



Clean Transport - Support to the Member States for the Implementation of the Directive on the Deployment of Alternative Fuels Infrastructure

Good Practice Examples

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ABBREVIATIONS AND ACRONYMS

AAP	Atmosphere Protection Plan
AC	Alternate Current
ACNUSA	Autorité de Contrôle des Nuisances Aéroporutaires
AEDIVE	Asociación Empresarial para el Desarrollo e Impulso del Vehículo Eléctrico
AFI	Alternative Fuel Infrastructure
AFV	Alternative Fuel Vehicle
AHU	Air Handling Unit
APU	Auxiliary Power Unit
BEV	Battery Electric Vehicle
BTS	Barge to Ship
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CCNR	Central Commission for the Navigation of the Rhine
CEF	Connecting Europe Facility
CHADEMO	CHArge de Move
CMP	Copenhagen-Malmö Port
CNG	Compressed Natural Gas
DC	Direct Current
DGAC	Direction Générale de l'Aviation Civile
DSO	Distribution System Operator
EAFO	European Alternative Fuels Observatory
EC	European Commission
EIB	European Investment Bank
ELENA	European Local ENergy Assistance
EMO	Electro Mobility Operator
ETS	Emission Trading System
EU	European Union
EV	Electric Vehicle

EVSE	Electric Vehicle Supply Equipment
FEGP	Fixed Electrical Ground Power
FEGP	Fixed Electrical Ground Power
FSRU	Floating Storage and Regasification Unit
GHG	GreenHouse Gas
GIE	Gas Infrastructure Unit
GPU	Ground Power Unit
GTA	Gendarmerie des Transports Aériens
HDT	Heavy Duty Vehicle
HRS	Hydrogen Refuelling Station
HVAC	Heating, Ventilation, and Air Conditioning
HVSC	High Voltage Shore Connection
IATA	International Air Transport Association
ICPDR	International Commission for the Protection of the Danube River
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardisation
ITS	Intelligent Transportation System
JRC	Joint Research Centre
LDV	Light Duty Vehicle
LEV	Light Electric Vehicle
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTO	Landing and Takeoff
MDO	Marine Diesel Oil
MDV	Medium Duty Vehicle
MS	Member State
NKL	Nationaal Kennisplatform Laadinfrastructuur
OPEX	Operational Expenditure
OPS	Onshore Power Supply
PCA	Pre-Conditioned Air
PCA	Pre-conditioned air systems
PHEV	Plug-In Hybrid Electric Vehicle
POU	Point Of Use
PPP	Public Private Partnership
RCS	Removable Container to Ship
ROPAX	Roll-on/roll-off Passengers

RTD&D	Research, Technological Development and Demonstration
SEAP	Sustainable Energy Action Plan
SECA	North European Sulphur Emission Control Area
SHHP	Scandinavian Hydrogen Highway Partnership
SSE	Shore Side Electricity
STS	Ship to Ship
SUMP	Sustainable Urban Mobility Plan
TEN-T	Trans European Network – Transport
TIM	Time In Mode
TPS	Terminal to Ship via Pipeline
TTS	Tank Truck to Ship
VAT	Value Added Tax
RATP	Régie Autonome des Transports Parisiens

1 INTRODUCTION

In Europe, the transport sector is responsible for around a quarter of greenhouse gas emissions making it the second biggest greenhouse gas emitting sector after energy; road transport alone contributes about one-fifth of the EU's total emissions of carbon dioxide (CO₂), the main greenhouse gas (European Commission 2015, Climate Action).

The main environmental goal of Europe is represented by the reduction of the global GHG emission and the transport sector plays a main role in the achievement of this objective. In fact, the Commission's White Paper proposed a reduction of 60% in greenhouse gas emissions from transport by 2050, as measured against the 1990 levels.

According to research¹, the use of alternative/clean fuels is one of the solutions that produce the most significant effects, mainly in the reduction of GHG emissions.

This objective will be reachable by breaking the over-dependence of European transport on oil and then with the introduction of the necessary alternative fuels infrastructure. In 2012, transport in Europe was 94 % dependent on oil, 86 % of it being imported (DG MOVE - Expert group on future transport fuels - State of the Art on Alternative Fuels Transport Systems, 2015).

The build-up of alternative fuel infrastructure will contribute to economic growth and support job creation in a sector of growing importance for Europe and worldwide. This will improve the competitiveness of EU industry in the fields of alternative fuel technologies for all modes of transport – in particular the automotive and shipping industries.

The build-up of a European alternative fuels infrastructure will also allow for free movement of goods and persons, with vehicles running on alternative fuels across the whole EU. This will facilitate the development of a single EU market for alternative fuels and vehicles which will permit the industry to benefit from economies of scale.

The policy framework in the field of alternative fuels is mainly defined by European Union, in particular with:

- Europe 2020 Strategy. COM 2010 (2020);
- Reports of the European Expert Group on "Future Transport Fuels" (First: January 2011²; Second: December 2011³; Third: 2015, July⁴);
- 2011 White Paper on Transport. COM 144 (2011);
- Clean Power for Transport Package (alternative fuels for sustainable mobility in Europe). COM 17 (2013), and COM 18 (2013);

¹ E.g. see U.S. DOE Energy Efficiency and Renewable Energy

² <http://ec.europa.eu/transport/themes/urban/cts/doc/2011-01-25-future-transport-fuels-report.pdf>

³ <http://ec.europa.eu/transport/themes/urban/cts/doc/2011-12-2nd-future-transport-fuels-report.pdf>

⁴ <http://ec.europa.eu/transport/themes/sustainable/studies/doc/2015-07-alter-fuels-transport-syst-in-eu.pdf>

- Directive 2014/94/EU (Directive, in the following) on the deployment of alternative fuels infrastructure, adopted by the European Parliament and the Council on 22 October 2014, defines alternative fuels as 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 (article 2 of the directive).

The Directive promotes the use of private investments rather than public resources for the development of the alternative fuel infrastructure and introduces the following main measures:

- **Minimum levels of infrastructure across the EU** – Member States are required to submit to the Commission national policy frameworks and to deploy minimum levels of infrastructure – refuelling and recharging points – for alternative fuels such as electricity, hydrogen and natural gas. The targets and objectives which Member States will set themselves will be published by the Commission. The Directive requires the Commission to assess the national policy frameworks and their coherence at Union level, including whether national targets and objectives are sufficient to deliver a critical mass of infrastructure or whether mandatory targets at EU level – as had been originally proposed by the Commission – will be needed;
- **EU wide standards for the infrastructure** - Common EU wide standards are essential for the development of alternative fuels. The agreement requires the use of common plugs for electric vehicles and standardised refuelling equipment for hydrogen and natural gas as well as the development of future standards for wireless recharging points, battery swapping technology and standardised plugs for buses and motorcycles. This will end the uncertainty that has been constraining supply and demand;
- **Clear consumer information to facilitate use of alternative fuels** – Clear and easy to understand information should be provided on the fuels available at refuelling stations and on the compatibility of the vehicle with different fuels or recharging points on the market in the European Union. Key information concerning the availability of recharging and refuelling points and any other information necessary for EU-wide mobility should be included, where applicable, within traffic and travel information services as part of the ITS. Last but not least, the Directive includes provisions regarding information enabling price comparison between different fuels.

Changes in the current national regulatory frameworks and intervention programs for the development of the alternative fuels in the transport sector are needed in order to create the conditions for fuel suppliers and distributors to invest in this sector.

The initial costs for alternative fuels infrastructure are generally higher than those of petroleum-based fuels, especially due to the lack of economies of scale and the small number of circulating vehicles ("chicken and egg" problem). There is a vicious circle whereby investors do not invest in infrastructure as there is an insufficient number of alternative fuels vehicles and vessels, while the manufacturing industry does not offer alternative fuels vehicles and vessels at competitive prices as demand is low, since consumers do not purchase alternative fuels vehicles and vessels as the alternative fuel infrastructure is lacking.

Coordinated policy frameworks in all Member States would provide the long-term security required for private and public investment in vehicle and fuel

technology, and infrastructure build-up. The result of this process could be reflected in minimising dependence on oil and on mitigating the environmental impact of transport.

Coordination among national policy frameworks and their coherence at Union level could be supported by cooperation between Member States and the Commission by means of exchange of information and good practices among Member States in the alternative fuels infrastructure deployment and management.

In the elaboration of the national policy frameworks, the following aspects could be taken into account:

- needs of the different transport modes existing on the territory of the Member State concerned;
- maturity level and level of dissemination of the alternative fuel and related technology and infrastructure in the Member State and at European and worldwide level. This means to acknowledge the different stages of development of each fuel technology, with reference to each transport mode, also considering the maturity of business models for private investors and the availability and user acceptance of alternative fuels;
- identification of national targets and objectives in close cooperation with regional and local authorities and with industry concerned, taking into account the needs of small and medium-sized enterprises;
- designation of urban/suburban agglomerations, of densely populated areas and of networks which are to be equipped with electric recharging points and CNG refuelling points; assessment of the need to install LNG refuelling points in ports outside the TEN-T Core Network and install electricity supply at airports for use by stationary airplanes;
- cooperation with neighbouring Member States, at regional or macro-regional level, to guarantee continuity of alternative fuels infrastructure coverage across national borders or the construction of new infrastructure in proximity of national borders;
- identification of possible supporting measures to create the necessary conditions to invest in the alternative fuel sector and to ensure that national targets defined can be reached.

2 ASSESSMENT OF THE CURRENT STATE AND FUTURE DEVELOPMENT OF THE MARKET AS REGARDS ALTERNATIVE FUELS IN THE TRANSPORT SECTOR

Much has been achieved since the EU adopted its first package of climate and energy measures in 2008. The EU is now well on track to meet the 2020 targets for greenhouse gas emissions reduction and renewable energy and significant improvements have been made in the intensity of energy use thanks to more efficient buildings, products, industrial processes and vehicles. The 20/20/20 targets⁵ for greenhouse gas emissions, renewable energy and energy savings have played a key role in driving this progress and it is now time to reflect on the policy framework we need for 2030. In line with stakeholders' responses to the Green Paper, there is a need to continue to drive progress towards a low-carbon economy which ensures competitive and affordable energy for all consumers, creates new opportunities for growth and jobs and provides greater security of energy supplies and reduced import dependence for the Union as a whole.

The 2030 policy framework should be based on full implementation of the 20/20/20 targets and on the application of the following key elements of the process: greenhouse gas emissions target, renewable energy target at EU level, energy efficiency, reform of the Emissions Trading System, ensuring competition in integrated markets, promoting security of energy supply⁶.

The European Commission launched in February 2015 the Energy Union Strategy that is a project to coordinate the transformation of European energy supply.

A Energy Union Framework Strategy will ensure that Europe has secure, affordable and climate-friendly energy. Wiser energy use while fighting climate change is both a spur for new jobs and growth and an investment in Europe's future.⁷

In the specific field of transport externalities and emissions the European Union has set concrete objectives for Member States. The main EU objective is an overall reduction of CO₂ emissions of 80-95% by the year 2050, with respect to the 1990 level (White Paper 2011 - European Union, 2011).

In the transport sector, strong efforts would be required to drastically reduce the oil dependency and the CO₂ emissions in the transport sector, in line with the goals put forward in the 2011 White Paper on Transport that has foreseen a 20% reduction in the CO₂ emissions by 2030 relative to 2008 levels and a 60% reduction by 2050 relative to 1990 levels.

An improvement of transport efficiency is necessary to support the reduction of CO₂ emissions, and to enable the use of renewable resources in the transport sector. Transport is one of the sectors most resilient to efforts to reduce CO₂ emissions due to its strong dependence on fossil energy sources and its steady growth, offsetting the considerable vehicle efficiency gains made.

⁵ Greenhouse gas emissions reductions (20%), share of renewable energy (20%) and improvements in energy efficiency (20%).

⁶ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN>

⁷ http://ec.europa.eu/priorities/energy-union/index_en.htm

Energy efficiency, transport efficiency, and effective transport demand management can contribute substantially to reducing emissions. However, increased efficiency is not an alternative to oil substitution but a bridge to alternative fuels. More efficient use of energy in transport stretches the potential for supply from finite oil reserves, contributes to curbing greenhouse gas emissions from the combustion of fossils, and facilitates full substitution by alternative fuels, which will be production limited rather than reserve limited, as fossil resources. Therefore, a consistent long-term strategy should aim at fully meeting the energy demand of the transport sector from sustainable and secure largely CO₂-neutral sources by 2050.

2.1 STATE OF THE ART OF ALTERNATIVE FUEL DEVELOPMENT

It is expected that alternative fuels will play an important role in the next years in view of the EU objectives of gradually substituting fossil fuels with fuels of renewable origin, transport decarbonisation and diversification of the energy sources.

However, there is currently a lack of attractiveness of fuel alternatives for consumers and businesses, and no clear market signals with regards to the potential of the different new alternative fuels. For instance, alternative fuel vehicles only represented 3.4% of the European car fleet in 2012 and the use of alternative fuels in heavy duty vehicles and maritime and aviation modes is negligible (European Commission, July 2015).

Based on the consultation of stakeholders and national experts, as well as the expertise reflected in the Communication from the Commission of 24 January 2013 entitled 'Clean Power for Transport: A European alternative fuels strategy', electricity, hydrogen, biofuels, natural gas, and liquefied petroleum gas (LPG) were identified as currently the principal alternative fuels with a potential for long-term oil substitution, also in light of their possible simultaneous and combined use by means of, for instance, dual-fuel technology system.

Biofuels are currently the most important type of alternative fuels. They can also contribute to a substantial reduction in overall CO₂ emissions if they are produced sustainably. They could provide clean power to all forms of transport. They are fully compatible with existing refuelling infrastructure, hence not addressed in this study.

In the chapters related to infrastructure only the fuels covered by Articles 4, 5 and 6 of the Directive are addressed.

2.1.1 Electricity

Electricity is an energy carrier that can be converted domestically from a wide variety of primary energy sources. A certain quantity of electricity can be produced from renewable energy sources, offering a nearly well-to-wheel zero-emission pathway, although this is not always the case; e.g. when a combination of renewable and non-renewable sources is used. Electricity will continue to become increasingly low-carbon as the power sector continues to reduce in carbon intensity.

Due to their current limits in their battery capacity and then on the driving range (generally 100-200 km for a small to medium-sized car), **electric vehicles** are today considered to be best suited to urban and suburban driving. In the recent years the new models of Tesla vehicles have increased

their range up to 300-400 km and therefore the expansion of the electrification of the road transport is expected to increase.

In the next tables, the total number of electric vehicles (PHEV: Plug-In Hybrid Electric Vehicle; BEV: Battery Electric Vehicle) and the number of recharging points in the different countries are reported (AVERE November 2015).

Table 2.1: Electrical Vehicles in Europe (EAFO)

Country	BEV					PHEV		
	Motorbikes	Quadracycles	Passenger Cars	Light Commercial Vehicles	Buses	Motorbikes	Passenger Cars	Buses
Austria	567	882	4476	415	131		1089	
Belgium	494	811	4006	589	120		3641	
Bulgaria		24	10	23			6	
Croatia			13	24			6	
Cyprus				23			3	
Czech Republic			406	37			193	
Denmark		286	5132	269	14		265	
Estonia			1076	11			44	
Finland	64		593	72	6		1212	
France		3719	41681	17593			7831	
Germany	5600 ⁸	4217	27180	2259	116 ⁹		16177	291 ¹⁰
Greece		23						
Hungary			33	24			33	
Iceland			533	42			174	
Ireland		11	938	90			119	
Italy			6541	9179			2388	
Latvia			181	35			11	
Lithuania			35	26			28	
Luxembourg		17	571	104			166	
Malta		12	45	29			5	
Netherlands	196	436	10726	1258	72		54663	
Norway		63	54666	1055			8177	
Poland		8	209	42			258	

8

<http://www.sueddeutsche.de/auto/elektromotorraeder-schwer-unter-strom-1.2070597-2>

⁹ <http://de.statista.com/statistik/daten/studie/259805/umfrage/bestand-an-bussen-mit-alternativen-antrieben-in-deutschland/>

¹⁰ <http://de.statista.com/statistik/daten/studie/259805/umfrage/bestand-an-bussen-mit-alternativen-antrieben-in-deutschland/>

Country	BEV					PHEV		
	Motorbikes	Quadricycles	Passenger Cars	Light Commercial Vehicles	Buses	Motorbikes	Passenger Cars	Buses
Portugal		219	1057	104			563	
Romania		18	51	29			19	
Slovakia			90	28			23	
Slovenia		2	135	23			51	
Spain	3086	2588	4150	1061	8	109	1308	45
Sweden		286	4662	1016	10		8544	
Switzerland	9533	1255	6026	249	52		3676	
Turkey		38	92	23			1	
United Kingdom	1013	555	19155	4501	154		24268	

Table 2.2: Recharging Points in Europe (EAFO)

Country	Stations						Points				
	CCS Combo	ChaDeMo	AC Type-2	Normal Charge (< 22kW)	Tesla Supercharger	Total	CCS Combo	ChaDeMo	AC Type-2	Normal Charge (< 22kW)	Tesla Supercharger
Austria	87	92	150	636	8	973	87	92	150	1929	48
Belgium	12	53	368	559	3	995	12	53	368	1703	18
Bulgaria	0	0	3	17	0	20	0	0	3	18	0
Croatia	1	2	9	25	1	38	1	2	9	61	6
Cyprus	0	0	0	0	0	0	0	0	0	0	0
Czech Republic	10	25	31	54	0	120	10	25	31	240	0
Denmark	103	91	78	626	8	906	103	91	78	1367	48
Estonia	1	164	150	15	0	330	1	164	150	25	0
Finland	34	54	64	175	2	329	40	60	70	776	12
France	60	471	159	5044	24	5758	60	471	159	22269	144
Germany	271	243	200	3882	45	4641	271	243	200	4787	270
Greece	1	1	11	17	0	30	1	1	11	20	0
Hungary	2	22	0	70	0	94	2	25	0	158	0
Iceland	0	11	0	8	0	19	0	11	0	11	0
Ireland	22	77	288	350	0	737	22	77	288	780	0
Italy	6	22	367	810	7	1212	6	22	367	2046	42
Latvia	4	4	6	13	0	27	4	4	6	66	0
Lithuania	6	3	9	12	0	30	6	3	9	33	0

Country	Stations						Points				
	CCS Combo	ChaDeMo	AC Type-2	Normal Charge (< 22kW)	Tesla Supercharger	Total	CCS Combo	ChaDeMo	AC Type-2	Normal Charge (< 22kW)	Tesla Supercharger
Luxembourg	1	3	55	70	1	130	1	3	55	202	6
Malta	0	0	99	64	0	163	0	0	99	107	0
Netherlands	94	267	0	0	6	367	99	355	9877	17165	36
Norway	193	254	1330	1344	24	3145	193	254	1330	9818	144
Poland	0	8	0	234	0	242	0	15	0	290	0
Portugal	5	28	414	451	0	898	5	28	414	1177	0
Romania	1	0	0	18	0	19	1	0	20	38	0
Slovakia	15	22	34	32	0	103	15	22	34	96	0
Slovenia	1	6	12	141	2	162	1	6	12	360	12
Spain	30	136	101	760	2	1029	30	136	101	1487	12
Sweden	131	125	224	1400	14	1894	131	125	224	1400	84
Switzerland	65	96	203	1300	8	1672	65	96	203	3603	48
Turkey	5	2	6	55	0	68	5	2	6	63	0
UK	460	452	464	2353	29	3758	460	492	479	7709	174

The expansion of electrification of road transport to urban buses is a growing trend in Europe with **electric buses** expected to reach market maturity soon. The full battery electrification of heavy-duty vehicles and long-haul bus and coach fleets is not likely to be a realistic option in the near future. However, these technologies could be considered in a longer-term perspective as such fleets are very likely to become at least partially electrified by the use of plug-in hybrid technology.

Actually the main project co-funded by the European Commission’s Directorate General for Mobility and Transport through the FP7 Programme about electric bus is ZeEUS - Zero Emission Urban Bus System, the main objective of which is to bring electrification to the heart of the urban bus network by testing electric solutions through live operational demonstrations on high capacity buses and facilitating the market uptake of electric buses in Europe (<http://zeeus.eu>).

More information on the project and on good practices on alternative fuels for public transport is reported at Paragraph 6.2.1.

The technological maturity in relation to **battery propelled maritime ferries**, is relatively low in comparison and additional feasibility cost studies have to be carried out in order to analyse the necessary supply infrastructure and overall implementability.

Recently, a feasibility study in electrical ferry operation has been approved by the EU Horizon 2020 programme. Green Ferry Vision (<http://www.greenferryvision.dk>) aims to perform a feasibility study for the design, production and operation of an innovative low weight ferry for cars and passengers - a ferry only powered by green electricity stored on batteries on board. The ferry design will be well beyond state-of-the-art when it comes to charging powers and capable operating distance.

In comparison to battery propelled maritime ferries, **shore-side electricity for vessels** at berth is a mature technology for improving air quality at ports. The implementation of shore-side electricity, however, has been rather challenging, partially due to the high power requirements associated with certain types of ships, e.g. cruise vessels, or peaks deriving from multiple ships berthed at ports at a certain moment. In addition, taxation has been an issue, as electricity produced on-board of vessels through auxiliary engines can be considerably cheaper than electricity obtained through the grid. Technical issues have mostly been resolved, although the costs of installing on-shore power supply on-board of vessels are still a limiting factor in the adoption of the technology. More information and good practices on the shore side electricity at ports are reported in the Chapter 10.

2.1.2 Natural Gas and Biomethane

Natural gas and bio-methane are considered as a single fuel. It can be sourced from fossil natural gas and as bio-methane from renewables or feedstock of non-biological (gasification) and biological (anaerobic digestion and gasification) origin, such as energy crops, agricultural wastes and residues, animal manure organic fraction of municipal waste, sewage sludge,. In addition to gasification of organic and non-organic feedstock, it can also be produced as synthetic gas via the methanization of hydrogen made from electrolysis of excess electricity (e-gas).

Natural gas and biomethane can be used in established combustion engines, with performances equivalent to gasoline or diesel units and cleaner exhaust emissions. Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) refueling infrastructure is necessary for running these vehicles.

The technology is mature for the dedicated natural gas engines in cars, vans, buses and trucks and the engine technology has been constantly improved since the first passenger cars produced in the 1990's.

Biomethane from organic matter offers an extension and gradually increasing substitution for fossil natural gas. It can be mixed at any ratio with natural gas when used in natural gas vehicles and currently standardisation work is ongoing in the European Committee for Standardisation (CEN TC 408 work programme).

Natural gas and biomethane could be also used in the form of Liquefied Natural Gas (LNG) for fuelling combustion engines in buses and trucks, boats and ships, the market mainly developed through dual fuel systems (engines burning together diesel and methane) and by now more and more LNG mono fuel systems with European type approval (ECE Regulation 110) are being introduced to the market. LNG increases the operability of commercial vehicles, as more energy can be stored on-board the vehicle, but the engine technology remains the same with CNG and LNG.

There are around 1.2 million vehicles running on CNG representing 0.7% of the EU28 vehicle fleet including Switzerland, 75% of the market is Italy. More than 3,000 refuelling points are available, 2/3 of which in Germany and Italy. 18 million CNG vehicles are running in the world, representing 1.2% of the world vehicle fleet.

There are approximately 1,500 EURO V and EURO VI LNG trucks and 55 refuelling points.

In the next Tables the total number of CNG/LNG vehicles and the number of refuelling points in the different countries are reported (NGVA data, 2015).

	CNG stations	LNG/LCNG stations	Gas Driven Vehicles
Austria	175	0	8.323
Belgium	20	3	1.033
Bulgaria	108	0	61.320
Croatia	3	0	329
Cyprus	-	0	-
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	0	98.172
Greece	10	0	1.000
Hungary	5	0	5.118
Iceland	5	0	1.371
Ireland	0	0	3
Italy	1.010	2	885.300
Latvia	1	0	29
Lichtenstein	3	0	143
Lithuania	1	0	380
Luxemburg	7	0	270
Malta	0	0	-
Netherlands	133	7	7.573
Norway	17	0	667
Poland	25	0	3.600
Portugal	3	3	586
Romania	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
United Kingdom	7	13	718
Total EU+EFTA	2.953	55	1.156.687

Regarding the availability of LNG facilities, operational large-scale terminals are available along the Western and Southern European seaside as well as in the Baltic Sea since the end of 2014. The current LNG receiving countries are Lithuania, the United Kingdom, The Netherlands, Belgium, France, Portugal, Spain, Italy, Greece and Turkey. The majority of the projects are located in the Baltic Sea as well in Southern Europe. The next LNG receiving country will probably be Poland. As regards small-scale LNG terminals, all terminals (operational, under construction, planned) are located in Northern Europe at the moment (Gas Infrastructure Europe, <http://www.gie.eu/>).

Most of the large-scale regasification terminals are located on-shore. There is one off-shore terminal and there are two Floating Storage and Regasification Units (FSRUs). Out of the 22 planned large-scale facilities another 7 are indicated as FSRUs.

	operational	under construction	planned
Large-scale	23	4	22
FSRUs and others	2	0	7
Small-scale	4	4	4
Total	27	8	26

Figure 2.1: Number of LNG Import Terminals per Type

More statistical data can be found in the databases provided by Gas Infrastructure Europe (<http://www.gie.eu/index.php/maps-data>) which support individual analysis as well.

The next table summarises the status of deployment of LNG port facilities.

Table 2.3: LNG Port Facilities – December 2015
(<http://www.gie.eu/>)

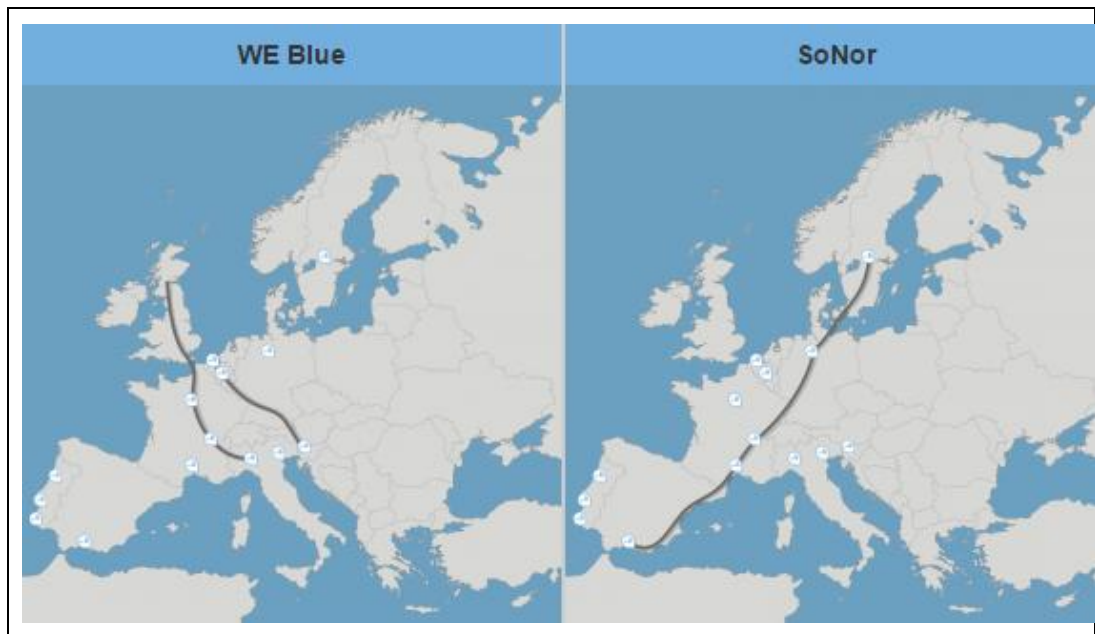
PORT	STATUS	RELOADING	TRANSHIP.	BUNKERSHIP LOADING	TRUCK-LOADING	RAIL-LOADING
ZEEBRUGGE	IN OPERATION	BY 2016	<input checked="" type="checkbox"/>	BY 2016	<input checked="" type="checkbox"/>	NO
FOS TONKIN	IN OPERATION	<input checked="" type="checkbox"/>	NO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NO
MONTOIR DE BRETAGNE	IN OPERATION	<input checked="" type="checkbox"/>	h	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NO
FOS CAVAOU	IN OPERATION	<input checked="" type="checkbox"/>	NO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NO
DUNKERQUE LNG	UNDER CONSTRUCC.	<input checked="" type="checkbox"/>	NO	UNDER STUDY	UNDER STUDY	NO
REVITHOUSSA	IN OPERATION	BY 2016	NO	BY 2020	BY 2017	NO
PANIGALLIA	NOT OPERATIVE	NO	NO	UNDER STUDY	UNDER STUDY	NO
PORTO LEVANTE	NOT OPERATIVE	NO	NO	NO	NO	NO
LNG TOSCANA	NOT OPERATIVE	NO	NO	UNDER STUDY	NO	NO
INDEPENDENCE	IN OPERATION	NO	<input checked="" type="checkbox"/>	BY 2017	BY 2017	NO
GATE TERMINAL	IN OPERATION	<input checked="" type="checkbox"/>	BY 2016	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NO
SWINOJSCIE	UNDER CONSTRUCC.	BY 2020	UNDER STUDY	UNDER STUDY	BY 2020	UNDER STUDY
SINES	IN OPERATION	<input checked="" type="checkbox"/>	NO	NO	<input checked="" type="checkbox"/>	NO
BARCELONA	IN OPERATION	<input checked="" type="checkbox"/>	NO	UNDER CONSTRUCC.	<input checked="" type="checkbox"/>	NO
HUELVA	IN OPERATION	<input checked="" type="checkbox"/>	NO	UNDER STUDY	<input checked="" type="checkbox"/>	NO
CARTAGENA	IN OPERATION	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	UNDER STUDY	<input checked="" type="checkbox"/>	UNDER STUDY

PORT	STATUS	RELOADING	TRANSHIP.	BUNKERSHIP LOADING	TRUCK- LOADING	RAIL- LOADING
BILBAO	IN OPERATION	<input checked="" type="checkbox"/>	NO	NO	<input checked="" type="checkbox"/>	NO
SAGUNTO	IN OPERATION	<input checked="" type="checkbox"/>	NO	UNDER STUDY	<input checked="" type="checkbox"/>	NO
MUGARDOS	IN OPERATION	<input checked="" type="checkbox"/>	UNDER STUDY	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NO
GJION	IN OPERATION	<input checked="" type="checkbox"/>	UNDER STUDY	UNDER STUDY	<input checked="" type="checkbox"/>	NO
ISLE OF GRAIN	IN OPERATION	<input checked="" type="checkbox"/>	BY 2016	BY 2017	<input checked="" type="checkbox"/>	NO
MILFORD HAVEN	NOT OPERATIVE	NO	NO	NO	NO	NO

Currently, the LNG Blue Corridor project, supported by the EC through the FP7 Programme, aims to establish LNG as a real alternative for medium and long distance transport, first as a complementary fuel and later as an adequate substitute for diesel (Appendix C).

LNG has the potential for contributing to achieving Europe’s policy objectives, such as the Commission’s targets for greenhouse gas reduction, air quality targets, while at the same time reducing dependency on crude oil and guaranteeing supply security. Natural gas heavy-duty vehicles already comply with Euro V emission standards and have enormous potential to reach future Euro VI emission standards, some without complex exhaust gas after-treatment technologies, which have increased procurement and maintenance costs.

To meet the objectives, a series of LNG refuelling points have been defined along the four corridors covering the Atlantic area, the Mediterranean region and connecting Europe’s South with the North and its West and East accordingly.



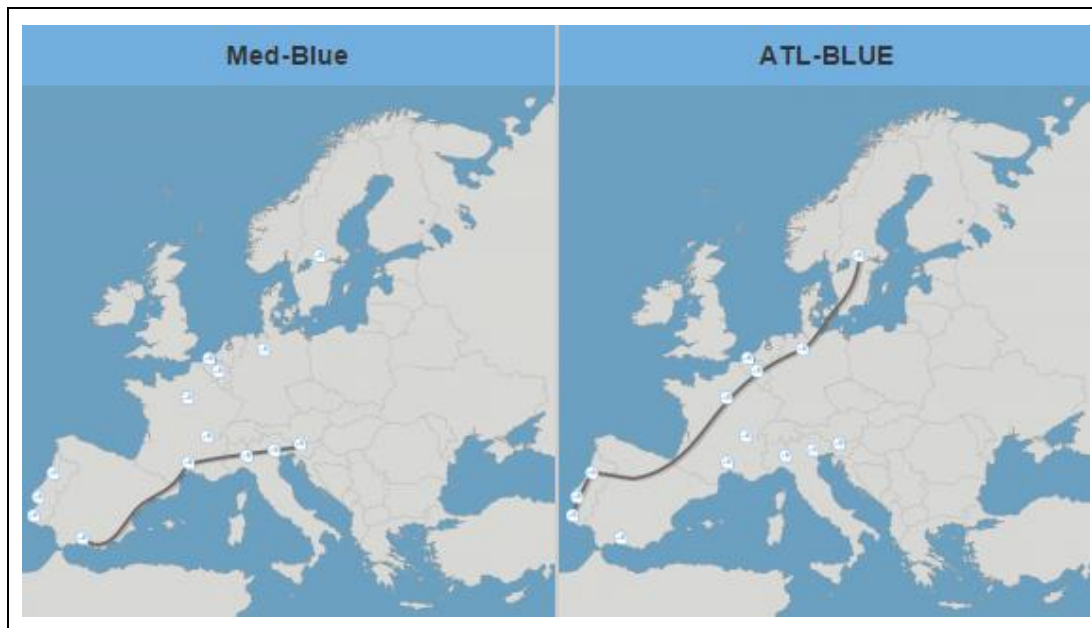


Figure 2.2: LNG Blue Corridors

In order to implement a sustainable transport network for Europe, the project has set the goal to build approximately 14 new LNG refuelling points, both permanent and mobile, on critical locations along the Blue Corridors whilst building up a fleet of approximately 100 Heavy-Duty Vehicles powered by LNG. At present, 5 LNG refuelling points have been inaugurated, and other 3 are ready to be opened. (LNG Blue Corridors, Guidance to implement the Directive on the deployment of alternative fuels infrastructure, November 2015).

Regarding LNG bunkering of inland waterway vessels, for the time being refuelling takes place from truck to ship, which requires the designation of a specific bunkering area and amendment of port regulations. Currently, regular LNG bunkering of inland vessels takes place in the ports of Antwerp, Mannheim, Amsterdam, and Rotterdam.

As of 2015 there is an ongoing LNG Masterplan safety study (<http://www.lngmasterplan.eu/news>), as part of the EU funded project LNG Masterplan for Rhine-Main-Danube (Decision 2012-EU-18067-S, Paragraph 8.3.11). The recently published studies focus on the technical, safety and operational risk aspects of LNG bunkering, as well as LNG loading and unloading.

The study aims to create a platform for the cooperation of authorities and industry stakeholders with the purpose of facilitating the creation of a harmonized European regulatory framework for LNG as fuel and cargo in inland navigation and to promote the introduction of LNG as a fuel and cargo for inland shipping. It delivers technical concepts for new and retrofitted vessels being propelled by LNG and transporting LNG as well as a significant number of pilot deployments of vessels and terminals. It also develops a comprehensive strategy together with a detailed roadmap for the implementation of LNG in line with the EU transport/energy/environmental policy goals and actions.

2.1.3 Hydrogen

Similar to electricity, hydrogen is an energy carrier that can be produced from a wide variety of primary energy sources. Currently, hydrogen is predominantly produced by steam reforming of methane, via a chemical transformation process generally involving decarbonisation of a hydrocarbon. Hydrogen can also be produced from renewable or nuclear energy using electrolysis or biomethane reforming, via organic feedstock and splitting of water (here we will refer to “thermal” hydrogen), which offers zero or close-to zero-emission pathways from well to wheel.

The technology for hydrogen production is mature and cheap production pathways are in place. It still needs significant efforts to set up the necessary hydrogen refuelling station infrastructure. However, it does not require a change in user habits in terms of mobility and refuelling, and it offers substantial benefits in terms of environmental and energy sustainability.

Hydrogen is used in fuel cell electric vehicles where the electricity is not stored in a battery but it is produced on board by a fuel cell using oxygen from the air and hydrogen stored in the tank.

This technology is mature, safe and ready for deployment in road transport. The commercialisation process has begun within some specific market segments such as passenger cars, buses and materials-handling vehicles.

There are already more than 500 electric vehicles powered by hydrogen (European Commission, July 2015) operating in Europe, mainly in Germany, Scandinavia, the UK, the Netherlands and in France.

However, the levels of cost competitiveness and performance required for large-scale deployment in road transport have not yet been achieved, neither for the vehicles nor for the refuelling points.

The Scandinavian Hydrogen Highway Partnership (SHHP) (<http://www.scandinavianhydrogen.org/>) consists of regional clusters involving major and small industries, research institutions, and local, regional and national authorities.

All activities are based on effective collaboration across the borders and are backed with strong public and private support in terms of funding, attractive financial tax exemption schemes and investments. Their goal is to create one of the first regions in Europe where hydrogen is available and used in a network of refuelling points.

The SHHP vision is to make the Scandinavian region one of the first regions in Europe where hydrogen is commercially available and used in a network of refuelling points.

The aim is to create a network of Hydrogen Refuelling Stations (HRS) by 2015 composed by 15 stations, 30 satellite stations and a large fleet of vehicles (100 buses, 500 cars and 500 special vehicles).

The operation of fleets of fuel cell buses for public transport has already started in London, Hamburg, Cologne, Milan, Oslo and other cities as part of European Projects (as reported in the following Paragraph 6.2.7). The ongoing CHIC project, for example, is a major European project deploying a fleet of zero emission fuel cell buses and hydrogen refuelling stations. The main figures of the project are: 9 cities/regions involved in the trial, 60 buses operated in total of which 26 are co-funded by the FCH JU and 9 hydrogen refuelling stations.

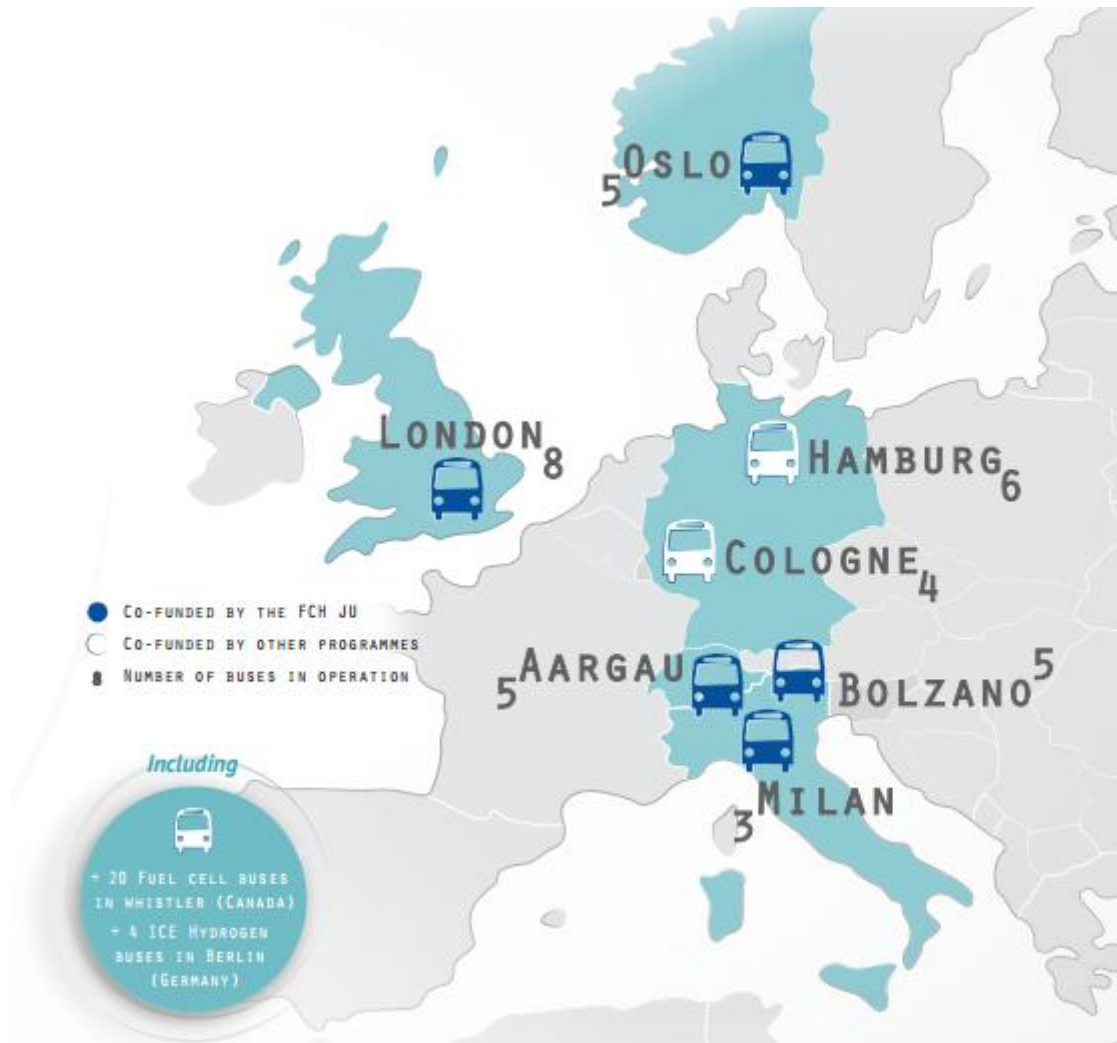


Figure 2.3: FCH JU Hydrogen Refuelling Stations

2.2 CROSS BORDER INITIATIVES

Cross-border continuity needs to be ensured if an international continuity in infrastructure is to be obtained. Cross-border links should be taken into account with a view of enabling alternative fuels powered motor vehicles to circulate Union-wide.

As indicated in the Directive, Member States should therefore cooperate, where necessary, with other neighbouring Member States at regional or macro- regional level, by means of consultation or joint policy frameworks, in particular where continuity of alternative fuels infrastructure coverage across national borders or the construction of new infrastructure in the proximity of national borders is required, including different non-discriminatory access options for recharging and refuelling points. The coordination of those national policy frameworks and their coherence at Union level should be supported by cooperation between Member States and assessment and reporting by the Commission.

The lack of harmonised development of alternative fuels infrastructure across the Union prevents the development of economies of scale on the supply side and Union-wide mobility on the demand side. New infrastructure networks

need to be built up, such as for electricity, natural gas (liquefied natural gas (LNG) and compressed natural gas (CNG)) and, where appropriate, hydrogen.

Currently, several initiatives and measures have been already taken into account and implemented to guarantee solutions ensuring interoperability across some neighbouring Member States.

These measures have been analysed and reported as good practices in the following paragraphs dedicated to good practices on implemented measures:

- Paragraph 4.4.3 - BE-DE-NL Interoperability: e-clearing.net & Cooperation Agreement;
- Paragraph 4.4.5 - BE-NL-DE-CH International organizations - cross-border continuity.

Common strategies at European level could be taken into consideration for the deployment of new infrastructure for alternative fuels vehicles. Especially with reference to the development of LNG in Europe, ad hoc masterplans have been implemented to support the deployment of these alternative fuels in the different transport modes.

An LNG Masterplan has been prepared regarding the use of this fuel in both the maritime and inland waterway sectors.

The following paragraphs report on the main aspects of these documents:

- Paragraph 8.3.17: the main result of the project was the LNG Masterplan for short sea shipping between the Mediterranean Sea and North Atlantic Ocean as well as the Deep Sea cruising in the North Atlantic Ocean towards the Azores and the Madeira Island.
- Paragraph 8.3.11 - LNG Masterplan for Rhine-Main-Danube

To support a common development of the technology and its deployment at European level with regards to the road transport sector, the LNG Blue Corridors project represents a good example of integration among Member States.

2.3 DEPLOYMENT AND MANUFACTURING SUPPORT

In order to foster the deployment of alternative fuels infrastructures and to reduce the European dependency on oil in the transport sector, Member States may allocate a specific budget for the alternative fuels infrastructure deployment to support manufacturing plants, broken down by alternative fuel and by transport mode (road, rail, water and air).

As an example of already planned allocation of public budget as support to the development of the current alternative fuels networks, the United Kingdom has planned to invest the following budget breakdown for the different alternative fuels:

- **Electromobility:** At least £32million on new infrastructure, with £8m for additional on-street charging, rapid and destination chargers in key locations and the wider public estate, and £15m to continue the Electric Vehicle Homecharge Scheme, which provides 75% toward the cost of installing a domestic charge point (capped at £700). This funding will also be used to address key strategic challenges including the maintenance and interoperability of the current network. As part of the "Roads Investment Strategy", an additional £15m between 2015 and 2020 has been committed to expand the existing charge point network to ensure that for 95 per cent of the time motorists will be no more than 20 miles from a charge point;
- **Hydrogen:** the UK is a participant in the UKH2mobility (www.ukh2mobility.co.uk) and recently announced the £11m Hydrogen for Transport Advancement Programme (HyTAP) to support the roll-out of FCEVs and associated refuelling infrastructure. The government also recently announced the successful bidders for funding to support an initial network of 10-15 hydrogen refuelling stations;
- **CNG-LNG:** a further 12 new refuelling points are planned through the trial and eight existing refuelling points are due to be upgraded with methane vent capture technology. In addition to this we have allocated a further £4m to gas infrastructure, with delivery of funding still to be confirmed.

2.4 RESEARCH, TECHNOLOGICAL DEVELOPMENT AND DEMONSTRATION (RTD&D)

In order to foster the deployment of alternative fuels infrastructures in the EU Member States by way of common strategies of development, Member States may allocate a specific annual budget to support research, technological development and demonstration (RTD&D) both at national and European level. The allocated budget may be broken down by fuel and by transport mode.

An example of supporting research and technical development is represented by a recent initiative of a group of 20 countries to double their current spending on clean energy research and development over the next five years. Most of countries of this group are European (i.e. Denmark, France, Germany, Italy, Norway, Sweden, and the United Kingdom).

A separate coalition of 28 private investors announced in November 2015 that they plan to funnel capital into "early stage companies that have the potential of an energy future that produces near zero carbon emissions and provides everyone with affordable, reliable energy," according to the group. It was unclear exactly how much the investors would spend. (<http://www.politico.eu/pro/20-countries-commit-to-double-clean-energy-research-development-technology/>).

An interesting example is in the Netherlands where a National Knowledge Centre for Charging Infrastructure (NKL) has been created. Its mandate and financial budget is limited to research projects in the time period up to 2018 (Paragraph 4.4.15.4).

2.5 THE EUROPEAN ALTERNATIVE FUELS OBSERVATORY

The European Commission intends to provide one central point of reference for data, information and news about alternative fuels in Europe, which can help the Member States to achieve compliance with the Directive.

For this reason, the Commission has established the “European Alternative Fuels Observatory” (EAFO) - a web portal¹¹ that will go live by February 2016 and will be updated on a monthly basis. The Observatory will integrate all relevant statistical data concerning vehicles and infrastructure, relevant legislation, support and incentives programmes, periodical analyses and general information like news and publications. The short-term focus is on battery electric, hybrid and fuel cell vehicles while natural gas and other alternative fuels will also be covered in a second stage. The Observatory will help support the market development of alternative fuels in the EU and be a key tool for the implementation of Directive 2014/94/EU on the deployment of recharging and refuelling points. The EAFO will also deal with L-category vehicles (LEVs), such as electric bicycles, scooters, motorcycles and other LEVs.

¹¹ <http://www.eafo.eu/>

3 NATIONAL TARGETS AND OBJECTIVES

Currently it seems that the lack of infrastructure for alternative fuels is a major obstacle to consumer acceptance and purchase of AFVs. In order to overcome this need the European legislator, by means of Directive 2014/94/EU, has mandated the deployment of an appropriate alternative fuels infrastructure's coverage. To this purpose, Member States should define national targets and objectives so as to encourage the circulation of AFVs, in particular for electric (Article 4), hydrogen (on a voluntary basis, Article 5) and natural gas (Article 6) powered vehicles.

As regards electricity, *"Member States shall ensure, by means of their national policy frameworks, that an appropriate number of recharging points accessible to the public are put in place by 31 December 2020, in order to ensure that electric vehicles can circulate at least in urban/suburban agglomerations and other densely populated areas, and, where appropriate, within networks determined by the Member States. The number of such recharging points shall be established taking into consideration, inter alia, the number of electric vehicles estimated to be registered by the end of 2020"* (Article 4(1)). Furthermore, *"Member States shall also take measures within their national policy frameworks to encourage and facilitate the deployment of recharging points not accessible to the public"* (Article 4(3)) and to *"ensure that the need for shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports is assessed"*, giving priority to ports of the TEN-T Core Network.

Similarly, the Directive foresees an appropriate infrastructure coverage for natural gas for road, maritime and inland navigation applications. Member States are requested to ensure *"that an appropriate number of refuelling points for LNG are put in place at maritime ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network by 31 December 2025"* (Article 6(1)). The same has to be guaranteed for *"inland ports TEN-T Core Network by 31 December 2030"* (Article 6(2)). In both cases, the designation of maritime and inland ports which are going to provide access to refuelling points for LNG has to *"take into consideration actual market needs"* (Article 6(3)). The importance of LNG for heavy duty vehicles is confirmed by Article (6(4)), according to which *"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"*. Moreover, *"Member States shall ensure that an appropriate LNG distribution system is available in their territory, including loading facilities for LNG tank vehicles, in order to supply the refuelling points"* previously discussed (Article 6(6)). Furthermore, *"Member States shall ensure, by means of their national policy frameworks, that an appropriate number of CNG refuelling points accessible to the public are put in place by 31 December 2020"*, in order to foster the circulation of CNG motor vehicles in urban/suburban agglomerations and other densely populated areas (Article 6(7)). The same objective has to be achieved by 31 December 2025 *"along the existing TEN-T Core Network, to ensure that CNG motor vehicles can circulate throughout the Union"*(Article 6(8)).

Finally, regarding hydrogen as alternative fuel for transport Article 5(1) requires "*Member States which decide to include hydrogen refuelling points accessible to the public in their national policy frameworks*" to "ensure that [...] an appropriate number of such points are available" so as to promote the circulation of hydrogen-powered motor vehicles.

3.1 CRITERIA THAT COULD BE TAKEN INTO ACCOUNT TO DEFINE THE NATIONAL TARGETS AND OBJECTIVES

The definition of the national targets could be based on specific criteria and could take into account the following issues:

- national environmental targets for the reduction of GHG and pollutant emissions;
- national objectives for the deployment of alternative fuels in the different transport modes (road, rail, water and air);
- future fleet of AFVs expected for different time horizons (namely 2020, 2025 and 2030) and estimation of future demand;
- increase of supply network (i.e. deployment of a proper infrastructure) to encourage the growth of AFVs and consequently, to fulfil future demand requirements.

Based on Article 3(1), Member States' national policy frameworks shall contain targets and objectives for alternative fuels infrastructure (i.e. number of refuelling/recharging points) to be deployed until the set deadlines. To this end, in Chapter 7, good practices proposed by the European Commission's JRC are explained in detail.

3.2 CONSULTATIVE APPROACH

The implementation of policies for mitigating the impact of transport requires coordinated efforts at every single governance level. This means that national targets and objectives could be defined in cooperation with local and regional authorities as well as with the industry. In this respect, Article 3(3) of the Directive states that "*National policy frameworks shall take into account, as appropriate, the interests of regional and local authorities, as well as those of the stakeholders concerned.*"

In this context, it is worth mentioning the multi-level approach proposed by "AustriaTech", namely the Federal Agency for Technological Measures in Austria, in combination with the Austrian Transport Ministry.¹² In particular, their on-going process for decarbonising road transport is based on the involvement of different governance levels as well as a wide variety of stakeholders in a transparent and open procedure. First experiences demonstrated that the organisation of regional workshops and the opening of an Austrian-wide online consultation provided important feedback for the identification of key bottlenecks for alternative fuels market development in the transport sector as well as an integration of national, regional and local planning in the National Policy Framework, which needs to be notified to the European Commission by November 2016 (Article 3). Similar procedures have been followed by other Member States (e.g. Germany, Italy and Spain).

¹² Spyra, H. And Salmhofer, .H.J. (2016). The Politics of Decarbonisation – A case study. Proceedings of 6th Transport Research Arena, April 18-21, Warsaw, Poland.

The “Mobility and Fuel Strategy” proposed by the German government¹³, for instance, was preceded by a comprehensive dialogue process involving all the relevant sectors and interest groups. More than 300 stakeholders from industry and science, as well as societal interest groups, took part in almost 20 workshops. Here, the stakeholders had their first opportunity to discuss “transport and energy” on a cross-industry and cross-energy basis and weigh up and, where possible, reconcile conflicting interests.

In Spain, the “Alternatively-fuelled Vehicles Strategy” is another example of coordinated support measures which provide a starting point to develop the National Policy Framework established in Directive 2014/94/EU¹⁴.

The Italian public administration promotes the process closer to the citizen and transparency into business and civil society (<http://www.partecipa.gov.it/>). Therefore, in Italy the development plan can be evaluated by stakeholders who have the possibility to propose changes.

3.3 ELECTRICITY SUPPLY FOR TRANSPORT

In Table 3.1, the specific elements that Member States have to identify in their national policy framework are summarised. Table 3.1 also links these elements to the chapters of this document in which some proposed methodologies and solutions are explained.

Table 3.1: Electricity Supply for Transport

Articles of Directive 2014/94/EU	Obligations required by the Directive	Deadline	Proposed methodology and solutions
Article 4 (1)	Identify the number of recharging points (public and private) necessary to fulfil the expected demand within urban and suburban areas	31 December 2020	see Chapter 7
Article 4 (2)	Ensure that an additional number of recharging points accessible to the public are put in place in each Member State at least on the TEN-T Core Network, in urban/suburban agglomerations and other densely populated areas.	31 December 2025	see Chapter 7
Article 4 (3)	Encourage and facilitate the deployment of recharging points not accessible to the public.		see Chapter 5
Article 4 (5)	Install shore-side electricity supply as a priority in ports of the TEN-T Core Network and other ports	31 December 2025	see Chapter 10

¹³http://www.bmvi.de/SharedDocs/EN/Anlagen/UI-MKS/mfs-strategy-final-en.pdf?__blob=publicationFile

¹⁴ http://www.minetur.gob.es/industria/es-ES/participacion_publica/Paginas/Cerradas/proyecto-RD-combustibles-alternativos.aspx

Articles of Directive 2014/94/EU	Obligations required by the Directive	Deadline	Proposed methodology and solutions
Article 3(1)	Assess the need to install electricity supply at airports for use by stationary airplanes		see Chapter 11

3.3.1 Examples in Member States

Many Member States have already started promoting strategies for the use of electricity as alternative fuel. Indeed, there are different good practices, studies and initiatives (both public and private) spread in Europe which can be considered as references for future policy implementation. In the following, some of the good practice examples are summarised.

Concerning the Art 4.1 a methodology has been proposed by the European Commission's Joint Research Center. It is applied in the city of Bolzano and described in Chapter 7.

In terms of measures for the **deployment of recharging points (Art. 4 (2))**, The Spanish AEDIVE initiative ("Asociación Empresarial para el Desarrollo e Impulso del Vehículo Eléctrico") for instance, collected information and proposed a study for the deployment of fast charging infrastructure for EVs along the Iberian corridors, in line with the deployment that is underway in other European countries. According to this study, the development of corridors is split into two phases:

1. The first one concerns the consolidation of existing activities and prioritization areas of high concentration of population and tourism (2020 is the time horizon considered);
2. The second one is based on the promotion of areas with high average daily traffic (time horizon becomes in this case 2020-2025).

Thanks to this procedure, it is possible to obtain some indications about the number of recharging points considering the following factors:

- Demographic density;
- Traffic level;
- Tourist attraction level.

A joint venture by Auchan and Nissan is a good example of promotion of electric vehicles initiated by the private sector. The commitment to zero emission mobility of Nissan and to sustainable development by Auchan brought the two companies together and resulted in a private joint EV infrastructure venture. The two companies have signed a letter of intention committing to deploy 130 recharging points (DC CHAdeMO- AC fast chargers) in the car parks of the super-market chain in France. This new network of chargers across France will enable longer EV inter-city travels throughout the entire country. The chargers, conveniently situated next to supermarket, give the possibility to EV drivers to do shopping, eat or drink coffee while waiting for their battery to fill up. The initiative will make Auchan the biggest operator of fast chargers in France and one of the biggest in Europe.

Nissan is also working with green energy provider Ecotricity and with IKEA for the installation of electric vehicle rapid charging points across Ikea Europe stores. Developed by Nissan, the high power charger units can recharge an

electric vehicle from empty to 80% full in just thirty minutes while people can spend their time within the store. The charging points are free for all customers to use and there is no charge for the 100% sustainably sourced green electricity from Ecotricity.

Ikea has been installing recharging points for electrical vehicles for several years. In 2013 Ikea signed an agreement with ENEL to equip its Italian retail centres.

As regards examples of national policy development measures, the Italian Government with national Law n.134/2012 has established that, since June 2014, every mobility plan should be completed by a section dedicated to electric mobility. Moreover, in order to achieve the qualification, new non-residential buildings (>500 m²) have to install electrical infrastructure for charging electric vehicle (**Art 4(3)**). A special fund was set up to finance the plan and a special credit line is active for the promotion of technological research.

Also shore-side electricity supply in ports of the TEN-T Core Network and other ports (**Art. 4 (5)**) has some significant examples like Antwerp, Gothenburg, Bergen in Europe. Other cities are currently planning to install shore power supply systems at their ports, such as Hamburg, Barcelona, Bremen, Copenhagen, Marseille, Civitavecchia, Rotterdam, Stockholm, Genoa and Venice. Additional details about this theme are provided in Chapter 10, with details about good practices in Paragraph 10.6.

Shore side electricity (Art. 4 (5)) is an important measure for reducing ship emissions in ports. That is why EC seeks to promote this strategy as earliest as possible for ports belonging to TEN-T core network, and for other ports by December 2025. According to the Directive, *"Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the TEN-T Core Network, and in other ports, by 31 December 2025, unless there is no demand and the costs are disproportionate to the benefits, including environmental benefits."*

Some Member States have already started discussing the benefits provided by this strategy. For example, the specific study carried out by Ecofys (i.e. "Potential for Shore Side Electricity in Europe"¹⁵) aims to quantify the economic and environmental potential for shore side electricity in European ports, as well as providing insight into the barriers for implementation and formulating recommendations on policy action that the Commission could take to accelerate the implementation in European harbours.

3.3.1.1 [Electromobility Guide for Local and Regional Authorities - Committee of the Regions Intergroup - "The future of the automotive industry in our territories" - December 2015](#)

The electro-mobility guide¹⁶ can be considered a practical document for the development of electric vehicles and related e-mobility strategies among local and regional European entities. The document collects basic information and provides guidance to facilitate the deployment of e-Mobility.

¹⁵ <http://www.ecofys.com/files/files/ecofys-2014-potential-for-shore-side-electricity-in-europe.pdf>

¹⁶ Electromobility Guide for Local and Regional Authorities. Committee of the Regions Intergroup. "The future of the automotive industry in our territories" December 2015

The document can be divided into two parts. The first one summarises the key elements suggested by EU, which have to be considered for a positive implementation of strategies in favour of electric vehicles. The second part presents a collection of good practices spread all over Europe, which could be used as examples by other Member States.

In the first part, the document provides the framework of European legislation including technical specifications of electric vehicles and recharging points. Main principles for the implementation of aid schemes and incentives are also described. In particular, it suggests that the content of a local-regional e-mobility strategy can consist in:

- Setting up of a e-mobility task force, that would include all relevant actors for e-mobility in the municipality or region including citizen participation, which is an essential element for the set up a e-mobility strategy;
- Diagnosis of the starting situation;
 - Planning the potential demand;
 - Identification and evaluation of possible measures to facilitate the use of electric vehicles;
 - Implementation of measures (regulatory measures, business models, public awareness measures, etc.);
 - Monitoring the measures;
 - Information campaign about the results of the strategy.

In addition, the document focuses on regulatory measures as well as public awareness measures to promote the diffusion of electric vehicles at local and regional level.

As said before, the second part collects main local and regional good practices in some European countries. The measures implemented vary from Member State to Member State and concern the deployment of the infrastructure or the promotion and financing of electromobility solutions for companies and the private sector.

In the following, the location and the name of these strategies are listed and where available, the number of proposed/implemented recharging points is also reported:

- Castilla y León: "Implementation of the electric vehicle charging network"¹⁷:
 - Number of recharging points: 34 recharging points in Valladolid and 10 in Palencia.
- Catalonia: "LIVE Public-Private Platform"¹⁸:
- Number of recharging points: The Catalonia region has more than 600 electric charging points in more than 250 locations of which 15 are fast-charging and 52 are semi-fast charging points. The objective for 2016 is to have 40 Fast charging points (50 kW) in the main Catalan cities and corridors;
- Britany: "Green Vehicle Bretagne (Véhicule Vert Bretagne)"¹⁹;

¹⁷ <http://www.cidaut.es/eren/>

¹⁸ www.livebarcelona.cat

- Nord-Pas de Calais: "Regional development plan for electric vehicles" 20:
 - Number of recharging points: 1250 normal to accelerated charging points. Minimum ratio required by the French State is 1 charging station for 6000 inhabitants;
- Flanders: "Living lab Electric vehicles (2011-2014)"²¹;
- Styria: "Strategy Clean Mobility (CMOB), E-Mobility Model Region Graz and E-Mobility Styria"²²;
- Birmingham: "A City Blueprint for Low/zero Carbon Refuelling Infrastructure"²³;
- Poitou- Charentes: "Deployment of electric charging infrastructure for electric and hybrid vehicles in the region" 24. The Region aims to have 3000 charging points by 2017. The current situation at 2015 is shown in the following Table.

Table 3.2: Current situation of deployment of electric charging infrastructure in Poitou- Charentes region

Year of scheduling	Number of beneficiaries	Number of terminals	Number of charging points	Amount of investment in k €
2012-2014	18 communities and businesses	58	111	604
2014-2015	11 communities	443	883	5,421
2015	12 communities and businesses	109	218	1351
TOTAL		610	1212	k€ 7376

3.3.1.2 Implementing Agreement for Co-operation on Hybrid and Electric Vehicle Technologies and Programmes (IA-HEV)

The IA-HEV proposed by the International Energy Agency²⁵ (IEA) is another demonstration of the efforts made by many countries in the world in promoting the diffusion of electric vehicles and technologies. The IEA is currently composed of 29 members, namely: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

The benefits provided by IA-HEV are:

¹⁹ <http://www.avem.fr/actualite-plan-vehicule-vert-bretagne-880-bornes-de-recharge-sur-le-territoire-breton-a-l-horizon-2017-4982.html>

²⁰ https://www.nordpasdecals.fr/jcms/c_47364/le-vehicule-electrique

²¹ www.proeftuin-ev.be

²² www.steiermark.at and www.acstyria.com

²³ http://www.makingbirminghamgreener.com/wp-content/uploads/2015/02/BCC-City-Blueprint_Feb-2015_FINAL_online-version.pdf

²⁴ http://www.poitou-charentes.fr/files/guide_aides/infrasrecharge-reglement.pdf

²⁵ <http://www.ieahev.org/>

- Shared costs and pooled technical resources;
- Avoided duplication of effort and repetition of errors;
- Harmonized technical standards;
- An effective network of researchers;
- Stronger national R&D capabilities;
- Accelerated technology development and deployment;
- Better dissemination of information;
- Easier technical consensus;
- Boosted trade and exports.

In November 2014, the IEA Committee on Energy Research and Technology (CERT) approved the fifth phase of operation for IA-HEV, which is scheduled to run from March 1st, 2015 until February 29th, 2020 and has the following strategic objectives:

- To produce and disseminate objective information – for policy and decision makers – on hybrid and electric vehicle technology, projects and programmes, and their effects on energy efficiency and the environment. This is done by means of general studies, assessments, demonstrations, comparative evaluations of various options of application, market studies, technology evaluations, highlighting industrial opportunities, and so forth
- To be a platform for reliable information on hybrid and electric vehicles;
- To collaborate on pre-competitive research projects and related topics and to investigate the need for further research in promising areas;
- To collaborate with other transportation related IEA Implementing Agreements, and to collaborate with specific groups or committees with an interest in transportation, vehicles and fuels.

The IA-HEV Annual Report²⁶ for 2014 collects good practices and results obtained by the IEA members. In particular, the document provides full descriptions and references to the most innovative technologies and research regarding electric vehicles, charging infrastructure, charging systems (e.g. fast charging, wireless charging) and batteries, giving indications on policies and strategies to adopt for the development of e-mobility.

Furthermore, a review of all development and demonstration projects carried out during 2014 worldwide (members and non-members of IEA) is provided, together with information of the actual status of infrastructure deployment, future targets on the number of recharging points to be installed and incentives for the purchase of e-vehicles.

3.4 NATURAL GAS SUPPLY FOR TRANSPORT

Natural gas supply for transport is the main theme of Article 6 of the Directive. Table 3.3 summarises the main principles and provides the links to the chapters of this document in which methodologies and solutions are shown.

Table 3.3: Natural gas supply for transport

²⁶ http://www.ieahev.org/assets/1/7/Report2015_WEB.pdf

Articles of Directive 2014/94/EU	Obligations required by the Directive	Deadline	Proposed methodology and solutions
Article 6 (1)	Ensure that an appropriate number of refuelling points for LNG are put in place at maritime ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network.	31 December 2025	see Chapter 8
Article 6 (2)	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.	31 December 2030	see Chapter 8
Article 6 (3)	Designate the maritime and inland ports that are to provide access to the refuelling points for LNG taking into consideration actual market needs.		see Chapter 8 and Chapter 9
Article 6 (4)	Ensure that an appropriate number of refuelling points for LNG accessible to the public are put in place at least along the existing TEN-T Core Network, in order to ensure that LNG heavy-duty motor vehicles can circulate throughout the Union.	31 December 2025	see Chapter 7
Article 6 (6)	Ensure that an appropriate LNG distribution system is available in their territory, including loading facilities for LNG tank vehicles, in order to supply the refuelling points referred to in paragraphs 1, 2 and 4.		See Chapter 8
Article 6 (7)	Ensure that an appropriate number of CNG refuelling points accessible to the public are put in place, in order to guarantee that CNG motor vehicles can circulate in urban/suburban agglomerations and other densely populated areas, and, where appropriate, within networks determined by the Member States.	31 December 2020	see Chapter 7
Article 6 (8)	Ensure that an appropriate number of CNG refuelling points accessible to the public are put in place at least along the existing TEN-T Core Network, to guarantee that CNG motor vehicles can circulate throughout the Union.	31 December 2025	see Chapter 7

3.4.1 Examples in Member States

Gas plays a key role in the EU energy system, accounting for around a quarter of final energy consumption, and will continue to be of major importance as we make the transition to a low carbon future. The security, affordability and sustainability of the EU gas system are therefore critical for the success of the Energy Union.

For this reason, the Directive focuses on the deployment of both the LNG and CNG networks.

LNG represents a significant opportunity to reduce the impact of **maritime transport** on the environment (pollutant emissions) and climate change (CO₂ emission). For this reason, the European Commission has set deadlines for the deployment of a proper infrastructure within the TEN-T core network. In particular, Member States by means of their national policy framework have to:

- Ensure that an appropriate number of refuelling points for LNG are put in place at maritime ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network;
- Designate the maritime and inland ports that are to provide access to the refuelling points for LNG;
- Ensure that an appropriate LNG distribution system is available in their territory, including loading facilities for LNG tank vehicles, in order to supply the refuelling points.

Many European projects concerning the development of the LNG use as alternative fuel have indeed been financed by the EU, among which it is worth mentioning²⁷:

- The “LNG infrastructure of filling stations and deployment in ships” project (2010-EU-21112-S) which consists of feasibility studies on LNG filling station infrastructure so as to develop framework conditions for the use of LNG in the maritime sector;
- The “Costa” project (2011-EU-21007-S) which proposes feasibility study results for assessing the use of LNG for ships in the Mediterranean, Atlantic Ocean and Black Sea areas;
- The “Costa II” project (2013-EU-21019-S) which is a direct continuation of the previous COSTA project and focuses on the eastern Mediterranean region/sea with five Member States (Greece, Cyprus, Italy, Croatia, Slovenia) in order to prepare a detailed infrastructure development plan promoting the adoption of LNG as marine fuel for shipping operations.
- The LNG Masterplan for Rhine-Main-Danube (2012-EU-18067-S), the main scope of this Action is to prepare and to launch the full-scale deployment of LNG as environmental friendly and efficient fuel in the inland navigation sector within the Priority Project 18 Rhine/Meuse-Main-Danube axis.

LNG could be very useful also in **road transport**, especially for heavy duty vehicles. Therefore, as required by the Directive, *“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*

²⁷ <http://emsa.europa.eu/main/sustainable-toolbox/relevant-eu-projects.html>

demand, unless the costs are disproportionate to the benefits, including environmental benefits." (Article 6(4)).

The economic assessment is therefore the main topic of numerous action plans financed by the EU. Some examples which can be used as references by Member States are:

- "Gas as an Alternative for Road Transport – GARneT" (2011-ES-92136-S). In this Action, Gas Natural Fenosa and Ham Criogénica undertake a study to demonstrate, promote and accelerate the wide scale use of LNG as an alternative environmentally friendly and cost effective transport fuel for heavy goods. In particular, the work focuses on identifying the logistical problems for the supply of LNG to refuelling points across Europe at an economically attractive price;
- "Study including pilot deployment to determine the viability of LNG as an alternative fuel for medium and long distance road transport" (2013-NL-92062-S). The project's overall objective is to speed up the growth of the LNG road infrastructure and assess its operational market within a short period of time. It is mainly based on the construction of a supply chain at pilot scale in The Netherlands and it provides operational data so as to eliminate the risk perceived by logistic service providers in switching to LNG as a fuel for medium to long distance road transport.

In the "Consultation document for a national strategy on LNG" carried out by the Italian Government, a complete and detailed assessment of the development of the LNG network in Italy is presented in with the requirements of the Directive. In particular, this document lays the groundwork for a following national policy concerning the use of LNG for both road and maritime transport sectors.

As for LNG, the Directive highlights the importance of developing a proper refuelling network for CNG motor vehicles within all Member States. The Directive requires that *"Member States shall ensure, by means of their national policy frameworks, that an appropriate number of CNG refuelling points accessible to the public are put in place by 31 December 2020, in order to ensure, in line with the sixth indent of Article 3(1), that CNG motor vehicles can circulate in urban/suburban agglomerations and other densely populated areas, and, where appropriate, within networks determined by the Member States."* and that *"Member States shall ensure, by means of their national policy frameworks, that an appropriate number of CNG refuelling points accessible to the public are put in place by 31 December 2025, at least along the existing TEN-T Core Network, to ensure that CNG motor vehicles can circulate throughout the Union."* Indeed, at the moment, there is a lack of harmonised development of CNG infrastructure across the Union. In particular, in their national policy framework, Member States shall designate the urban/suburban agglomerations, other densely populated areas and networks which, subject to market needs, are to be equipped with CNG refuelling points (Article 3(1))

Numerous action plans have already been financed with the aim to provide good practices and references to encourage the development of a proper CNG network. Some examples are:

- "Biomethane and LNG in the North for growth and competitiveness in EU" (2013-SE-92044-S). This study covers the pilot deployment of some new filling stations in Sweden providing important feedback which can support the decision making process for other possible CNG filling stations in Europe;

- “Pilot deployment of a smart (bio-) LNG/CNG network in Flanders, investigating an innovative ‘mobile CNG pipeline’ concept” (2014-BE-TM-0170-S). This Action aims at extending the LNG/CNG supply network in Belgium based on the innovative concept of “virtual mobile CNG pipeline”. This consists of the production of CNG and LNG centrally located mother station and the road transport of L-CNG to several satellite CNG stations. A specific test on a first pilot network consisting of a mother LNG/CNG station and a satellite CNG station in Belgium will validate the technical, economic and ecologic viability of the solution.

3.5 HYDROGEN FOR TRANSPORT

Hydrogen technologies were identified amongst the new energy technologies needed to achieve a 60 % to 80 % reduction in greenhouse gases by 2050 in the European Strategic Energy Technology Plan presented along with the Energy Policy Package in January 2008. As shown in Table 3.4, Directive 2014/94/EU recognizes the potential of hydrogen, establishing that Member States which decide to include hydrogen refuelling points accessible to public in their national policy shall ensure that, by 31 December 2025, an appropriate number of such points are available (Article 5(1)).

Table 3.4: Hydrogen supply for transport

Articles of Directive 2014/94/EU	Obligation required by the Directive	Deadline	Proposed methodology and solutions
Article 5 (1)	ensure that an appropriate number of such points are available, to guarantee the circulation of hydrogen-powered motor vehicles, including fuel cell vehicles, within networks determined by those Member States, including, where appropriate, cross-border links.	31 December 2025	see Chapter 7

3.5.1 Examples in Member States

Some important initiatives have already started in Europe to support the introduction of hydrogen as a transport fuel by developing and implementing a strategy for the deployment of a national network. These are:

- “UK H2 Mobility” (see <http://www.ukh2mobility.co.uk/>);
- “Mobilité hydrogène France” (see <http://www.afhycac.org/>);
- “Scandinavian Hydrogen Highway Partnership” (see <http://www.scandinavianhydrogen.org/>);
- “H2 Mobility” (see <http://h2-mobility.de/>).

Similar initiatives are running in other countries such as Austria, Italian, Belgium, Finland, Netherlands, Switzerland.²⁸

These initiatives can be considered as pilot actions which can be followed by other Member States for the adoption of a national hydrogen policy. In

²⁸ Joanna Brahova (2015). “Fuel Cells and Hydrogen - State of Play & Perspectives”. New Energy World Industry Grouping (NEW-IG) Brussels, 29 June 2015

particular, the above mentioned projects demonstrate that the development of hydrogen as alternative fuel is possible where there is:

- an established strategy for rolling out hydrogen refuelling stations;
- a strong national government support (e.g. tax exemptions for cars, non-financial incentive);
- an important presence of industrial actors in the field of fuel cells and hydrogen;
- a potential for green hydrogen production.

These can be recognized as elements for defining a strategy for hydrogen vehicles and infrastructure.

4 MEASURES NECESSARY TO ENSURE NATIONAL TARGETS AND OBJECTIVES ARE REACHED

In order to promote alternative fuels and the development of the relevant infrastructure, the national policy frameworks may identify a list of supporting actions/measures that could be classified into the following categories according to their nature:

- *Legal measures*: which consists of legislative, regulatory or administrative measures to support the build-up of alternative fuels infrastructure. ;
- *Policy measures*: which consists of measures to support the implementation of the policy framework;
- *Cross Border Continuity*: which consists of measure to guarantee the interoperability among Member States.

In the following paragraphs a list of measures is proposed. A specific fact sheet template has been prepared to describe all the measures in the same way.

The template includes the following information:

- Section A: Measure characteristics. The main information on the measure is reported in this section to describe:
 - title of the measure,
 - measure category,
 - description of the measure,
 - main targets and objectives,
 - type of infrastructure involved (e.g. recharging or refuelling point),
 - transport means involved (e.g. private cars, light or heavy duty vehicles, public transport),
 - entity responsible for the measure (e.g. Member States, local authorities, etc.);
- Section B: Implementation and results. The main information on the implementation of the measure and the results achievable are reported in this section:
 - steps for application/implementation of the Directive,
 - effectiveness of the measure (on a scale 1 – 5),
 - cost for implementation/application (on a scale 1 – 5).

Further in this chapter, we give a list of examples in various Member States, describing the actions that can serve as good practices.

It should be noted that the measures described in the following paragraphs and in the next chapter **can be applied for all Alternative Fuels as defined in the Art. 2 of the Directive**:

(1) '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,
- synthetic and paraffinic fuels,
- natural gas, including biomethane, in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)),
- liquefied petroleum gas (LPG).

4.1 LEGAL MEASURES

4.1.1 Include alternative fuels infrastructures in formal strategic plans

Public and private organizations of a given size could be legally bound to produce strategic plans to address specific issues related to their activities. These strategic plans can relate to environmental performance, waste management and mobility plans.

Requirements on the content of these strategic plans could include actions on alternative fuel infrastructure.

Section A: Measure characteristics	Measure Title		<i>Alternative Fuels Topic in Strategic Plans</i>
	Measure Category		Planning Criteria
	Description		The alternative fuels topic could be considered in the redaction of the strategic planning plans prepared by Local Authorities with a number of habitants higher than a fixed value (e.g. Mobility Urban Plan, Sustainable Energy Action Plan (SEAP), Sustainable Urban Mobility Plan (SUMP), etc.).
	Main targets and objectives		Local Authorities awareness on the subject
	Infrastructure		Recharging and refuelling station
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		MS	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of most suitable plans to incorporate AFI requirements 2. Definition of minimum city size (e.g. population, employees) for application of the measure 3. Implementation of national decree to set up requirements 4. Follow-up on the application of the decree
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	

	- Cost for application / implementation:	N.A.	
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4.2 POLICY MEASURES

4.2.1 Financial Incentives

Given that alternative fuels vehicles and infrastructure are still more expensive than conventional ones, financial incentives can make a difference in generating market penetration. Financial incentives can target both the vehicles as well as the fuel infrastructure. These incentives can vary widely from direct subsidy to tax breaks.

The Directive indicates the use of different types of resources for the development of alternative fuels infrastructures: European, national and private resources and investments.

The EIB, in close cooperation with the Member States and the European Commission, already supports the financing of the development and market introduction of new technologies and innovations, fostering clean and more sustainable mobility, as well as the deployment of the supporting infrastructure for alternative fuels.

The potential beneficiaries of EIB financing can be public, private or PPP legal entities, depending on the type, the conditions and the scope of the initiatives (DG MOVE - Expert group on future transport fuels - State of the Art on Alternative Fuels Transport Systems). For more details see Paragraph 4.4.13.

In addition, the deployment of infrastructure for alternative clean fuels on the broader comprehensive TEN-T network will be able to receive financial assistance from the Connecting Europe Facility (CEF) in the form of procurement and financial instruments, such as project bonds (Paragraph 4.4.14).

Specific financial supporting actions could also be introduced by the Member States to facilitate the growth of alternative fuels in the transport sector. In the next paragraph examples of financial support are reported.

4.2.1.1 Co-financing

Special funds could be set up to finance special credit lines for the promotion of technological research and to foster the deployment of alternative fuel infrastructures.

Member States could participate in financing the research, demonstration and deployment activities related to alternative fuels. The percentage and the method for the definition of the co-financing could be defined by each Member State also according to general rules defined by the European Commission that could support Member States in this activity.

Public budget could be allocated yearly to support alternative fuels research and demonstration projects. All fuels of interest to the concerned Member State and all the different transport modes could be considered.

4.2.1.2 Credit facilitated

The credit facilitated can be guaranteed using adequate financial instruments and dedicated programmes.

Such instruments aim to help ease access to finance for alternative fuels investors. Member States and regions could adapt and use these models to set up financial instruments to secure loans for investments in this sector.

4.2.1.3 Reduction and/or Suspension of Taxation

A financial advantage based largely on alleviated taxation may improve the attractiveness of the use of alternative fuel vehicles for the users and foster the deployment of alternative fuel infrastructure due to a reduction of tax burden for investors.

Examples of subsidies, tax breaks, indirect financial stimulus for infrastructure and vehicles are:

- exemption or reduction of the registration tax and/or of the ownership tax for the vehicle users;
- subsidy for installation of recharging/refuelling infrastructures and/or reduction of yearly taxation on revenues.

Section A: Measure characteristics	Measure Title		<i>Subsidy for alternative fuel infrastructure Deployment</i>
	Measure Category		Financial Contribution
	Description		Grant a subsidy for the deployment of Alternative Fuel Infrastructure to reduce initial cost for investors
	Main targets and objectives		decrease cost for investors and start to solve the chicken-egg-problem: increase the demand as a consequence of the increase of the supply
	Infrastructure		Alternative fuel refuelling and recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Subsidies could be applied also to public transport sector (recharging and/or refuelling points could be available in depot)
Responsible		MS, Local Authorities with competence to grant subsidies	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Allocation of a public budget 2. Identification of a strategy (different subsidies could be available: co-funding, loan with special conditions, etc.) 3. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	2	The financial impact depends on the allocated budget

Section A: Measure characteristics	Measure Title		<i>Reduction and/or suspension of taxation</i>
	Measure Category		Financial Contribution
	Description		Tax break or reduction applicable to recharging points and refuelling stations selling alternative fuels
	Main targets and objectives		Foster the deployment of alternative fuel infrastructure for recharging and refuelling
	Infrastructure		Recharging and refuelling points selling alternative fuels
	Transport means		Comments
	<input type="checkbox"/>	Private cars	N.A.
	<input type="checkbox"/>	Light Duty Vehicle	
<input type="checkbox"/>	Heavy Duty Vehicle		
<input type="checkbox"/>	Public Transport		
Responsible		MS, Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • Identification of basic requirements for vehicles powered by alternative fuel • Implementation of national decree
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	it depends on the burden of taxation
	- Cost for application / implementation:	1	the financial impact influences the Member State incomes

4.2.2 Measures to Increase the Demand of Alternative Fuels Vehicles

In order to facilitate the growth of alternative fuels in the transport sector, the development of a proper infrastructure is not sufficient if it is not supported by specific measures which directly affect the demand of AFVs. To this end, besides the proposed actions shown in the previous paragraph, other strategies can be implemented in favour of potential customers.

Section A: Measure characteristics	Measure Title		<i>Incentives for the purchase of private AFVs</i>
	Measure Category		Financial contribution for purchasing AFVs
	Description		Definition of policies and incentives for AFVs. Incentives have to concern both the purchase and the mobility of AFVs. In order to make incentives more effective: <ul style="list-style-type: none"> • They have to be attractive enough for

		<p>consumers to pay the higher price of the vehicle.</p> <ul style="list-style-type: none"> • There could be a relationship with the contribution they make towards lower CO2, better air quality and lower noise levels. • Their level could have, after an initial success, a negative effect on political will/support and public opinion. • They should be perceived as fair and not favouring certain classes of vehicles or buyers. • They should be smart in time: adapt to developments in technology, cost and market offerings.
	Main targets and objectives	Foster the purchase and the use of AFVs
	Infrastructure	
	Transport means	Comments
	<input type="checkbox"/> Private cars	
	<input type="checkbox"/> Light Duty Vehicle	
	<input type="checkbox"/> Heavy Duty Vehicle	
<input type="checkbox"/> Public Transport		
Responsible	Member State and Local Authorities	
Section B: Implementation and results	Steps for application/implementation	<ul style="list-style-type: none"> • Evaluation of possible incentives such as special fee for parking, access to restricted areas, exemption from payment of car taxes for a given period, zero VAT and so on; • Assessment of financial contributions needed and benefits stemming from the increase of AFV demand; • Implementation of a national decree to set up the incentives; • Follow-up on the application of the decree.
	Direct impacts: (1: low - 5:high)	Comments
	- Effectiveness:	5
	- Cost for application / implementation:	N.A.

4.2.3 Communication

One of the main reasons which prevent AFVs from developing is surely the lack of information concerning the technological and safety characteristics of this kind of vehicles. Indeed, in the majority of the cases, people are not well informed and do not trust new AFV technologies, thinking that they are more expensive and above all not safe (e.g. gaseous fuels are often considered more dangerous than other fuel typologies).

It is therefore important to support different forms of communication and advertisement in order to increase public awareness about the maturity of the technology, operational costs for vehicles, vehicle impacts (both environmental and societal) and safety level of AFVs.

Section A: Measure characteristics	Measure Title		<i>Awareness on technological and safety characteristics of AFVs</i>
	Measure Category		Communication and advertisement
	Description		Advertise technological and safety characteristics of AFVs
	Main targets and objectives		Increase public awareness on technological and safety characteristics of AFVs
	Infrastructure		
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member State and Local authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> Organise meetings with the main AFV automakers; Organise workshops; Support any form of advertising which describes the characteristics of AFVs so that people can be fully aware of safety and technology of this kind of vehicles.
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	
	Cost for application / implementation:	N.A	

4.2.4 Leading by example

Specific financial supporting actions have to be addressed to the purchase and the use of AFVs. These actions have to concern both private citizens and above all, public administrations. It is indeed likely that a potential growth of AFVs used by public administrations can encourage the same development even in the private transport sector.

Section A: Measure characteristics	Measure Title		<i>Encourage public administrations to use AFVs</i>
	Measure Category		Communication and advertisement and financial contribution
	Description		This measure aims to increase the use of AFVs in public administrations (e.g. public fleets, car sharing) and public transport services.
	Main targets and objectives		Starting from public services, this measure might increase the spread of alternative fuels even for private use.
	Transport means		Comments
	<input type="checkbox"/>	Private cars	e.g. official vehicles

	<input type="checkbox"/>	Light Duty Vehicle	e.g. delivery vans, LDV for technical services
	<input type="checkbox"/>	Heavy Duty Vehicle	e.g. waste lorry
	<input type="checkbox"/>	Public Transport	e.g. buses
	Responsible		Member State and Local Authorities
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • Sensitise politicians, Public administrations, Public transport operators to the adoption of AFVs; • Involve all stakeholders (e.g. alternative fuel suppliers, leasing companies and so on) so as to obtain advantageous prices and introduce financial contributions for supporting AFVs; • Implementation of a national decree to support public administrations in gradually increasing their own AFV fleet; • Follow-up on the application of the decree.
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	N.A.	

4.3 CROSS BORDER CONTINUITY

Policy to guarantee cross border continuity

Technical interoperability occurs when similar and compatible technologies are set up to ensure the continuity of cross-border mobility between two neighbouring countries.

Removal of regulatory, financial, administrative and technical barriers is necessary. Furthermore, the coordination at European level on the implementation process could be desirable.

A master plan could be prepared to guarantee the maximum level of commitment. The main steps of the process could be:

- establishment of a partnership of all parties concerned: public and private, EU Institutions, Member States, suppliers and users;
- promotion of technical harmonization and create unified standards and certification schemes for technologies and procedures for interoperability;
- improvement of the preconditions for interoperability infrastructure, including new infrastructure construction: harmonise and standardise physical interfaces to ensure the compatibility of components for recharging/refuelling.

Section A: Measure characteristics	Measure Title		<i>National interoperability</i>
	Measure Category		Technical and financial interoperability among Member States
	Description		Alternative fuel infrastructure will be owned and run by different operators. To fully enjoy the benefits of a dense network, the different networks need to be interoperable. This includes common payment platforms, standardized protocols and, if possible, compatible business models. This measures deals with interoperability within a Member State
	Main targets and objectives		Maximize network-effects while still allowing private competition
	Infrastructure		Recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member States	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of stakeholders (network operators, network users,..) 2. Outlining & communicating a (technical) "desired situation" from the perspective of the public authority on interoperability of networks 3. Facilitation & coordination of interoperability approach, initiated by the network owners/operators 4. Changes to national law (if needed) to support interoperability (e.g. permit system)
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	(not clear, sectorial empirical evidence not available, past experience in other sectors suggest possible high impact)
	- Cost for application / implementation:	1	Limited to coordination efforts

Section A: Measure characteristics	Measure Title		<i>International interoperability</i>
	Measure Category		Technical and financial interoperability among Member States
	Description		Different Member States may choose different approaches to manage actors in the alternative fuel infrastructure space. E.g. some may give priority to electricity distribution operators; others may leave it to the private sector. In order to avoid national borders to become a "technical" border for electric vehicles, the different networks need to be interoperable. This includes common payment platforms, harmonized legislation, and international collaboration on installation of infrastructure. This measure deals with interoperability between Member States
	Main targets and objectives		Harmonization of legislation/organization of AFI between Member States
	Infrastructure		Recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member States / European Commission	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Dialogue with neighbouring countries 2. Identify conflicting governance, identify need for AFI investment on borders 3. Changes to national law (if needed) to support interoperability
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	
	- Cost for application / implementation:	1	Limited to coordination efforts

Section A: Measure characteristics	Measure Title		<i>Coordination in geographical implementation</i>
	Measure Category		Technical interoperability between Member States
	Description		It is important that AFI-coverage is adequate also in border areas; Member States could make sure AFV-users are properly served in their border areas. Neighbouring Member States could coordinate optimal implementation of AFI, avoiding blind spots in the network as well as avoiding inefficient investment by preventing overlaps. Co-investment can be an option.
	Main targets and objectives		Ensuring network coverage in all areas
	Infrastructure		Recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member States / European Commission	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • Dialogue with neighbouring countries in purposely setup working groups • Map needs for AFI investment in border area's • Joint decision on implementation sites, agree on burden-sharing
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	
	- Cost for application / implementation:	1	Limited to coordination efforts

4.4 EXAMPLES OF MEASURES APPLIED IN MEMBER STATES

4.4.1 EE: Deployment of a (fast-)charging network

CONCEPT: “ELMO-program” electro mobility in Estonia. The infrastructure component of the plan encompasses the deployment of a public fast-charging network (CHAdeMO-standard).

IMPLEMENTATION:

All roads with dense traffic are covered with a distance between quick charging points of about 40-60 km. All settlements with over 5000 inhabitants are served. Charging points are built in various locations: shopping centres, refuelling stations, post offices, bank buildings, parking lots, etc. Total number: 165-168

The network is publicly owned, but not free of charge to use.

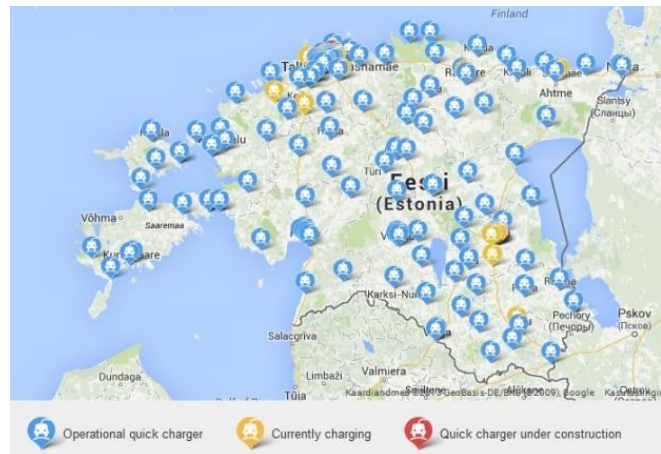
Pricing is done in different ways:

1. Monthly fee
2. Pay per charge (2.5€)

Different packages are available.

FURTHER READING:

<http://elmo.ee/elmo/>



4.4.2 NO: Financial Stimulus

CONCEPT: Comprehensive financial stimulus package for electric vehicles

IMPLEMENTATION: Norway has chosen an aggressive stimulus policy for electric vehicles by providing a variety of financial incentives, focusing on the vehicle. The expectation is that “infrastructure follows vehicles”, i.e. if there are more electric vehicles on the road, a market for EVSE (Electric vehicle service equipment) will be created as EV users grow.

The list of the key financial incentives used is as follows:

1. Exemption on purchase taxes
2. Exemption of VAT (25%)
3. Toll exemption
4. Exemption of parking fees

In total, this can add up to 50% of net vehicle prices. The financial incentives are very strong and has indeed led to a surge in sales. At the start of the incentive program, the target was 50.000 EV's and this was achieved 2 years earlier than expected. Currently, 25% of new sales are EV's.

The program cost is high. Some sources claim a cost of +/- 500M€ per year in missed revenue from purchase tax exemption and other benefits. With the target met, currently discussions are ongoing to reduce benefits (end of the VAT exemption).

4.4.3 BE-DE-NL Interoperability: e-clearing.net & Cooperation Agreement

CONCEPT: E-clearing.net is a solution for cross-functional charging of electric vehicles. The core of this solution is a platform for the exchange of roaming authorisation, charge transaction and charge point information data.

IMPLEMENTATION: Founded and developed by several EVSE service providers in 3 different countries (BE, NL and DE), E-clearing.net is an open clearing and settlement platform which enables the mutual and international exchange of electric car charging data between the organizations. Because of this agreement, a customer of any one of the member organizations now can use their local user card to access electric car charging in any of the other seven countries, because costs can easily be settled between the participating providers.

This includes a software platform ensuring interoperability between different types of EV (slow-)charging networks. EV-users linked with a (private) infrastructure provider can use their payment protocol also with charging points owned by other operators that are part of the platform. Network owners/operators pay an annual membership fee.

At institutional level, BE, NL and DE signed the "Treaty of Vaals" committing the respective Member States to this approach for cross-border interoperability.

The initiative receives a limited subsidy/grant from participating Member States for its operations.

FURTHER READING:

<http://www.ieahev.org/%E2%80%9Ctreaty-of-vaals%E2%80%9D-enables-electric-car-charging-in-7-european-countries/>

<http://e-clearing.net/>

4.4.4 AT-FR-NL-IE: internal organization

CONCEPT: Measures to be taken can fall under different competences, different ministries/administration at different regional level (local, regional, national). Internal organisation is needed to provide a coherent NPF.

IMPLEMENTATION: Various Member States have taken the logical step to name an authority in charge of defining and implementing the plan at national level. For example, in NL, a working group is setup with representatives of different ministries, holding frequent meetings and aligning efforts within their respective agencies. It is essential to have clear alignment as different ministries may have conflicting objectives due to initiatives other ministries are not aware of.

The organization is very specific for each Member State as competences can be with different ministries and different level of authorities. As such, Member States could identify themselves the appropriate participants to the discussion platform.

Regardless of the configuration of participants, it is important to assign a leading agency to constructing the NPF. This can be the agency which holds the bulk of the competence (e.g. FR, NL where the Ministry of Environment is taking the lead).

4.4.5 BE-NL-DE-CH International organizations - cross-border continuity

CONCEPT: Cross-border continuity is mainly about interoperability, compatibility of AFI-models as well as availability of refuelling points in neighbouring countries. Existing international organizations can facilitate cooperation as available discussion platforms as well as executive competence.

IMPLEMENTATION:

Examples:

1. The Central Commission for the Navigation of the Rhine (CCNR) sees to the requirement that uniform regulations apply for all those participating in Rhine navigation and for all national sections of the river. To ensure that these regulations are continuously updated, a common administration for Rhine navigation has been established. This legislative competence guarantees harmonised and even unified technical and legal requirements for navigation and directly related activities.

The CCNR and its partners are bringing together top representatives from politics, business and society to assess the prospects of liquefied natural gas (LNG) as fuel and cargo in inland waterway transport. It is organizing a stakeholder consultation and discussion platform for its members to determine the next steps to take with regards to the profession's inland navigation on the Rhine and the policy framework regarding LNG.

2. The BENELUX countries use the existing discussion platforms to make agreements about a common approach for alternative fuel infrastructure deployment. The Benelux organization was used as a platform to agree on the topics and level of cooperation, which lead to a formal recommendation for its members (i.e. Belgium, The Netherlands and Luxembourg). The recommendations include following elements:
 - a. Exchange of know-how and good practices between members
 - b. Timing of cooperation (i.e. before submitting NPF to the EC)
 - c. Specific attention to be given to cross-border aspects: location of infrastructure deployment, joint infrastructure deployment projects (including joint use of CEF) and ensuring interoperability.
 - d. The above is to be executed by the (existing) working group of competent authorities from the 3 members: "Alternative Transport - Electric Transport" (VE-TER-AV-EV). This working group reports to the Benelux, not to the individual members
 - e. Focus on Electricity, CNG/LNG and Hydrogen, in line with the Directive.

The formal recommendations are published in the 5th bulletin of 2015, published on 01/12/2015 (p12). See also in references.

Similar initiatives are possible e.g. at the level of the International Commission for the Protection of the Danube River (ICPDR), although

competence is not strictly the same as CCNR. At country levels, similar approaches are possible in Iberia, Visigrad, NB8, etc.

FURTHER READING:

<http://www.ccr-zkr.org/11010400-en.html>

<http://www.inland-navigation.org/observatory/innovation-technologies/Ing/Ing-database/>

<http://www.benelux.int/fr/energyweek/>

http://www.benelux.int/files/4814/4896/9787/Bulletin_2015-5_FR.pdf

4.4.6 Planning of fast charging networks for electric vehicles – Austrian Crossing Border Project

CONCEPT: The aim of CROSSING BORDERS is to develop and test intelligent, cross border e-mobility systems and services in the project corridor from Bratislava via Vienna to Munich.

IMPLEMENTATION:

The Austrian Crossing Borders project developed an automated network planning optimization algorithm for the design of an efficient fast charging infrastructure for e-mobility.

The Network Planning Optimization Algorithm works on the basis of standardized input datasets and parameters. As main data sources traffic demand model data (origin-destination matrices, traffic flows differentiated by trip distances and trip purposes) and geo-referenced location data (POI like motorway service areas, shopping centres, supermarkets, petrol stations, parking etc.) are used. A main asset of the approach is the synchronous consideration of traffic volumes and location attractiveness from a customer’s point of view. The results are not to be considered as static; rather does the algorithm offer the possibility of up-to-date recalculations whenever necessary. Already existing stations can be considered, and whenever a set of new charging stations is realized (e.g. because of pragmatic reasons like the interest of suitable location partners) or if certain locations cannot be realized due to practical reasons, we can integrate these information and provide an updated optimized network plan immediately. As all the input datasets are standardized and adjustable parameters are used, the algorithm can be applied for network planning in any other country/region as long as suitable traffic model and location data is available.

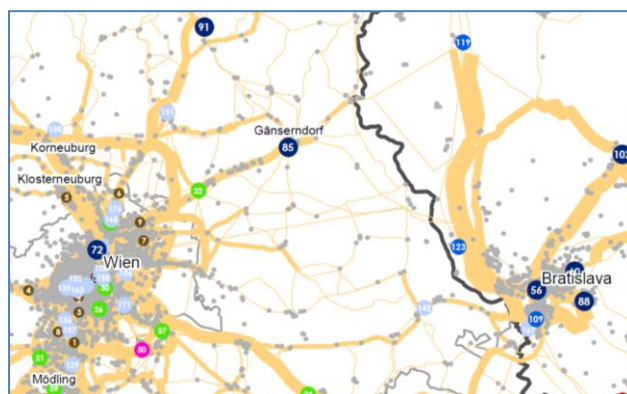


Figure 4.1: Austrian Crossing Border Project – Example of Network planning results

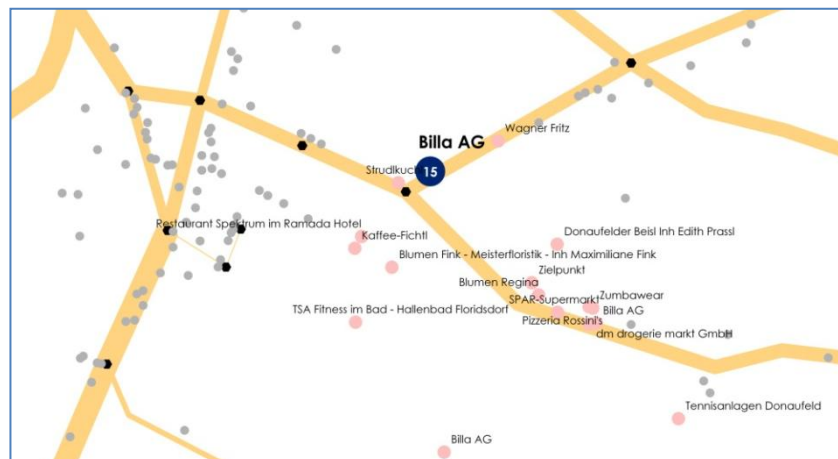


Figure 4.2: Austrian Crossing Border Project - Example of Optimization results and alternative locations

In addition, for the results of the optimization algorithm, for each selected location a number of possible alternative locations (nearby locations that are assigned to the same road network node) are listed. The listing of these alternative locations provides a substantial added value, because in case that a location chosen by the algorithm cannot be realized due to practical reasons, there is a number of alternatives (that offer more or less the same traffic coverage) at hand.

FURTHER READING:

<http://www.crossingborders.cc/en/project>

4.4.7 DK-SE: Cooperation between ports

CONCEPT: LNG bunker stations require a high investment cost, but once in place can serve vessels in a larger region than only the own port. Cooperation between adjacent ports, also in different countries, can decrease the financial burden and create opportunities for risk sharing to come to a win-win outcome.

IMPLEMENTATION:

The cooperation between Copenhagen-Malmö Port (CMP) and the Baltic Sea Ports offers an example of joint investment in LNG bunkering.

CMP is an example of unique cross-border alliance. Two ports in two different countries have joined all their port operations into one company, one organisation and one legal entity. CMP was founded 2001, following the merger of port and terminal activities in Copenhagen and Malmö. Extended with Aarhus, Helsingborg, Helsinki, Stockholm, Tallinn and Turku, these ports associate in the Baltic Sea Ports.

Baltic Ports Organization has announced the development of the “LNG in Baltic Sea Ports II” initiative within five ports of the Baltic Sea Region. This involves ports from Sweden, Germany and Lithuania. Three of them are TEN-T Core Network seaports and two are comprehensive ports. LNG small scale bunkering infrastructure studies are scheduled in the ports of: Helsingborg, Trelleborg, and Sundsvall, Rostock and Klaipėda (Klaipėdos Nafta).

FURTHER READING:

<http://www.Inginbalticseaports.com/>

<http://www.Ingterminalgothenburg.com/>

<http://www.portofgothenburg.com/About-the-port/Sustainable-port/Liquefied-natural-gas--LNG/LNG-terminal-at-the-Port-of-Gothenburg-/>

4.4.8 NL: Amsterdam municipality

CONCEPT: In a densely populated city with few private parking options, the local authorities set ambitious targets on AFI deployment with a variety of local measures to help EV-owners by deploying charging points on demand and an e-car sharing service.

IMPLEMENTATION: Amsterdam is a densely populated city and is challenged in providing sufficient public parking for its citizens. Also private parking spaces are in limited supply. The city is using the lack of parking space as a means to stimulate electric vehicles.

EV-owners can apply for deployment of an EV charging point for their vehicle, in the public domain close to their residence. The deployment of the AFI is done by different private actors. EV-owners are also granted priority when applying for a parking license. In some NL cities, waiting lists can accumulate up to several years as such granting priority can generate a strong non-financial incentive towards EV's.

Apart from the above, the Amsterdam municipality is also offering a subsidy when AFI is included in new buildings. The rationale is that AFI in the private space and when included in new building sites is less expensive compared to building new public charging points.

The Amsterdam municipality is the owner of some public parking places. It has installed charging points on the parking lots it owns and is offering free charging sessions on its public parking places.

Amsterdam is also enabling a peer-to-peer system for charging of EV's at other individual private charging infrastructure ("vereniging van eigenaren" - association of owners).

Finally, Amsterdam is home to about 750 city-wide EV's in e-car sharing service, car2go.

The Amsterdam case shows that local authorities can do a lot to enable AFI deployment, given a coherent national regulatory framework.

FURTHER READING:

<http://www.mobieurope.eu/the-project/ongoing-initiatives/amsterdam-electric/>

<http://www.iamsterdam.com/en/media-centre/city-hall/dossier-electric-transport/electric-transport-facts-figures>

<https://www.amsterdam.nl/parkeren-verkeer/amsterdam-elektrisch/amsterdam-elektrisch/publicaties/brochure-elektrisch/>

4.4.9 BE: Procurement Criteria

CONCEPT: Public administrations and/or public enterprises are often owners of a large fleet of vehicles. Public procurement of vehicles is regulated and contracts are awarded on a set of pre-defined criteria. In Belgium, the

procurement procedures are adapted, favouring AFI by emphasising environmental performance as an award criterion.

IMPLEMENTATION: A "National Master plan for encouraging electric mobility in Belgium" was drawn up by the FOD Economy to successfully introduce electric mobility in Belgium. One of the 13 action domains is the "Role of the Government as launching customer". This action domain concerns the use of the government fleet as a test case, a pioneer for switching from conventional to electric mobility within their own fleet.

A study revealed 6 possible pilot projects for the 1500 to 2000 vehicles currently in the federal governmental services fleet. Some of options considered are: the partial replacement of conventional pool and/or technical intervention vehicles by electric alternatives. The introduction of electric bicycles and the replacement of vehicles dedicated to leading functionaries by electric alternatives provide good opportunities to introduce electric mobility in the federal government services.

Procurement award criteria have now been changed, favoring AFV vehicles, by adding to the weight of environmental performance in the overall assessment.

While this action focuses on the vehicle side, the goal is to invest likewise in charging infrastructure which will be made available for public use ("infrastructure follows vehicle").

FURTHER READING:

http://economie.fgov.be/nl/modules/pressrelease/s4/20140820_spf_economie_spf_mobilite_testent_des_vehicules_electriques_hybrides_et_au_gaz_naturel.jsp

<http://proeftuin-ev.be/content/belgian-platform-electric-vehicles-government-launching-customer-electric-mobility-belgi%C3%AB>

4.4.10 NL: Mobile LNG-bunkers

CONCEPT: Mobile LNG bunkers in ports to limit investment cost and increase flexibility – changes to regulations to enable transition.

IMPLEMENTATION: As of 1 July 2014 vessels can bunker LNG (Liquefied Natural Gas) in the port of Rotterdam. The Municipality of Rotterdam took over the proposals of the Port of Rotterdam Authority Harbour Master to that end and amended the Rotterdam Port Management bylaws accordingly.

The legislative amendment is a huge impulse for the introduction of LNG as fuel for shipping.

The legislative amendment is in line with the aim of the Port of Rotterdam Authority to promote the use of LNG as shipping fuel and to become a leading LNG hub. The Port Authority previously supported an initiative to open an LNG terminal on the Maasvlakte in 2011. The European Union (EU) supports these initiatives warmly. A subsidy of €40 million was awarded at the end of last year to stimulate the use of LNG as shipping fuel on European waters. This concerns the LNG Masterplan for Rhine-Main-Danube, in which the Port Authority plays an important coordinating role. The Dutch LNG Platform also supports the use of LNG by trucks, inland and seagoing shipping.

Ship-to-ship

The Port Authority has worked intensively over the past two years with other ports to achieve a legislative amendment which enables LNG-fuelled vessels to bunker from an LNG bunkering vessel. The new rules also imply that LNG

may only be bunkered at designated locations within the Municipality of Rotterdam. The legislation is based on national and international safety studies and laws and regulations, standards and good practice guidelines of other ports.

Truck-to-ship

With TTS, the LNG truck is connected to the ship on the quayside, generally using a flexible hose. This is today the most widely used bunkering method, because of the still limited demand in combination with the lack of infrastructure and the relatively low investment costs. For these reasons, truck-to-ship bunkering is a good provisional solution for LNG bunkering. This bunkering method is only suitable for bunkering quantities up to 50 tonnes and is therefore only suited to smaller-sized LNG-fuelled vessels.

FURTHER READING:

<http://www.lngbunkering.org/lng/bunkering/bunkering-practice/truck-ship>

<https://www.portofrotterdam.com/en/news-and-press-releases/lng-bunkering-in-rotterdam-now-also-possible-for-seagoing-ships>

<https://www.portofrotterdam.com/en/cargo-industry/lng-liquefied-natural-gas>

<http://www.platts.com/latest-news/shipping/london/shell-invests-in-lng-bunkering-facilities-at-21857446>

4.4.11 FR: Financial Stimulus of Vehicles

CONCEPT: Favourable taxation for electric vehicles

IMPLEMENTATION: As of 2015, France has adjusted an existing bonus-malus tax based on the CO₂-emissions of vehicles, giving a direct financial incentive to EVs by adding a new CO₂-bracket to the existing ones.

Taux d'émission de CO ₂ (en grammes par kilomètre)	Montant du bonus au 1er janvier 2015 (en euros)
0 à 20 g	6 300 (dans la limite de 27 % du coût d'acquisition)
21 à 60 g	4 000 (dans la limite de 20 % du coût d'acquisition)

FURTHER READING:

<http://www.developpement-durable.gouv.fr/Bonus-Malus-definitions-et-baremes.html>

<http://electriccarsreport.com/2015/02/france-announces-new-electric-car-incentives/>

4.4.12 FR-ES-PT: International Coordination

CONCEPT: joint investment in charging infrastructure, ensuring service and interoperability alongside an international corridor

IMPLEMENTATION: In the run-up to COP21 in Paris, France, Portugal and Spain made a joint statement with proposals for action to accelerate the penetration of electro mobility. One of the proposals is a joint investment in charging infrastructure alongside busy international corridors.

The countries recognize the need for interoperability as well as cross-border continuity in terms of service and as such have decided to cooperate, specifically for these international corridors.

The objective is to set-up a consortium with public and private partners to develop AFI alongside this corridor.

FURTHER READING:

<http://www.aveve-france.org/Uploads/Documents/14483046208f78268aa14736d8df21a92a54ca820c-France,%20Espagne%20et%20Portugal,%20ensemble%20face%20au%20%C3%A9fi%20mondial%20de%20la%20mobilit%C3%A9%20%C3%A9lectrique.pdf>

4.4.13 Financial Support by the European Investment Bank

As already said at the beginning of the chapter, the EIB, in close cooperation with the Member States and the European Commission, supports the financing of the development and market introduction of new technologies and innovations, fostering clean and more sustainable mobility, as well as the deployment of the supporting infrastructure for alternative fuels.

The potential beneficiaries of EIB financing can be public, private or PPP legal entities, depending on the type, the conditions and the scope of the initiatives (DG MOVE - Expert group on future transport fuels - State of the Art on Alternative Fuels Transport Systems).

The ELENA Fund (“European Local ENergy Assistance”, <http://www.eib.org/products/advising/elena/index.htm>) is part of the EIB’s broader effort to support the EU’s climate and energy policy objectives. This joint EIB-European Commission initiative helps local and regional authorities to prepare energy efficiency or renewable energy projects. It is on track to mobilise more than EUR 1.6bn in investments over the next few years.

ELENA covers up to 90% of the technical support cost needed to prepare, implement and finance the investment programme. This could include feasibility and market studies, programme structuring, energy audits and tendering procedure preparation. With solid business and technical plans in place, this will also help attract funding from private banks and other sources, including the EIB. So whether it is the retrofitting of public and private buildings, sustainable building, energy-efficient district heating and cooling networks, environmentally-friendly transport etc., ELENA helps local authorities get their projects on the right track.

This fund has already co-founded the following initiatives, described in the following (the fact sheets are report in Appendix A):

- Central Denmark Energy Planning and Investment (CeDEPI);
- Global Roadmap for Energy Efficiency and New Energy Resources in Extremadura (GREENER-EX);
- MADEV (MADrid Electric Vehicles).

Similar initiatives for public transport are described in Paragraph 6.2.2.

4.4.13.1 Central Denmark Energy Planning and Investment (CeDEPI)

CeDEPI focuses on energy efficiency in public buildings and in street lighting.

The investment programme consists in building refurbishment, and specifically:

- building shell improvement;
- upgrade of energy building equipment's (around 100 buildings have been identified);
- RE electricity generation, through the installation of PV plants on foreseen 17 buildings;
- street lighting upgrade and replacement (approx. 5,700 lighting columns, 20,000 fixtures).

Moreover, the purchase of electrical vehicles and charging points is foreseen in 2 municipalities.

Project expected results include a total annual energy saving of 30,680 GWh, an annual renewable electricity generation of 1,600 GWh and an annual total reductions of CO₂ emissions of 7,040 CO₂ eq t.

4.4.13.2 Global Roadmap for Energy Efficiency and New Energy Resources in Extremadura (GREENER-EX)

The project focuses on energy efficiency and renewable energy resources in buildings, street lighting and e-mobility.

The investment programme consists in:

- analysis of measures to improve EE and increase RES generation in 326 public buildings;
- realisation of three regional biomass collection centres;
- energy efficient street lighting systems in three municipalities.

Moreover, investments in e-mobility, including 26 charging points and 49 electric vehicles is foreseen.

The market replication potential for other Spanish regions is considered high, notably for street lighting projects, the use of biomass for heating, and the innovative bundling approach.

4.4.13.3 MADEV (MADrid Electric Vehicles)

The ELENA assistance supports the first large scale investment programme for electric vehicles in Spain.

The investment programme main goal is the acquisition of 1 400 Electric Vehicles (EV) and the acquisition of 1 870 charging points (CP).

The expect results include energy savings of 4160 MWh/year and CO₂ reduction of 1800 CO₂-eq [t]/year.

The market replication potential for other municipalities, notably in the Spanish market, is considered high.

4.4.14 Connecting Europe Facility (CEF) Programme

In addition, the deployment of infrastructure for alternative clean fuels on the broader comprehensive TEN-T network will be able to receive financial assistance from the Connecting Europe Facility (CEF) in the form of

procurement and financial instruments, such as project bonds. This kind of support was already provided by the Commission in the previous years (TEN-T Programme).

The complete list of the Action in negotiation phase is available at the following link: <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/>.

4.4.15 Publicly accessible infrastructure deployment

4.4.15.1 Fastned

Another private initiative deploying an own network of fast-charging points is FastNed. Fastned is building a network of fast charging points for electric cars, directly along the highway. Here, you can charge your car rapidly and continue your journey. Fastned home market is the Netherlands, but the goal is to develop a European network of fast charging points.

Fastned is currently building one new fast charging station per week. In a few years, nearly every service area along the highways will feature a Fastned station. Charging points are designed in a way that is compatible with frequent hardware and software updates.

Revenue is generated in a model with different subscriptions structures, starting from a pay-per-charge, to a pay per kWh or a simple monthly fee, without additional charge per charge.

<http://fastned.nl/en/>



Figure 4.3: Fastned Network

4.4.15.2 IT-IE: DSO-model

CONCEPT: The distribution system operator (DSO) takes the lead in deployment, operations and/or ownership of charging points.

IMPLEMENTATION: The position of the DSO as an actor in the landscape of EVSE differs between Member States. The DSO can be a fully public company, but it can also be semi-private. DSOs in general generate revenue from a mark-up on the electricity wholesale price. The DSO services are primarily bringing the electricity supply from the high-voltage network (TSO) to the final end-consumer. In this sense, they are mainly an asset manager in a capital intensive sector. The objective of the DSO is to guarantee supply and ensure safety in the network.

DSO's have expanded their services beyond classic distribution of electricity by also offering energy efficiency consultancy and have been tasked with

additional services as set by national law (e.g. budget metering, guaranteed supply, issue green certification of renewables etc.).

The DSO is financing additional services from the mark-up fee, as such creating a redistribution-effect.

In some countries, e.g. Italy, the DSO will deploy and operate an EVSE network. It will be able to set low prices for charging, in public places for free charging and as such operate the charging network at a loss, but compensates this with a marginal increase of the mark-up fee on the overall electricity price it is distributing. In the future, when the market has developed further, the DSO can change pricing and generate a profitable service. In Italy, ENEL is working in such a model.

In Denmark, CLEVER is owned by the utility companies SEAS-NVE, SE, NRGi, EnergiMidt and Energi Fyn. The five large utility companies in Denmark have all invested in the leading Danish Electro Mobility Operator (EMO).

CLEVER delivers charging solutions for all models of electric cars. CLEVER's products consist of charging solutions to households, companies and municipalities. CLEVER's network currently counts 350 charging points. The objective is for CLEVER to be a profitable venture, gaining revenue from charging, per instance or with subscription fees.

FURTHER READING:

http://193.205.130.237/aeit/sites/default/files/AEIT-GM2012_Federico_Caleno.pdf

<http://www.baringa.com/our-thinking/baringa-blog/september-2015/the-emergence-of-the-active-dso-model-introducti/>

http://www.ceer.eu/portal/page/portal/EER_HOME/INTERN/PUBLIC_QUESTIONNAIRE?p_formselect=10325&p_SelectedUser=-14420&pKey=2549337560

<https://www.clever.dk/english/>

https://www.clever.dk/media/156704/CLEVER_corporate_UK_SCREEN.pdf

4.4.15.3 BE: Natural Gas rollout plan in Belgium (Region of Wallonia)

CONCEPT: In a joint effort, ENGIE, a private French multinational energy utility company, together with the Walloon government are deploying a network of CNG refuelling-points and plan investment in CNG (mostly) heavy duty vehicles (bus & lorries)

IMPLEMENTATION: ENGIE, FCA and Iveco have established a joint commitment to set a program proposal to develop alternative fuel solutions in Region of Wallonia.

The initiative consists in proposing to public stakeholders, a set of initiatives based on the following scheme:

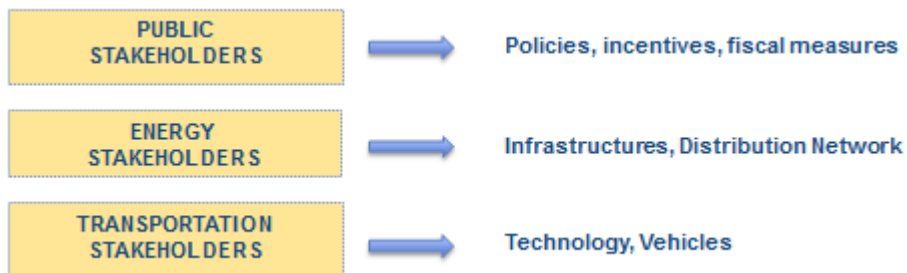


Figure 4.4: Scheme for Natural Gas Rollout Plan in Belgium (Region of Wallonia)

The target of the project is to create a network of CNG refuelling station (from 30 to 40 from 2020 up to 2030, open also to the public) and have a public fleet composed by 263 lorries, 705 buses and 1740 cars and light commercial vehicles. This plan will be presented at the beginning of 2016.

Key elements for the private party willing to invest:

1. A stable regulatory framework. This is needed to reduce risk for the private investor for his long term capital intensive investment.
2. The project targets both supply and demand: simultaneous deploy infrastructure and procure clean fuel vehicles.

FURTHER READING:

<https://www.electrabel.be/en/companies/offer/electricity-gas-service/sustainable-mobility/natural-gas-car>

4.4.15.4 NL: "Green deals"

CONCEPT: An agreement between the public and private sector including a commitment to achieve joint set targets.

IMPLEMENTATION: In the Netherlands, public authorities opt to include the private sector as much as possible in the deployment of AFI. The rationale is that, as new technology becomes more mature, it could create a new functioning private market for EVSE. As such, it is best to include the private sector from the beginning, de facto co-creating this new market.

Principles Dutch government:

- EV-drivers with possibilities to charge at own house (drive way, carport, garage) buys his own charging unit
- Companies, shopping centres etc. are stimulated to build semi-public charging infrastructure for employees and clients
- Public infrastructure is the capstone to provide for charging infrastructure for EV-drivers who cannot charge at home or at work
- Infrastructure roll-out is in the end not a government task, but a commercial market activity.

"Green deals" are a common instrument in the Netherlands. It holds a joint setting of ambitions and targets, for both the public and the private sector:

- The commitment from the private sector lies in achieving set targets related to the overall green deal objective (e.g. #public charging points, waste recycling %, CO2-emission target for a municipality).

- The commitment from public authorities lies in the facilitation of the ambitions of the private sector. This includes changing the legal framework according to the sector needs, indirect support from public knowledge centres. In principle, no direct financial support is included, though indirect fiscal stimulus can be part of a green deal.

The commitment of the government in this green deal is to create a financially viable business model for charging infrastructure. The action plan on electric vehicles includes the "Green Deal Charging infrastructure" following specific measures:

1. Financial support (€ 5mln overall; € 900,- per charging pole). The financial support is necessary in order to arrive at financial viability of publicly accessible charging points by cost reduction of public charging points by 75% by use of supporting R&D and financial support. Financial support is given indirectly, by issuing open tenders of right to build and operate public infrastructure. The financial support is due to end in 2018.
2. National Knowledge Centre for Charging Infrastructure (NKL). The mandate and financial budget for NKL is limited to research projects in the time period up to 2018.
3. Experiments with license/subsidy model

FURTHER READING:

http://www.polisnetwork.eu/uploads/Modules/PublicDocuments/eeo-workshop_-dutch-policy.pdf

<http://www.rvo.nl/actueel/nieuws/green-deal-voor-laadinfrastructuur-elektrisch-vervoer>

<http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/elektrisch-rijden/praktijkverhalen/green-deals>

5 MEASURES THAT CAN PROMOTE THE DEPLOYMENT OF PRIVATE ALTERNATIVE FUELS INFRASTRUCTURE

This chapter focuses on supporting measures that can facilitate the deployment of AFI by private parties, including some examples in selected Member States or the EU as a whole.

Measures are listed in the same measure template as in the previous chapter.

5.1 LEGAL MEASURES

Legal measures focus firstly on creating a suitable regulatory setting in which charging infrastructure has its proper place, clear to all stakeholders, public and private. Private investment in alternative fuel infrastructure will only happen when there is no uncertainty over the legal status of AFI.

In this chapter we list the options for legal measures Member States could take in this respect.

5.1.1 Building code/permits

A building code, or building law, encompasses rules that specify requirements for constructed objects such as houses, apartments, offices, shops and parking lots. The building code can be imposed by different governmental authorities. Compliance with the building code is required to get a building permit. Depending on the regulatory situation in each Member State, the requirements can also be linked to environmental permitting.

The way building codes are imposed and enforced varies considerably among the Member States. In some countries building codes are developed by the national government agencies while in other countries, local authorities impose building codes. In most cases, at least some level of coordination is done at national level. At EU-level, Eurocode aims to harmonize national building codes.

Building codes can include various requirements such as fire safety properties, energy provision, available parking places, etc.

Authorities responsible for the code are free to add further requirements to new building on alternative fuel infrastructure, for different types of buildings. As such, adaptation of the existing legally set building codes incorporating requirements on alternative fuel infrastructure generates a hard incentive. We list some examples of how AFI can be included:

1. Non-residential buildings: apart from (existing) requirements on number of parking space, include a minimum of parking spaces equipped with AFI above a certain threshold of size
2. Residential buildings: include AFI facilities for residents, above a certain threshold of size
3. Parking lot: include a minimum of parking spaces equipped with AFI above a certain threshold of parking lot size
4. Fuel stations concessions: include AFI facilities requirements

Section A: Measure characteristics	Measure Title		<i>EV recharging points in new or renewed (non-) residential buildings</i>
	Measure Category		Planning Criteria
	Description		New or renewed (non-)residential buildings with an area bigger than a defined value could be required to have recharging points for EVs installed
	Main targets and objectives		Foster the use of EV due to a capillary network of re-charging points. Decrease cost of AFI deployment by including in overall construction of buildings
	Infrastructure		EV recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member State and Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • in case of non-residential: Identification of basic requirements for new and renewed non-residential area as: <ul style="list-style-type: none"> - commercial area - factory - offices - exhibition area/museum - etc. • in case of residential: Identification of basic requirements for residential area for private electric vehicles • Implementation of code via national decree or other (depends on Member State situation)
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	Low economic impact as cost is negligible compared to total investment

Section A: Measure characteristics	Measure Title		<i>Electric Vehicle Supply Equipment (EVSE) on parking lots</i>
	Measure Category		Planning Criteria
	Description		New or renewed parking lots above a certain size could be required to have recharging points for EVs installed
	Main targets and objectives		Increase the deployment of charging points for EVs in big parking areas. Decrease cost of AFI deployment by including in overall construction and design
	Infrastructure		EV recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member State and Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • re-assess current building code/permit for parking lots, identify the competent authority • consult with stakeholders (contractors, parking managers, local authorities, EVSE service providers,...) for changes to the code • Implementation of code via national decree or other (depends on Member State situation)
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	Low economic impact as cost is negligible compared to total investment

Section A: Measure characteristics	Measure Title		<i>Alternative fuels in conventional fuel station concessions</i>
	Measure Category		Planning Criteria
	Description		Set requirements for EVSE when awarding fuel station concessions.
	Main targets and objectives		Foster the use of EV due to a capillary network of re-charging points. Increase the deployment of charging points for EVs and refuelling points for CNG in conventional fuelling stations. Decrease cost of AFI deployment by including in overall construction and design
	Infrastructure		EV recharging points – CNG
	Transport means		Comments

	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
	Responsible		Member State and Local Authorities
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • consult with stakeholders (local authorities, fuel station operators, AFI providers...) on desirable adoption rates • explore different models of cooperation between stakeholders and define adjustments needed to the fuel station concessions • adapt concession procurement procedure
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	Low economic impact as cost is negligible compared to total investment

5.1.2 Facilitation – regulatory framework

Long and complicated permitting and planning procedures are generally a main bottleneck for new actions. An appropriate and accurate planning and regulatory framework is necessary to avoid delays during the authorisation procedure and speed up the implementation of the action in general.

Member States could define streamlined planning procedures to ensure a faster and more reliable permitting scheme.

Section A: Measure characteristics	Measure Title		<i>Reduce administrative hurdles – clear regulatory framework</i>
	Measure Category		Facilitation
	Description		Cut red-tape faced by charging infrastructure providers.
	Main targets and objectives		Simplify the introduction to the charging infrastructure market to market players
	Infrastructure		EV recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		Member State and Local Authorities (possible the DSO or local grid operator)	

Section B: Implementation and results	Steps for application/implementation		1.Critical analysis of regulatory requirements & required permits, at the different levels of authority and identify law/regulation/code to be adapted 2. Establish with different levels of public authorities and stakeholder a desirable legal frame encompassing all aspects of installing and operating charging infrastructure 3.Roll-out: adapt laws, regulations and code
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	(Unclear – evidence from private stakeholders suggest a potential high impact)
	- Cost for application / implementation:	1	Cost limited to effort in public authorities

Section A: Measure characteristics	Measure Title		<i>Facilitation of permitting processes</i>
	Measure Category		Facilitation in permitting
	Description		Facilitation in obtaining permits needed for the implementation of an alternative fuel recharging/refuelling point, according to a fixed time schedule and to national policy frameworks
	Main targets and objectives		Reducing waiting time to get permits and certain approval if the requirements fixed by law are respected
	Infrastructure		Alternative fuel recharging and refuelling points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		MS	
Section B: Implementation and results	Steps for application/implementation		1. Identification of requirements needed for obtaining the permits 2. Time schedule for the implementation of the permitting process 3. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	N.A.	

5.2 POLICY MEASURES SUPPORTING THE DEPLOYMENT FOR PRIVATE INFRASTRUCTURE

5.2.1 Public-Private Partnership

A public-private partnership (PPP) is a business relationship which is funded and operated through a partnership between the public sector and one or more private sector companies.

The PPP has the purpose of completing a project that will serve the public but is financed also by the private sector. Public-private partnerships are generally applied to finance, build and operate projects such as public transportation networks or infrastructure.

The PPP model could be used to raise additional finance in an environment of budgetary restrictions by making the best use of private sector operational efficiencies to reduce cost and increase quality to the public. The main result of this measure could be the ability to speed up the infrastructure development.

The aims of involving the private sector in the development of transport infrastructure are to attract capital on one side and to combine private sector efficiency with public sector policy setting and regulatory oversight on the other side. The scale and manner in which the private sector contributes to transport infrastructure provision and operation differ between projects. In a PPP a private company designs, finances, constructs and operates transport infrastructure.

Section A: Measure characteristics	Measure Title	<i>Creation of a refuelling/recharging network</i>
	Measure Category	Public Private Partnership
	Description	Implementation of a recharging/refuelling network to combine stations with different potential
	Main targets and objectives	The combination of stations with a low potential with stations with a high potential allows to have a more capillary network and foster the deployment of the alternative fuel supply by reducing investment risks of for investors.
	Infrastructure	Alternative fuel recharging and refuelling points
	Transport means	Comments
	<input type="checkbox"/> Private cars	
	<input type="checkbox"/> Light Duty Vehicle	
	<input type="checkbox"/> Heavy Duty Vehicle	
	<input type="checkbox"/> Public Transport	
Responsible	MS	
Section B: Implementation and results	Steps for application/implementation	<ol style="list-style-type: none"> 1. Identification of the areas for stations 2. Assessment of the potential of each one (e.g. on the basis of their location) 3. Grouping the stations in a network according to the principle to have assigned areas with a high potential and areas with a low potential

		4. Follow-up
	Direct impacts: (1: low - 5:high)	Comments
	- Effectiveness:	4 Fostering the deployment of alternative fuels station and then increasing the demand
	- Cost for application / implementation:	N.A.

Section A: Measure characteristics	Measure Title	<i>Guaranteed fee for investors for a limited period</i>
	Measure Category	Financial Contribution
	Description	Government guarantees a fee for a fixed and limited period to the private investor of the alternative fuel refuelling/recharging point to eliminate the risk of low demand in the first years of activity
	Main targets and objectives	Foster the deployment of the alternative fuel supply by reducing the risk of investment for investors and solve the chicken-egg-problem
	Infrastructure	Alternative fuel refuelling and recharging points
	Transport means	Comments
	<input type="checkbox"/> Private cars	
	<input type="checkbox"/> Light Duty Vehicle	
	<input type="checkbox"/> Heavy Duty Vehicle	
	<input type="checkbox"/> Public Transport	
	Responsible	MS
Section B: Implementation and results	Steps for application/implementation	1. Definition of ad hoc agreement between Member States and private investor who is also concessionaire of the infrastructure 2. Implementation of the infrastructure 3. Yearly fee paid by Government to the investors for a fixed number of year 4. Follow-up
	Direct impacts: (1: low - 5:high)	Comments
	- Effectiveness:	4 Elimination of the risk of low demand for the private investor in the first years of activity
	- Cost for application / implementation:	2 Depends on the fee paid by the Government

Section A: Measure characteristics	Measure Title		<i>Alternative fuel distribution in large service stations</i>
	Measure Category		Planning Criteria
	Description		Conventional refuelling stations selling more than a certain amount of petrol or diesel per year could be required to provide at least one kind of renewable fuel. The extra economic strain on the owners of conventional refuelling stations, obliged to pay the investment costs, could be partially refunded by the government
	Main targets and objectives		Foster the deployment of alternative fuels
	Infrastructure		Alternative fuel refuelling and recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		MS	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification and mapping of the refuelling stations 2. Identification of distributor dimension according to the volume of conventional fuels sold 3. Definition of minimum dimension for application of the measure 4. Follow-up on the application of the measure and collecting of results
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	3	Cost of setting up another refuelling pump in an existing station is less expensive than built a new one. Other measures, as for example financial contribution could be applied

5.3 GOOD PRACTICE EXAMPLES

5.3.1 TESLA

CONCEPT: Network of “Supercharges”

IMPLEMENTATION:

Tesla is taking a different road compared to most EV-OEMs by offering both electric vehicles as well as an elaborate charging network. Tesla is now deploying a network of “Supercharges”. Superchargers are free connectors that charge vehicle “Model S” in minutes instead of hours. Stations are strategically placed to minimize stops during long distance travel and are conveniently located near restaurants, shopping centres, and WiFi hot spots. Each station contains multiple Superchargers to increase the availability of recharging points. At the moment, Tesla has installed 563 Supercharger stations all over the world with 3227 Superchargers²⁹.



FURTHER READING:

<https://www.teslamotors.com/supercharger>

5.3.2 AT: Harmonization of Building Codes

CONCEPT: A simplification of building codes as a means to facilitate private investment in charging infrastructure.

IMPLEMENTATION: Despite some clear financial incentives for e-mobility, Austria is not at the same pace of adoption of e-mobility as more successful European countries.

The national authorities, in a working group comprising of 3 ministries (“Bundesministerium für Verkehr, Innovation und Technologie”, “Bundesministerium für Wissenschaft und Forschung” and “Ministerium für ein lebenswertes”) have set up a survey for Austrian cities and regions, interest groups and companies. One important finding was that the adaptation and harmonization of building regulations came forward as one of the measure expected to be most effective and to find the most support.

There is a need for coordination between different levels of authorities. The regional and community level is active on the policy domains which are important for the further diffusion of e-mobility (building codes, possibilities to install charging points, etc.). These are partly regulated at the regional or community level.

In the next steps, the national administration will work together with the local authorities to make changes to the building regulations.

FURTHER READING:

<https://www.innovationpolicyplatform.org/system/files/AUSTRIA%20-%20e-mobility.pdf>

²⁹ At 18 December 2015

http://www.select-project.eu/sites/select-project.eu/files/attachments/elocot_cleanpowerfortransport_hans-juergensalmhofer1.pdf

5.3.3 FR: Legislation for Mandatory Charging Point in Buildings

CONCEPT: Via national decree, it is mandatory for new and existing buildings to include charging points (as well as secure parking) for EV's.

IMPLEMENTATION: A national decree requires building owners to have charging points available to the users. Charging infrastructure is expensive to implement in existing building, as such it is preferred to considered deployment in the design phase. Additional equipment needs to be installed and reworks to existing infrastructure may be needed. The rationale of including charging points in the design phase is to limit the cost of charging infrastructure, gradually building a dense network of charging points as the building stock turn-over continues over time.

The French decree is set up in 2 phases:

1. For new buildings (i.e. buildings for which permit is asked after 1/1/12) the installation of charging infrastructure is mandatory
2. For existing buildings, the requirements to have charging infrastructure available are effective since 1/1/15.

The decree is effectively an adaptation to existing building codes. Note that the decree does not impose any requirements on the charging infrastructure itself bar the minimum voltage and common safety requirements. It only includes the requirement to have charging infrastructure in place, free to the infrastructure owner to implement any system.

The decree sets different requirements on the amount of charging points for houses, condominiums, parking lots and offices, in urban or non-urban context.

In the next future, different implementing regulatory texts will be published to give more details on these new requirements.

FURTHER READING:

<https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031044385&categorieLien=id>

5.3.4 NL: City Rebate for Deployment of Private Charging Points

CONCEPT: subsidy to cover cost of deploying charging infrastructure by private individuals & companies

IMPLEMENTATION:

The city of Amsterdam is granting subsidies to private persons or private companies who want to install a charging point in their home or garage. There are several criteria that need to be met in order to be eligible for a rebate:

1. Location of the charging point is in the semi-public or private domain
2. Has to be installing by a licenced installer
3. The infrastructure has to comply to set standards

Eligible costs are infrastructure purchase cost, cost of installation, cost of modification of the existing electrical installation as well as subscription fees for use of the communication services of the charging infrastructure.

In the case of Amsterdam, 1000€ rebate is granted for semi-public infrastructure (max of 50 charging point per site), 500€ rebate for fully private infrastructure (max of 20 charging point per site). The max total for a single application is 65.000€.

The objective is to stimulate private parties to also invest in charging infrastructure, not only for own use but also other potential users.

FURTHER READING:

https://www.amsterdam.nl/veelgevraagd/?productid={AAF229B1-2BFF-46A3-982E-A331F871FFDE}#case_{69A499CC-4351-45E0-AFFC-3DDF7A742802} (Dutch)

5.3.5 UK: Facilitation & Rebate for Private Charging Infrastructure

CONCEPT: information campaign about private (domestic) charging infrastructure including subsidy to cover cost of installation

IMPLEMENTATION:

In the UK, the central government has set up a central fund for the promotion of charging infrastructure in the domestic domain, i.e. households and private individuals. The fund is setup by the Ministry of transport, Office for Low Emission Vehicle (OLEV).

Only EV-owners are eligible for the fund and a list of accepted EV's is given on the OLEV-website. The grant is fixed at £700.

As with the case of the city of Amsterdam, a list of authorized installers is provided to the customers.

The website also includes a tool to calculate if EV's are an economical choice, centralizing information about subsidies and rebates for EV's and EV infrastructure

FURTHER READING:

<http://www.energysavingtrust.org.uk/domestic-chargepoint-funding>

<http://www.bbc.com/news/uk-politics-21503532>

6 MEASURES THAT CAN PROMOTE THE DEPLOYMENT OF ALTERNATIVE FUELS INFRASTRUCTURE IN PUBLIC TRANSPORT SERVICES

In order to promote alternative fuels and the development of the relevant infrastructure, the national policy frameworks may identify also a set of supporting actions/measures dedicated for public transport services: for bus, for car sharing and also for taxis.

In the following paragraph a list of measures is proposed, using the same template adopted in Chapter 4.

In addition to these, we present an overview of some of the most significant experiences at European Level:

- Contribution of EIB for public transport (ELENA FUND);
- ZeEUS Projects – Zero Emission Urban Bus System (<http://www.zeeus.eu>);
- Statistics about the diffusion of Alternative Fuel Buses in Europe;
- BUS 2025 project (http://www.ratp.fr/en/ratp/r_118194/ratp-launches-the-bus-2025-project/).

6.1 MEASURES FOR PUBLIC TRANSPORT SERVICES

Section A: Measure characteristics	Measure Title	<i>Increase number of parking places for car sharing, reserved to AFVs</i>
	Measure Category	Planning Criteria
	Description	In several cities the car sharing system has a dedicated network of parking areas. The parking places could be increased, reserving places only for the AFVs. If this network doesn't exist, it could be created. Some of these parking places can be equipment with recharging points
	Main targets and objectives	Increase the diffusion of AF in public transport Increase the diffusion of AFI
	Infrastructure	Recharging points
	Transport means	Comments
	<input type="checkbox"/> Private cars	
	<input type="checkbox"/> Light Duty Vehicle	
	<input type="checkbox"/> Heavy Duty Vehicle	
	<input type="checkbox"/> Public Transport	Car Sharing
Responsible	MS, Local Authorities	

Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of big parking areas (minimum number of parking spaces) 2. Identification of number of places dedicated to AFVs (car sharing) 3. Identification of number of spaces dedicated to recharging for EV (definition of classes of parking dimension) 4. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	

Section A: Measure characteristics	Measure Title		<i>Increase number of parking places for taxi equipped with recharging points</i>
	Measure Category		Planning Criteria
	Description		The parking places dedicated to the taxi can be equipped with recharging points
	Main targets and objectives		Increase the diffusion of AF in public transport Increase the diffusion of AFI
	Infrastructure		Recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Taxi
Responsible		MS, Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of number of spaces dedicated to recharging for EV (definition of classes of parking dimension) 2. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	

Section A: Measure characteristics	Measure Title		<i>Alternative Fuels Topic in Strategic Plans</i>
	Measure Category		Planning Criteria
	Description		The alternative fuels topic could be considered in the redaction of the strategic planning plans prepared by Local Authorities with a number of habitants higher than a fixed value (e.g. Mobility Urban Plan, Sustainable Energy Action Plan (SEAP), Sustainable Urban Mobility Plan (SUMP), etc.).
	Main targets and objectives		Local Authorities awareness on the subject
	Infrastructure		Recharging and refuelling station
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
<input type="checkbox"/>	Public Transport	The above mentioned plan could also focus on the use of AFVs and consequently also on AFIs	
Responsible		MS	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of available planning instruments 2. Definition of minimum city size (i.e. population) for application of the measure 3. Implementation of national decree to set up requirements 4. Follow-up on the application of the decree
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	N.A.	

Section A: Measure characteristics	Measure Title		<i>Reserved lanes</i>
	Measure Category		Planning Criteria
	Description		The AFVs for public transport could use bus lanes. These measures can be adopted only in the first stage to avoid the decrease level of service of the buses. A monitoring of the interferences between buses and cars (taxi and car-sharing) is suggested.
	Main targets and objectives		Local Authorities awareness on the subject
	Infrastructure		Recharging and refuelling station
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Taxi and Car sharing (if not yet adopted)
Responsible		MS, Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of available planning instruments 2. Definition of minimum city size (i.e. population) for application of the measure 3. Implementation of national decree to set up requirements 4. Follow-up on the application of the decree
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	
	- Cost for application / implementation:	1	

Section A: Measure characteristics	Measure Title		<i>Subsidy for alternative fuel infrastructure Deployment</i>
	Measure Category		Financial Contribution
	Description		Grant a subsidy for the deployment of Alternative Fuel Infrastructure to reduce initial cost for investors
	Main targets and objectives		Decrease cost for investors and start to solve the chicken-egg-problem: increase the demand as a consequence of the increase of the supply
	Infrastructure		Alternative fuel refuelling and recharging points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Subsidies could be applied also to public transport sector (recharging and/or refuelling points could be available in depot)
Responsible		MS, Local Authorities with competence to grant subsidies	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 4. Allocation of a public budget 5. Identification of a strategy (different subsidies could be available: co-funding, loan with special conditions, etc.) 6. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	2	The financial impact depends on the allocated budget

Section A: Measure characteristics	Measure Title		<i>Facilitation of permitting processes to allow the use of Public Transport existing or planned AFIs by private cars</i>
	Measure Category		Facilitation in permitting
	Description		Usually the Public Transport Companies has AFIs dedicated for refuelling its vehicles. The infrastructures could be also used by private car users.
	Main targets and objectives		Reducing waiting time to get permits and certain approval if the requirements fixed by law are respected Increase the income of the Public Transport Company
	Infrastructure		Alternative fuel refuelling points
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	
Responsible		MS	
Section B: Implementation and results	Steps for application/implementation		<ol style="list-style-type: none"> 1. Identification of requirements needed for obtaining the permits 2. Time schedule for the implementation of the permitting process 3. Follow-up
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	

Section A: Measure characteristics	Measure Title		<i>Awareness on characteristics of AFVs</i>
	Measure Category		Communication and advertisement
	Description		Advertise: <ul style="list-style-type: none"> • the purchasing costs • the operating costs • the technical performance • the safety level • the social benefits of the AFVs
	Main targets and objectives		Increase public awareness on technological and safety characteristics of AFVs
	Infrastructure		
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Bus, Taxi, Car Sharing
Responsible		Member State and Local authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • Organise meetings with the main AFV automakers; • Organise workshops; • Support any form of advertising which describes the characteristics of AFVs so that people can be fully aware of safety and technology of this kind of vehicles.
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	3	
	Cost for application / implementation:	N.A	

Section A: Measure characteristics	Measure Title		<i>Incentives for the purchase of public AFVs</i>
	Measure Category		Financial contribution for purchasing AFVs
	Description		Definition of policies and incentives for AFVs for public transport. Incentives have to concern both the purchase and the mobility of AFVs. For taxis, the measures could be also similar to the measures proposed for private AFVs In order to make incentives more effective: <ul style="list-style-type: none"> • They have to be attractive enough for consumers to pay the higher price of the vehicle. • There could be a relationship with the contribution they make towards lower CO₂, better air quality and lower noise levels.

		<ul style="list-style-type: none"> • Their level could have, after an initial success, a negative effect on political will/support and public opinion. • They should be perceived as fair and not favouring certain classes of vehicles or buyers. • They should be smart in time: adapt to developments in technology, cost and market offerings.
	Main targets and objectives	Foster the purchase and the use of AFVs
	Infrastructure	
	Transport means	Comments
	<input type="checkbox"/> Private cars	
	<input type="checkbox"/> Light Duty Vehicle	
	<input type="checkbox"/> Heavy Duty Vehicle	
	<input type="checkbox"/> Public Transport	Bus, Taxi, Car Sharing
Responsible	Member State and Local Authorities	
Section B: Implementation and results	Steps for application/implementation	<ul style="list-style-type: none"> • Evaluation of possible incentives such as special fee for parking, access to restricted areas, exemption from payment of taxes for a given period, zero VAT and so on; • Assessment of financial contributions needed and benefits stemming from the increase of AFV demand; • Implementation of a national decree to set up the incentives; • Follow-up on the application of the decree.
	Direct impacts: (1: low - 5:high)	Comments
	- Effectiveness:	5
	- Cost for application / implementation:	N.A.

Section A: Measure characteristics	Measure Title		<i>National or Regional Central Purchase</i>
	Measure Category		Policy Measure
	Description		Setup of central purchase at national or regional level to support the public transport companies in tender preparation. The approach could reduce the purchase cost of the vehicles and also of the refuelling/recharging system (pooling of procurement)
	Main targets and objectives		Foster the purchase and the use of AFVs
	Infrastructure		
	Transport means		Comments
	<input type="checkbox"/>	Private cars	
	<input type="checkbox"/>	Light Duty Vehicle	
	<input type="checkbox"/>	Heavy Duty Vehicle	
	<input type="checkbox"/>	Public Transport	Bus, Taxi, Car Sharing
Responsible		Member State and Local Authorities	
Section B: Implementation and results	Steps for application/implementation		<ul style="list-style-type: none"> • Verification of the measure compatibility with the existing laws • Possible modification of the laws • Central Purchase organisation
	Direct impacts: (1: low - 5:high)		Comments
	- Effectiveness:	4	
	- Cost for application / implementation:	1	

6.2 GOOD PRACTICES

6.2.1 ZeEUS Projects – Zero Emission Urban Bus System (<http://www.zeeus.eu>)

ZeEUS aims to be the main EU activity to extend the fully-electric solution to the core part of the urban bus network. It fits within the context of the [European Commission's objective](#)³⁰ to create a competitive and sustainable transport system. The project has a total budget of €22.5 million with €13.5 million provided by the European Commission's Directorate General for Mobility and Transport through the FP7 Programme.

To achieve its mission, ZeEUS is testing innovative electric bus technologies with different charging infrastructure solutions in **demonstration sites** across Europe:

- Bonn;
- Barcelona;
- Stockholm;

³⁰ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0144&from=EN>

- London;
- Paris,
- Randstad;
- Warsaw;
- Münster;
- Cagliari;
- Plzen.

Thanks to varied geographical and topographical characteristics, the ZeEUS demonstrations validate the economic, environmental and societal viability of the electric solutions.

The ZeEUS consortium represents the entire stakeholder spectrum: public transport authorities and operators, bus manufacturers, industry suppliers, energy providers, national and international associations, research centres and consultancies.

Moreover, the ZeEUS project closely follows the development of electric bus systems all around the world through the <http://zeeus.eu/demonstrations-activities/observatory-of-electric-bus-systems-activities>. Selected Observed and Monitored Demonstrations directly contribute to some of the ZeEUS core activities and strategic outputs (<http://zeeus.eu/demonstrations-activities/observatory-of-electric-bus-systems-activities>). The project objectives are:

- Extend fully-electric solution to the core part of the urban bus network composed of high capacity buses;
- Evaluate the economic, environmental and societal feasibility of electric urban bus systems through live operational scenarios across Europe;
- Facilitate the market uptake of electric buses in Europe with dedicated support tools and actions;
- Support decision-makers with guidelines and tools on "if", "how" and "when" to introduce electric buses.

6.2.2 ELENA FUNDS

The European Investment Bank (EIB)'s ELENA Fund has supported two projects involving public transport (the fact sheets are report in Appendix A).

6.2.2.1 [Electrobus: Energy Efficient Bus Network for Barcelona](#)

ELECTROBUS is led by the city's public transport authority TMB (Transports Metropolitans de Barcelona). The goal is to convert the city's buses into hybrid vehicles and to redesign the entire urban transport network.

The programme is expected to allow for energy savings that amount to 61.4 GWh over the duration of the project and an annual CO₂ reduction of 16,400 t.

The ELECTROBUS programme consists of two sets of action:

- the conversion of the bus fleet into hybrid vehicles and the purchase of new commercial hybrid vehicles;
- the redesign of the bus network for higher efficiency and clarity.

In the first phase, converting existing buses into hybrid vehicles is expected to yield energy and CO₂ savings of 25-30% per vehicle. The engineering part

of the program - designing the buses' conversion process - is made by TMB as part of the project. It is one of the innovative aspects of ELECTROBUS that can be replicated in other cities.

The second part of the project, i.e. the redesign of Barcelona's bus network, aims at making the bus system more user-friendly and thus easing and increasing the use of public transport. The new routes of the network cover the same total distance as before, but they are more evenly distributed over the metropolitan area; special efforts are made to make the new network easier to understand, both for citizens and tourists. The new network could allow passengers to change buses maximum once during most of their trips. Buses will not run the same route twice (notably thanks to a reduction in redundant routes between the centre and the outskirts) and linkages between peripheral areas will be increased.

The programme is expected to allow for energy savings that amount to 61.4 GWh over the duration of the project and an annual CO₂ reduction of 16,400 t.

6.2.2.2 [The Zero Emission Buses in the Netherlands](#)

The objective of the project is to replace the complete fleet of diesel buses currently used in the province of North-Brabant and Limburg by Zero Emission Buses.

A total of 626 zero emission buses and related charging infrastructure is included in the investment programme.

The planned investment programme is expected to reduce energy consumption by a total of 72,7 GWh per year.

Energy savings will reduce CO₂ emissions by an estimated 26,9 k-ton per year, if the average energy mix of the Netherlands is assumed. The reduction of CO₂ emissions would roughly double (to 53,9 kton per year), if the energy were sourced from green alternative sources.

Other impacts are related to the reduction of noise levels and particulate matter.

6.2.3 **Central Purchase in France**

The Nord-Pas de Calais has adopted the "Regional Development Plan Electric Mobility" (PRDME). The plan is supporting the Local Authorities to enable a seamless and interoperable development of a service charge to the public of their territories, to promote and support the collaborative projects for electric mobility.

To enable homogenization of regional service on the public space, the Region has also setup, a February 16, 2015, a Central Purchase system for electric mobility. Thus, the Region and its associate members are able to provide a public service to their constituents by using a single operator on the whole of its territory.

6.2.4 **FR: E-car sharing**

CONCEPT: Initiate an e-car sharing service in a PPP, Auto'lib.

IMPLEMENTATION: Auto'lib is an e-car sharing service, started in Paris and quickly broadening the scope in other French cities with plans to expand to other cities outside of France.

The concept is similar to other car-sharing initiatives, but there are some specific features. Users pay a single subscription fee + a use-fee (per half hour). The consortium owns its own charging network, which is also made available to private EV-owners as a paying service. In fact, the use of the charge network by private EV-owners is part of the business model and generates revenue for Auto'lib.

The program has been assessed as a great success with 460.000 registered users, 3485 vehicles, 1005 charging stations, 5450 charging points, and 17.900 rentals/day in Paris (figures published in November 2015).

Auto'lib is a public-private partnership with the Paris municipality and the industrial Bolloré group as main partners.

FURTHER READING:

<https://www.autolib.eu/en/>

<https://en.wikipedia.org/wiki/Autolib>

6.2.5 BUS 2025 project

The Bus 2025 project is the ambitious RATP (Régie Autonome des Transports Parisiens) plan for the deployment of a 100% ecological bus fleet by 2025.

This ambitious plan demonstrates the willing to completely suppress the diesel buses of Paris region network. By 2025, RATP will field a fleet in the Paris region consisting of buses running solely on electricity and buses using renewable gases. The Bus2025 plan is in line with the target to reduce greenhouse gas emissions by 20%, as specified in the Paris Region Urban Travel Plan. RATP will radically transform its industrial facilities (bus centres) thanks to this plan and fully launch the energy transition phase for its bus fleet. The transition has already begun with the acquisition of its first hybrid buses, a necessary step before deploying electrical buses.

The energy transition will be in three phases:

- Phase 1: consolidate the position of hybrid buses in the RATP fleet. All new bids will now apply to hybrid, electrical and NGV buses.
- Phase 2 (2015-2017): tests and experiments with all current electric bus and recharging systems; preparation of the program to adapt bus depots.
- Phase 3 (2017-2025): launch of bids for a wholesale deployment of electric and biogas buses.

The RATP target for 2025 is a fleet comprising approximately 80% electric buses and 20% vehicles using renewable gas and non-fossil fuels. RATP will also use the plan to send a strong message to the sector's industry. The renewal of a landmark fleet of 4500 buses means a fine outlook for the sector and could encourage investment in research and development as well as in industrial tools. The Bus2025 plan will reduce the RATP carbon footprint by 50%.

6.2.6 Natural Gas Buses in Europe

Several European cities operate public transport services using Natural Gas buses. The following table shows the number of CNG buses for each Member State.

Table 6.1: Total Natural Gas Vehicles: LD (Light Duty), MD (Medium Duty), HD (Heavy Duty), NGVA Statistics

EU countries	Total NGVs	LD+MD+HD Vehicles	LD Vehicles	MD+HD Buses	MD+HD Trucks	Other	% of total LD+MD+HD vehicles in the country	% of total NGVs in the area	Month	Year
Austria	8.323	8.321	8.100	167	54	2	0,16%	0,72%	September	2014
Belgium	1.033	1.033	1.015	3	15	0	0,02%	0,09%	June	2014
Bulgaria	61.320	61.320	61.000	280	40	0	1,83%	5,34%	May	2014
Croatia	329	300	219	78	3	29	0,02%	0,03%	September	2014
Cyprus	0	0	0	0	0	0	0,00%	0,00%	July	2014
Czech Republic	7.488	7.243	6.650	512	81	245	0,14%	0,65%	September	2014
Denmark	104	104	61	26	17	0	0,00%	0,01%	July	2014
Estonia	340	340	300	30	10	0	0,05%	0,03%	September	2014
Finland	1.689	1.665	1.600	45	20	24	0,05%	0,15%	May	2014
France	13.550	13.550	10.050	2.400	1.100	0	0,04%	1,18%	September	2014
Germany	98.172	97.619	95.708	1.735	176	553	0,20%	8,54%	May	2014
Greece	1.000	1.000	280	618	102	0	0,02%	0,09%	September	2014
Hungary	5.118	5.118	5.000	86	32	0	0,15%	0,45%	June	2014
Ireland	3	3	3	0	0	0	0,00%	0,00%	June	2013
Italy	885.300	885.300	880.000	2.300	3.000	0	2,16%	77,04%	June	2014
Latvia	29	29	29	0	0	0	0,00%	0,00%	September	2014
Lithuania	380	380	80	300	0	0	0,02%	0,03%	September	2014
Luxembourg	270	270	230	39	1	0	0,07%	0,02%	June	2014
Malta	0	0	0	0	0	0	0,00%	0,00%	July	2014
Netherlands	7.573	7.570	6.498	686	386	3	0,09%	0,66%	May	2014

EU countries	Total NGVs	LD+MD+HD Vehicles	LD Vehicles	MD+HD Buses	MD+HD Trucks	Other	% of total LD+MD+HD vehicles in the country	% of total NGVs in the area	Month	Year
Poland	3.600	3.500	3.050	400	50	100	0,02%	0,31%	June	2014
Portugal	586	486	46	354	86	100	0,01%	0,05%	December	2011
Romania	0	0	0	0	0	0	0,00%	0,00%	July	2014
Slovakia	1.426	1.426	1.100	261	65	0	0,07%	0,12%	September	2014
Slovenia	58	58	29	24	5	0	0,00%	0,01%	June	2014
Spain	3.990	3.836	905	1.609	1.322	154	0,01%	0,35%	December	2013
Sweden	46.715	46.713	43.795	755	2.163	2	0,92%	4,07%	September	2014
United Kingdom	718	678	20	37	621	40	0,00%	0,06%	December	2011
Total	1.149.114	1.147.862	1.125.768	12.745	9.349	1.252	0,41%	100,00%		

6.2.7 Hydrogen Buses in Europe

Clean Hydrogen in European Cities (CHIC)

CHIC (Clean Hydrogen in European Cities) is a major European project deploying a fleet of fuel cell electric buses and associated hydrogen refuelling stations. CHIC aims to further enhance fuel cell urban bus technology and offers a functional solution for European cities to decarbonise their fleets.

The main objectives of the project are:

- deployment of 26 fuel cell electric buses in daily public transport operations, and their refuelling infrastructure in five European "Phase 1 cities" (new adopters) : Aargau (Switzerland), Bolzano/Bozen (Italy), London (UK), Milan (Italy), and Oslo (Norway);
- additional buses deployed in "Phase 0 cities" (early adopters): Hamburg, Cologne, Berlin and Whistler (Canada) ;
- 56 fuel cell buses demonstrated in total during the project, and 4 hydrogen ICE buses
- 9 hydrogen refuelling stations deployed in total
- studies on assessment of the environmental, economic and social impacts of the use of fuel cell buses

Reference website: <http://chic-project.eu>

HyFLEET:CUTE

HyFLEET:CUTE aims at diversifying security energy sources while reducing CO₂ and other emissions harmful to the environment and human health. Hydrogen is a key element in this future strategy for road transport. The project will see the operation of 47 hydrogen powered buses in regular public transport service in 10 cities on three continents. The HyFLEET:CUTE bus fleet will be supported by a hydrogen infrastructure which will produce, refine, distribute and dispense hydrogen in many different ways. New advanced prototypes of hydrogen Fuel Cell and Internal Combustion Engine buses will also be developed and trialled.

An advanced hydrogen infrastructure is being established in Berlin which is capable of refuelling a fleet of up to 20 buses. This is aimed to achieve reliability and availability performance as good as current CNG (Compressed Natural Gas) infrastructure, and to be highly energy efficient.

Reference website: <http://www.global-hydrogen-bus-platform.com>

Clean Urban Transport for Europe (CUTE)

The Clean Urban Transport for Europe (CUTE) was a European Union project which saw the development and testing of 27 Citaro fuel cell buses - three in each of nine cities in Europe that took part in the project.

The aim of the project was to demonstrate the feasibility of an innovative, highly energy-efficient, clean urban public transport system. Different hydrogen production and refuelling infrastructures were established in each of the cities. The project saw practical applications of renewable energy sources to the transport system.

Reference website: <http://www.global-hydrogen-bus-platform.com>

Ecological City TranspOrt System (ECTOS)

ECTOS was an initiative to test three Citaro fuel cell buses in Reykjavik, Iceland. The project was financially supported by the European Commission.

The overall objective of ECTOS was to implement a demonstration of state-of-the-art hydrogen technology by running part of the public transport system with fuel cell buses within Reykjavík, Iceland. The energy chain was almost CO₂ free, because domestic geothermal and hydro-powered energy sources were used to produce hydrogen by electrolysis. The main research objectives concerned the socio-economic factors involved in changing the energy base of a modern urban society.

Reference website: <http://www.global-hydrogen-bus-platform.com>

H2 Aberdeen

The Aberdeen Hydrogen Bus Project is made up of two separate European funded projects, High Vlo City, which funds 4 buses and HyTransit which funds 6 buses, both of which are supported by the Fuel Cells and Hydrogen Joint Undertaking (FCHJU).

The project, which has backing from public and private sector organisations from the UK and Europe, will deliver a hydrogen infrastructure in Aberdeen, including:

- Production of hydrogen from a 1MW electrolyser - supplied by Hydrogenics
- Establishing a state-of-the-art hydrogen refuelling station, Scotland's first commercial-scale hydrogen production and bus refuelling station that will include hydrogen production through electrolysis
- Deployment of a fleet of 10 hydrogen buses, to be operated by First Group and Stagecoach
- The development of a hydrogen safe maintenance facility, within an operational fleet maintenance depot.

Reference website: <http://highvlocity.eu/>

Reference website: <http://www.hyer.eu/>

6.2.8 CEF Proposal for Hydrogen Buses in Europe

EAS-HyMob

The "Département de la Manche" and the Basse-Normandie Region set up an innovative energy transition roadmap with hydrogen as a cornerstone. A regional hydrogen mobility plan is being implemented to replace part of the regional fleet. The Action aims to study, optimize and test the conditions for hydrogen to be a competitive solution. It corresponds to the second phase of the regional plan. The Action will aim to analyse the cost-efficiency and the deployment strategy of the distribution infrastructure to address the initial deployment of fuel cell vehicles, mainly in captive fleets. The Action consists of studies on the design of innovative and client-oriented offers, new business models, techno-economic fine-tuning and environmental and social impact. It includes also pilot deployment of around 10 refilling stations through a grant scheme to test its various aspects and components in real-life conditions, including logistic and telematics. The Action

Reference website is <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/road>

H2Nodes - Evolution of a European Hydrogen Refuelling Station Network by Mobilising the Local Demand and Value Chains

Located on the North Sea - Baltic Core Network Corridor (namely in Tallinn, Pärnu, Riga, Kaunas, Arnhem, Rotterdam and Amsterdam) the proposed pilot Actions will look into sustainable hydrogen production pathways and will deploy a chain of hydrogen refuelling stations (HRS), tackling at the same time demand for hydrogen vehicles. The Action is divided into three main activities: studies to map the locally available pathways for hydrogen production from renewable energy sources and establish the provision of hydrogen for real life tests; building and real life testing of HRS in Riga, Pärnu and Arnhem and planning for additional HRS capacity for these cities; testing of hydrogen buses and cars at the HRS. Further growth of the hydrogen vehicle fleet will be pursued by mobilisation at local and regional level, to engage in building the business case throughout the value chain.

Reference website: <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/road>

Connecting Hydrogen Refuelling Stations (COHRS)

A number of European countries have developed plans for a roll-out of hydrogen refuelling stations (HRS) for Fuel Cell Electric Vehicles (FCEV) customers. The urban nodes where the HRSs are deployed need to be linked by "connecting stations". The proposed Action aims to study in a pilot trial, deployment of 20 connecting HRS along the main TEN-T corridors in Austria and Germany in order to understand the business case, network planning implications and the customer interface with these stations. It is a part of a Global Project on HRS roll-out plans part of the national hydrogen mobility activities in Austria and Germany. Included activities: Project Coordination; Pilot HRS deployment and operation; HRS monitoring and customer surveys; Supporting studies; Dissemination. The project's results will ultimately be used for the standardisation of investment models across Europe and cross-functional incorporation of optimal standards in the industry. Consequently, the industry commitment in expanding the national HRS networks will be further reinforced.

Reference website: <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/projects-by-transport-mode/road>

7 PROPOSED METHODOLOGY FOR THE LOCATION OF RECHARGING AND REFUELING POINTS

7.1 LOCATION OF RECHARGING AND REFUELING POINTS IN URBAN AND SUBURBAN AREAS

As stated in Chapter 3, the lack of infrastructure for alternative fuels, both within urban and non-urban areas, is one of the major obstacles to the purchase of low-emission-vehicles.

The availability of recharging/refuelling stations is not only a technical prerequisite for the functioning of alternative fuel vehicles, but also one of the most critical components for consumer acceptance³¹. The importance of infrastructure for alternative fuels has been largely recognised by all actors. As highlighted by the Impact Assessment accompanying the Proposal for a Directive on the deployment of alternative fuels infrastructure³², the network for the provision of electricity, hydrogen and natural gas (LNG for trucks and waterborne transport and CNG for road transport vehicles) is currently insufficient compared to a network that would be necessary to enable market take up of these fuels and is not likely to become available in the near future.

For example, as regards electricity, while a large part of the infrastructure needed for the deployment of electric vehicles (i.e. the electricity grid) exists, the charging points for vehicles remain to be developed. The number of dedicated e-mobility installations, including those commissioned in 2012, can be estimated to be around 26,080 (5,830 existing and 20,250 commissioned in 2012) private and 29,800 (10,400 existing and 19,390 commissioned in 2012) public Alternative Current (AC) connectors. However, this is not sufficient.

In this context, the Impact Assessment accompanying the document proposal describes the minimum necessary network for vehicles powered by electricity, hydrogen and natural gas (LNG and CNG). In the case of EVs, the minimum necessary network has to be considered as an infrastructure network that is not only capable of servicing the existing fleet of vehicles, but ensures that alternative fuel infrastructure is available in line with the critical mass of production needed for vehicle manufacturers to achieve reasonable economies of scale in the initial phases of deployment of a new technology. The International Energy Agency (IEA)³³ considers this critical mass to be in the range of 50,000 to 100,000 vehicles per year and per model, in terms of global production. The European Automobile Manufacturers' Association

³¹ "Examining choice data from a survey of potential car buyers in Germany, we have shown in this paper that demand for alternative-fuel vehicles strongly depends on the availability of fuelling infrastructure. Consequently, a failure to significantly expand the network of stations for alternative fuels would significantly hamper the adoption of alternative-fuel vehicles in coming years." Source: Acthnicht et al., 2012, The impact of fuel availability on demand for alternative-fuel vehicles. Transportation Research Part D 17 (2012) pp. 262-269. Examples of other studies supporting this statement: Egbue et al, 2012, Barriers to widespread adoption of electric vehicles: Analysis of consumer attitudes and perceptions; Deloitte Development LLC, 2010, Gaining traction - A customer view of electric vehicle mass adoption in the U.S. automotive market.

³² http://eur-lex.europa.eu/resource.html?uri=cellar:fb30100-319d-45d6-b4d6-684edcc98a3e.0001.03/DOC_1&format=PDF

³³ IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

(ACEA) estimates a 3 to 10% market share by the mid-2020s³⁴, which corresponds to “new electrically chargeable vehicle registrations of between 450,000 and 1,500,000 units by 2020 to 2025”³⁵.

The above mentioned Impact Assessment document provides also a methodology to determine the number of charging points calculated for each Member State, which is mainly based on motorisation and urbanisation rates (see Figure 7.1). The level of car ownership also serves as a proxy for income per capita, while the share of population residing in densely populated areas shows the potential for deployment of EVs, which will have limited operating range (< 200km) in the near future.

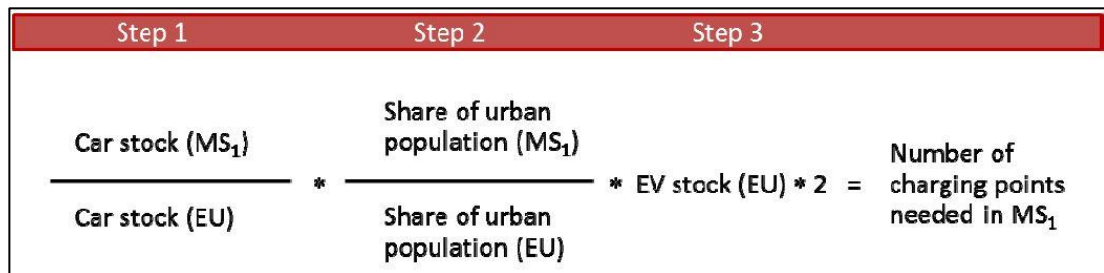


Figure 7.1: Methodology for Estimating the Minimum Number of Recharging Points

In line with the proposal document, the Directive 2014/94/EU requires Member States to deploy an appropriate infrastructure. This results in the need to estimate the number of recharging and refuelling points which have to be installed in urban and non-urban areas.

In particular, for urban areas, a study³⁶ carried out by the Organisation for Economic Co-operation and Development (OECD) in collaboration with the EU (Eurostat and EC-DG Regio), proposes a definition according to which urban areas have to be considered as “functional economic units”, thus overcoming previous limitations linked to administrative boundaries.

In this particular context, the assessment of the number of recharging/refuelling points as well as their potential sites is based on specific criteria, namely:

- future fleet of AFVs (Directive 2014/94/EU considers 2020 as time horizon);
- demographic and land use data such as:
 - population,
 - population density,
 - working population,
 - locations of railway stations, ports or airports,
 - existing refuelling stations;

³⁴ Speech by Dieter Zetsche, President ACEA, CEO Daimler on the future of electric cars at the Informal Competitiveness Council of San Sebastian, 9 February 2010 available at: http://www.acea.be/images/uploads/files/20100211_Speech_Dieter_Zetsche.pdf

³⁵ ACEA position paper on electrically chargeable vehicles, 6 Sep 2011, available at: http://www.acea.be/images/uploads/files/ACEA_on_ECVs.pdf

³⁶ For details see OECD (2012) Redefining “urban”: A new way to measure metropolitan areas, OECD, Paris and OECD (2013) Definition of Functional Urban Areas (FUA) for the OECD metropolitan database, OECD, Paris.

- traffic level emitted/attracted by each district.

In the following sections, the methods that can be adopted for locating recharging/refuelling points for electric and CNG vehicles are dealt with separately.

7.1.1 Electric charging points in urban/suburban agglomerations

The European Commission's Joint Research Centre (JRC) has proposed a complex methodology for the optimal allocation of **electric vehicle** charging infrastructure (Gkatzoflias et al., 2015)³⁷.

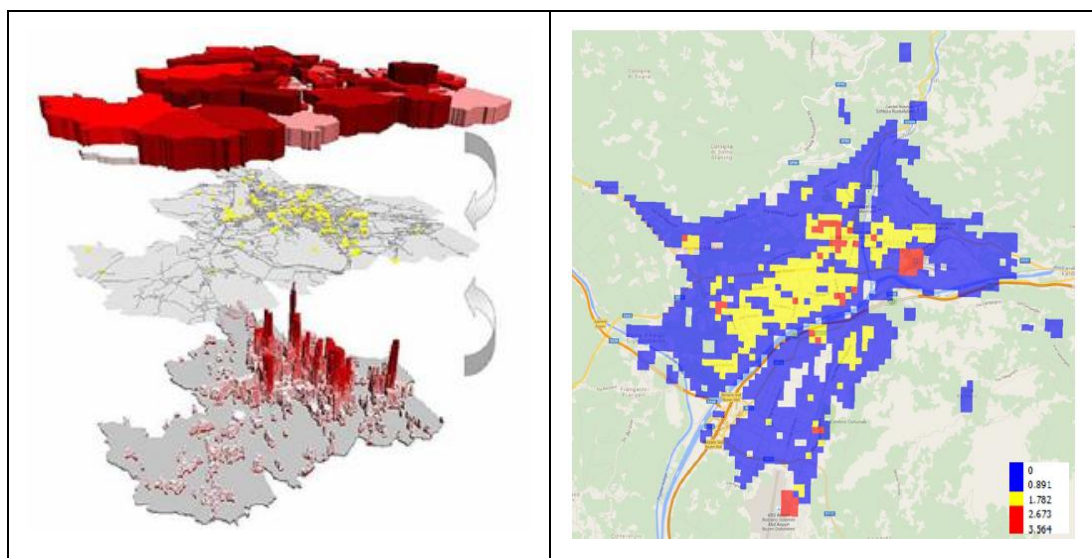
The method is based on two different approaches depending on the area of the study. The first approach is for a city level while the second is addressed to the analysis of regional/national contexts (see paragraph 7.2).

The approach to a city level analysis requires the collection of geospatial data which is then edited and transformed into raster layers. Based on different weighting factors and with the use of map algebra, a map is created with cells of 100x100m. This map indicates the optimal areas of a city where EV charging infrastructure could be placed according to specific scoring levels.

Basically, the input data required for the evaluation of the amount of recharging points and their suitable locations are:

- residential statistics (-> population density);
- parking places and lots;
- electrical power grid;
- public transport stations;
- public access buildings (hospitals, museums, universities etc);
- shopping/food areas (stores, malls, restaurants etc).

It should be mentioned that the required input data may vary depending on the scope of the study and the examined area.



³⁷ Gkatzoflias, D., Drossinos, Y., Dialra, P. & Thiel, C. (2015). *Optimal allocation of electric vehicle charging infrastructure for city and regional/national level*. Joint Research Center (JRC) science and technical report.(to be published)

Figure 7.2: Example of Application of the JRC Model in the city of Bolzano

7.1.2 CNG refuelling points in urban/suburban agglomerations

The methodology explained above explicitly refers to the location of charging points for electric vehicles. However, according to the Directive (i.e. Article 6(7)), Member States shall ensure the circulation of CNG vehicles in urban/suburban agglomerations and other densely populated areas. The JRC approach still remains a valid solution for locating CNG refuelling points, although more safety requirements might be taken into account.

Nevertheless, more simplified criteria exist. In Spain, for instance, as part of the "Spain Alternative Fuelled Strategy (2014-2020)"³⁸, it has been estimated that at least one refuelling station has to be located:

- In provincial capitals and cities with number of inhabitants higher than 100000;
- between provincial capitals and other main cities (e.g. Santiago de Compostela, Lugo, Pontevedra, Orense, Huesca, Lérida, Gerona, Soria, Palencia, Zamora, Segovia, Ávila, Guadalajara, Teruel, Cuenca, Toledo, Cáceres, Trujillo, Badajoz, Ciudad Real, Cartagena);
- in other important cities at the borders (e.g. Irún, Figueres, Ayamonte, Tuy);
- when the distance between two refuelling stations exceeds 230 km.

Following these principles, in Spain the estimated target for CNG stations amounts to 134 and, according to the current infrastructure, 107 new refuelling stations have to be installed (see Figure 7.3).



³⁸ Cros, A. "Spain's Alternately-fuelled Vehicles (AFVs) Strategy (2014-2020)", Brussels, 16th September 2015.

Figure 7.3: Location of CNG refuelling points in Spain (source: Cros, A. "Spain's Alternately-fuelled Vehicles (AFVs) Strategy (2014-2020)", Brussels, 16th September 2015)

To have an idea of the present deployment of CNG refuelling points, in Table 7.1 the actual densities in some European countries are collected, together with some information regarding CNG vehicle distribution.

Table 7.1: Number of CNG vehicles and CNG Refuelling Points in some European countries (source: Natural & Bio-Gas Association (NGVA) – <http://www.ngvaeurope.eu/>)

Member State	Total CNG stations	Public CNG stations	CNG vehicles	% light vehicles	CNG vehicles/ total vehicles	Total stations/ vehicles
Italy	1040	990	885300	99.4%	2.16%	1:851
Germany	920	840	98172	97.5%	0.20%	1:107
France	310	40	13550	74.2%	0.04%	1:44
Sweden	205	147	46715	93.7%	0.92%	1:228
Austria	180	175	8323	97.3%	0.16%	1:46
Netherlands	141	134	7573	85.8%	0.09%	1:54
Bulgaria	110	108	61320	99.5%	1.83%	1:557
Czech Republic	88	63	7488	88.8%	0.14%	1:85

7.2 LOCATION OF RECHARGING AND REFUELING POINTS IN EXTRAURBAN AREAS (CORRIDORS)

At regional/national level, the analysis has as a target the allocation of infrastructure for every x km, where x should be enough for an EV to charge appropriately and avoid any battery depletion. In this case, two road typologies can be considered - highways and rural roads.

As a first step, highways are being studied based on a relevant geospatial polyline shapefile³⁹ with the set of the available refuelling stations and rest areas (as a geospatial point shapefile) along the highway. The suitable and optimal refuelling stations/rest areas are then selected by means of an algorithm that compares all the distances between them. For the rest of the regional network, the geospatial shapefile of the main rural roads is used and split in a way that there is adequate infrastructure for an EV to travel throughout the region without being left out energy.

In order to reduce the cost and time of constructing new areas, charging points on the highways have to be placed in specific and already built areas (rest areas, refuelling stations etc.) According to a mobility data analysis that the JRC has performed and was based on both conventional and electric vehicles from various regions (Donati et al., 2015), the maximum range of 60km (actual road distance and not Euclidean distance) has to be covered by each charging point. Furthermore, it should be taken into account that each charging point covers the distance only towards a specific direction of the

³⁹ A geospatial polyline shapefile format is a popular geospatial vector data format for geographic information system (GIS) software. It is a digital vector storage format for storing geometric location and associated attribute information. The shapefile format can store the primitive geometric data types of points, lines, and polygons. Shapes (points/lines/polygons) together with data attributes can create infinitely many representations about geographic data.

highway since the rest and service areas cannot be accessed from both directions.

The case of rural roads needs a different approach than the highway since each suggested area can serve both directions of the road. Furthermore, there is a whole road network across the province that has to be covered but the infrastructure has to be placed along the main roads. Additionally, the charging infrastructure can be installed either at refuelling stations or public parking areas that already exist or can be assigned close to the main roads.

Even though the above-mentioned methodology refers to electric vehicles, it can be adapted to other types of AFVs as well.

Further considerations are necessary though. The first one regards the driving behaviour. Indeed, the type of AFV influences the behaviour of drivers in terms of single-trip distances and their duration, daily distance travelled (daily mobility), parking duration, parking start and end time, number of daily trips (Donati et al., 2015)⁴⁰. The assessment of this attitude could provide important indications about infrastructure requirements within urban and non-urban areas and cannot be neglected. Furthermore, it is worth highlighting the fact that the technical feasibility of a new refuelling site (especially for LNG, LPG and CNG) is in any case subjected to the respect of several safety and environmental requirements which strongly affect the final location.

A simplified method for the location of recharging and refuelling points in extra-urban areas can be based on the average maximum range which can be travelled by AFVs. In particular, the main principle is that "it may not be advisable to travel farther than needed to reach a refuelling station". Indeed, drivers would like to find an available refuelling station along their path without increasing their travel distance.

In order to make clearer this concept, the following example is provided.

Assuming that (see Figure 7.4):

- distance AB is the maximum range of the generic vehicle;
- distance AC corresponds to half the maximum range of the generic vehicle;
- distance AD is the travel distance up to the destination point;
- only at locations A and B, there is a refuelling station.

the generic driver who would like to reach point D, would be forced to travel up to point B only for refuelling, before coming back to the starting point A. Evidently, this would require to travel a longer distance than desired.

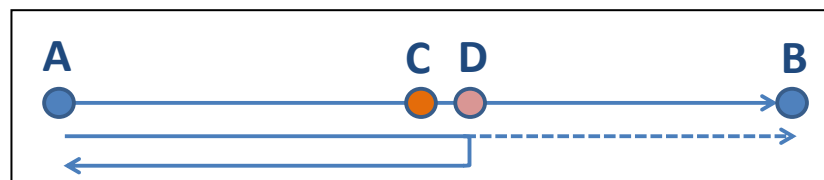


Figure 7.4: Proposed Method for the Evaluation of minimum Distance between Refuelling/Recharging Points

⁴⁰ Donati, A.V., Dilare, P., Thiel, C., Spadaro, A., Gkatzoflias, D. & Drossinos, Y. (2015). Individual mobility: From conventional to electric cars. Joint Research Center (JRC) science and policy report. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97690/eur_27468_en_online_v3.pdf

As a consequence, the optimal distance between two refuelling points can be expressed as:

$$L = \frac{MR}{2} - d(\%) \tag{1}$$

Where:

- *MR* is the maximum range distance;
- *d* is a percentage of the maximum range distance which enables the driver to travel a little bit more so as to reach his/her destination and refuelling during the backward trip.

Obviously, the amount of *MR*, as well as its percentage *d*, depends on the alternative fuel considered. However, these values can be calibrated considering the above mentioned study proposed by JRC, and the maximum average distance of all AFVs (see Table 7.2: Maximum Range Distance per Type of alternative Fuel Vehicle).

Table 7.2: Maximum Range Distance per Type of alternative Fuel Vehicle⁴¹

Electric	Compressed Natural Gas	Liquefied Petroleum Gas	Liquefied Natural Gas	Hydrogen
130 km	400 km	450 km	600 km	300 km

For electric vehicles for instance, since JRC suggests a maximum range between recharging points of 60 km (*L*), knowing the average maximum distance of the class (i.e. *MR*=130km), it comes out from equation 1 that *d* is about 3% (see Table 7.3).

Table 7.3: Optimal Distance between Recharging Points for Electric Vehicles

L	MR	d
60 km	130	2,5%

In the same way, as shown in Table 7.4, the optimal distance *L* can be evaluated for other AFVs.

Table 7.4: Optimal Distance Between Refuelling Points for other AFVs

Compressed Natural Gas	Liquefied Petroleum Gas	Liquefied Natural Gas	Hydrogen
195 km	220 km	290 km	295 km

Figure 7.5 represents in a simplified way the optimal location (i.e. point E) for the alternative fuel station according to the average travel distance AD.

⁴¹ These values have been drawn from official data provided by the main automakers and refer to the 2015 catalogue.

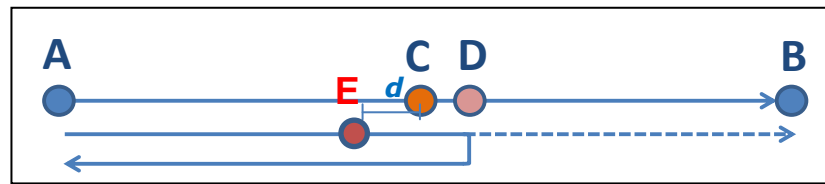


Figure 7.5: Simplified Representation of the suggested Location for the Alternative Fuel Station

The planning criterion explained above enables the evaluation of the average distance among refuelling points. However, it is necessary to determine some landmarks so as to locate more precisely the refuelling points. For instance, it would be convenient to consider a corridor at international level and identify national borders as landmarks. In this case, the distance L provided by equation 1 could be split into two approximately equal parts taking into account possible critical points.

As far as the LNG refuelling points are concerned, the network has to be designed considering port locations, where proper supply system is already installed. Obviously, border criterion still remains a valid solution for keeping the network connected beyond national limits. However, as suggested by the Directive, along the TEN-T Core Network it is recommended to consider an average distance between LNG refuelling points of approximately 400 km. According to this criterion, in Spain⁴² it is estimated that at least 10 additional LNG refuelling points have to be installed, in addition to other stations necessary to cover demand (see Figure 7.3)



⁴² Cros, A. "Spain's Alternately-fueled Vehicles (AFVs) Strategy (2014-2020)", Brussels, 16th September 2015

Figure 7.2: Location of LNG refuelling points in Spain (source: Cros, A. "Spain's Alternately-fuelled Vehicles (AFVs) Strategy (2014-2020)", Brussels, 16th September 2015)

Finally, the number of refuelling/recharging points to be installed according to the proposed methodology has to be compared with the present density, so as to understand actual baseline state and assess the feasibility of the investments. To have an idea, in Table 7.5, the current refuelling station density of the main countries in Europe is shown.

Table 7.5: Number of Refuelling Stations in Europe

	Number of Refuelling Stations	Population	Refuelling Station Density (Station/10000*Inhabitants)
Austria	2640	8507786	3,10
Belgium	3158	11203992	2,82
Bulgaria	2980	7245677	4,11
Cyprus	280	858000	3,26
Czech Republic	3745	10512419	3,56
Denmark	2004	5627235	3,56
Estonia	440	1315819	3,34
Finland	1877	5451270	3,44
France	11476	65856609	1,74
Germany	14622	80780000	1,81
Greece	6500	10992589	5,91
Hungary	1568	9879000	1,59
Ireland	1798	4604029	3,91
Italy	21800	60782668	3,59
Latvia	609	2001468	3,04
Luxembourg	236	549680	4,29
Netherlands	3922	16829289	2,33
Norway	1782	5142000	3,47
Poland	6745	38495659	1,75
Portugal	2654	10427301	2,55
Romania	2050	19942642	1,03
Slovakia	876	5415949	1,62
Slovenia	546	2061085	2,65
Spain	10617	46507760	2,28
Sweden	2703	9644864	2,80
Switzerland	3547	8160900	4,35
United Kingdom	8611	64308261	1,34

8 ASSESSMENT OF THE NEED OF LNG POINTS IN PORTS OF THE TEN-T CORE NETWORK

The global shipping industry faces a challenge as new legislation in force since the beginning of 2015 is imposing significant limitations with regards to air emissions from ships. The Directive (Recital 42) indicates LNG as *an attractive fuel alternative for vessels to meet the requirements for decreasing the sulphur content in marine fuels in the SO_x Emission Control Areas which affect half of the ships sailing in European short sea shipping, as provided for by Directive 2012/33/EU of the European Parliament and of the Council (1). A network of refuelling points for LNG at maritime and inland ports should be available at least by the end of 2025 and 2030, respectively.*

The following sections provide examples for defining the main equipment used for different types of refuelling points and describe a methodology for Member States to assess the need for measures to install LNG points on TEN-T ports based on the approach of the TEN-T COSTA project (Paragraph 8.3.12). The chapter is completed with some example of TEN-T Actions.

8.1 TYPE OF REFUELLING POINTS - DEFINITION

The refuelling operation in port, either sea or inland, can be executed adopting the logistics solution for refuelling in the different approaches, described in the next section (based on the COSTA Project, Paragraph 8.3.12):

- TTS – Tank Truck to Ship
- TPS – Terminal to Ship via Pipeline
- BTS – Barge to Ship
- STS – Ship to Ship
- RCS – Removable Container to Ship

The facilities used for this operation can be:

- LNG terminals,
- tanks,
- mobile containers,
- bunker vessels and barges

8.1.1 LNG terminals

The term “LNG terminal” includes all natural gas facilities located onshore waters that are used to receive, unload, load, store, transport, gasify, liquefy, or process natural gas.

8.1.2 Tank Trucks

A tank truck has an LNG loading capacity usually between 30 and 80 m³ (the typical loading capacity is 55 m³). Trucks have been used for distribution of LNG in USA since 1969. LNG distribution by truck for bunker use has been carried out since 2001 in Norway.

The advantage of using a tank truck in ship bunkering is to be found in several aspects:

- This method allows LNG bunkering anywhere where necessary in the port.
- Storage LNG facilities are not needed, although the distance between the LNG storage facilities and the supply point is limited by the road transportation costs.
- This method allows only for small transfer capacities, so suitable only for small vessels.

The limitations of this approach are to be found in:

- The low loading capacity per truck.
- The significant amount of time need for the supply operation.
- The risks associated with road transportation.



Figure 8.1: LNG Refuelling using a Tank Truck

8.1.3 Mobile containers

Bunkering through portable refuel unit containers is very simple, as it consists of the replacement of an empty fuel tank with a full one. The portable refuel unit containers have a typical size of 1 TEU and a typical LNG loading capacity of 30 m³.

The advantages of using mobile containers are as follows:

- They allow LNG bunkering into ports wherever necessary.
- Storage LNG facilities are not needed, although the distance between the tank yard (LNG container loading and storage facilities) and the supply point is limited by the road transportation costs.
- The bunkering time is the lowest. Suitable for big and medium sized ships.



Figure 8.2: LNG Mobile Container

8.1.4 Bunker Vessels and Barges

Ship to ship LNG has some important advantages compared to on-shore bunkering:

- STS bunkering allows bunkering operations where necessary (in the port or outside).
- It is suitable for big and medium sized ships with high transfer capacity.
- LNG storage facilities not needed although closely linked to the large import-export terminals.

This operation can be executed using a bunker barge or a bunker⁴³ vessel.

⁴³ The barge is a flat-bottomed boat, either motorised or towed, used to carry products in rivers or canals. In the context of bunkering, a bunker barge is usually a small tanker and not a barge as defined here. A bunker barge will deliver marine fuel to ships, usually in port (<http://www.maritimeinfo.org/en/Glossary/>)

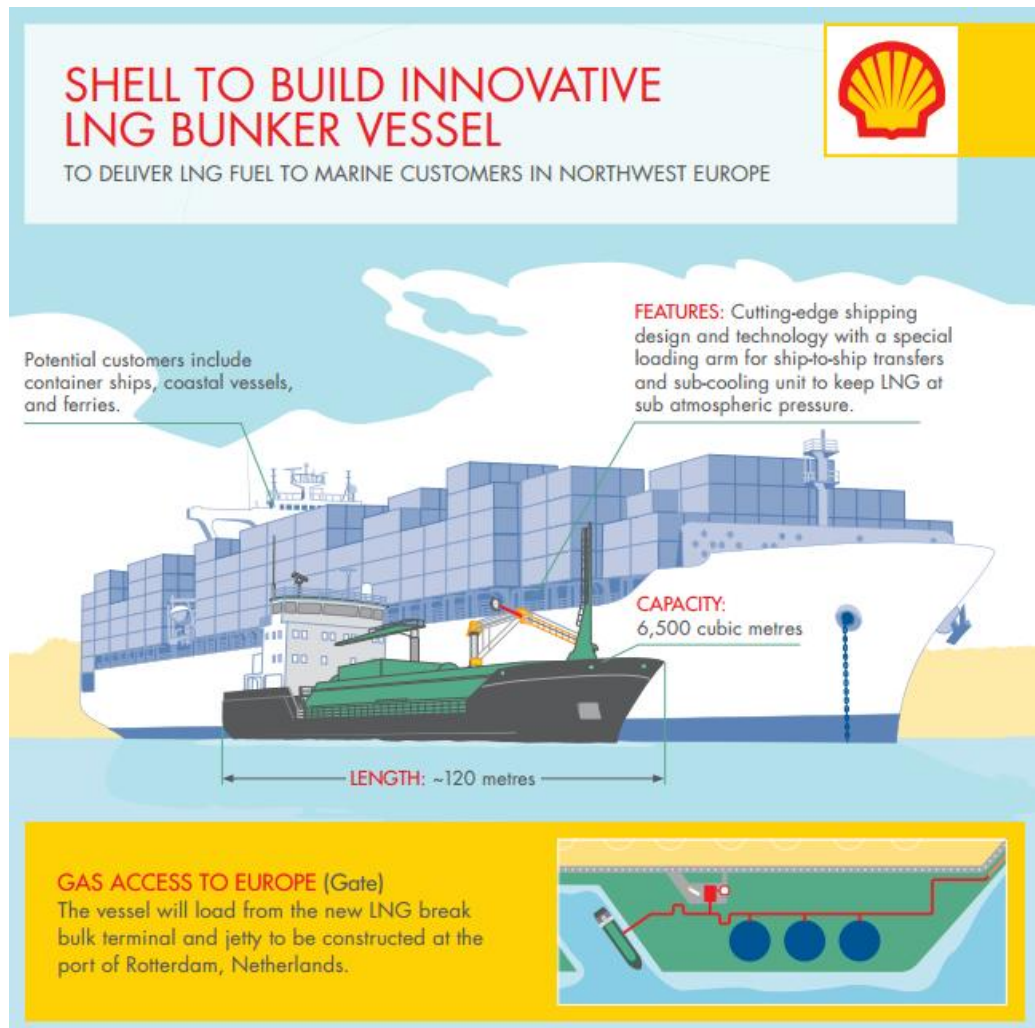


Figure 8.3: New Bunker for LNG

(Source <http://www.shell.com/global/products-services/solutions-for-businesses/shipping-trading/innovative-bunker-vessel.html>)

8.2 METHODOLOGY

In general, the methodology to assess the need for LNG refuelling points in ports of the TEN-T core network could consist in developing a feasibility study to be completed with a Cost Benefit Analysis if necessary. The CBA can be executed following the guidelines provided by European Commission ("Guide to Cost-Benefit Analysis of Investment Projects Economic appraisal tool for Cohesion Policy 2014-2020", http://ec.europa.eu/regional_policy/index.cfm/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020). This approach is also requested by INEA: each request of contribution must be justified by a CBA. The main steps for this activity are:

- Demand analysis: evaluation of the quantity of LNG needed for bunkering;
- Selection of the better logistics solution and cost estimation (CAPEX and OPEX);
- Evaluation of the revenues;

- Evaluation of the social (including environment) costs and benefit.

Concerning the selection of the logistics solution, it is important to have an approach at system level. This means that the needed facilities and the logistics process should be studied not considering the single port, but evaluating the synergies at network level.

An example of this is the project GAINN (GAs INnovative Network), submitted by Spain, France, Croatia, Italy, Portugal, Slovenia in the last CEF Call (March 2015). In this context, the Italian Ministry of Infrastructure and Transport proposed the following preliminary schema:

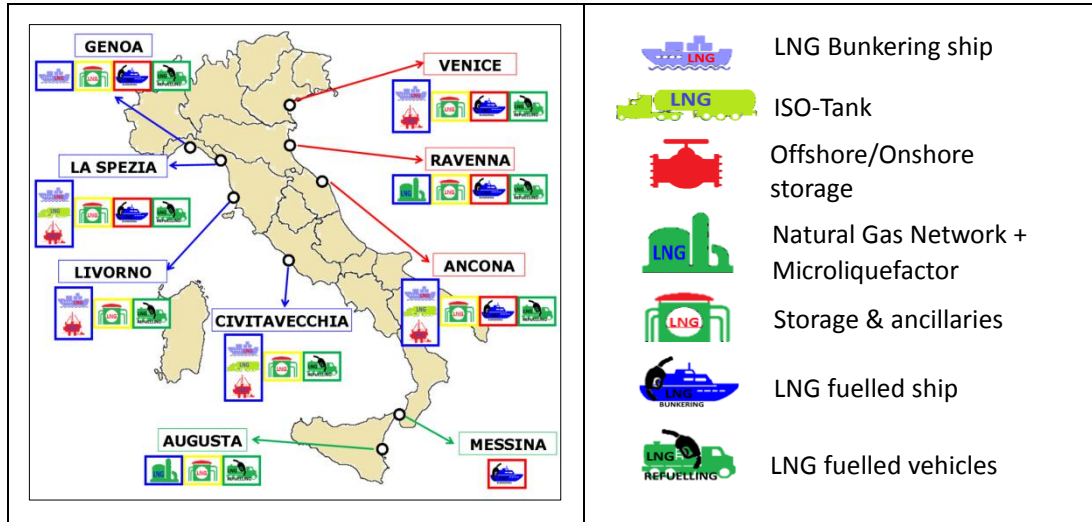


Figure 8.4: Preliminary LNG Installation in Italian Ports

In this hypothesis not all the ports have offshore/onshore storage, in some cases the refuelling is provided only by fuelled ships, etc.

The abovementioned analysis concurs in the determination of the sustainability of the intervention both from a financial (analysis without social impacts) and an economic (analysis containing social impacts) point of view.

The sustainability can be evaluated calculating financial and economic indicators like Net Present Value, Return of Investment, etc.

If the intervention is sustainable only from an economic point of view, because the social benefit (reduction of emission) compensates the difference from costs and revenue, the public administration could contribute to equilibrate these differences.

The contribution can consist in co-funding the initiative, in reducing the taxation, or in providing a loan at a low interest rate.

8.3 GOOD PRACTICES IN THE EU

In Europe there are several initiatives related to the installation of LNG facilities in ports, both sea and inland. The TEN-T programme has co-funded more than 20 initiatives both at study level and at design and implementation level. The support provided by the Union is continuing with the CEF Programme, which usually funds projects involving more than one Member State.

The next table summarizes some of these initiatives, providing information about:

- Decision number (when the code contains “EU”, there are more Member States involved);
- Title of the action
- Classification of the action:
 - maritime transport,
 - multimodal transport, but with maritime component
 - other actions in maritime context

In the next paragraph details about these are provided, while Appendix B contains the official fact sheets of these projects (partnerships, budget, etc.).

Table 8.1: LNG TEN-T Projects

DECISION	TITLE	MARITIME	MULTI-MODAL	OTHER
2013-EU-92045-S	LNG uptake in the UK: a real-life trial with the first small scale bunkering infrastructure in Teesport and innovative LNG vessels		X	
2013-EU-21019-S	Costa II East - Poseidon Med	X		
2013-EU-21018-S	Pilot Implementation of a LNG-Propulsion System on a MoS Test Track in the Environmental Model Region 'Wadden Sea	X		
2013-EU-21007-S	LNG in Baltic Sea Ports II	X		
2013-EU-21005-S	Channel LNG	X		
2013-EL-92080-S	Sustainable Maritime Transport with LNG between Greek mainland and islands in the Archipelagos (ARCHIPELAGO-LNG)	X		
2013-DE-92056-S	Realising, real-life demonstration and market introduction of a scalable, multi-modal LNG-terminal in the seaport of Bremen for the reliable supply of LNG as alternative fuel to all transport modes		X	
2012-EU-21009-M	LNG Bunkering Infrastructure Solution and Pilot actions for ships operating on the Motorway of the Baltic Sea	X		
2012-EU-21006-S	SEAGAS	X		

DECISION	TITLE	MARITIME	MULTI-MODAL	OTHER
2012-EU-21003-P	LNG Rotterdam Gothenburg		X	
2012-EU-18067-S	LNG Masterplan for Rhine-Main-Danube	X		
2012-ES-92068-S	LNG hub in the north-western Iberian Peninsula		X	
2012-ES-92034-S	Flexible LNG bunkering value chain in the Spanish Mediterranean Coast		X	
2011-FR-92026-S	Technical & design studies concerning the implementation of a LNG bunkering station at the port of Dunkirk	X		
2011-EU-92151-S	Green technologies and eco-efficient alternatives for cranes & operations at port container terminals (GREENCRANES)			X
2011-EU-92079-S	Make a Difference	X		
2011-EU-21007-S	COSTA	X		
2011-EU-21005-S	LNG in Baltic Sea Ports	X		
2010-EU-21112-S	LNG infrastructure of filling stations and deployment in ships	X		

8.3.1 LNG uptake in the UK: a real-life trial with the first small scale bunkering infrastructure in Teesport and innovative LNG vessels

The aim of this project is to realise a breakthrough in the application of LNG (liquefied natural gas) for short sea shipping through a dedicated LNG supply and demand chain in the UK. It will show the viability of LNG as a significantly environmental sound alternative to present marine fuels and its potential for short sea shipping in the UK and the North Sea.

It will deploy a LNG bunkering facility in the port of Teesport and carry out a real-life trial in two vessels (ethylene carriers) propelled with an innovative LNG fuel system.

It will also demonstrate the potential of LNG in UK marine and road transport through technical and market studies, in order to help advance the roll-out of LNG technology in the UK.

State of progress on 31 December 2014: The two vessels are equipped with the innovative LNG propulsion systems. The construction of the LNG bunkering facilities (permanent and temporary solution) is ongoing. Studies are under elaboration as well, according to plan.

8.3.2 Costa II East - Poseidon Med (2013-EU-21019-S)

COSTA II focuses on the eastern Mediterranean region/sea with five Member States (Greece, Cyprus, Italy, Croatia, and Slovenia) in order to prepare a detailed infrastructure development plan promoting the adoption of LNG as marine fuel for shipping operations. It will design a LNG transport, distribution, and supply (including bunkering) network and infrastructure and define the framework for a well-functioning and sustainable relative market (vessels) for its demand. It has the following four objectives, namely to:

1. Study the establishment of a comprehensive LNG network (sources and destinations) in the East Mediterranean area (including the Adriatic)
2. Investigate all of the necessary activities to develop a sustainable market for LNG as marine fuel in the aforementioned Member States
3. Revive shipping in the area and increase fleet competitiveness, efficiency, and sustainability
4. Serve and satisfy EU/TEN-T objectives with respect to emission reduction, increased efficiency and competitiveness of EU shipping, in order to ensure and strengthen the accessibility to all areas of the Comprehensive Network, diversify EU energy supply sources, create new employment opportunities, and promote the mobility of people and goods in a safe and socially responsible way.

8.3.3 Pilot Implementation of an LNG-Propulsion System on a MoS Test Track in the Environmental Model Region 'Wadden Sea' (2013-EU-21018-S)

The specific objective of this Motorways of the Sea project is to deliver the pilot development and testing of an innovative methodology for LNG retrofitting. One of the vessels that are operating the Borkum service will be converted to LNG by retrofitting its propulsion system in an innovative manner.

The project constitutes the continuation (Phase 2) of a previous action MarITIM implemented under INTEREG IV which is an R&D project with feasibility study.

Based on the findings of this R&D project, the first vessel under German flag will be retrofitted and equipped with LNG propulsion. The pilot project takes the function of the demonstration project in the framework of the LNG Master Plan in the Wadden Sea and will aim to drive the development of the accelerated introduction of LNG in the Wadden Sea.

8.3.4 LNG in Baltic Sea Ports II (2013-EU-21007-S)

The main objective of this project is to minimise maritime transport pollution in the Baltic region by supporting the widespread use of LNG (liquefied natural gas) while maintaining the competitiveness of maritime transport.

The project encompasses pre-investment studies, related technical design, associated permits and risk assessment procedures for LNG bunkering infrastructure (land based and floating) in partner ports in a harmonised manner.

It builds on and extends the on-going "LNG in the Baltic Sea Ports" project, and contributes to the Global Project "Development of an LNG bunkering network in the seaports of the Baltic Sea region" as part of the Baltic Motorways of the Sea programme.

The extension includes roll-out of the network to four new Baltic ports (Trelleborg, Sundsvall, Rostock and Klaipeda) and a further development of the know-how (alignment of LNG facilities between ports, training schemes).

The next (second) phase of the Global Project will be the construction and launching of LNG bunker terminals within the Baltic Sea region. These activities will be developed at a later stage.

8.3.5 Channel LNG (2013-EU-21005-S)

The main objective of the Global Project is to enable a gradual but rapid transition towards the viable supply of LNG (liquefied natural gas) for a fleet of vessels operating in the SECA and within the EU.

This project covers three main objectives, namely the:

1. Installation of small scale equipment for LNG bunkering in the Zeebrugge terminal (Belgium) to break down large quantities of LNG into smaller ones for further distribution in the North Sea and the Channel region. Zeebrugge would become the first European terminal open to the public for this kind of operation.
2. Equipment of three ferry berths with automatic quick release mooring hooks, two at the Port of Portsmouth (UK) and one in the Port of Caen/Quistreham (France).
3. Establishment of an optimal logistic chain for LNG in order to deliver LNG to ports and ships remote from the main European gas import terminals and therefore encourage the rapid growth in the number of vessels using LNG.

8.3.6 Sustainable Maritime Transport with LNG between Greek mainland and islands in the Archipelagos (ARCHIPELAGO-LNG) (2013-EL-92080-S)

This project covers a study aiming to promote the use of LNG (liquefied natural gas) as a marine fuel in the passenger and shipping sectors of the Greek islands, in order to reduce supply costs and the environmental impact of oil derivative-based fuels. The main objective is to motivate and to provide the Greek authorities with the necessary tools in order to adopt a regulatory framework for the bunkering of gas-fuelled (LNG) ships in the region by:

- Identifying the key technical and economic framework of small-scale LNG as marine fuel value chain in South Aegean, e.g. main supply chain options, required retrofits and infrastructure in ports, ships and shipyards, business plans for each operator
- Providing legislative recommendations to the Greek authorities with regards to the technical and financial aspects of the LNG supply chain in the island regions, using the South Aegean region as a reference

The project will bring together key Greek stakeholders representing a cross-section of the LNG as marine fuel supply chain - including national ministerial and regional authorities, LNG suppliers, ship owners/operators and shipyards, supported by academic/research institutes.

8.3.7 Realising, real-life demonstration and market introduction of a scalable, multi-modal LNG-terminal in the seaport of Bremen for the reliable supply of LNG as alternative fuel to all transport modes (2013-DE-92056-S)

The project features a study with pilot deployment concerning the construction of a flexible, multi-modal LNG terminal to provide a reliable supply of LNG for different modes of transport.

Activities include planning, design and engineering, as well as the definition, construction and operation of an LNG filling station of 400m³. While the initial size will be relatively small, the flexible approach ensures that effective market demand can be accommodated by enlarging the facility at a later stage.

The pilot study will make a contribution towards a more widespread use of LNG propulsion and offer alternative fuels supply facilities. The LNG terminal aims to stimulate LNG use by maritime, road and potentially also rail users in a geographical area of around 300-400 km.

8.3.8 LNG Bunkering Infrastructure Solution and Pilot actions for ships operating on the Motorway of the Baltic Sea (2012-EU-21009-M)

The aim of the Global Project is implementing three pilot actions for LNG, methanol and the use of scrubbers. These pilots look at meeting the sulphur legislation in 2015 in the Sulphur Emission Control Area and support the development of a competitive and environmentally sustainable shipping sector in the Baltic Sea.

The Action is composed of works and studies. The works aim at the implementation of an LNG bunker supply infrastructure for the use of LNG at the Port of Brofjorden in Sweden. The technical studies aim at the deployment of new LNG technologies in full scale Pilot Actions in vessels in the Baltic Sea and in the North Sea.

The Action will establish LNG bunkering infrastructure including the components required from the terminal to bunker vessel, and from the bunker vessel to the LNG fuelled vessels.

The deployment of new LNG technologies will result in demonstration of full scale solutions of vessels in commercial operation in the Baltic Sea and in the North Sea, as well as design recommendations, recommended good practices for operation, and suggestions for development of rules and regulations. The Action will additionally investigate financial mechanisms to support ship-owners/operators in converting their fleets to new technology.

8.3.9 SEAGAS (2012-EU-21006-S)

The Action aims at determining the feasibility of implementing LNG bunkering facilities in the Port of Roscoff (north-west of France) and the Port of Santander (north of Spain). The studies will take into account the conformity of the infrastructures and the equipment with the standards for risk prevention (SEVESO Directive), and the eventual constraints, to be revealed by the environmental impact assessments studies and the public inquiries. The findings of these studies will be an essential decision making tool a) for the ferry operator, to start the construction and the retrofit of LNG vessels; b) for port authorities in Roscoff and Santander that will be able to plan the design and the implementation of LNG bunkering stations; and c) for the

authorities in charge of the public passenger transport in Cantabria. The project will contribute to the development of the Atlantic Motorway of the Sea as a wider benefit action, serving all the ship-owners operating in the region and looking into synergies of different transport modes.

8.3.10 LNG Rotterdam Gothenburg (2012-EU-21003-P)

At present, the European market for LNG fuel for maritime transport is limited and infrastructure is almost inexistent for small-scale supply of LNG. The market requires the ports to have LNG bunkering infrastructure, while the ports expect sufficient LNG demand to build infrastructure.

To solve this situation and develop the maritime LNG sector, the present Action will create break bulk infrastructure for small-scale LNG supply in the Ports of Rotterdam and Gothenburg. These large ports combined have a critical mass to assist in the market transition to maritime LNG in northern Europe.

The facilities in Rotterdam will distribute stored LNG in the Gas Access To Europe terminal in smaller quantities. From this new break bulk facility other LNG infrastructure facilities can be supplied with LNG, like smaller terminals in other ports or fuelling infrastructure for ships. The LNG break bulk facility in Rotterdam will additionally provide a truck loading bay, which enables ships to bunker LNG in the port using trucks.

The facility in Gothenburg will be the first satellite terminal to be supplied from the Rotterdam break bulk facility. It serves as a proof of concept as well as a means to serve the Scandinavian LNG bunkering market.

The combined facilities for fuelling ships and trucks in both ports will create a synergy effect to address the importance of providing alternative fuel solutions for transport.

8.3.11 LNG Masterplan for Rhine-Main-Danube (2012-EU-18067-S)

The Action's overall objective is to prepare and to launch the full-scale deployment of LNG as environmentally friendly and efficient fuel in the inland navigation sector within the Priority Project 18 Rhine/Meuse-Main-Danube axis. It is a combined effort from sea and inland ports, authorities and barge and terminal operators, as well as logistic service providers, which will remove market barriers and take the first steps in realising a new LNG supply chain.

The Action is a multi-partner involvement from 12 EU Member States. It will specifically elaborate a comprehensive strategy –a Masterplan - with a detailed roadmap and appropriate guidelines and recommendations for the implementation of LNG as a fuel and cargo on the Rhine-Main-Danube axis. The Masterplan will follow an integrated approach and encompass the full LNG logistic chain from the supplier through the carriers and distribution network to the end user.

The Masterplan will also build on the results and lessons learned from pilot deployments of LNG vessels and terminals. The pilot deployments will be performed by barge and terminal operators, logistics service providers as well as shipyards together with their commercial partners and suppliers. All pilots will cover parts of an entire LNG supply chain from the LNG import terminal to the end-client.

The Masterplan will be published and widely disseminated at local, national and European levels of decision and policy makers.

Although not on the axis, Italy participates in this action in order to understand if and how to implement similar strategy for the PO river.

8.3.12 LNG hub in the northwestern Iberian Peninsula (2012-ES-92068-S)

The objective of the Action is to develop a hub for LNG as fuel for the Port of Ferrol in the northwest of the Iberian Peninsula.

It focuses on the design of the necessary facilities, infrastructure and procedures in order to supply LNG as fuel along the entire port logistics chain: from the port services to ships navigating on the Atlantic corridor, which belongs to the Motorway of the Sea Western Europe.

LNG is rapidly emerging as a more environmentally friendly fuel for the shipping sector and its uptake is encouraged by the European Union.

The studies contribute to climate change mitigation and to the reduction of the impact of transport on the environment. The results will be disseminated among stakeholders and the project can be used as an example for the promotion and for policy making in the field of sustainable transport.

8.3.13 Flexible LNG bunkering value chain in the Spanish Mediterranean Coast (2012-ES-92034-S)

The project looks at overcoming the existing barriers to establish an LNG bunkering supply chain in the Mediterranean basin of Spain.

The transition towards an LNG bunkering supply network requires a double axis action. On one hand, the existing and future maritime fleet needs to be adapted in terms of technology of engines and storage. On the other hand, terminals and other facilities at ports need to be upgraded or developed in order to deploy a full supply chain providing enough security of supply.

The Action will consist of studies to address both maritime fleet and port facilities transition simultaneously, reducing the time-to-market of the LNG Bunkering Service in the Spanish Mediterranean ports.

To meet the objective, a study will be conducted to analyse the technical, operative, economic and legal aspects of LNG bunkering vessel operations enabling medium term deployment (2015-2020). It will include a detailed evaluation and design of an optimised LNG supply chain in key Spanish ports of the Mediterranean Sea (the ports of Barcelona, Valencia and Cartagena), based on existing onshore infrastructure and an LNG bunkering vessel aiming to offer a flexible supply to a set of nearby locations.

8.3.14 Technical & design studies concerning the implementation of an LNG bunkering station at the port of Dunkirk (2011-FR-92026-S)

The Global Project is the construction of a Liquefied Natural Gas (LNG) bunkering station at the Port of Dunkirk. The station will fuel vessels coming from and to the North European Sulphur Emission Control Area (SECA) and passing through the Dover Strait and inland transportation. LNG will be provided to the bunkering facilities through a pipe from an adjacent LNG import terminal being constructed in Dunkirk. The Global Project will enable the completion of a missing bunkering gap for ships on the southern border of the North European SECA.

The Action consists in the preparation of feasibility and design studies for the construction of an LNG bunkering station infrastructure in the Port of Dunkirk (GPMD), located in the south of the North European SECA .

The Action implementation will involve consultation with a group of technical partners including Voies Navigables de France, relevant ports and the Dunkirk LNG terminal operator (DK LNG) and some ship owners. The final general results will be disseminated among the maritime community to raise awareness of LNG bunkering opportunities.

8.3.15 Green technologies and eco-efficient alternatives for cranes & operations at port container terminals (GREENCRANES) (2011-EU-92151-S)

The Action's objective is to test new technologies and alternative fuels (i.e. LNG, Hydrogen, Diesel TIER 4 and other ecofuels) including pilot deployment in existing port container terminals (PCTs), thereby contributing to mitigating climate change and reducing GHG emissions.

The final objective is to enable PCTs' managers and investors, EU policy-makers, citizens and industry to understand and decide which technologies generate the best socio-economic value and have the highest potential for rapid deployment across the EU. Intending to enable quick deployment at EU level, particular attention will be given to the definition of good practices that support the swift creation of critical mass in the EU.

For this purpose, the proposed Action will develop three prototypes and will pilot them based on complementary approaches:

- Evaluation of LNG versus Diesel TIER 4 fuel alternatives for PCT yard equipment, to be developed at Noatum Container Terminal Valencia (NCTV), Port of Valencia, Spain.
- Implementation of a real time energy monitoring system to control energy consumption associated to port container operations, to be developed at the Port of Koper, Slovenia. This prototype will take advantage of the requirements and procedures of the international standard ISO 50001 about energy management systems.
- Adaptation of a Reach Stacker vehicle to a different motorisation such as LNG, hydrogen or bio-fuels for reducing the environmental impact and energy consumption, to be developed at the Port of Livorno, Italy.

8.3.16 Make a Difference (2011-EU-92079-S)

The Action aims to identify and minimise the barriers when building and operating a Liquefied Natural Gas (LNG) fuelled vessel. This will be achieved by analysing the technical requirements and issues regarding regulations and environmental operation permits that need to be resolved in the shift from traditionally fuelled engines to LNG.

This Action will find solutions to the operational issues from the ship-owner perspective. Concretely, the Action will:

- prepare for the LNG certification process for vessels and operators
- harmonise land-based and sea-based regulations and bunkering requirements
- select and demonstrate vessel environmentally efficient solutions
- identify logistic solutions for energy efficiency

- develop safe and efficient technologies for LNG bunkering and fuelled vessels
- assess safety issues
- coordinate with other initiatives and disseminate results

The results of parallel studies will be used. It will coordinate with the relevant ongoing LNG projects and the European Maritime Safety Agency

8.3.17 COSTA (2011-EU-21007-S)

The COSTA Action aims at developing framework conditions for the use of LNG for ships in the Mediterranean, Atlantic Ocean and Black Sea areas. It will result in preparing an LNG Masterplan for short sea shipping between the Mediterranean Sea and North Atlantic Ocean as well as the Deep Sea cruising in the North Atlantic Ocean towards the Azores and the Madeira Island. The feasibility study results will promote Motorways of the Sea sustainability, contributing to the common effort addressing climate change, in particular in view of the forthcoming requirements with respect to the implementation of the requirements of Annex VI of the MARPOL Convention.

The project will complement the results of the on-going LNG North Sea and Baltic project 2010-EU-21112-S. This will all increase the potential of Motorways of the Sea by lowering transport costs and reducing CO₂, NO_x and SO_x emissions, in conjunction with greening the transport corridors and using of LNG as an alternative to marine bunker. If COSTA's policy recommendations are implemented, it is expected that CO₂ emissions from shipping could drop by 25% in 2020 and by 50% in 2050. For the air pollutants the use of LNG would eliminate SO_x and reduce NO_x by 90%.

8.3.18 LNG in Baltic Sea Ports (2011-EU-21005-S)

The aim of the proposed action is to develop a harmonised approach towards LNG bunker filling infrastructure in the Baltic Sea region. By sharing knowledge between 7 Baltic partner ports (Aarhus, Helsingborg, Helsinki, Malmö-Copenhagen, Tallinn, Turku, Stockholm) from 4 countries and their stakeholders, a more standardised process for planning and constructing LNG infrastructure could be achieved.

The proposed action builds on previous activities and foresees pre-investment studies directly preparing for investments in LNG bunkering infrastructure in the ports. The actual infrastructure investments will be made at a later stage.

In addition, a stakeholder platform will be initiated to gather the key actors from the Baltic Sea but also from the North Sea around the same table and secure dissemination of the project process and results. The participating ports will build on existing knowledge in the field and will share their experience and findings. The practical outcome of this cooperation will be a guidebook that will function as a benchmark for other ports and stakeholders and for other regions in Europe.

The project is expected to contribute significantly to the implementation of the Baltic Sea Strategy (COM(2009)248) which underlines that the Baltic Sea region could turn into a model region for 'clean shipping' and a range of measures could be aimed at reducing the environmental impact of maritime transport.

8.3.19 LNG infrastructure of filling stations and deployment in ships (2010-EU-21112-S)

The project is a strategic study taking the form of a pilot action in relation to the implementation of the Motorways of the Sea. It emerged as a project under the European Union Strategy for the Baltic Sea Region but its geographical scope has been expanded with the North Sea and the English Channel because of the trading between these areas and because of the Emission Control Area provisions setting more restrictive limits on sulphur and nitrogen oxides emissions from 2010, 2015 and 2016.

The project consists of feasibility studies on LNG (Liquefied Natural Gas) filling station infrastructure as well as a full scale pilot action. The study part of project will create a strategic decision paper relevant for central stakeholders, aiming at developing framework conditions for the use of LNG for ships and will validate a full scale pilot action aiming at demonstrating the LNG option as competitive fuel from shipping and an LNG supply chain points of view. The project further aims at harvesting positive environmental and climate effects.

The aim of the full scale pilot project is to modify the design of two new build vessels to a LNG propulsion system, a more environmentally friendly system, which is in line with the requirements of the revised Annex VI of MARPOL 73/78 adopted by The International Maritime Organization (IMO) in 2008.

This will be the first time that a Ro/Pax vessel of this size (1350 lane metre for trucks) will be built with LNG propulsion. The pilot action will be followed by an extensive measurement programme for validating its environmental and climate benefits as LNG contains no sulphur and emits 90% less NOx than traditional fuels and CO2 can be reduced by up to 25%.

The lessons learnt from the project are expected to have a wider benefit also for other geographical areas within the EU, demonstrating that LNG propulsion is achievable for a larger ro-pax vessel and could play an important role in further implementation of LNG in similar vessels throughout Europe on short international routes, as well as for domestic traffic.

9 ASSESSMENT OF THE NEED OF LNG POINTS OUTSIDE THE TEN-T CORE NETWORK

The EU is promoting the use of LNG in shipping as bunker fuel also in ports outside the Ten-T Core Network: *"...The initial focus on the core network 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..."*.

The assessment of the need can be developed in two main phases:

- Port classification on the base of the existing bunkering services;
- Cost-Benefit Approach to evaluate the need and the sustainability of the intervention.

The first step consists in selecting ports where the bunkering services are already working or are already planned. These ports can be ranked on the basis of the volume of fuel provided. This approach allows for the definition of a priority list for the subsequent performance of the assessment.

The second step consists in conducting a feasibility study including a cost-benefit assessment in order to evaluate the need to stall LNG facilities in these ports.

It is recommended that feasibility studies for the core network ports (as described in the previous section) involve a system level assessment that takes into account the potential synergies from plans encompassing multiple ports (e.g. sharing of some infrastructures and barge vessels).

From a technical point of view, Phase 2 can be developed with the same approach used for the core ports:

- Demand analysis: evaluation of the quantity of LNG needed for bunkering;
- Selection of the better logistics solution and cost estimation (CAPEX and OPEX);
- Evaluation of the revenues;
- Evaluation of the social (including environment) costs and benefit.

More details about these are provided in the previous chapter. Also examples of good practices are reported in the previous chapter.

10 ASSESSMENT OF THE NEED TO INSTALL SHORE SIDE ELECTRICITY IN PORTS

Shore Side Electricity (SSE) is a process that enables a ship to turn off its engines while berthed and to plug into an onshore power source. The ship's power load is transferred to the shore-side power supply without a disruption of on-board services. This process allows emergency equipment, refrigeration, cooling, heating, lighting, and other equipment to receive continuous electrical power while the ship loads or unloads its cargo.

Shore Side Electricity has been adopted in some ports around the world as a measure belonging to the "Green Ports" concept. This concept refers to a set of several measures aimed at achieving sustainability at ports, considering that a port not only meets all the environmental standards in its daily operations, but also has a long-term plan for continuously improving its environmental performance.

Auxiliary engines run by ships in ports generate SO_x, NO_x, CO₂ and particle discharge as well as noise and vibration. These pollutants cause negative health and environmental impacts on the surrounding communities. Independent studies have found that shore side electricity generates many environmental and social benefits, by reducing emissions from vessels docked in ports, so it can be considered a relevant part of "green ports".

The first investments in Shore Side Electricity have been done 25 years ago and a lot of studies about SSE technology have been done in the last 10 years.

The development of SSE is based on the proven environmental benefits it provides in port cities.

This technology is already available in 97 berths worldwide:

- 24 in US
- 64 in Europe
- 9 in Asia

and other port cities are currently planning to install shore power supply systems.

If all seagoing and inland ships in European harbours would use SSE by 2020 for covering their energy demand at berth, they would consume 3,543 GWh annually, which is approximately 0.1% to the electricity consumption in Europe as a whole in 2012. Furthermore, SSE offers the potential to mitigate 800,000 tons of CO₂ emissions⁴⁴

10.1 BACKGROUND AND DEVELOPMENT

Shore Side Electricity is a shipping industry term that first came into use when all ships were equipped with coal-fired engines. When a ship tied up at port there was no necessity to continue to feed the fire and the iron engines would literally cool down, eventually going completely cold.

Historically, ships were not submitted to emission controls and regulation and diesel engines were their main source of power. However, in the last 10 years

⁴⁴ Ecofys, Potential for Shore Side Electricity in Europe, 2014

the growing attention to sustainability at ports and protection of marine environment began to gain in importance.

As a consequence, new environmental regulations were set-up by the International Maritime Organization (IMO) at a global level. In 2004, the MARPOL Convention (73/78) placed limits on sulphur oxide (requiring use of <4.5% sulphur fuel by 2010, and its target is to reduce world maritime sulphur output to <0.5% by 2020) and nitrogen oxide emissions from ship exhaust and prohibited deliberate emissions of ozone depleting substances. In 2005, EU Directive 2005/33/EC limited the amount of sulphur to 0.1% in all marine fuel used while at berth for more than 2 hours in European ports after 2010. In 2006 a new environmental EU recommendation came into force: EU Recommendation 2006/339/ EG asked to Member States to promote shore-side electricity facilities. The EC recommendation also called for the development of harmonized international standards and provided guidance on costs and benefits of connecting ships to the electricity grid.

Then, Directive 2014/94/EU was adopted, which includes the aim to include shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports.

10.2 STATE OF THE ART

From a technical and operational viewpoint, shore side electricity is a technological system made by the following elements: electrical infrastructure at ports (engineered and integrated systems are required to fit all types of ports); electrical infrastructure on ships (retrofits or new builds); connection and control solutions to ensure personnel safety and seamless power transfer. In particular, a complete on-board system solution could include all power equipment necessary to connect the ship to a shore-side power point; all control equipment necessary to secure seamless automated power transfer of the ship load from the on-board power plant to the shore-side source and back. Furthermore, this integrated system needs to comply with new international standards including: IEC/ISO/IEEE 80005-1 Utility Connections in port - Part 1: High Voltage Shore Connection (HVSC) system.

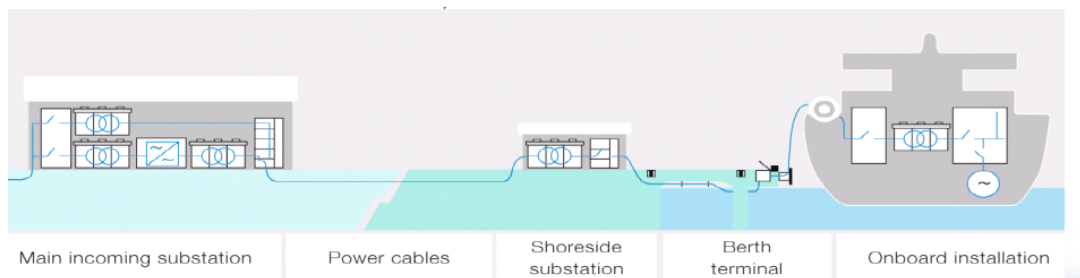


Figure 10.1: Example Shore Side Electricity Installation

Considering economic and financial aspects, it is important to underline that shore side electricity is most effective and convenient for those vessels that call frequently at the same port and operate on dedicated routes, and for those that consume huge amounts of power and emit high levels of air pollutants when berthed. Typical vessel typologies include: ferries, cruise ships, containerships and tankers.

The main benefits generated by the application of shore side electricity are social and environmental. Firstly, if this innovative technology is implemented properly, it can contribute to air quality improvement by strongly reducing the

emissions and disturbance of vessels locally, in the port. The use of shore side electricity could lead to a significant reduction in CO2 emissions. Indeed shore side electricity system, due to the higher efficiency and to the “limiting emissions facilities” in lower plants, enable the reduction of more than 30% of CO2 emissions and more than 95% of nitrogen oxygen and particulate matter. It has been demonstrated that, in 10 hours of stop of a cruise ship, its emissions drop from 72.2 to 50.1 tonnes of CO2, from 1.47 to 0.04 tonnes of nitrogen oxide and from 1.23 to 0.04 tonnes of sulphur oxide. This system also allows for the reduction of noise pollution. Other positive impacts are better on-board comfort while in port, green profiling for ship owners and customers, and also reduced lifecycle cost by reduced fuel consumption and maintenance cost.

10.3 STANDARDS

Shore side electricity can be said to consist of a set of mature technologies, reaching the standard status but the standards have been rather late and shore side electricity has evolved differently on ports and new ship constructions.

Below is a wrap up about the standardization status of Shore Side Electricity:

1. Seagoing vessels (cruise, ro-ro, ferry, tanker, bulk), requiring more than 1MVA of power are covered by standard released in 2012, IEC IEC/ISO/IEEE 80005-1 Utility Connections in port - Part 1. Depending on the type of vessels, it sets the voltages of the connection (6.6kV or 11kV) the maximum power need, number of cables, place of cables, type of cables and all the safety requirements. The main requirements are listed in the below tables:

Table 10.1: Standardization status of Shore Side Electricity

Vessel type	Shore connection nominal voltage	Shore connection maximum power need	Frequency	Number of MV cables to feed the vessel	Place of the cable management system	Shore connection earthing system
Roro, Ro-Pax, Cargo vessels	11kV accepted 6.6kV for waterborn transportation service	6.5MVA	50Hz or 60Hz	1	At berth	LRE with 335/200 Ohms NGR
Container vessels	6.6kV	7.5MVA	50Hz or 60Hz	2	On board	LRE with 335/200 Ohms NGR
LNG carriers and tankers	6.6kV	11MVA	50Hz or 60Hz	3	At berth	unearth
Cruise vessels	6.6kV and/or 11kV	20MVA	50Hz or 60Hz	4	At berth	LRE with 540 Ohms NGR

2. The standard for smaller vessels, requiring less than 1MVA of power, typically inland vessels, river cruises or OSV is not yet released but a Public Available Specification is available (IEC IEC/ISO/IEEE 80005-3). The final publication of this standard is planned for 2016.
3. All design, installation and tests of Shore Side Electricity system for seagoing vessels should be done according to the specification of the IEC/ISO/IEEE 80005-1 standard

10.4 ASSESSMENT OF ALTERNATIVE MARITIME POWER (SHORE SIDE ELECTRICITY) AND ITS IMPACT ON PORT MANAGEMENT AND OPERATIONS

Shore side electricity starts by port assessment studies including long term ship traffic and power forecasting infrastructure and investment return and fuel and electricity supply costs scenarios (see project TEFLES Technologies and Scenarios for Low Emissions Shipping).

Port specifications start from the feasibility studies, and are linked to the selection of the Onshore Power Supply (OPS) provider proposal.

Shipping lines and ports pioneering shore side electricity are included in the feasibility studies of the port and aim at compatibility with their other calling ports systems. Both ports and ship operators could face not only new investment costs but also retrofitting costs.

Ports start by piloting shore side electricity posts on a dock, for a specific ship type, (cruise, containership or ferry or RoPax), each with specific electricity consumption (supply capacity) and optimum voltage.

Then the main purpose of the assessment is to determine the following aspects about the shore side electricity facility in relation to the environmental benefits:

- a. Cost effectiveness analysis for shipping companies
- b. Cost analysis for ports
- c. Return on Investment
- d. Safety in port.

The assessment for the introduction of Shore Side Electricity in ports needs a cost-benefit analysis as required by the European Union for funding requests of calls under CEF. However, so far in all projects, SSE is resulted eligible to CEF fundings.

The economic analysis appraises the project's contribution to the economic welfare of the region or country. It is made on behalf of the whole of society instead of just the owners of the infrastructure, as in the financial analysis. The key concept is the use of accounting shadow prices, based on the social opportunity cost, instead of observed distorted prices.

There may be project costs and benefits for which market values are not available. For example, there might be impacts, such as environmental, social or health effects, without a market price but which are still significant in achieving the project's objective and thus need to be evaluated and included in the project appraisal.

When market values are not available, effects can be monetised through different techniques, in part depending on the nature of the effect considered. 'Money' valuation here has no financial implication. CBA "money" is just a convenient welfare metric and, in principle, any numeraire can be used just as well.

The standard approach suggested in the Guide for Cost Benefit Analysis on Investment Projects, consistent with international practice, is to move from financial to economic analysis, starting from the performance of the investment regardless of its financial sources. To do so, appropriate

conversion factors could be applied to each of the inflow or outflow items to create a new account which also includes social benefits and social costs.

The analysis is based on demand analysis, the number of ships and the global volume of movements in the port and future forecast.

Starting from data on dwell times, following the guidelines of the MEET methodology for estimating emission factors, pollutant emissions (nitrogen oxide NO_x, sulphur oxides SO_x, volatile organic compounds VOC, particulates PM, carbon monoxide CO) will be estimated as a basis for calculating externalities for the Cost-Benefit Analysis (CBA).

Based on a probabilistic analysis of the terminal occupation by ships (disposal of ship stalls on each quay) some operational scenarios will be defined.

Each scenario will be defined on the basis of an economic evaluation by means of a cost-benefit parametric analysis with the aim of providing the maximum financial results for assigned budgets.

From a comparison of the results of the cost-benefit analysis and an estimate of possible investment costs, it will be noticed that the scenario providing coverage of both financial and economic investment includes the minimum number of electrified stalls and ships journeys reorganization.

A sensitivity analysis of the CBA is recommended, in order to evaluate the variation of indicators according to reference conditions variation.

10.5 BARRIERS TO THE INCREASE OF INSTALLATION AND USE OF SHORE SIDE ELECTRICITY

The first case of successful implementation of shore side electricity can be found in the US state of Alaska about twenty years ago. The success here is mainly due to an economic factor: the cost of energy. In contrast to the price of fuel, quite consistent worldwide, the price of electricity can vary a lot accordingly to local circumstances. In Alaska the energy cost is lower than in Europe due to the huge availability of energy sources.

Therefore, the cost of electric energy represents a first barrier to the spread of shore side electricity in Europe. However, shore side electricity could represent a cheaper solution in certain cases if compared with vessels switching to marine distillate (MDO) while in port as required by many local regulations (MDO burns cleaner than bunker fuel, but it is about twice as expensive).

Another barrier can be found in the shore side electricity infrastructure at marine terminals. They require extra electrical capacity, conduits, and the "plug" infrastructure that will accept power cables from a vessel. A large container ship usually requires approximately 1,600 kilowatts (kW) of power while at berth, but the power requirements can differ substantially, depending on the size of the vessel and the number of refrigerated containers on board. Port electrical infrastructure equipped for shore side electricity costs more than a conventional terminal, and it represents an investment that not all ports can afford. A possible solution to incentivise ports to invest in this new technology could be the use of emission reduction credits: they could help offset this expense and provide short term incentives.

A further barrier, in past, was represented by some technical problems concerning the lack of standardisation. Those issues are covered within the 80005 standard, released since 2012. Connectors and cables are internationally standardized since 2012.

There are other legal implications to outsourcing primary power source.

A possible barrier to the spread of Shore Side Electricity systems may derive from the adoption of innovative engines and innovative fuelling systems such as the LNG propelled ships. But SSE and LNG must be regarded as complementary, in fact, LNG enables to reduce emissions of vessels sailing, while SSE intent to cut emissions of vessels berthing in ports, where the shipping emissions are especially harmful. The vessels of the future is likely to combine both SSE and LNG.

Finally a barrier can derive from ship owners, in fact they have to find it convenient as investment. A recommendation to Member States could be to stimulate ship owner demand through implementation of incentives which will help ship owners to have a return on investment. Example of incentives, already in place in several countries, can be: detaxation of electricity supplied to vessels (i.e Germany, Sweden) reduction of port fees for vessels using SSE (i.e Spain) and funding for ship retrofit (i.e France).

10.6 GOOD PRACTICES

Several ports around the world have already implemented shore-to-ship power The following table illustrates the developments of SSE installations in Europe ports⁴⁵.

Table 10.2: Ports using SSE

Year of introduction	Port name	Country	Capacity (MW)	Frequency (Hz)	Voltage (kV)	Ship types making use of SSE
1985	Stockholm	Sweden	2.5	50	6.9	ROPAX
2000-2010	Gothenburg	Sweden	1.25-2.5	50 & 60	6.6 & 11	RoRo, ROPAX
2000	Zeebrugge	Belgium	1.25	50	6.6	RoRo
2006	Kemi	Finland		50	6.6	ROPAX
2006	Kotka	Finland		50	6.6	ROPAX
2006	Oulu	Finland		50	6.6	ROPAX
2008	Antwerp	Belgium	0.8	50 & 60	6.6	container
2008	Lübeck	Germany	2.2	50	6	ROPAX
2010	Verkö, Karlskrona	Sweden	2.5	50		cruise
2011	Oslo	Norway	4.5	50	11	cruise
2012	Rotterdam	Netherlands	2.8	60	11	ROPAX
2012	Ystad	Sweden	6.25-10	50 & 60	11	cruise
2013	Trelleborg	Sweden	0-3.2	50	10.5	
2015	Hamburg	Germany	12	50 & 60	6.6 & 11	cruise
On going	Genoa	Italy				container

In the following paragraphs are some best practices of some European ports (Stockholm, Göteborg, Lübeck, Hamburg, and Genoa).

⁴⁵ WPCI website

10.6.1 Port of Stockholm

In 1985, Port of Stockholm (Sweden) inaugurated their first shore-side power supply facility for connection of bigger vessels. The connection is located in Stadsgården and connects ships that are operating to Aland Island - Viking Cinderella and Birger Jarl. These ships are connected with a low voltage connection, 400 V/50 Hz. To be able to deliver sufficient amount of power to the vessels (2.5 MW), 9 cables need to be connected before the electricity generators on board the vessel are shutdown.

During spring 2006 another shore-to ship low voltage connection, 690 V/50 Hz, was inaugurated to Tallink passenger ferries - Victoria I and Romantika - at Freeport terminal in Port of Stockholm. The power is distributed via a transformer substation on the quay.

10.6.2 Port of Göteborg

The first step for shore side power supply in Port of Göteborg (Sweden) was taken in 1989. The port converted a terminal to service Stena Lines passenger ferries to Kiel with a low-voltage, 400 V, shore side power supply system. This service is run by the two combined passenger and Ro/Ro ferries Stena Scandinavica and Stena Germanica.

10.6.3 Port of Lübeck

In 2008, Port of Lübeck (Germany) successfully installed a shore-side electric supply system. The system grid at the port is 10 kV. A transformer rated 2.5 MVA is installed in a concrete substation on the harbour site for separating the harbour grid and the ship grid electrically and to lower the voltage to 6 kV. Another component of the shore-side connection is a smaller cabinet with a 6 kV/50 Hz outlet enabling power to be obtained from the berth via a cable supplied by the ship. After connection, an automation system installed on-shore can automatically initiate the start-up of the shore side power supply system. The auxiliary engines of the on-board power supply can then be shut down.

10.6.4 Port of Hamburg

The Hamburg Port Authority, with the project "Tackling the environmental impact of shipping: Pilot implementation of a shore-side electricity supply for ships with increased energy demand (market innovation)" (2012-DE-92052-S), funded by the European Community, undertakes an action combining a study with a pilot deployment aiming at supplying and testing a pioneering, innovative shore side power supply system for ships with high energy requirements.

Instead of using the polluting on-board power supply system, the vessels will be connected to the on-shore power grid in order to enable energy-efficient and environmentally friendly power generation during the time spent at port, thus considerably reducing the emission of greenhouse gases. The accompanying study will develop good practice guidelines as well as a checklist based on the pilot case that aim to be spread at European level, whilst the pilot implementation itself will provide proof of technical feasibility at this scale of energy demand.

10.6.5 Port of Genoa

The Port Authority of Genoa, with European Community funding, involved the realization of the shore side power supply in the Voltri port basin that will allow commercial ships to connect to electricity supply from shore while moored at the quay.

Currently in the whole port area the onshore power supply for ships is not available, thus the installation set-up will be the first of this kind to be realized and operating in the port.

The objective of the system is to ensure the full operation of the moored ship without the use of its on-board energy power stations in order to reduce pollution and the noise level of ship operations and improve the liveability of the port community and citizens. It will still be possible for vessels to use the on-board power stations as a reserve against disruptions of the ground energy supply system.

The project will be able to provide for onshore electricity two commercial ships at the same time at the voltage of 6.6 kV and a frequency of 60 Hz.

11 ASSESSMENT OF THE NEED TO INSTALL ELECTRICITY SUPPLY INFRASTRUCTURE FOR STATIONARY AIRPLANES IN AIRPORTS

11.1 BACKGROUND AND DEFINITION

Every airplane whether in the air, or on the ground – needs power of 115 V at 400 Hz and oxygen supplies for its safe operations and the control of the airplane. During taxiing, the electricity is generated by on-board equipment that provides energy/power for functions other than propulsion, i.e. the **auxiliary power unit (APU)** located at the rear of the airplane. When parked, the APU can be used to power the plane during passenger boarding, disembarking, cleaning, engine start etc. and especially to power the plane's air-conditioning. However, this involves high levels of Green House Gases (GHG) emissions (e.g. 550 l/h of kerosene are required for B 747-400) and causes a noise level of some 80 decibels (dB) at the airfield apron, with the APU's efficiency range estimated to be between 10 and 14 %.

The installation of **electricity supply at airports for use by stationary airplanes** is one key operational opportunity for terminals to minimize fuel consumption and the resulting noise and CO₂ emissions.

11.2 TYPES OF ALTERNATIVE INFRASTRUCTURE FOR ELECTRICAL SUPPLY

There are alternative methods to supply power and air conditioning to stationary airplanes (other than APU):

- **Fixed Electrical Ground Power (FEGP)** drawing power from the airport's electrical grid and powering the airplane air conditioning system. Since power at most airports operates on either 50 or 60 Hz, frequency converters are required to change this to the 400 Hz required for airplane operation. This can be installed in two ways:
 - on the bottom of a passenger bridge - bridge mounted devices are attached to the passenger embarkation/disembarkation bridges and electrically controlled to dispense the 400 Hz cable. After operations, the device will electrically rewind the cable back onto its cable reel, or
 - on a fixed stand on the tarmac near the parked airplane's nose that can be in-and above-ground.
- **Pre-conditioned air systems (PCA)** using ground-based equipment. The electrically driven PCA systems do not require any liquid fuel, their noise level is 70 dB, and their efficiency is up to 50 % (for central systems in terms of primary energy use). For the sake of comparison and according to the logarithmic scale, a noise level of 70 dB at the airfield apron instead of 80 dB corresponds to a 10-fold noise level reduction.

These APU-alternative types of infrastructure can be provided either as portable diesel-powered systems, point-of-use (POU) systems or centrally:⁴⁶

- Portable diesel-powered ground power units (GPUs) and air conditioning units can be mounted on the back of a truck or they can be trailer/cart mounted for greater mobility.

⁴⁶ http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_064.pdf

- Point of Use (POU) systems provide the primary infrastructure needed for the power/ heating, ventilation, and air conditioning (HVAC) capability at the use location.
- Central systems provide their primary function at a central location. For the PCA element, central systems are often integrated into the airport's overall HVAC system.

As each alternative system type can be used to satisfy the power and PCA load requirements for multiple airplane types, the choice of which alternative system to implement is based on various factors related to costs, infrastructure requirements, and operational considerations and there are number of international standards that can be employed in the selection of suppliers in order to ensure the efficiency of the installed infrastructure.⁴⁷

11.3 ASSESSMENT OF ALTERNATIVE INFRASTRUCTURE TYPES

The considerations for planning the implementation of an alternative system⁴⁸ can most broadly be categorised as:

- Implementation and operation,
- Regulations,
- Environmental,
- Costs, and
- Funding

While airport operators generally understand that implementation of alternative systems can result in reduced APU-related emissions and fuel consumption, there is little information regarding the relative benefits and costs associated with the primary types of alternative systems. For example, while POU have lower upfront costs compared to central systems for power and PCA, POUs operating and maintenance costs can be substantial over time- Furthermore, because size, layout, fleet makeup, and climatic conditions vary by airport, the same alternative system cannot be implemented at all airports. There is no one-size-fits-all solution—alternative system specifications must be tailored to the conditions at each individual airport.

To properly compare these systems on a cost basis, life-cycle cost assessments should be conducted taking into account varying ranges of numbers of gates expected to be serviced by the alternative systems and the

⁴⁷ Non-exhaustive list: ISO 6858 - Aircraft ground support electrical supplies; BS 2G 219 - General requirements for ground support equipment; SAE ARP 5015 - Ground Equipment 400HZ ground power performance requirements; DFS 400 - Specification for 400HZ aircraft power; MIL-STD-704 - Aircraft electrical power characteristics; EN2282 - Characteristics of aircraft electrical supplies; EN61439 - Low-Voltage switchgear and controlgear assemblies; EN61000-6-4 - Electromagnetic compatibility, Generic emission standard; EN61000-6-2 Generic immunity standard; EN12312-17 Aircraft ground support equipment, specific requirements; EN12312-20 - Specific requirements for electrical ground power units; EN1915 -1/-2 - Aircraft ground support equipment, general safety requirements; EN62040-1-1 General & safety requirement; EN61558-2-6 General & safety requirement; EN12312-20 Machinery; specific safety requirements

⁴⁸ The following discussion of the advantages and disadvantages of different types of APU-alternative infrastructure are based on Transportation research board (2012) Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems (ACRP Report 64), Available on http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_064.pdf

years of expected service. To conduct such assessments, the following variables need to be considered:

- Airplane types or categories expected to be serviced;
- Airplane/APU operations or number of Landing and Take Off (LTO) cycles;
- APU times in mode (TIM) values that the alternative systems will duplicate;
- Electric utility costs (both consumption and demand costs);
- Natural gas costs (i.e., cost of natural gas used by airport boilers); and
- Annual average and seasonal ambient conditions – e.g. percent of the year that temperatures are cold, neutral, and hot.

Life-cycle cost assessments should be completed keeping in mind the life spans for each type of alternative system. For example, POU systems have a life span of approximately 15 years and central systems are considered to have a life span of 20 years or more. POU PCA units are expected to have a life span of about 13 years, and POU ground power equipment is expected to have a life span of about 20 years. Through a fair system of fees, the airport can recover its investment and on-going operating and maintenance costs. The airlines benefit from the savings gained as a result of reduced fuel consumption and lower APU operating costs. Such infrastructure also addresses the risk of health related issues of ground service personnel caused by increased emissions by use of APU's.

Methodologies for quantifying fuel consumption and emissions and estimating costs for alternative systems are available in the US Transportation research board's 2012 Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems (ACRP Report 64).⁴⁹

Example with Zurich Airport⁵⁰

The required investments for 400Hz/PCA systems designed and implemented for Zurich Airport are approximately 1 million Swiss francs (CHF) per gate; the costs are about 45% for the 400 Hz systems and 55% for the PCA system.

The costs of service vary according to the services required and the handling agent providing the service. By way of information, the following table gives an overview of the service charges at Zurich Airport (as levied by the handling agent).

⁴⁹ Available on http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_064.pdf

⁵⁰ Zurich Airport (2013) Aircraft Ground Energy Systems at Zurich Airport

Aircraft Group	400 Hz Electricity (CHF/hour)	Pre-Conditioned Air (CHF/hour)
Size A: RJ70, RJ100, B737, F70, F100, MD80	36.-	75.-
Size B: A300, A310, A319/20/21, B757, B767	62.-	130.-
Size C: A330, A340, B747, B777, MD11	87.-	190.-

Charging Rules:

0-10 min.	no charge
11-70 min.	1.0 hour (=minimum charge)
71-100 min.	1.5 hours
101-131 min.	2.0 hours
131-160 min.	2.5 hours
etc.	

By way of comparison, APU operating costs are estimated as much higher, even without reflecting any potential CO2 compensation costs.

Aircraft Group	APU Fuel (kg/h) ¹	Fuel Costs (CHF/h) ²	Maint. Costs (CHF/h)	Total Costs (CHF/h)
Short haul aircraft	107	115.00	35.00	150.00
Long haul aircraft	240	255.00	85.00	340.00

¹ ICAO Doc 9889, Version 1, Table A1.4.6
² IATA, Basis April 2013 (1,100 USD/mt)

11.4 PROPOSED MEASURES FOR THE DEPLOYMENT AND USE OF ALTERNATIVE INFRASTRUCTURE

Increasing the deployment and use of electricity supply infrastructure for stationary airplanes can be achieved through a combination of measures taken at different levels in order to achieve emission reduction targets. The following sections outline such measures currently used within Europe and internationally.

11.4.1 Member States Policy Measures

At Member State level, **national policy frameworks** shall consider the need to install electricity supply at airports for use by stationary airplanes. Based on a mapping of the different categories of airports, their air traffic profile and the airport facilities currently available, action plans can be drawn together with the air transport industry to determine the optimal course of action and the optimal level of coordination, which could be national as well as regional.

Once the need for concrete policy action is established, regulatory bodies can set **regulatory guidelines** concerning APU use while airplane are stationary and provide financial incentives for the installation of such systems.

Inspiration for national actions plans can be found in the Aircraft on the Ground CO2 Reduction Programme (AGR) developed by BAA through the Sustainable Aviation coalition.⁵¹ The programme provides practical guidance to help airlines, air navigation service providers, ground handling companies and airport operators cut CO2 emissions from airplane movements on the ground and has already resulted in impressive savings:

⁵¹ Sustainable Aviation CO2 Road-Map 2012, Available on: <http://www.sustainableaviation.co.uk/wp-content/uploads/2015/09/SA-Carbon-Roadmap-full-report.pdf>

- An estimated 100,000 tonnes of CO₂ per year was saved at Heathrow compared to doing nothing from reduced engine taxiing as well as use of FEGP and PCA.
- Approximately 20% efficiency savings per movement for ground based airplane activity today, with potential to go higher in the future
- That translates to around 6 million tonnes CO₂ annually on a global basis (estimated by IATA).

The following table developed by the AGR programme presents a menu of pragmatic and effective “action steps” that Member States and airports can take, working with the wider aviation community to deliver CO₂ savings.

Module	No	Phase	Action Step	Responsible party/parties
APU	1	Measure	Collect comprehensive data on rates of current APU usage.	Airport
	2		Collect comprehensive data on the rates of FEGP and PCA availability.	Airport
	3	Plan, Assess and Deliver	Establish an FEGP performance standard and take steps to provide FEGP capable of adequately supporting power requirements of aircraft systems for all relevant aircraft types, and thus can effectively substitute (with Pre-Conditioned Air (PCA)) for APU use.	Airport
	4		Take steps to provide PCA capable of adequately meeting the requirements of all relevant aircraft types, and thus which can effectively substitute for APU use in terms of air conditioning requirements.	Airport
	5		Encourage the implementation of an adequate financial charging structure to encourage use of FEGP and PCA where practicable.	Airport
	6		Review and update local operating rules to minimise the permitted APU running times and develop a hierarchy for the use of energy sources with a view to promoting the use of FEGP and PCA.	Airport
	7		Encourage reduced APU usage by publishing the APU running restrictions in the Aeronautical Information Publication (AIP).	Airport
	8		Encourage airlines to revise and update airline standard operating procedures to ensure use of FEGP and PCA in preference to use of APUs wherever possible.	Airport/Airlines
	9		Examine opportunities for CDM to provide additional opportunities for reduced usage of APUs.	Airport/NATS
	10		Develop and run awareness and education programmes with airline/airport personnel on the benefits of reduced APU use and alternative systems available.	Airport/Airlines
	11		Monitor and review	Work with ground handlers and airport engineers to encourage the use of PCA and FEGP in line with best practice and to encourage continuous improvement in terms of operating and usage of the facility.

Figure 11.1: Action plan for Implementation

An additional step in the action plan can be the control of implementation of APU usage. For example, in 2013 the French air transport police (GTA) carries out controls on compliance with the regulation in force at Paris-Charles de Gaulle, Paris-Orly and Paris-Le Bourget and identified failures to comply are liable to sanctions from the French Airport pollution control authority (ACNUSA).

11.4.2 Airport Authorities and Operators

Airport authorities and operators are key factors for the deployment of alternative infrastructure and central to the facilitation of its use by airline operators. Typically, airports that have installed FEGP and PCAs set restrictions for the use of APUs. For example, Zurich Airport has laid down the following requirements:⁵²

AIP SWITZERLAND¹
LSZH AD 2.21

1.2 Auxiliary Power Units (APU)

1.2.1 Docking stands
Primarily, the stationary airport pneumatic and electrical service units shall be used. Alternatively, mobile units shall be used.

1.2.2 Other stands
For pneumatic and power supply of aircraft not parked at docking stands, mobile units shall be used.

1.2.3 APU shall only be started:

- to start engine, but no earlier than 5 minutes before off-block time
- if maintenance work on the aircraft makes it unavoidable; in that case the service period shall be kept as short as possible.
- if the stationary or mobile units are not available or unserviceable for specific aircraft types. In that case APU shall be started no earlier than at 60 minutes before off-block time (exemption: GA sector 1: no earlier than 30 minutes before off-block time) and kept in operation no more than 20 minutes after the on-block time.

In particular cases the airport authority may permit longer service periods.

In addition to providing alternative infrastructure, airports could ensure that ground based facilities are kept well maintained and serviceability rates are high, in order to establish confidence in their continuing availability.

Airports could also work with airplane operators and ground handling agents to ensure that airport terminal or ground based facilities are adequate, fit for purpose and well maintained and sufficient focussed training is provided to ensure that these facilities are used efficiently and safely.

11.4.3 Airline Operators

Airline operators also have a role to play in increasing the use of alternative infrastructure. Some airlines establish additional and company based procedures to limit the usage of APU, dependent on airplane type, actual take-off weight and characterisation of the airport (altitude, runway length, etc.). For example, one airline operating in and out of Zurich Airport has established the following procedures (properly reflecting the airport's regulations):

⁵² Zurich Airport (2013) Aircraft Ground Energy Systems at Zurich Airport

4. USE OF APU
- Use of APU restricted.
Use APU for ENG – start MAX 5 MIN before block off.
If GPU U/S: Start APU MAX 60 MIN before block off.
APU OPS MAX 20 MIN after block on.
For A320 taxi-in without APU approved.
 - ACFT on hard stands: switch off APU when GND Power Unit (GPU) connected.
 - Terminal A/B: Preconditioned air and electrical power avbl.
 - Energy saving:
The crew shall decide, depending on WX COND or technical requirements, whether air conditioning is required or not.
Generally, the air conditioning system should be switched off with AOT of APRX 10°C to 25°C. The air conditioning system should also be switched off after PSGR have disembarked or before leaving the ACFT.

Since the use of aviation jet fuel in APUs is expensive and inefficient, it is recommended that operators and ground handling agents follow the ground power **hierarchy** of using airport terminal, which, if followed, can save fuel, reduce significantly noise and GHG emissions. The following hierarchy shall not override the safety rules nor the control of the airplane at all times:

1. Airport Terminal, ground based facilities such as FEGP and PCA powered from the electrical grid, should always be used where provided.

2. When they are not available, mobile diesel-powered GPUs and air-conditioning units should be used as these provide a reduction in fuel, emissions and noise over APUs,

3. When FEGP, PCA or GPUs are not available, on-board APUs and associated generators and air bleeds from compressor (high pressure and temperature) should be used.

4. If none of the above is available, the main engine driven generators and air bleeds should be used as a last resort.

An example of the codification of such practices is the UK Industry Code of Practice for Reducing the Environmental Impacts of Ground Operations and Departing Aircraft,⁵³ which call on airport operators, flight operators and air traffic controllers to cooperate in order to reduce the use of APU.

In general, airline operators should ensure that their airplanes are kept in a configuration that requires the lowest power requirement when at the terminal.

11.5 GOOD PRACTICES

The availability of electricity supply for stationary airplanes is currently in place at many airports in Europe, but there is no overview of the exact number or characteristics of airports that provide FEGP/PCA.⁵⁴

Copenhagen Airport has been particularly adamant in decreasing the use of APUs,⁵⁵ due to the complex mixture of potential health damaging air pollution

⁵³ Available here: <http://www.sustainableaviation.co.uk/wp-content/uploads/2015/09/Departures-Code-of-Practice-June-2012.pdf>

⁵⁴ A 2011 database listing airports with APU restricting measures is available from airplane producer Boeing: <http://www.boeing.com/commercial/noise/list.page>

⁵⁵ <https://www.cph.dk/en/about-cph/csr/Environment-and-energy/noise/apu1/>

it generates for airports staff.⁵⁶ The National Board of Industrial Injuries in Denmark has now recognised several cancer cases most likely caused by air pollution in airports. Copenhagen Airport's APU policy has been to limit the use of APUs to five minutes after the airplane is on block and five minutes before the airplane is expected off-block.

The following key actions have been accomplished to reduce the pollution with ultrafine particles in Copenhagen Airport:

- Investment in electrical GPUs.
- Requirements for green engines.⁵⁷
- Increased share of newer (green) engines.
- Retrofitted particulate filters on snow removal vehicles.
 - Installed batteries and heaters in vehicles to avoid idle running.
 - Campaigns to ensure the APU regulations are fulfilled.
 - Campaigns to ensure engines are turned off when possible.
 - Rules for airplane taxiing to/from take-off on one engine.
 - On-going measurements to monitor and improve air quality.
 - An action plan with deadlines and clear division of responsibilities.

All violations are reported to the safety inspector and investigated further to ensure compliance with the rules.

⁵⁶ The Danish Ecocouncil (2012) Air pollution in airports: Ultrafine particles, solutions and successful cooperation. ISBN: 978-87-92044-37-2

⁵⁷ Copenhagen Airport and companies operating in the airport have agreed on binding targets for green engines. A still rising percentage of the engines in the airport needs to be green engines. The purpose is to increase the replacement of old engines used for handling and loading with new and less polluting engines. The definition of green engines is revised as less polluting engines are developed.

12 SUGGESTED TEMPLATE FOR NATIONAL POLICY FRAMEWORKS

Appendix A contains a suggested template for drafting the National Policy Framework (NPF). This suggested template has been prepared taking into account the following aspects:

- the template could allow Member States to describe the approach followed to implement the Directive. According to this principle, a document is proposed in addition to a set of tables to be filled in with quantitative information;

The suggested template is divided into twelve chapters as reported in following table.

Table 12.1: Template for Member States

CHAPTER NR.	TITLE	SHORT DESCRIPTION
1	ASSESSMENT OF THE CURRENT STATE OF ALTERNATIVE FUELS IN THE TRANSPORT SECTOR	In this chapter, information about the total number of AFI could be provided. The chapter is organised in five paragraphs, respectively addressed to: <ul style="list-style-type: none"> • use of alternative fuel in transport • information about number of AFV • electricity • natural gas • hydrogen
2	NATIONAL TARGETS AND OBJECTIVES	This chapter has the same structure of the previous one, but contains information about targets and objectives for the years 2020, 2025 and 2030
3	MEASURES NECESSARY TO ENSURE NATIONAL TARGETS AND OBJECTIVES ARE REACHED	This chapter could contain the measures for public sector actors proposed/adopted to promote the use of AFs in general. The measures can be classified in: <ul style="list-style-type: none"> • Legal measures • Policy measures
4	MEASURES THAT CAN PROMOTE THE DEPLOYMENT OF PRIVATE ALTERNATIVE FUELS INFRASTRUCTURE	This chapter could contain the measures for private sector actors proposed/adopted to promote the use of AFs in general. Also in this case the measures can be classified in: <ul style="list-style-type: none"> • Legal measures • Policy measures
5	MEASURES THAT CAN PROMOTE THE DEPLOYMENT OF ALTERNATIVE FUELS INFRASTRUCTURE IN PUBLIC TRANSPORT SERVICES	The proposed measures to promote the use of AFs in public transport will be listed in this chapter
6	INSTALLATION IN DENSELY POPULATED AREAS AND ALONG EXTRA-URBAN NETWORK	This chapter is organized in four paragraphs. In the first one, after the description of the criteria used to define the urban/suburban areas and other densely populated areas , it is requested to provide information of these areas (number of inhabitants, number of AFI). The other paragraphs contain information regarding: TEN-T Core and Comprehensive Network and other extra-urban roads

CHAPTER NR.	TITLE	SHORT DESCRIPTION
7	REFUELLING POINTS FOR LNG AT MARITIME AND INLAND PORTS INSIDE TEN-T CORE NETWORK	This chapter includes data about the refuelling points in maritime and inland ports inside TEN-T Core Network.
8	ASSESSMENT OF THE NEED FOR LNG REFUELLING POINTS AT MARITIME AND INLAND PORTS OUTSIDE THE TEN-T CORE NETWORK	This chapter includes data about the refuelling points in maritime and inland ports outside TEN-T Core Network.
9	SHORE SIDE ELECTRICITY IN MARITIME AND INLAND PORTS	This chapter includes data about the shore side electricity installation in inland ports (specifying the terminal and if the whole port is equipped to provide this service). We propose to classify the ports as INSIDE or OUTSIDE the TEN-T Core Network
10	ELECTRICITY SUPPLY AT AIRPORTS	This chapter includes data about the airports that can supply electricity for stationary airplanes. We propose to classify the airports as INSIDE or OUTSIDE the TEN-T Core Network
11	INFRASTRUCTURE FOR OTHER ALTERNATIVE FUELS	Complementary to the information provided in Chapter 1, each Member State can add further details (e.g. number of refuelling points) regarding other alternative fuels (e.g. Biofuels, LPG, Methanol, etc.)