EUR using an exchange rate of 27 CZK per EUR)
- 2007-2011 – rate of CZK 0 per tonne (EUR 0 per kilogram);
- 2012-2014 – rate of CZK 500 per tonne (EUR 0.0185 per kilogram);
- 2015-2017 – rate of CZK 1 000 per tonne (EUR 0.037 per kilogram);
- 2018-2019 – rate of CZK 2 000 per tonne (EUR 0.074 per kilogram);
- 2020 onwards – rate of CZK 3 355 per tonne (EUR 0.124 per kilogram), or the minimum EU level;
- zero road tax on CNG vehicles up to 12 t and urban mass transport vehicles;
- subsidies by the transport ministry for the purchase of CNG buses for public transport (a total budget of CZK 1.5 billion);
- subsidies by gas companies for the purchase of CNG buses for public transport;
- government subsidy for the purchase of a new bus at EUR 20 700 per bus;
- contributions by gas companies of EUR 6 900 for marketing support.

New support mechanisms under consideration:

- investment support for the construction of public refuelling points;
- investment support for the construction of refuelling points for urban mass transport and rail transport;
- increased depreciation rates in the first year of depreciation of refuelling point infrastructure;
- an extension to the period of the reduced excise duty rate;
- scrap allowance – a subsidy following the production of a document evidencing the environmentally friendly disposal of an end-of-life vehicle and the purchase of a new vehicle running on CNG;
- a reduction in the charge for motorway vignettes depending on vehicle parameters – the lower the emissions, the lower the charge;
- a manual on a uniform method for the approval of the construction of CNG refuelling points;
- the extension of the reduced road tax to CNG vehicles above 12 t;
- a subsidy for the purchase of CNG vehicles for bodies of State administration and local government and their subordinate organisations;
- support for the purchase of vehicles running on alternative fuels for transport companies and

urban mass transport, and for suburban bus services;
- a revision of regulations relating to the indoor parking of CNG vehicles;
- a revision of regulations and standards relating to the servicing of gas vehicles;
- educational and communication events for industry insiders and the general public.

➢ **Austria**

- a reduced excise duty rate for fuel, currently valid until 2025 (EUR 0.09 per kilogram);
- *NoVA-Bonus* – a EUR 600 concession by the finance ministry to compensate for the difference in the purchase price between a CNG version and a conventional version of a vehicle, applicable until the end of 2015 – when purchasing a vehicle that protects the environment;
- *klima:aktiv mobil* – a EUR 500 subsidy for the purchase of a vehicle running on natural gas, applicable to vehicles up to 2.5 t, and a EUR 1 000 subsidy for vehicles between 2.5 t and 5 t;
- a special charge for the transmission of natural gas intended for the production of CNG in the Austrian gas network;
- individual regions and energy suppliers provide subsidy-related assistance:
  - Burgenland – EUR 750 for passenger cars running on CNG;
  - Lower Austria – EUR 700 for passenger cars running on CNG, and EUR 2 000 for taxis and driving school cars;
  - Upper Austria – refuelling vouchers for new CNG vehicles, discounts for vehicles, tyres, insurance and leasing;
  - Salzburg – refuelling vouchers for new CNG vehicles up to 500 kg, a subsidy of up to EUR 500 for CNG vehicles used as taxes;
  - Styria – a subsidy from Steiermark energie AG for CNG vehicles of EUR 600 for undertakings, EUR 800 for taxis, and EUR 950 for driving school cars + EUR 300 from the federal government; extra scheme by the federal government – a subsidy for new CNG vehicles of up to EUR 2 450 if they are to be used as taxis;
  - Tyrol – a subsidy of EUR 1 310 for new CNG vehicles;
  - Vorarlberg – refuelling vouchers for new CNG vehicles up to 500 kg;
  - Vienna – a subsidy for new CNG vehicles of EUR 1 000 for private individuals and EUR 3 000 taxis.

➢ **Germany**

- a discount on excise duty on fuel, currently valid until 31 December 2018. CNG and LNG are taxed at EUR 13.90 per MWh; without the discount, excise duty is EUR 31.80 per MWh;
- Special-rate tax on motor vehicles, depending on the engine capacity and the amount of CO_2 produced. An extra EUR 2 is paid per gram of CO_2 above the EU limit;
- gas companies provide support of up to EUR 1 000 (this support is mainly provided in the form of a fixed-amount refuelling voucher).

New support mechanisms under consideration:

- continuation of the special-rate excise duty on CNG until 2026 (the German Parliament has ordered the government to extend the period of this special rate);
- the preparation of a policy for the transparent presentation of CNG pricing (ideally in litre equivalents);
- the preparation of an efficient support scheme for the introduction of CNG in heavy-duty freight transport and in logistics transport;
- the introduction of methodology for the calculation of running costs over the life cycle of a vehicle in accordance with Directive 2009/33/EEC for public contracts;
- a reduction in charges for access to the gas network.

➢ **Italy**

- a scrap allowance for CNG vehicles (EUR 1 500 for purchasing a CNG vehicle)/(EUR 6 500 in 2009/10);
- a government financial subsidy for the purchase of CNG vehicles (up to 2010);

- regional subsidies for the construction of CNG refuelling points (2009-2011);
- a financial subsidy for the conversion of a vehicle to run on CNG;
- zero road tax on CNG vehicles or vehicles with CO_2 emissions of up to 120 grams per kilometre;
- reduced excise duty on CNG.

➢ **Sweden**
- reduced excise duty on CNG;
- reduced road tax for CNG vehicles;
- reduced personal income tax for the use of a CNG company car for private purposes, up to EUR 900 per year;
- financial support (usually up to 30% of the overall investment) for the construction of CNG refuelling points;
- free parking for environmentally friendly vehicles in cities.

➢ **France**
- a tax bonus for purchasing a CNG passenger car;
- a special 12-month depreciation period for CNG freight vehicles;
- subsidies for the purchase of CNG vehicles (30% of the overcharge for freight vehicles; EUR 15 000 for buses; EUR 7 500 for municipal vehicles);
- reduced excise duty (EUR 0.04 per kilogram);
- a financial subsidy for the conversion of a vehicle to run on CNG.

➢ **Netherlands**
- a discount on the vehicle registration tax;
- an exemption from vehicle tax;
- a scheme for reduced excise duty on natural gas used to produce CNG, depending on the quantity;
- financial support for the construction of refuelling points for alternative fuels.

Annex 5 Current range of CNG vehicles[16]

Passenger cars

- Audi A3 Sportback g-tron
- Fiat Qubo Natural Power
- Fiat Panda Natural Power
- Fiat Punto Natural Power
- Fiat 500L Natural Power
- Fiat 500 L Living Natural Power
- Lancia Ypsilon Ecochic CNG
- Mercedes-Benz B-Class B 200 NGD
- Mercedes-Benz E-Class E 200 NGD
- Opel Zafira Tourer 1.6 CNG Turbo
- Seat Mii Ecofuel
- Seat Leon TGI
- Seat Leon ST TGI
- Škoda Citigo G-TEC
- Škoda Octavia Limusine G-TEC
- Škoda Octavia Combi G-TEC
- Volkswagen eco up!
- Volkswagen load up!
- Volkswagen Golf TGI
- Volkswagen Golf TGI Variant
- Volvo V60 Bi-fuel
- Volvo V70 Bi-fuel

Bus transport

- IVECO Urbanway /Crossway/ Daily Citys CNG
- MAN Lion's city CNG
- Scania Citywide LE/LF CNG
- Solaris Urbino CNG
- SOLBUS Solcity CNG (the only producer who also offers an LNG version for buses)
- Van Hool CNG
- Vectia Veris CNG

Light commercial vehicles

- Fiat Panda Van Natural Power
- Fiat Punto Van Natural Power
- Fiat Fiorino Natural Power
- Fiat Fiorino Cargo Natural Power
- Fiat Doblo Natural Power
- Fiat Doblo Cargo Natural Power
- Opel Combo 1.4 CNG Turbo
- Opel Combo Cargo 1.4 CNG Turbo
- Volkswagen Caddy Panel / Passenger TGI

Vans

- Fiat Ducato Cargo Natural Power
- Iveco Daily Natural Power
- Iveco Daily Cabinato Natural Power
- Mercedes-Benz Sprinter NGT Panel Van
- Mercedes-Benz Sprinter NGT Group Van (up to 9 seats)
- Mercedes-Benz Sprinter NGT Pickup Van

[16] Source: http://www.ngvaeurope.eu/ng-vehicle-catalogue.

Freight logistics transport and municipal vehicles

- Iveco Stralis Hi Road Cabinato CNG
- Mercedes-Benz Econic NGT
- Renault D Wide CNG
- Scania P/G 280/340 CNG
- Volvo FE CNG

Long-distance freight transport

- IVECO Stralis Hi Road LNG (tractor)
- SCANIA P/G 280/340 LNG (tractor)

Annex 6 Utility, combustion and application characteristics of hydrogen

Table 22 Utility, combustion and application characteristics of hydrogen

	Pros	**Cons**	**Remarks**
high calorific value	142 MJ/kg – 3 times higher than that of petrol	Higher consumption of H_2. Larger engine displacement for H_2.	Energy released from hydrogen: 10.7 MJ/m^3, 119 MJ/kg
Low density			Density = 0.0899 kg/m^3
Combustion	- wide range of flammability - possibility of combustion in poor blend - lower combustion temperature – lower emissions.	Combustion is hard to identify because it burns with a bright blue ('hidden') flame with a high temperature from 2,800 to 3,100 °C.[17]	Colourless, tasteless and odourless gas.
Low ignition energy	Much less energy is required to ignite hydrogen than petrol.	Premature ignition of the blend of hydrogen and air from the hot engine components.	The blend is ignited almost immediately.
A high auto-ignition temperature	- possibility of employing a higher compression ratio - possibility of a higher pressure of the blend of hydrogen and air.	The need for increased fire safety measures.	The high auto-ignition temperature limits the use of hydrogen as a fuel for compression-ignition engines.
High-speed flame spread	An order of magnitude higher than that of petrol.	The need for increased fire safety measures.	The entire combustion process is close to the ideal thermodynamic cycle of the engine.
High diffusion	- more homogeneous blend of hydrogen and air; - better combustion.	- penetration of hydrogen molecules into construction materials - hydrogen corrosion – causing fragility and the poor strength of materials - migration of carbon from steel - need for the use of construction materials resistant to hydrogen corrosion.	If hydrogen leaks into the environment, it quickly dissipates.

Source: Slovak Association of Petroleum Industry and Trade, 2016

[17] Hydrogen will not be used in cars with conventional internal combustion engines, but in cars with fuel cells. This renders the above disadvantage irrelevant when used in the transport sector.