Supporting mechanisms for the development of biomethane in transport

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Content

Abbreviations

AT	Austria
bioNG	biogas/biomethane
CH	Switzerland
CNG	Compressed Natural Gas
DE	Germany
EBA	European Biogas Association
EC	European Commission
EU	European Union
FQD	Fuel Quality Directive
FR	France
GHG	Green House Gas
GRDF	Gaz Réseau Distribution France
HDV	Heavy Duty Vehicle
ILUC	indirect land use change
IT	Italy
LCV	light commercial vehicles
LDV	Light Duty Vehicle
LNG	Liquefied Natural Gas
Mtoe	Million tonne of oil equivalent
MW	MegaWatt (10^6 Watt)
NG	natural gas
NL	the Netherlands
PJ	PetaJoule (10^{15} Joule)
PM	particulate matter
RED	Renewable Energy Directive
SE	Sweden
TTW	Tank-To-Wheel
TWh	TeraWatthour (10^{12} Watthour)
WTW	Well-To-Wheel
UK	United Kingdom

Summary

Objective of this study

GRDF would like to gain insight into the supporting measures applied in European countries to support biomethane in transport. Therefore the main objective of this study is to provide insight in the support measures taken at the national level by various European countries and to identify the most promising measures and to assess their transferability to the French context. The focus of this study is on the use of biomethane in the transport sector (vehicle uptake, fuel uptake and filling infrastructure developments), but biogas production and upgrading of biogas to biomethane is also taken into account, as they constitute necessary first steps in the supply chain.

Research approach/methodology

Seven countries (Austria, Germany, Italy, the Netherlands, Sweden, Switzerland and the United Kingdom) are chosen as case study countries, together with France. These countries have been selected, because of their high uptake of (natural) gas vehicles, high share of biomethane in the natural gas share in transport, number of filling stations and strong biogas industries. Factsheets have been produced based on literature review in order to identify the most promising policy measures. Additional interviews have been held with French experts to assess the transferability of policy measures to the French context.

Current uptake of biomethane in the transport sector

Statistics show that the investigated eight countries cover almost the entire market of biogas production and biomethane in transport. Regarding biogas production, the case study countries, including France, represent 81% of EU biogas production and 99% of all the biomethane produced in the EU. The role of biomethane in transport is still very limited in most countries, especially in relation to total fuel sales (including diesel and petrol). Italy has a strong natural gas market for transport with a large share of natural gas filling stations (in % of all filling stations) and relatively high uptake of NG vehicles in the passenger car and truck fleet segments. Probably as a result of the focus on HDV (Heavy Duty Vehicles), the share of NG buses and trucks is also relatively high in France (in % of total HDV). In terms of fuel uptake, Sweden and Switzerland sell a relatively high portion of biomethane compared to natural gas sales in transport: in Sweden biomethane consumption in transport even exceeds natural gas consumption in transport.

Case study findings

In Table 1 the most common policy measures are listed including an indication of which countries these measures are applied in. This way, the differences between France and the other case studies countries become clear.
The measures in bold have been identified as the most promising measures to also be implemented in France.

Table 1 Overview of applied individual measures per aspect

		FR	AT	DE	IT	NL	SE	CH	UK
 Fuel uptake	Specific target for bioNG	X		X	X[1]				
	Lower fuel tax for NG compared to diesel and petrol	X	X	X	X	X	X	X	X
	Lower fuel tax for bioNG compared to NG		X [2]				X	X	
	BioNG included in the blending obligation			X	X	X			X
 Vehicle uptake	Specific target for vehicles running on NG	X	X						
	Vehicle tax exemption based on CO_2/low-carbon vehicles	X						X	X
	Company car taxation/tax reduction for environmental investments/tax measured aimed at commercial vehicles	X	X	X[3]		X	X		
	Subsidies for retrofitting/scrapping schemes		X		X				
	Climate investment grants for municipal vehicle fleets						X		
	Low-interest loans	This measure is applied in Egypt and was identified during the literature review.							
 Filling infrasturcture	Co-finance projects for the deployment of CNG stations and compatible vehicle fleets	X							
	Direct link to biogas plants		X						
	Demand for realisation of public infrastructure in public procurement				X				
	Simplification of procedures				X				
	Subsidy scheme for alternative fuel infrastructure					X			
	Obligation to offer at least one alternative fuel at filling stations						X		
	Research activities								X

Identification of most promising measures and assessment of their transferability to the French context

The transferability of the identified measures to the French context has been assessed as follows:

- Including biomethane in the blending obligation, as is for example the case in the Netherlands, does not seem to be feasible on the short term in France and within the current system, but seems to be important to create a level playing field between biofuels and biomethane and to make biomethane part of the decarbonisation strategy for transport. Extending the scope of the blending obligation might be included in any reforms on the medium term as part of the new post-2020 EU policy framework.
- Fuel tax differentiation, including lower taxes for bioNG compared to NG, a measure applied in Sweden and Switzerland, seem to be the most effective way to stimulate the uptake of biomethane in transport. Due to the shortage of green certificates and in order not to harm the natural gas market it is recommended to implement this gradually or at least to pre-emptively announce it before actual implementation.
- Providing low-interest loans for vehicles, as is the case in Egypt, seems to be a risk-free option that can be complementary to other measures. A pilot project could be started in an area with a high share of public accessible NG stations, to see whether this measure also works in France.

1 The target also includes biofuels, but Italy has a strong focus on bioNG.

2 Only in case where biomethane is consumed on-site.

3 Provisions have been changed at the end of 2016.

Because most filling stations are private, actions are required to reach a higher share of public accessible filling stations at the same time.
- Depending on the type and size of tenders, a requirement to build filling infrastructure in public procurement, as is the case in Italy, seems to be a good option. However, attention has to be paid to the amount of vehicles that will make use of this filling infrastructure and the location and distribution of filling stations in an area. Filling stations need to add value to the current system in place and therefore any extra station has to be integrated into a broader system.
- Establishing a direct link between filling stations and biogas plants as is the case in Austria might help to increase awareness and understanding among consumers and to increase the visibility and public awareness of biomethane in a municipality.
- The extent to which a system such as the Green Gas system in Göteborg would be helpful to overcome investment risks due to differences in development time between production and market demand ('chicken and egg' problems) remains undecided: it seems to be more helpful to realise a better market for green gas certificates and to increase the availability of these certificates.

Main conclusions and recommendations

Based on the outcomes of the case study and the assessment of the transferability to the French context the following recommendations have been identified:

- Allow the market of natural gas and biomethane in transport to grow (because it also took some years in other successful countries). This requires a long term, coherent and stable policy framework.
- Keep a specific eye on the development of NG and bioNG in transport in Sweden and Italy, since the policies and underlying strategy of these two countries seems to fit best to the French situation. One has to keep in mind that the policy measures in these countries form part of a broader long term strategy build also on national circumstances, on bioNG in transport (Sweden) and NG in transport (Italy).
- Integrate biomethane more in the decarbonisation strategy of the transport sector and create a level playing field between biofuels and biomethane; this could be achieved by, for example including biomethane in the blending obligation (when the current system will be reformed).
- Introduce measures gradually to allow companies to adjust and to take these changes into account in their investment decisions.
- Fuel differentiation between NG and biomethane can work as an enabler for other policy measures.
- Improve the system of guarantees of origin and green certificates, because the current availability of certificates is not sufficient for a higher demand in case additional policy incentives for the uptake of biomethane will be implemented.
- Strengthen the natural gas market further through low-interest loans for commercial vehicles.
- Maintain the focus on HDV.
- Make the link between biogas production and biomethane in transport more visible to the public.

1 Introduction

1.1 Background

Biogas is a very versatile form of bioenergy, as it can be produced from a range of feedstocks and valorized in various energy forms: for electricity production, heating and cooling, and in transport. The current biogas production level in the EU is 13.4 Mtoe[4] (155.8 TWh), of which 9.4% is produced by wastewater treatment plants, 21.6% is landfill biogas and the remainder, 69%, is biogas produced by anaerobic digestion of feedstock such as agricultural, industrial or household waste and energy crops. In comparison: total natural gas consumption was estimated to be 356.3 Mtoe (4143.8 TWh) net calorific value, according to 2015 estimates of Eurogas.

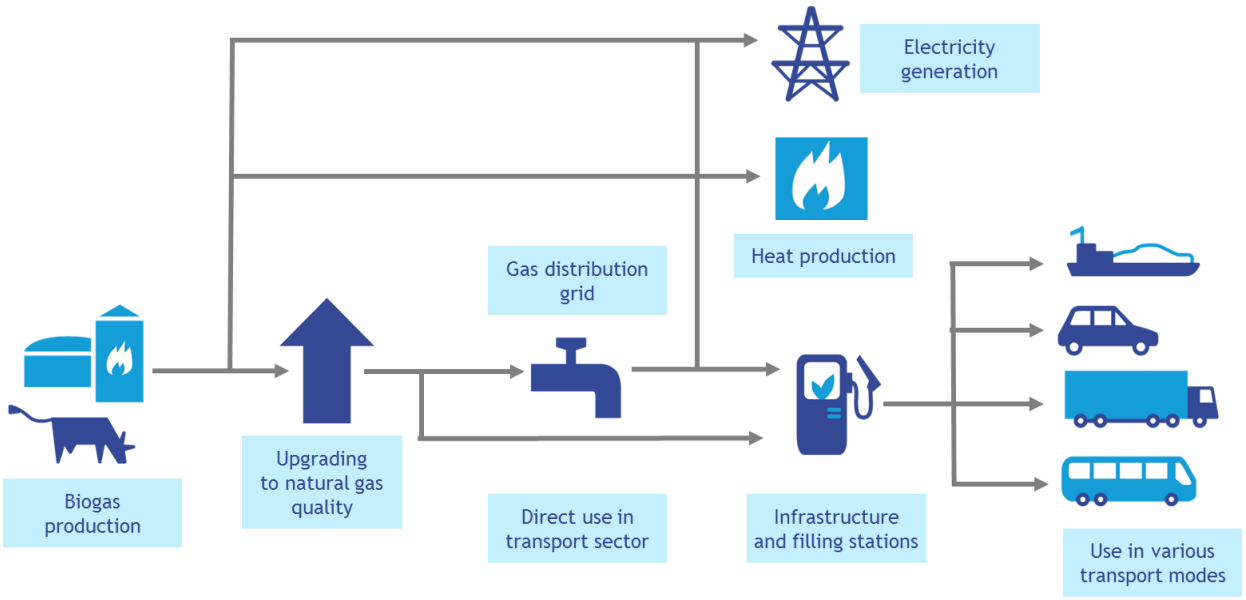
Biogas can contribute to the decarbonisation of various sectors, to an increasing share of renewable energy and to reaching energy security objectives.
Due to successful policies in various Member States, EU-wide biogas production increased rapidly in recent years. Germany, the UK and Italy alone are responsible for more than 77% of the EU's biogas production[2]. Since biogas has higher production costs than natural gas, the differences in biogas production between the European countries reflect differences in national energy strategies and subsequently differences in supporting measures for biogas production. As some of the existing policies were recently modified and incentives reduced, it is also expected that this level of growth will not be sustained in the coming years.

In relation to the transport sector, the Renewable Energy Directive (RED) (EC, 2009a) and the Fuel Quality Directive (FQD (EC, 2009b) are the main drivers on the EU level for the share of renewable energy in the transport sector. The RED obliges Member States to realise a 10% share of renewable energy in the final energy consumption of the transport sector by 2020.
The Fuel Quality Directive (FQD) obliges fuel suppliers to reduce the average GHG intensity of their fuels by 6% in 2020 compared to 2010 levels (Article 7a). Many Member States have introduced a blending obligation at the national level to ensure the realisation of both targets. To the present day this has mainly resulted in blending of liquid biofuels in conventional fuels, but biomethane, renewable electricity in electric vehicles and renewable hydrogen also count towards the 10% target.

Biomethane has the potential to reduce GHG emissions. The actual GHG reduction potential depends on the feedstocks, the mode of operation (of the biogas plant) and the utilisation pathway. In addition, biomethane, like natural gas, also reduces air polluting emissions, like particulate matter (PM) and NO_X.
The use of biomethane in transport requires incentives at different levels in the supply chain of biogas/biomethane. As depicted in Figure 1, the use of biomethane requires production of biogas, its upgrading to natural gas quality, distribution through the grid or direct filling on-site, sufficient refuelling infrastructure and vehicles that are engineered to run on natural gas/biomethane and are actually filling up their tanks with biomethane.

[4] 2013 (primary energy) data, EurObserv'ER barometer.

Figure 1 Supply chain of biomethane



1.2 Objective

GRDF would like to gain insight into the supporting measures applied in European countries and the transferability of these measures to the French context. Therefore the main objective of this study is to provide insight into the support measures taken at the national level by various European countries to stimulate the use of biomethane in the transport sector and to assess the transferability of successful measures to the French context.
This objective results in the following main research questions:

- What supporting measures are applied to stimulate the use of biomethane in relation to the 10% transport target of the Renewable Energy Directive?
- What measures can then be mirrored and applied to the French context?

1.3 Approach/methodology

This study consists of three tasks. In the first two tasks the current uptake of biomethane in the transport sector and the policy measures applied in the eight case study countries have been investigated by means of a literature review and additional requests for information where a gap was identified. Data has been gathered by the various country experts using a factsheet format developed for this purpose. Note that in some cases other countries were also taken into account (only when found during the literature review). At the end of Task 2 CE Delft analysed the factsheets in order to identify similarities and differences between the various countries and to identify future potential measures for the French context. In the third phase interviews were conducted with French experts to assess the transferability to the French context. Based on these findings final conclusions and policy recommendations have been formulated.

1.4 Scope

This study focuses on the national supporting mechanisms in place to stimulate biogas. This includes both financial measures, such as tax measures, as well as non-financial measures, such as quota to bring a certain amount of biomethane on the market.

Concerning the time horizon, this study will focus on the measures currently in place applied and planned measures (until 2020). Attention will also be paid to the recent developments in order to account for current shares of biomethane in transport.

The geographical scope is limited to the EU policy framework (and Switzerland) and the analysis of supporting measures at the national level will be limited to France plus the seven selected case study countries:

- Austria;
- Germany;
- Italy;
- the Netherlands;
- Switzerland;
- Sweden;
- United Kingdom.

Other applications of renewable energy in transport and the use of biogas in other sectors, like the electricity or the heat sector, will only be described as a way to put the use of biomethane into perspective. Biomethane is linked to natural gas developments as well, because natural gas vehicles are both able to run on natural gas and biomethane and because the natural gas grid can be used for the distribution of biomethane as well.

1.5 Outline of this report

This report consists of the following sections:

- **Section 2** describes the use of biomethane within the context of the 10% target of the RED and provides an overview of the current levels reached in the various countries, investigated in this study. This includes both production and consumption. Shares of NG filling stations and vehicle uptake in various market segments are also presented.
- **Section 3** provides an overall comparison of the findings as outcome of the various case studies. In this way insight will be gained in the differences and similarities in the supporting measures applied at the national level.
- **Section 4** aims to assess the transferability of supporting measures effectively applied in other countries to the French context.
- Finally, **Section 5** presents the main conclusions and policy recommendations to French public authorities.
- Annex A contains more details about the European legislative framework briefly outlined in the introduction.
- The factsheets for each case study country can be found in the Annexes, which are included in a separate document. These factsheets contain e.g. the detailed information about the policy measures of each country.

2 Biomethane use within the case study countries

2.1 Introduction

As already stated in the introduction section, the use of biomethane is, because of the additional cost, almost completely driven by policy. This section aims to provide a short overview of the most important EU policies that can be seen as the main drivers behind biomethane consumption.

Secondly, this section aims to provide insight into current biomethane use in the European Union (and Switzerland) and in the case study countries in particular. From these overviews it will become clear why these countries have been selected as case studies. In the next section, current biomethane uptake in the transport sector as described in this section will be linked to the various policy strategies and individual policy measures. By doing so conclusions on successfulness of policy strategies can be drawn. For example, this might lead to the conclusion that the countries with a high uptake of biomethane in transport all have applied one specific policy measure.

This section is based on data sources as the Biogas report of the European Biogas Association (EBA) published at the end of 2016, EurObserv'ER and Eurostat. These last two sources do, however, not contain data on 2015 or 2016. The reports covering this information have not been published yet.

2.2 Policy context

The main EU policies providing an incentive for the uptake of biomethane in the transport sector are:

Renewable Energy Directive

The Renewable Energy Directive (EC, 2009a) of 2009 sets a binding target for renewable energy in general (20% by 2020), but also includes a specific target for the transport sector of at least 10% of renewable energy in transport by 2020. In order to count towards this target, biofuels and bioliquids have to meet the sustainability criteria as laid down in this Directive and amended by the ILUC Directive (EU, 2015b). Advanced biofuels produced from waste and residues are allowed to count double towards the transport target. Although renewable electricity and hydrogen can also count towards the transport target, the target will be mainly fulfilled by the consumption of biofuels. Many Member States have implemented a national blending obligation for fuel suppliers to reach compliance.

Fuel Quality Directive

The Fuel Quality Directive (EC, 2009b), also of 2009, aims to reduce the average GHG emissions intensity of fuels along the supply side. Therefore the average GHG intensity should be 6% lower by 2020 compared to 2010 levels. This can also be realised by upstream reduction measures, but until now the FQD has mainly resulted in the uptake of biofuels. The same blending obligation as for the RED can be used to fulfil the FQD target, although the FQD does not allow double counting.

ILUC Directive

As result of impacts of indirect land use change, land based biofuels can result in indirect GHG emissions. If these indirect emissions are taken into account as well, biofuels might even cause an increase in GHG emissions rather than a reduction. In order to limit the share of land based biofuels **the ILUC Directive** (EU, 2015b) has introduced a cap on land based fuels and has introduced a sub-target for the most advanced biofuels. Because biogas is mostly produced from waste and residues, biogas does not fall under this cap (except biogas from energy crops).

Directive on the deployment of alternative fuels infrastructure

The **Clean Power for Transport Directive** (or the Directive on the deployment of alternative fuels infrastructure (AFI), (EC, 2014) focuses on the build-up of an EU-wide network of recharging and refuelling points, interoperability (by means of standards and technical specifications) and clear consumer information to raise awareness. The Directive contains minimum requirements to be implemented through Member States' national policy frameworks. This includes recharging and refuelling infrastructure for electric vehicles, natural gas (LNG and CNG) and hydrogen.

Clean Vehicle Directive

The Clean Vehicle Directive (EC, 2009c), or the Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles aims at the broad market introduction of environmental-friendly vehicles on the market. This includes that the energy and environmental impacts over the entire lifetime of a vehicle should be taken into account in all purchases of road transport vehicles covered by the Directives regulating public procurement and the public service Regulation. These impacts can be monetised for inclusion in the purchasing decision and requires the use of specific calculation rules for calculating the lifetime costs and are laid down in the Directive.[5]

EU Winter Package

Above mentioned Directives are all part of the current policy framework. However, many new investments will be based on the post-2020 policy framework. At the end of November 2016 the European Commission has published the so-called Winter Package which includes a proposal for a new Renewable Energy Directive. The proposal includes a target for renewable energy in transport of 6.8% for all types of renewable energy in transport, including advanced biofuels, biogas, renewable electricity etc. by 2030, abolition of the double counting provision, further strengthening of the cap on land based biofuels and an increasing sub-target for advanced biofuels.

More detailed information on the policy framework can be found in Annex A.

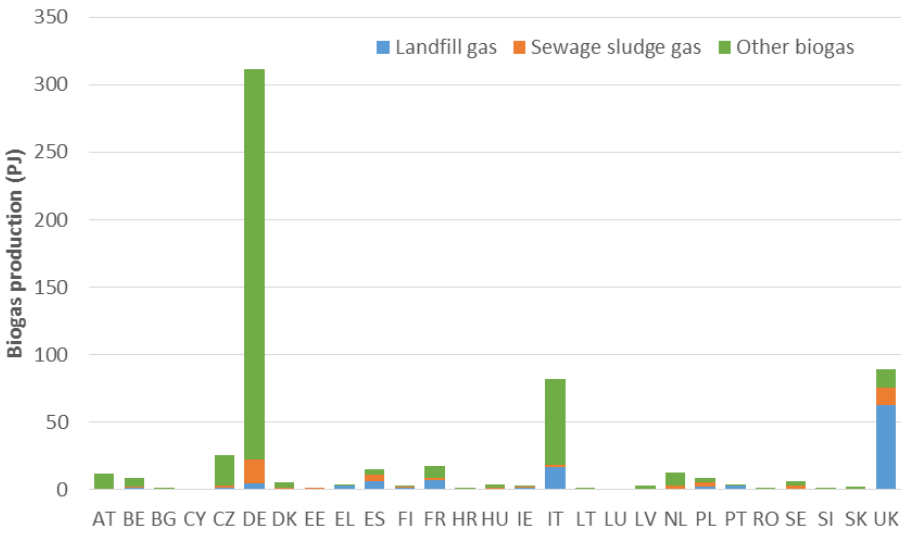
2.3 Biogas production

Total biogas production

Biomethane is produced by upgrading biogas to required gas quality for injection into the gas grid or use as Bio-NGV (BioCNG or BioLNG). The total biogas production in the EU is 625 PJ, based on the most recent data of 2014 from Eurostat (622 PJ according to EurObserv'ER). This is about 172.8 TWh. It accounted for 7.6% of the total primary energy production from renewable energy sources in 2014. Germany produces by far the largest amount of biogas, followed by Italy and the UK; France produced 17.6 PJ biogas in total, which is about 4.9 TWh.

5 www.ec.europa.eu/transport/themes/urban/vehicles/directive_en

Figure 2 Biogas production per EU member state in 2014 (PJ)



Source: Graph from (CE Delft, DLO and Eclareon, 2016), data from (EurObserv'ER, 2015).

Number of biogas plants

The number of biogas plants and yearly biogas production in the case study countries and total EU28 is given in Table 2. In France the number of biogas plants was 717 in 2015, 19 plants less compared to 2014 (EBA, 2016). In terms of biogas plants and biogas production over 2015 the case study countries represent 88% of all biogas plants and 86% of total EU biogas production.

Table 2 Number of biogas plants in 2015

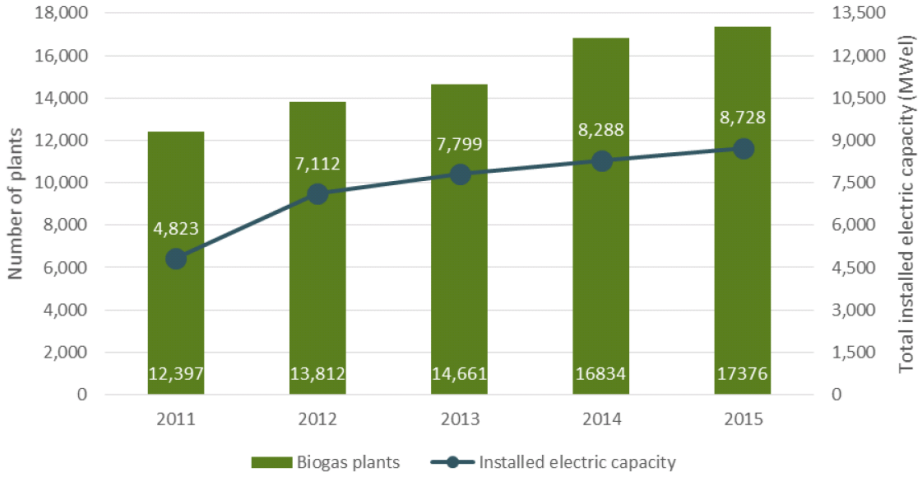
	Biogas plants #	Biogas production GWh/year
Austria	444	1,584
France	717	5,079
Germany	10,846	61,500
Italy	1,555	26,556
Sweden	282	3,843
Switzerland	638	1,909
the Netherlands	268	1,044
United Kingdom	523	17,791
Total case studies	**15,426**	**119,306**
Share presented by case studies	88%	81%
Total	**17,376**	**138,340**

Source: (EBA, 2016).

Installed capacity

The installed capacity in the EU almost doubled in five years time (2010-2015) from 4,823 MW_{el} to 8,728 MW_{el}, as is depicted in Figure 3 (EBA, 2016).

Figure 3 **Development of the number of biogas plants and installed electric capacities in the EU**



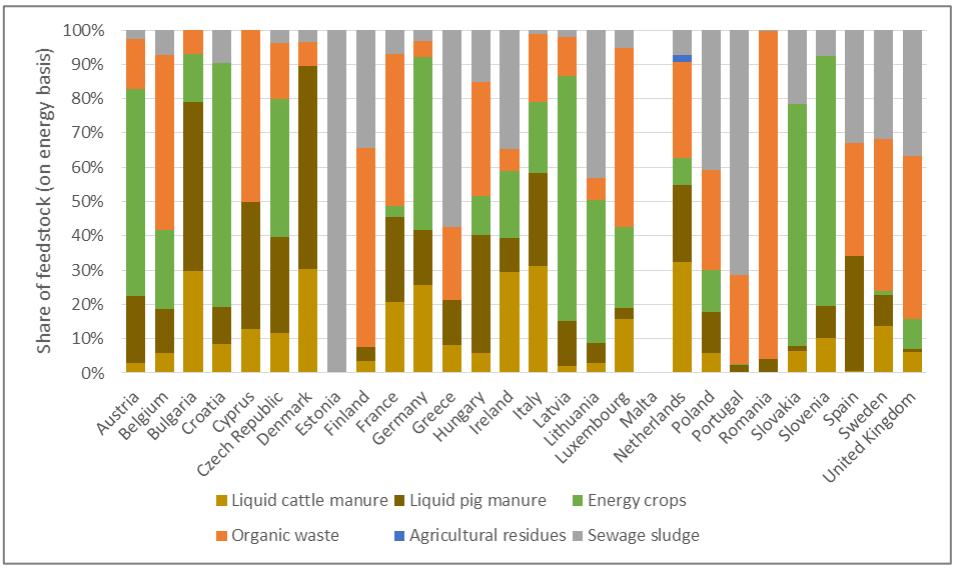
Source: (EBA, 2016).

Feedstocks used

Figure 4 shows the result of an analysis of the feedstocks used for the production of biogas in 2014 by CE Delft, DLO and Eclareon (CE Delft, DLO and Eclareon, 2016). Energy crops (mainly maize) was the main feedstock, used for about half of the biogas production (318 PJ/88.3 TWh), followed by landfill (114 PJ/31.7 TWh), organic waste (including municipal waste) (86 PJ/23.9 TWh), sewage sludge (57 PJ/15.8 TWh) and manure (46 PJ/12.8 TWh). However, expressed in terms of mass, manure contributes about 43%, since the biogas/energy yield of manure is relatively low (CE Delft, DLO and Eclareon, 2016).

Compared to the other case study countries France has a relative low share of biogas produced from energy crops, while Austria and Germany have a relatively high share. The latter is less sustainable as result of the indirect emissions, which are the result of the consumption of energy crops.
In the Netherlands and Italy about 50-60% of biogas is produced from manure. About 80% of biogas is produced from sewage sludge and organic waste in Sweden and the United Kingdom.

Figure 4 Share of feedstock use for biogas (on energy basis), estimates[6]



Source: Graph from (CE Delft, DLO and Eclareon, 2016).

2.4 Biomethane production

The total production of biomethane in Europe was 12.03 TWh (EBA, 2016). According to the same report: 'Germany, Sweden and the UK are leading the way in terms both of the number of facilities and infrastructure for biomethane use. In the UK, Germany, Switzerland, Austria and France nearly all plants are connected to the national gas grids. This was made possible by policies and support schemes that are in place for both producers and consumers'.

Biomethane plants are sites where biogas is produced and subsequently upgraded to biomethane on-site. The number of biomethane plants in the case study countries are listed in Table 3 and this table shows that the case study countries almost completely cover all the biomethane plants: only 9% of biomethane plants are located outside the case study countries. Note that these biomethane plants cover biomethane production for various uses and not only for injection into the grid.

[6] EurObserv'ER data stated only landfill gas and sewage sludge for Estonia, while EBA data stated also other feedstock use.

Table 3 **Number of biomethane plants (2015)**

Country	#
Austria	13
France	20
Germany	185
Italy	6
Sweden	61
Switzerland	35
The Netherlands	21
United Kingdom	80
Total case studies	**421**
Share presented by case studies	91%
Total	**459**

Source: (EBA, 2016).

On average 12% of the biogas is used to produce biomethane: the other 88% is used to generate electricity or heat. The case studies represent 99% of all produced biomethane and 88% of all electricity generated from biogas and 91% heat used. Note that there are substantial differences between the various countries: in Sweden 74% of all biogas is dedicated to biomethane production. In the Netherlands and Switzerland 26% and respectively 19% of biogas is used to produce biomethane, while this is only 2% in France.

Table 4 **Produced biomethane compared to generated electricity and generated heat (GWh/yr), in 2014**

	Electricity generated	Heat used	Biomethane produced annually	Share of produced biomethane in total
Austria	560	310	82	9%
France	2,738	2,190	85	2%
Germany	31,890	18,069	8,771	15%
Italy	9,368	14,052	n.a.	n.a.
The Netherlands	1,148	1,863	704	19%
Sweden	62	387	1,257	74%
Switzerland	316	443	271	26%
United Kingdom	7,280	n.a.	722	9%
Total	60,644	40,804	12,027	
Total case studies	53,362	37,313	11,892	
Share presented by case studies	88%	91%	99%	

Source: (EBA, 2016).

2.5 Natural gas and biomethane consumption

If we look specifically at biomethane consumption, data on biomethane is very limited and for most countries no volumes are reported at all. This implies that the biomethane consumption in transport is still very limited and might also imply that the data collection and reporting has not developed into a mature system yet. The data that has been collected on natural gas and biomethane consumption are depicted in Table 5.

Table 5 Fuel uptake

	Natural gas consumption	Biomethane consumption	Total energy consumption in transport	% of natural gas in total energy consumption	% of biogas in total natural gas (NG + biomethane)
	GWh	GWh	GWh	%	%
France	1,163	n.a.	56,9870	0.2%	n.a.
Austria	5,554	6	101,483	5.5%	0.1%
Germany	2,300	460	738,121	0.3%	16.7%
Italy	10,025	0.3	466,200	2,2%	0%
Netherlands	417	46	161,831	0.3%	9.9%
Sweden	457	1131	362,890	0.1%	71.2%
Switzerland	386	134	84,800	0.5%	25.8%
UK	n.a.	28	594,677	n.a,	n.a.

According to EBA (2015) slightly more biomethane ended up in the transport sector in 2014 compared to 2013 levels: 11.75% compared to 10% in 2013. This is mainly the result of biomethane consumption in Sweden (78% of all biomethane is consumed in the transport sector), Switzerland (33%) and Germany (3%). Besides the case studies, in Finland also 43% of biomethane is consumed in transport, but the production has been assessed to be too small to add it as a case study.

2.6 Natural gas vehicle uptake

The uptake of vehicles is very limited compared to the size of overall fleets. Although this share is very limited, a strong growth (sometimes 4-5 times higher than five years ago) has occurred in our case studies (except in Germany, where the sales in new NGV has dropped in 2015 compared to 2014. In some countries the share of bi-fuelled vehicles is far higher than the share of natural gas vehicles.

Italy has by far the highest number of NG passenger cars: the 837,470 passenger cars represent a share of over 2% of all passenger cars. Of all the case study countries Italy also has a large share of NG trucks, but France has an even higher share with 2.63%. Almost 30% of all buses in France also run on natural gas.
With almost 17% a considerable amount of buses in Sweden are running on natural gas as well. Overall the uptake of natural gas in the bus fleets seems to be more successful compared to passenger cars and trucks. No information on vehicle statistics could be found for the United Kingdom. Note that the data presented in Table 6 is compiled using various data sources for the most recent year available. References can be found in the factsheet report.

Table 6 Share of NG vehicles in vehicle market segments

	AT	CH	DE	FR	IT	NL	SE	UK
Number of NG passenger cars	5,087	11,278	80,300	2,549	837,470	7,452	42,675	20
Total number of passenger cars	4,750,000	4,500,000	45,071,209	32,325,000	37,332,024	8,100,864	4,669,069	3,181,300
% of passenger cars	**0.1%**	**0.3%**	**0.2%**	**0.01%**	**2.2%**	**0.1%**	**0.9%**	**0.0%**
Number of NG buses	485	173	1,422	2,172	3,668	674	2,357	37
Total number of buses	9,679	6,779	78,345	7,344	97,910	9,833	14,144	169,000
% of buses	**5.0%**	**2.6%**	**1.8%**	**29.6%**	**3.8%**	**6.9%**	**16.7%**	**0.0%**
Number of NG trucks	2,086	129	15,523	364	82,530	623	8,079	621
Total number of trucks	427,515	400,000	2,800,780	13,828	4,460,389	157,562	596,214	4,411,000
% of trucks	**0.5%**	**0.03%**	**0.6%**	**2.6%**	**1.9%**	**0.4%**	**1.4%**	**0.0%**

2.7 Filling infrastructure developments

Regarding filling infrastructure developments there are large differences between the various countries. Italy also has, besides the largest share of NG passenger cars, the highest share of NG filling stations with almost 24% of all filling stations in Italy (including multi-use stations). Other countries, like Austria, Germany and Sweden all three have a share of about 6%. The other countries, Switzerland, France, the Netherlands and the United Kingdom all have lower shares.

Table 7 Share of NG filling stations in total filling stations

	NG filling stations	Total filling stations	%
AT	172	2,641	6.5%
CH	140	3,461	4.1%
DE	883	14,531	6.1%
FR	288	11,269	2.6%
IT	1,046	4,420	23.7%
NL	140	4,000	3.5%
SE	162	2,680	6.1%
UK	16	8,490	0.2%

2.8 Conclusions

Based on this section it can be concluded that a few countries are being responsible for most of the biomethane transport market in Europe. This is also summarised in Table 8 in which the shares covered by the case study countries are depicted for the indicators discussed in this section.

Table 8 Shares covered by case study countries for four indicators

Indicator	Share covered by case study countries
Biogas plants	88%
Biogas production	86%
Number of biomethane plants	91%
Biomethane production	99%
Biomethane consumed in transport	56%
Natural gas vehicles	68%
Filling stations	98%

In the next section the indicators discussed in this section will be linked to the policy strategies and individual policy measures in the countries. In this way conclusions can be drawn on the effectiveness of these policies.

3 Supporting measures at the national level

3.1 Introduction

Based on the previous section it can be concluded that the selected case studies together with France cover almost the entire biomethane and biogas market in the EU. There are, however, also large differences between countries in terms of vehicle uptake, share of natural gas filling stations and share of biomethane.

In this section we aim to analyse the policy strategy and individual measures in each case study country in order to provide insight in the link between policy incentives and biomethane uptake in transport.

Because of the focus on the transport sector, natural gas vehicle uptake, uptake of natural gas and biomethane and infrastructure developments are discussed in more detail than aspects related to biogas production and grid injection.

Before zooming in on the individual policy measures a short description of the overall strategy is presented per case study country. After that an overview of the measures applied is given followed by a description of the individual measures according to the following stages in the supply chain:

- developments in natural gas vehicle uptake;
- uptake of fuel;
- infrastructure and filling stations;
- link with biogas production and grid injection.

Detailed information per case study can be found in the factsheets in the Annexes. The Annexes also include all the references used, like strategic papers and regulatory documents.

3.2 Summary of policy strategy per case study country

The case study outcomes have shown that the uptake of biomethane in transport is mostly the result of broader policy strategies targeting more than one element. Therefore, we will start by giving a short summary for each case study country to describe the overall policy strategy. A graphic overview of the strategies is also provided.

France

The market for natural gas vehicles and filling stations is not seen as a mature market yet and the transition towards biomethane is yet to truly take place. The share of biomethane in the transport sector is expected to strongly increase in the next years. According to the French energy agency ADEME, bioNGV represents the best alternative for the use of biomethane production in the future. In this regard, the multi-annual energy programme (Ministère de l' Environment, 2016) established by the French government in October 2016, sets a consumption target for bioNGV of 0.7 TWh by 2018 and 2 TWh by 2023, in order to achieve 20% of all NGV consumed by 2023. Due to the focus on HDV

and the focus of policy on air quality in urban areas, France has a large share of NG buses in the national bus fleet and natural gas trucks. The share of passenger cars is quite low. An explanation for this is that there are less alternatives available for heavy duty vehicles to meet the requirements of environmental zones in urban centres. Heavy duty vehicles also have a higher need to meet the requirements of environmental zones, because their businesses depend on the access to these areas.

Austria

From all the case study countries, Austria shows a modest share on all indicators studied. This can be explained by the broader decarbonisation strategy applied by the country, which is not specifically targeted at biomethane, but includes all type of renewable options for the transport sector and even has a strong focus on e-mobility, as is the case in Germany. Austria has a tax exemption for natural gas in transport. Biomethane is exempted only in case refuelling occurs on the production site. No information has been found on support schemes for infrastructure, but Austria has some filling stations, of which at least 3 are directly linked to biogas plants.

Germany

The German strategy has shifted away from biomethane to electromobility, both for incentives to stimulate fuel, as well as for vehicles and infrastructure. Fuel tax exemptions have ceased or will be ceased in the short term. Due to the focus on e-mobility there are currently no substantial incentives or measures to stimulate the uptake of natural gas vehicles, because natural gas vehicles are no longer included within the support schemes for new low-emission vehicles. However, new incentives might be implemented in the coming years. Given the slow progress in reducing GHG emissions in the transport sector, the German Government is set to place an increasing emphasis on the use of natural gas and biogas as transportation fuels. To that end, the Ministry of Economy and Energy launched in September 2016 the Rounde Table Natural Gas Mobility (Runde Tisch Erdgasmobilität) composed of the representatives of the industry and the government. It declared the ambitious goal of reaching 4% of natural gas share in fuel consumption by 2020. The proportion of biomethane in natural gas for transportation is expected to be at 20%. In 2015, the share of natural gas (together with biomethane) in the final fuel consumption was only 0.38% (Initiative Erdgasmobilität, 2016).The Ministry for Economic Affairs and Energy also announced the plans to extend the tax benefits for CNG vehicles beyond 2018. The sources can be found in the Factsheet report.

Italy

Italy has already a long history in natural gas in transport. Although current biomethane consumption is negligible, the natural gas market is large and mature, including high share of natural gas vehicles in the passenger car fleet and a substantial role for natural gas in the HDV fleet. These large shares in the vehicle fleet are linked to a well-developed infrastructure network in which natural gas stations have a substantial share. This is in line with the fact that policy measures have been focused on vehicle and infrastructure measures and the large tax advantage of natural gas over diesel and petrol. The system of certificates (CICs) first needs to be further developed before biomethane can take off.

The Netherlands

The Netherlands show a modest growth in both natural gas and biomethane. In terms of vehicle fleet penetration the share of passenger cars and trucks is lower compared to most other case study countries. Only, the share of buses is above average. A subsidy scheme for alternative fuel filling stations has been in place, but no longer exists. Market actors behind the natural gas stations have committed themselves to realising a 100% share of biogas in natural gas by 2015. It is not clear to what extent this has been realized.

Sweden

Sweden is not characterized by the highest share of natural gas in transport, but by the large share of biomethane. The consumption of biomethane has exceeded the natural gas consumption in transport, which can be explained by the lower taxes for biomethane compared to natural gas. Because the tax exemptions apply to all fuels and all vehicle segments, both the share of NG passenger cars as well as the share of NG trucks are relatively high. Due its strong push for natural gas in public procurement by local governments a large share of the bus fleet also runs on natural gas.

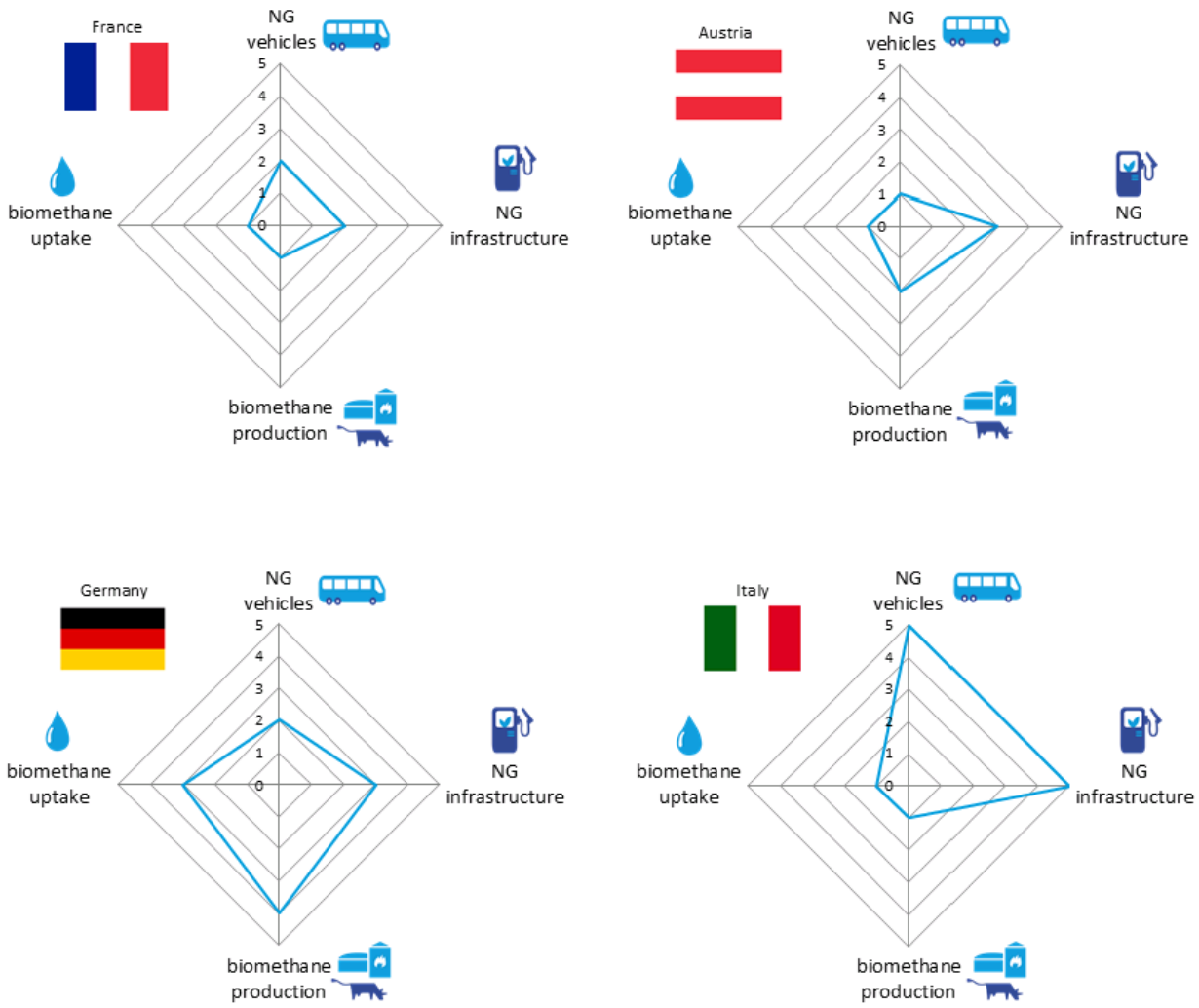
Switzerland

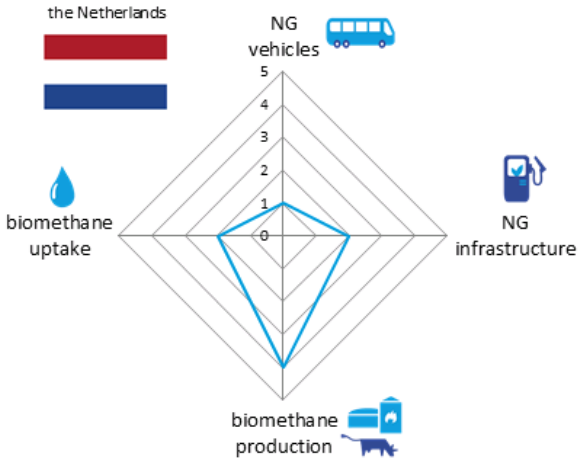
Within its strategy Switzerland, like Sweden, has specific measures to stimulate the uptake of biomethane in transport by lower fuel taxes (even an exemption in case the sustainability criteria are met) and biogas in transport is preferred over use in other sectors. This explains the higher uptake of biomethane in transport in Switzerland compared to other case studies. Vehicle measures are comparable to other case study countries by being targeted at low-emission vehicles in general.

United Kingdom

The United Kingdom has a relatively modest uptake of natural gas and biomethane. This can probably be explained by the broader scope of the policy measures, which are focused on low-emission fuels and alternative fuel cars without having specific incentives for natural gas and biomethane. Incentives are limited to use biomethane under the blending obligations and some research activities and pilot projects.

Figure 5 Schematic overview of national strategies and status of the market




the Netherlands
NG vehicles
5
4
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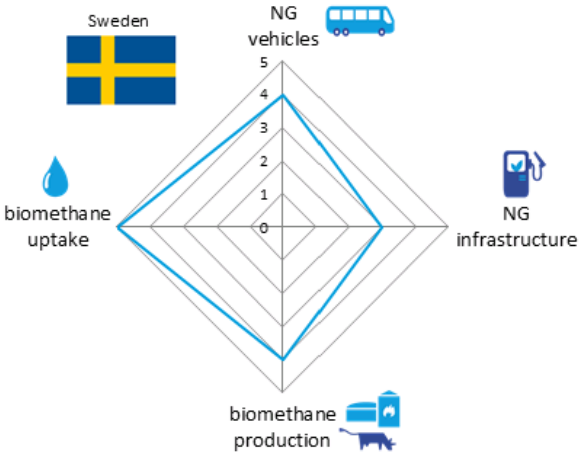
biomethane uptake
NG infrastructure
biomethane production


Sweden
NG vehicles
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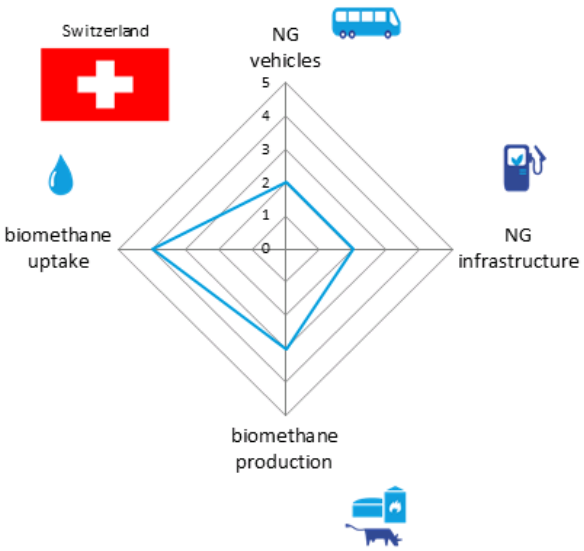
biomethane uptake
NG infrastructure
biomethane production


Switzerland
NG vehicles
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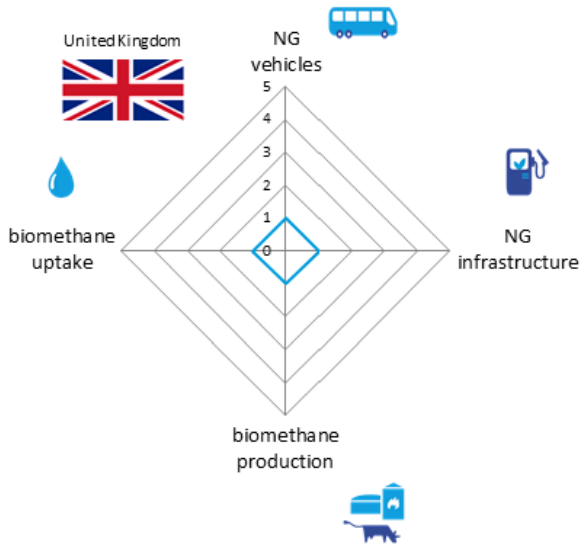
NG infrastructure
biomethane production


United Kingdom
NG vehicles
5
4
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0
biomethane uptake
NG infrastructure
biomethane production

3.3 Overall comparison of policy measures

The strategies as depicted in Figure 5 are the result of individual policy measures. Table 9 summarizes the main policy measures as identified in the case studies and shows in which countries these measures have been applied.

Table 9 Overview of applied individual measures per aspect

		FR	AT	DE	IT	NL	SE	CH	UK
 Fuel uptake	Specific target for bioNG	X		X	X[7]				
	Lower fuel tax for NG compared to diesel and petrol	X	X	X	X	X	X	X	X
	Lower fuel tax for bioNG compared to NG		X[8]				X	X	
	BioNG included in the blending obligation			X	X	X			X
 Vehicle uptake	Specific target for vehicles running on NG	X	X						
	Vehicle tax exemption based on CO_2/low-carbon vehicles	X						X	X
	Company car taxation/tax reduction for environmental investments/tax measured aimed at commercial vehicles	X	X	X[9]		X	X		
	Subsidies for retrofitting/scrapping schemes		X		X				
	Climate investment grants for municipal vehicle fleets						X		
	Low-interest loans	This measure is applied in Egypt and was identified during the literature review.							
 Filling infrasturcture	Co-finance projects for the deployment of CNG stations and compatible vehicle fleets	X							
	Direct link to biogas plants		X						
	Demand for realisation of public infrastructure in public procurement				X				
	Simplification of procedures				X				
	Subsidy scheme for alternative fuel infrastructure					X			
	Obligation to offer at least one alternative fuel at filling stations						X		
	Research activities								X

3.4 Fuel uptake

Below the policy measures aimed at the realisation of fuel uptake are listed for each country.

France

The act on energy transition published in 2015 has set an objective of 10% renewable energy in total energy consumption of transport by 2020 and at least 15% by 2030. The Multi-annual Energy Programme is the main implementing tool to be carried out by 2018 and 2023. The specific targets for bioNGV are 0.7 TWh by 2018 and 2 TWh by 2023. This shall cover 20% of total NGV consumed in 2023.

7 The target also includes biofuels, but Italy has a strong focus on bioNG.

8 Only in case where biomethane is consumed on-site.

9 Provisions have been changed at the end of 2016.

Austria	Biomethane and natural gas are subject to the same tax. It is forbidden to increase the tax for natural gas applied in transport. Biogas is exempt from tax when consumed on the spot.
Germany	The use of natural gas as a fuel offers a tax reduction until 2018. At the start this reduction was envisaged until 2024, but this period has been significantly reduced. The tax benefits for biomethane have ceased completely in 2015.
Italy	5.5% of total fuel consumption should come from biofuels and biomethane by 2016 through 'Certificates of Release for Consumption' (CIC) for biofuels. (Ministero dello Sviluppo Economico, 2014)). Although this target can also be met with other biofuels, Italy strongly focuses on the role of biomethane. No support for biomethane solely for the transport sector has been found. Natural gas fuel taxes are lower compared to petrol and diesel. The system for certificates called CICs can be used to fulfil the blending obligation with biomethane. This system has not yet resulted in significant shares of biomethane, partly because this system required further development.
The Netherlands	Biomethane is part of the blending obligation: biotickets (now changed into Renewable Fuel Units) could be traded and could help to realise the blending obligation. The double counting provision helps to improve the business case. Fuel tax on CNG is considerably lower compared to diesel and petrol. The Dutch market actors responsible for the natural gas stations have committed themselves to deliver solely 100% biomethane by 2015. It is not clear to what extent this has been realised.
Sweden	The price at different CNG filling stations might vary due to differences in distance between the production/upgrading plant and the filling station and on the availability of distribution options. Increased supply of LNG through LNG terminals might affect the price in the future. A network fee will also be included in the gas price. The CO_2 and energy tax which both determine the total fuel tax on biomethane result in a lower fuel tax for biomethane compared to natural gas, which is also lower compared to diesel and petrol. Tax exemptions for biogas have been approved by the European Commission.
Switzerland	Biogas is exempted from mineral oil tax if biogas meets the sustainability criteria. The tax on natural gas is also lower compared to petrol. Biogas has a tax advantage in transport compared to use in other sectors. Tax exemptions for biogas have been approved by the European Commission.
United Kingdom	Biomethane can play a role in the UK blending obligation, called the Renewable Transport Fuel Obligation (RTFO). Fuel taxes for natural gas are lower compared to diesel and petrol.

Overall conclusions

France is a frontrunner in setting targets for the consumption of bioNG (together with Italy and Germany). However, the differentiation in French fuel taxes does not favour biomethane. A lower fuel tax exists for natural gas, which is also common in the other countries. Even lower taxes for bioNG are only applied in Sweden, Switzerland and to some extent Austria. A majority of the countries also offers the opportunity to let biomethane count towards the blending obligation. However, this seems to have less impact on biomethane uptake compared to lower fuel taxes for bioNG according to the statistics as presented in the previous section.

As result of the differences between France and case study countries the following measures have been identified as most promising measures to incentives fuel uptake:

- the lower fuel tax for bioNG;
- including biomethane in the blending obligation.

3.5 Developments in natural gas vehicle uptake

Below the policy measures aimed at the realisation of natural gas vehicle uptake are listed for each country.

France

France is one of the few countries with a specific target for the share of natural gas vehicles: the **Multi-annual Energy Programme** strongly focuses on HDVs and aims to increase the share of HDVs on natural gas to 3% by 2023 and 10% by 2030. The amount of LDVs (light commercial vehicles and passenger cars) is expected to increase accordingly. Until recently the use of NGV in captive fleets was hindered by the legal and fiscal frameworks, but with the Multi-annual Energy Programme several supporting measures are foreseen for the coming years, like **a tax reduction since 1 January 2016 for vehicles over 3.5 tons**. This is valid for CNG, LNG, bioCNG and bioLNG and companies may deduct up to 40% of the original value from their taxable income from 1 January 2016 until 31 December 2017. This will cost 0.6 million euros for a total of 1,500 LCVs, which is very limited compared to total public budget, while this is a substantial measure to stimulate the uptake of (bio)methane by company cars.

ADEME also manages a national call for tenders within the framework of Future Investments Programme **'Demonstrators of the ecological and energy transition'**. The tender aims to co-finance projects for the deployment of CNG stations and compatible vehicle fleets. Final submission is scheduled for end of March 2017. The projects shall foresee at least 5 filling stations and at least 20 vehicles per station. Financial support could be up to € 300,000 (for 1 station and 20 vehicles) of which € 100,000 in grants and € 200,000 in repayable advances.

The project **Equilibre** financially supported the acquisition of natural gas vehicles, while at the same time supporting the realisation of filling stations.

The **Paris Town Hall** has granted bonuses for small companies to purchase electric or natural gas vehicles (LCVs, vans or HDVs).

Austria

Although the decarbonisation strategy of Austria mainly is targeted at e-mobility, the scheme **'klimaaktiv mobil'** of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW, ongoing) offers a total budget of 18.25 million euros to for example the environmental friendly refurbishment of vehicle fleets of companies. Grants could be € 500 or € 1,000 per vehicle and is limited to 50% of the eligible cost for enterprises and 30% of the eligible cost for local authorities. Projects can receive support in case at least a minimum share of 50% is deployed.

There has also been **a tender for cabs and car-sharing** on a federal level. The acquisition or retrofitting of up to ten passenger cars is promoted by offering a lump sum of € 1,500 for CNG vehicles. Various electric vehicles are also promoted. The premium is doubled in case green electricity is used. The tender closed on 15 October 2016.

Germany

Due to the focus on e-mobility there are currently no substantial incentives or measures to stimulate the uptake of natural gas vehicles.

The **KfW Environmental Programme** (KfW, 2017) supports environment protective measures in the commercial business sector, such as low-interest loans for the commercial purchase of new emission-low vehicles. While these new emission-low vehicles addressed also the one powered by biogas and biomethane, the provisions have been changed at the end of 2016. Currently, under the same programme, only hybrid, electrical cars and such vehicles fuelled by hydrogen are eligible.

Italy

Since 2009 Italy has been offering incentive for the conversion of vehicles on gasoline to LPG and CNG vehicles. The fund has been renamed several times to **ICBI incentive (Low Impact Fuel Initiative)**. For 2016 the fund was 1.8 million euros. Incentives are 500 euro for LPG vehicles and 650 euro for CNG vehicles. 150 euro is from the installer and the rest is dispensed by the ICBI.

In addition to this, subsidies have also been granted for the **acquisition of new low-emission vehicles** (enacted by Law 134/2012) between 2013-2015. Low-emission vehicles include CNG, LNG, higher blends of biofuels, hydrogen, hybrid and electric cars. The height of the subsidy is a share of the purchase price and depends on the period in which the vehicle is acquired and the CO_2 emissions in g/km. Total budget was 120 million euros. The old used vehicle should be supplied to a wrecker.

The Netherlands

In the Netherlands several local governments offer **vehicle subsidies to natural gas vehicles**. At the national level tax reduction is possible, because a NGV is seen as **environmental investment**. In 2014 there has also been a subsidy scheme for LNG trucks.

Sweden

Sweden applies **an income tax reduction for companies** for the use of natural gas vehicles (incl. biomethane), plug-in hybrid vehicles and electric cars. Although the maximum amount of funding has been reduced from 1,714 euro to 1,029 euro, the support scheme has been extended until the end of 2019.

Under the **climate investment grant for municipalities** local authorities can receive support for various biogas projects, including projects targeted at the municipal vehicle fleet. The main aim of all projects should be GHG reduction. In 2015 total granted aid was 12,8 million euro and another 61,6 million euro is available for 2016-2018.

In 2015 a draft of the **national biogas strategy** has been published by a group of main stakeholders in the biogas industry (gas user trade association Energigas Sverige, gas network owner/operator Swedegas, and the municipality of Region Skåne). In this draft the following measures are proposed, but this roadmap has not been implemented:

- a policy instrument to promote ‘environmental trucks’;
- a premium for electric buses has already been proposed by the government, the draft biogas strategy gas-powered buses should also be included in this premium, especially in relation to outlying areas where electric buses are not an option;
- a bonus-malus system for LDVs (based on gCO_2/km of a vehicle) should also cover gas-powered vehicles;
- maintaining the benefits for company cars (see first point).

Switzerland

More and more cantons grant a reduction on the motor vehicle tax for low-emission vehicles (such as electric, hybrid, fuel cell or energy efficient cars, but also for natural gas, biogas and hydrogen.

United Kingdom

In the UK vehicle tax rates for cars (registered after 2001) are based on fuel type and CO_2 emissions. The lower the emissions, the lower the tax. This also applies for alternative fuel cars.

Regarding HDVs, the Low-Carbon Truck Trial, funded by the Department for Transport, the Office for Low-Emission Vehicles and Innovate UK, budget was provided to invest prime procurement of low-emission heavy goods vehicles (HGV) technologies and supporting infrastructure. The aim is to raise awareness and to enable low-carbon vehicle producers to develop products in a new way. The publically-accessible gas refuelling infrastructure should help with the monitoring of data to emission reductions, fuel savings and operational benefits. By the end of 2014 317 trucks were on the road (91 additional dual fuel LNG and 51 CNG additional vehicles) compared to the end of 2013.

Overall conclusions

Overall, France is the only country with a specific target for the share of natural gas vehicles. France also strongly focuses on heavy duty vehicles.

The measures aimed to increase the vehicle uptake of natural gas vehicles at the national level are focused on low-carbon vehicles in general, which include natural gas vehicles, electric vehicles, but also vehicles on hydrogen or higher blend of biofuels. Because many measures are technology neutral, natural gas vehicles compete with for example electric vehicles. On the one hand, this competition can be seen as an unwanted effect, but on the other hand, policy measures formulated in a technology neutral way are more likely to result in cost-effective results, because the choices are left to the market.

We can distinguish the following measures:

- Reduction of motor tax levels (based on fuel type and or gCO_2/km).
- In several countries, motor tax levels are based on fuel type and gCO_2/km in line with the CO_2 regulation for light duty vehicles at the EU level. Because CO_2 regulations solely focus on the TTW emissions of vehicles no difference is made between natural gas and biomethane.
- Subsidies for the purchase of new vehicles or retrofitting of existing vehicles; at the national level or local level, specific vehicle types (for example LNG trucks).
- Income tax deduction for companies/environmental investment.
- Climate investment grant for municipalities in for example Sweden and France.
- Pilot project to gain more knowledge on natural gas trucks in the United Kingdom.
- Local measures: environmental zoning, benefits (dedicated lane, parking policy).
- Low-interest loans for commercial vehicles.

The policy measures aimed at vehicle uptake often do not include additional incentives to stimulate the uptake of biomethane by these vehicles.

Because France has mostly already applied the measures applied in other countries the following measure has been identified as most promising measure to incentives vehicle uptake:

– Low-interest loans for commercial vehicles.

This measure has been applied in Egypt and has been found during the literature study for the case study countries.

3.6 Infrastructure and filling stations

Below the policy measures aimed at the realisation of infrastructure and filling stations are listed for each country.

France

In France the majority of filling infrastructure is privately owned, while the filling infrastructure in other countries is mainly public. This can partly be explained by the larger role of HDVs: HDV fleets often have their own filling infrastructure, but according to the French Association for natural gas vehicles (AFGNV) a strategic network of filling infrastructure is required, requiring a total number of 150 public stations (40 LNG stations and 110 CNG stations) by 2020 in order to meet the national objectives of the government for HDV. This equals an investment of 150 million euros. In addition to this, the AFGNV also recommends to expand the network of stations for private vehicles, especially in urban areas. This will require 100 filling stations by 2020 and equals an investment of about 25 million euros. This equals 250,000 euros per filling station.

There have been several initiatives from the French Energy Agency (ADEME) at national and regional level to develop the filling infrastructure for NGVs. At the regional level the project, called 'Equilibre', has taken place in the Rhône-Alpes Region in 2011. This project has resulted in 25 NGV stations and 1,200 NGVs using this infrastructure in February 2015. The initiative 'GNVolontaires' aims to duplicate this project in other regions and cities across the country.

The partnership between GRDF and the city of Paris, the French Post and Ile de France Region launched in December 2014 has resulted in equipping the vehicle fleets of Paris and the post offices with CNG and the realisation of CNG filling infrastructure across the region.

Austria

In Austria there are four biomethane filling stations across the country which are open to the public and of which three are directly connected to biogas plants. In case of the fourth filling station the biomethane is fed into the natural gas grid and allocated to the filling stations. No information has been found on support schemes for infrastructure.

Germany

The number of filling stations offering biomethane in a blend or 100% is dropping due to the strong increase in charging infrastructure for electric vehicles. The German government puts all its efforts in the establishment of a strong e-mobility network. Therefore no supporting measures could be mentioned here.

A L-CNG filling station was operating in Munich between October 2001 and May 2007 as part of a pilot project.

Italy

According to CIB, the current natural gas fuelling stations should double to 2,000 by 2020 in order to keep up with the developments in NGVs. In Italy the supporting measures in place are aimed at the simplification of procedures for

new distribution plants, which also includes the procedures for self-delivery at guarded and non-guarded facilities. The development of natural gas infrastructure is also part of the DDL Competition, which makes that within public procurement the need/obligation to develop an alternative fuel network is confirmed, unless there are technical and economic obstacles that can be proven and which will be assessed by the authorities involved. The development needs of alternative fuel infrastructure are linked to the Clean Power for Transport Directive (EC, 2014).

The Netherlands

In the Netherlands over 50% of the public filling stations offering CNG offer 100% biomethane. Around 2009/2010 the Dutch government and local authorities have invested in a subsidy scheme for alternative fuel infrastructure, including biomethane, but also E85, B30, etc. The first tender was open for natural gas, biogas and bioethanol. The second tender only for biodiesel. Both rounds in total involved about 6 million euro. Currently, the support for filling infrastructure is part of the Dutch National Fuel Strategy which has been defined together with the involvement of stakeholders and which includes the overall strategy for the decarbonisation of the transport sector. There are also some private initiatives where energy companies work together with fuel suppliers to build a network of biomethane filling infrastructure, like Essent and Tamoil have done. The biomethane brought on the market is called OGO CNG.

Sweden

Sweden is the only country which has introduced an obligation to offer alternative fuels at filling stations. Already in 2005 the Pump Act (Pumplagen) was introduced and obligates larger filling stations to offer at least one renewable fuel. From a cost perspective offering bioethanol was more attractive, which makes that the Pump Act has mostly resulted in bioethanol rather than biomethane or natural gas.

Switzerland

There is no information available on support measures for filling infrastructure. The minimum share of biogas in the CNG/LNG gas mix is in every Swiss filling station 10%. The average share of biogas in 2015 was 24.5%.

United Kingdom

Besides the implementation of the Clean Power for Transport Directive (CPT/AFI), the UK is, together with the Netherlands, involved in a study on innovative natural gas solutions for road transport. Flexible modular natural gas filling stations have been designed using containers which can easily meet customers' needs. The project is partly financed by the European Commission and will be finished by December 2018.

Overall conclusions

Based on the information on the case study countries, the following conclusions can be drawn in relation to supporting measures to stimulate the realisation of infrastructure and filling stations:

Public versus private

Compared to other countries, France has a low number of public accessible filling stations, while the majority of filling stations in other countries is accessible to the public. From the interviews it can be concluded that a large share is private, because most filling stations have been dedicated to captive fleets, like garbage trucks. These trucks refuel at low speed overnight and therefore are not accessible to the public. However, more recently more attention is given to public accessible fillings stations by AFGNV, so there does not seem to be a need to address this issue by supporting measures.

Matching infrastructure to specific fleets

Based on the analysis, France seems to be frontrunner in projects aimed at providing investment support to projects realising filling stations and demand for infrastructure at the same time: these projects ensure that at least a number of vehicles will make use of the infrastructure. This could be seen as a bonus to the (older) subsidy scheme in the Netherlands where only the filling station was subsidized.

Obligation

Sweden has experienced that an obligation to offer at least one renewable fuel at a filling station will likely not result in strong increase of natural gas infrastructure, because other alternatives are less expensive. Italy has formulated a requirement to realise infrastructure in alternative fuels in (part of the) public procurement procedures.

Physical link between biogas plants and filling infrastructure

Austria has shown that filling infrastructure could also be directly linked to biogas plants. Although this ensures the consumption of biomethane, a physical connection might be in many options an expensive option compared to grid injection or administrative ways to account biomethane to the transport sector. There are, however, two arguments which might make this an interesting option for France:

- In the interviews several interviewees have mentioned the aspect of communication to the wider public: biomethane in transport is more difficult to understand compared to biofuels, where biofuels are actually blended with the fossil fuels. Aspects like the grid and green certificates make biomethane less transparent. A direct link to the production plant might help in raising awareness among the public.
- Another reason might be the long distance between biogas plants and the natural gas grid, which is sometimes also the case in France. This is more likely to happen in remote areas.

As a result of the differences between France and case study countries the following measures have been identified as most promising measures to incentives filling stations and infrastructure:

- demand for realisation of public infrastructure in public procurement;
- direct link to biogas plants.

3.7 Aspects related to biogas production

Due to the existence of green certificates biomethane can be delivered to the transport sector in an administrative way. This makes the realisation of the physical link with the biogas sector and distribution less important. However, information about these stages of the supply chains has been collected as well, including information on grid injection and distribution and biogas and biomethane production. The main findings are shortly discussed below.

France

Most producers prefer grid injection, because granted feed-in tariffs. 40% of the producers cannot benefit from these feed-in tariffs, because their production plants are too far away.

Austria

The national goals on biomethane deployment intend to foster its grid injection and the purchase at petrol stations. However, many of the biogas plants in Austria are not situated close to the natural gas distribution grid

making further extension necessary, but the impacts of and requirements for these extensions are mostly not part of the feasibility studies carried out. In general, a legal framework for the injection of biomethane and its deployment in the transport sector is missing in Austria.

Germany

No incentive to feed-in biomethane into the natural gas grid anymore. Since January 2016 no tax exemption for biomethane are granted anymore.

Italy

Interconnection costs are shared between grid operator and the biomethane producer. In 2015 incentive schemes have been accepted for the biomethane injected into the grid and guidelines for network operators. Incentives are focused on biomethane from biogas to produce electricity and heating in co-generation and CIC-certificates for biomethane as fuel for vehicles, but the value of these certificates have not been determined yet.

Until 31 October 2016 technical rules were not in place and there was also no value in place for CIC-certificates. Therefore no biomethane was injected to the grid. Only demonstration plants, but expectations for 2018 are 225 million m^3 biomethane as transport fuel.

The Netherlands

There is a lot of discussion on the future of the role of natural gas in the energy mix and therefore, also on the future of the gas infrastructure in the Netherlands, especially in relation to households/heating. Grid operators wait with allocating their investment accordingly. Biogas production itself has a strong place within the subsidy scheme (in the form of a tender system) for renewable energy in general. Biogas granted subsidy under this scheme cannot be used to meet the blending obligation to avoid double financing.

Sweden

Biomethane is injected into the gas grid only from a limited amount of biomethane plants. Hence, 75-80% of the produced biomethane is transported by trucks to the gas station. There are no support measures to stimulate the grind injection of biomethane in Sweden.

Switzerland

In Switzerland financial support is granted for investments in new biogas plants as well as for the feed-in and submission into the grid. The fund consist of approximatively 2,8 million euro provided by local utilities. Over a period of three years, producers of biogas and grid operators can receive funding depending on the quantity of their additional expenditure. Only biogas from waste and residues but not from food (or cultivated energy plants) are promoted.

United Kingdom

There is no (free) capacity to connect AD plants in the UK. There is also no incentive for grid operators to accept biomethane.

Overall conclusions

Several case study countries, including France, Germany and Austria face problems in relation to the distance between biogas plants and the natural gas grid. The various case studies show also that there are different ways to share connection costs.

Because biomethane upgrading might form a barrier between biogas production and the use of biomethane in transport. Therefore, a measure which stimulates the use of biomethane in transport without the need for biomethane upgrading facilities has been identified as promising measure. This concerns green gas credits in Sweden, where raw biogas is injected into a grid and attributed to the transport sector.

4 Transferability to the French context

4.1 Introduction

In the previous section various aspects of the case study countries have been compared. Based on a comparison between the situation in France and the policy framework in the case study countries, a number of measures have been identified, which currently do not seem to be implemented in France (or could be improved or applied on a larger scale). The identified measures are taken from the case studies or were identified through a literature review.

This section provides a description of the French context in Section 4.2. A description of the identified measures is given in Sections 4.3 and 4.4.

For the assessment of the transferability several interviews have been conducted with French experts. Interviews have been held by phone. The interviewees are listed in Table 10.

Table 10 Overview of interviews

Organisation	Name
GRDF	Mr. Almosni
FNTR	Mr. Daly
GRDF	Mr. De Singly
French Ministry of environment, energy and the sea	Mrs. Chini
French Ministry of environment, energy and the sea	Mr. Denieul

4.2 French context

The French context should by now become clearer from the data collected in the case study comparison. However, the interviews were useful in order to contextualise and to gain further insight into the current attitudes of various stakeholders regarding the support for biomethane in transport.

New window of opportunity

First of all, France faces a new window of opportunity due to the national elections in April/May 2017. This opens the possibility for a review of the policy framework for biomethane in transport which could last for at least five years. The target for NGV in transport is seen as a strong signal from the national government to the various actors, but requires more specific policy instruments in order to reach these objectives.

Driven by local air quality policies

Despite the national objectives natural gas in transport seems to be more driven by regional and local authorities and their aim to improve air quality than by the need to decarbonise the transport sector. Many cities have implemented local restrictions, like low-emissions zones, which require companies active in these areas to invest in less polluting vehicles. For heavy duty vehicles and commercial vehicles in general natural gas is currently the

most cost-effective option to comply with new requirements, from total cost of ownership (TCO) perspective, especially compared to electric vehicles. According to the interviewees, the impact on TCO is very important: supporting measures targeting the uptake of biomethane should only to a limited extent affect the TCO. Companies will only consider biomethane as an option in case their customers are willing to pay the additional price for biomethane. An important argument for this is how competitive French transport companies are in comparison with, in particular, Central European transport companies. These have a competitive advantage in terms of labour costs.

Room to invest and willingness to pay of customers

Based on the interviews it can be concluded that local authorities have more room to invest in biomethane projects than transport companies and agricultural businesses. Transport companies face strong competition from outside France and agricultural businesses are often too small to invest in biogas projects, while multiple actors getting involved in one project often complicate preliminary procedures which pre-empt the launch of these projects. Local authorities have more room to invest than transport companies and are able to accept a longer Return On Investment (ROI) than private companies; private companies only accept a return of investment of 4-5 years, while local authorities may accept payback times of ten years.

Market distortion

According to the interviewees, supporting measures that increase the total cost of ownership, like some measures aimed at the uptake of biomethane, might even harm the developments of natural gas in transport. This because the natural gas market, as niche market in the transport sector, is still assessed to be very fragile. The interviewees, therefore, recommend to first build a mature NGV market before focusing on biomethane.

Although transport companies will not benefit from an increase in the price of biomethane, biogas projects might benefit from a higher demand and this higher price for biomethane. This will likely improve the business case. The fact that price increases might impact the various aspects of the supply chain in a different way should be taken into account and considered at the time of decision making process. Impact assessment can help to investigate potential impacts. In addition to the fear for market distorting effects at the demand side, there is also a lack of green certificates to meet an increase in demand (according to the interviews much of the green certificates sold for fuel use are already needed by the Carréfour initiative). This means that any other initiative from a larger company might face a shortage of green certificates. For these two reasons, the realisation of cost reduction in biomethane production is a key priority and makes that many measures aimed at an increase of biomethane in transport are likely to be hindered by barriers at the supply side.

Two-step approach

Currently natural gas is one of the best ways to meet the air quality standards of environmental zones/low-emissions zones, especially for heavy duty vehicles. However, this might change in the future: as result of stricter emission standards diesel vehicles are likely to also achieve very low emissions. The cost, performance and CO_2 reduction of electric vehicles will

also improve.[10] Natural gas might then no longer be the preferred option, unless it can offer even lower CO_2 emissions. Therefore, natural gas should be perceived to be the first step towards a 100% biomethane uptake by the transport sector.

This transition could be compared to the market penetration of electric vehicles: first electric vehicles are brought on the market, secondly, the electricity mix will become decarbonized. In case of biomethane the step from natural gas to biomethane will be very important to further realise the decarbonisation potential: natural gas itself reduces carbon emissions by 10-15% and full uptake of biomethane could reduce CO_2 emissions by up to 80% or 95% depending on the feedstock used to produce biomethane. A stagnation of the shift from natural gas to biomethane might endanger the realisation of long term decarbonisation targets for the transport sector. Therefore, making biomethane in transport an integral part of the decarbonisation strategy for the transport sector is a key priority as well.

First of all, biomethane is, in a few of the case study countries a more integral part of the current national implementation of the Renewable Energy Directive and Fuel Quality Directive. It is important to link biomethane not only to air quality policies, but also to the national decarbonisation strategy of the transport sector. Not only by having targets in place in national strategies, but also by means of specific obligations for stakeholders. In this way these stakeholders can be held accountable for the realisation of these targets.

Secondly, at the vehicle level there are some options to provide additional incentives for the use of biomethane at the time of purchase. Many of the vehicle tax exemptions granted are based on TTW emissions and therefore do not benefit vehicles driving on biomethane. This because the main emission reduction occurs during well-to-tank phase (CO_2 is 'stored/captured' in the biomass sources), which is responsible for low or even negative emissions. It is, however, complicated to verify the use of biomethane by a vehicle owner. As the interviewees have also pointed out the need to develop a mature natural gas market before shifting to biomethane, providing strong incentives for the use of biomethane does not seem to be the best option on the short term, especially for individual vehicle owners. Because of the strong competition in the transport sector a measure has been identified, which helps vehicle owners to overcome the additional investments costs for natural gas vehicles compared to diesel or petrol vehicles. This measure differs from most fiscal incentives for vehicle uptake applied in the case studies, as most of these take the form of subsidies.

Because of the high investment needed to upgrade biogas, a measure applied in Sweden to couple regional biogas production to regional biomethane consumption in transport, in an administrative way, before investing in upgrading facilities seems to be a potential good measure to shift from natural gas towards biomethane. This is described in more detail in Section 4.4.6.

[10] www.afdc.energy.gov/vehicles/natural_gas_emissions.html

4.3 Identified measures

Before zooming in on individual supporting measures it should be noted that the case studies have shown that the countries being successful in the stimulation of natural gas and/or biomethane in transport have been successful because of a mix of individual measures. These broader strategies stimulate various parts of the supply chain, although each country has different focus areas. It is therefore hard to assess the effectiveness of individual measures. Also note, that some of the case study countries, like Italy and Sweden, already have a long history in the support for natural gas and/or biomethane. This proves that the duration of some measures, and therefore ensuring a long term perspective is taken, is also an important aspect.

The following measures have been identified as potential supporting measures, because these have not yet been implemented in France (or not to the same extent) and have turned out to be successful or at least have played a significant role in natural gas developments or biomethane in transport developments in case study countries.

Uptake of fuel:
- lower fuel tax for bioNG (Sweden);
- including biomethane in the blending obligation (the Netherlands, Germany, Italy, UK).

Use in various transport modes:
- low-interest loans for commercial vehicles (Egypt).

Infrastructure and filling stations:
- demand for realisation of filling infrastructure in public procurement;
- direct link to biogas plants.

Other measures related to distribution and biogas production:
- Green Gas system Göteborg.

4.4 Description of the individual measures

For each measure a description can be found below.

4.4.1 Including biomethane in the blending obligation for fuel suppliers

Link biomethane to decarbonisation policies rather than only air quality policy

Biomethane and natural gas offer both more or less the same benefits in terms of air quality compared to diesel. In addition, biomethane also results in a significant WTW reduction of GHG emissions (about 80-95% depending on feedstock use), while natural gas only reduces GHG emissions to some extent (about 10-15%) compared to conventional fuels. Most supporting measures in France are, however, linked to air quality problems in larger cities. From an air quality perspective, there seems to be no need to pay the additional cost for biomethane. To justify the higher cost of biomethane, biomethane should be linked to the national or local policies to decarbonise the transport sector and to policies aimed at increasing the share of renewable energy in transport.

Blending obligation

An important difference between France and other case study countries is the fact that France has not included biomethane in the blending obligation, which fuel suppliers have to fulfil in order to reach the renewable energy targets for the transport sector. Countries like the Netherlands, Italy, the UK and Germany all have the option to fulfil the biofuel quota partly through biomethane, mostly in the form or tradable certificates enabling the exchange for market prices. The new Renewable Energy Directive (RED II), as proposed for the post-2020 period, might give renewed importance of including biomethane in the blending obligation. The target for renewable energy in transport of 6.8% in combination with a declining role for land based biofuels will require a higher contribution from renewable electricity, advanced biofuels and biogas.

Double counting provision

Although biomethane is mostly more expensive compared to first generation biofuels, the double counting provision strongly improves the business case of biomethane in transport: half the quantity of biomethane is required to meet the same target.

Positive business case

In the Netherlands the inclusion of biomethane by means of tradable biotickets and now Renewable Fuel Units means that the use of biomethane in transport has resulted in the most positive business case for biomethane from sewage sludge compared to the use in other sectors, even without the subsidies (in the Netherlands it is forbidden to receive a subsidy and use the biomethane to meet the blending obligation at the same time, because this will not result in additional biomethane on the market).

Relevant policy developments

There are, however, some discussion points, which should be taken into account when considering this measure to be implemented in France as well:

- **Double counting provision:** according to the recently published Winter Package of the European Commission there will probably no longer a double counting provision after 2020. In the Netherlands there is currently also a discussion in the Dutch Parliament to abandon double counting, because the targets of the ILUC-Directive provide an incentive for advanced biofuels as well. It is still uncertain what the political decision will be. The new policy framework probably implies that France can still implement the double counting provision, but that this will not count towards the targets set at the European level.
- **Emission reduction versus volumes:** Member States might shift from an obligation based on volumes to an obligation based on emission reduction, as is the case in Germany. This would be a positive development for biomethane, because biomethane mainly results in higher emission reductions compared to first generation biofuels.
- **FQD blending limits:** currently, fuel suppliers face difficulties in meeting the blending obligation, because the current blending obligation is above the blending limit for FAME (B7) as laid down in the Fuel Quality Directive. Because it is unclear when the Commission will allow a higher biodiesel content in regular diesel, biomethane seems to be a good alternative together with fungible biofuels (like HVO, which are also most expensive than FAME).
- **Implementation of the ILUC Directive:** the cap on land based biofuels will limit the role of biofuels from food crops and will result in a stronger role of biofuels or biogas from waste and residues. This results in opportunities

for biogas from waste and residues, but some other types of biogas produced partly from food crops, like maize, will be limited. The EU Winter Package is in line with the ILUC Directive, because it proposes to further limit food/land based biofuels (however, some stakeholders think these types of biofuels should be completely eliminated by 2030).
- **Price impacts:** no information could be found on market distorting effects. Based on the interviews it can be concluded that including biomethane in the blending obligation would be good for biogas production, because of the higher demand for green certificates and probably a higher price. The current proposed revisions of the system of guarantees of origins in the EU Winter package might change the business case of guarantees of origins: RED II envisages that GOs would no longer be the property of the producer, but of the state. This makes that a higher price would have no impact on producers and the business model, but rather on state revenue. This is different in case of tradable units under a blending obligation, like Renewable Fuel Units in the Netherlands. This might still impact the price of and demand for biogas production. However, exact impacts will depend on the final text and the implementation of the RED II.

Advantages
- creates a level playing field for biofuels and biomethane;
- makes biomethane a more integrated part of the decarbonisation strategy for the transport sector;
- a premium price might help to improve the business case of biogas production.

Disadvantages
- Might increase the cost of biomethane as result of higher demand.
- Does not fit within the current French system, because France has specific targets for each fuel. Because the current share of NG is so low, having a target for bioNG in NG will not have a large impact. There are already targets in place in France, but these targets are part of the high level strategy, but this still requires implementation in specific policy instruments.
- Because the end is near of the current EU policy framework.
- Redesigning the systems might better take place after 2020.

4.4.2 Fuel tax differentiation between natural gas and/or biomethane

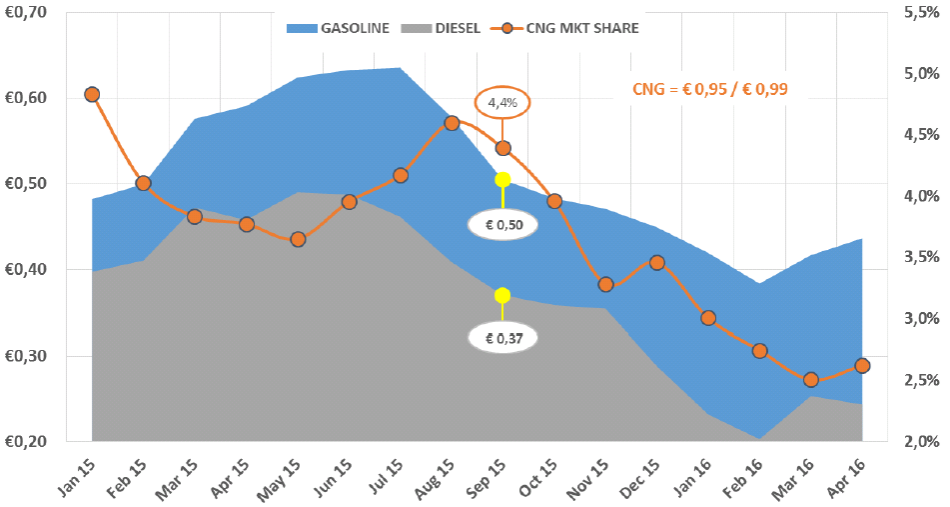
There are two strong examples on how fuel tax differentiation can impact the share of natural gas vehicles and/or the share of biomethane in the transport sector. A fuel tax exemption for natural gas is also applied in France, but the example of Italy is important as it shows the extent to which a measure aimed at fuel uptake is extremely linked to the vehicle uptake and that a market can respond very quickly to decreasing support, thus showing significant policy-dependency.

Italy

In Italy, the country with the highest share of NGVs, natural gas developments have been partly realised by the price difference between natural gas and petrol and diesel. The following graph shows a lower market share of new purchases of CNG vehicles as a consequence of the lower fuel price gap between petrol, diesel and natural gas. These price gaps are partly caused by favourable taxes for natural gas. Note that the Italian tax level of petrol is among the highest in the European Union. CNG is on average 64% cheaper than

petrol and by 57% cheaper than diesel.[11] Fuel tax differentiation is not the only reason for the successful market development of natural gas in Italy: the government has also invested in infrastructure and vehicle subsidies. Note that fuel tax differentiation cannot only be reached by lowering the tariffs for natural gas or biomethane, but also by applying higher taxes on petrol and diesel.

Figure 6 **CNG OEM market share versus gasoline and diesel fuel price gap in Italy in the period January 2015-April 2016**



Source: (NGV Italy, 2016).

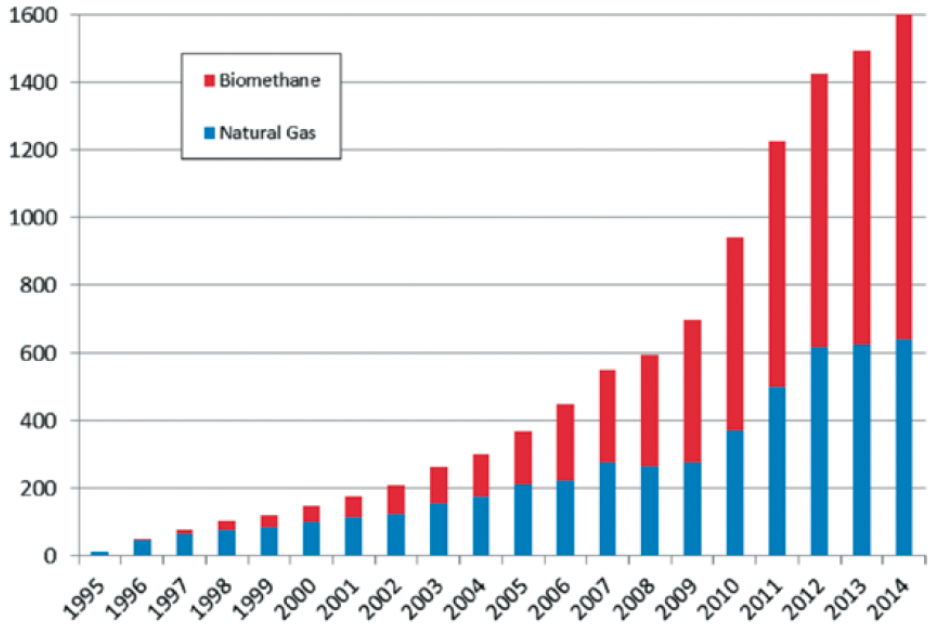
Sweden

The example of Sweden shows that a further differentiation between natural gas and biomethane can also result in a higher share of biomethane in transport. In 2014 more than 50% of the produced biogas was used as biomethane in transport and this biomethane represents 70% of all the CNG sold on the market. This is the result of a combination of a surplus of gas from biogas plants (mostly sewage treatment plants) and a low electricity price. These factors, in combination with a fuel tax exemption for biomethane in transport, make the transport sector a more attractive sector. The tax exemption is applied as an exemption from the carbon dioxide tax being applied an no energy tax on biogas. Sweden has asked the European Commission for a continuation of the tax exemption until 2020. In December 2015 the European Commission has granted Sweden permission to apply the tax exemption to biogas used as fuel up to and including the end of 2020, and for other biofuels the decision applies up to and including the end of 2018 (PWC, 2015).

Other measures have shown that a fuel tax exemption on biomethane could add to the impact of parallel measures: for example, in the case of public procurement requiring public transport buses to run on biomethane, the measure will be more acceptable in the case where transport companies do not face strong price increases, or better, a reduction in fuel cost (see Figure 7).

[11] www.gazeo.com/up-to-date/reportages-interviews-road-tests/reportages-and-interviews/Natural-gas-as-motor-fuel-in-Italy,report,8470.html

Figure 7 Volumes of CNG/biomethane used in Sweden (GWh)[12]



Advantages

- consumers/companies are likely to go for the cheapest option;
- might make it easier to demand the use of biomethane in public procurement without resulting in disproportional cost;
- might enable systems like the SmartCard system in Egypt, which we outline below: this requires a price difference;
- strong relation between vehicle sales, because of operational cost.

Disadvantages

- shortage of green gas certificates in France:
- other fuels might become more expensive;
- competition between natural gas and biomethane;
- requires sufficient green gas certificates on the market to cover higher demand for biomethane in case it becomes more attractive due to the lower price.

4.4.3 SmartCard system in Egypt

The following supporting measure is not in place in any of the case study countries, but has been found in the literature review carried out for the project and is nonetheless a good example of how the vehicle uptake of NGVs can be stimulated without subsidies. The so-called SmartCard system in Egypt has resulted in converting many vehicles to natural gas vehicles, in particular taxis.

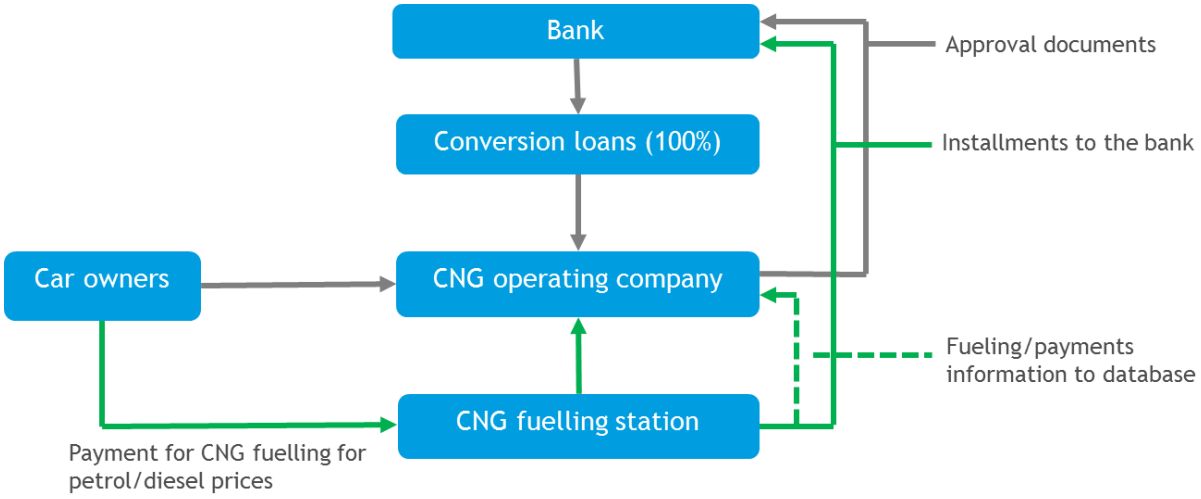
The additional cost for natural gas vehicles can be a financial burden for drivers, which negatively affects the total cost of ownership. To overcome this burden, the financing scheme in Egypt provides no cost 'loans' to drivers in order for them to convert their vehicles. This has been a cooperation with local banks. The conversion is provided for 'free'. Drivers repay this

[12] wwww.archiwummotoryzacji.pl/images/AM/vol71/PIMOT_71_Backman_7-20.pdf

investment by paying the same prices as petrol, for the natural gas they consume until the loan has been repaid. After the repayment period drivers directly benefit from the lower fuel costs. The repayment system works with a so-called SmartCard system which can be used at filling stations to pay for fuel use. The payback period strongly depends on the price differences; therefore, no exact payback time can be given. No information could be found in the literature sources on the durations and payback periods associated with this measure.

To participate in the scheme any car owner who would like to convert his or her car to an NGV could contact an NGVs operating company. This company can approve to join the smart card program. After this approval, the bank transfers the total conversion cost to the NGVS operating company and issues a smart card to the vehicle owner. With the smart card the vehicle owners pays an equivalent to the price of petrol until he has paid back his loan. The role of various actors is presented in a schematic overview below.

Figure 8 **Schematic overview of the SmartCard scheme to convert vehicles to NGVs**[13]



Such supporting measure can be a joint partnership between local banks, gas companies, filling stations and national or local governments. It is known whether it is profitable for the local banks to participate, but there is portably construction possible, where governments provide an incentive to local banks to make it attractive to join. Regarding filling stations, it might be an option to link the Smart Card system to a specific brand of filling stations: participating in the scheme will make that the brand consisting of various filling stations has a minimum number of clients during the payback periods and has a better basis to expand the number of filling stations in an area. This measure does not directly stimulate the uptake of biomethane in transport, but in line with the interview outcomes a stronger uptake of natural gas in transport must be reached before the transition towards biomethane can truly take place. In case fiscal measures are implemented that result in lower prices for biomethane compared to natural gas and/or petrol and diesel this scheme will automatically result in a higher uptake of biomethane. A higher price difference between petrol/diesel and natural gas/biomethane

[13] http://css.escwa.org.lb/SDPD/3451/1-2.pdf

will ensure that loans are paid back in a shorter time period. Note that it is important to guarantee a long term security with regards to the natural gas price compared to diesel/petrol.[14] [15] [16]

Advantages

- No government support needed or any form of subsidies. There will be some cost associated with setting up the system, but the vehicle owner will pay back the additional cost for the natural gas vehicle.
- Can stimulate vehicle uptake also for individual vehicle owners.
- Links vehicle uptake to filling infrastructure and by doing so might ensure higher demand for natural gas or biomethane in case a filling station is part of the system.

Disadvantages

- requires lower natural gas price/biomethane price;
- requires sufficient filling infrastructure: a certain share of filling stations need to be involved to make it attractive for a user;
- system of loans might increase the administrative burden, because an administrative system needs to be in place.

4.4.4 Demand for realisation of filling infrastructure in public procurement

As described in the previous section, Italy has made the development of natural gas infrastructure part of public procurement procedures (within the DDL Competition in particular), which demonstrates that the need/obligation to develop an alternative fuel network is confirmed, unless there are technical and economic obstacles that can be proven and which will then be reviewed by the authorities involved. The development needs of an alternative fuel infrastructure are linked to the Clean Power for Transport Directive (EC, 2014).

It is not exactly clear what the exact requirements are and in what cases these requirement are applied. Because of the lack of data on the specific requirements in the public procurement procedures further research is required, for example by consulting the Italian government.

Below we present some potential advantages and disadvantages:

Advantages

- can contribute to the gradual developments of both vehicle and infrastructure at the same time;
- shows the commitment of the government to the development of the natural gas infrastructure for transport and can strengthen the role of the government as launching customer;
- is likely to result in cost-effective realisation of infrastructure, because it involves tendering of contracts.

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14 www.nigerianbestforum.com/index.php?topic=305795.0;wap

15 http://css.escwa.org.lb/SDPD/3451/1-2.pdf

16 https://cleancities.energy.gov/files/u/news_events/document/document_url/6/ngv_policymaking.pdf

Disadvantages

- This is only useful in case filling infrastructure forms a barrier towards the uptake of natural gas and biomethane. For example, when the number of filling stations is lagging behind compared to the levels of vehicle uptake.
- Requires close coordination of distribution of filling stations, preferably at the regional or national level. Local governments might not have sufficient oversight to be involved.
- Might increase the projected cost of government support to disproportional height.

4.4.5 Direct link to biogas plants

From the case studies it became clear that Austria in particular had built some biomethane filling stations which are directly linked to biogas plants. This also seems to be the case in France and could be a logical choice in case garbage trucks drive on biomethane produced from collected waste. Because the issue of visibility and public acceptability of biomethane in transport among the general public has been mentioned several times in the interviews, this measure has been selected to put forward a solution to these issues.
The advantages and disadvantages of establishing a direct link between biomethane production and filling stations are listed below.

Advantages

- in case there is a need for filling infrastructure nearby biogas production, realising a direct link might avoid grid injection and thus costs;
- in some countries, like Austria, tax exemptions are granted for biomethane in case the biomethane is consumed on the spot;
- establishing a direct link might contribute to the circular economy in a region;
- consumers might better understand the biomethane supply chain in case they know the origin of the biogas and location of production.

Disadvantages

- A direct link might result in unnecessary cost; these could be avoided using green certificates/guarantees of origin.
- Linking a filling station only to one biogas plant makes a filling station dependent on the production of the specific biogas plant as it is not directly connected to the natural gas network, but only to that specific biogas plant.
- Distances between biogas plants and preferred locations of filling stations can be very long. This can, however, also be the case for the natural gas grid making the realisation of filling stations with a direct link a better option in that case. These considerations clearly explain why a direct link between biogas plant and a filling station should be assessed on a case by case basis.

4.4.6 Green gas credits in Sweden

In terms of linking biogas production to the transport sector investments are also needed to upgrade the biogas to biomethane and for grid injection and distribution. Especially at the early stage of development, where the demand for biomethane in transport is still uncertain, a lack of investments could form financial and technical barriers. The following example illustrates how biomethane production can be stimulated in transport before any investment in upgrading capacity takes place.

The system applied in Göteborg is an example of how credits can be traded in an administrative way, while stimulating biogas production and use in transport at the same time. From 2001 onwards Göteborg required the bus operators to use gas buses in combination with an increasing amount of renewable fuels. At that time there was however no upgraded biogas available. Therefore the concept of 'green gas credits' was developed.
The company Göteborg Energy owns the 'town gas' grid, which is primarily used for cooking. On an annual basis Göteborg Energi purchased a certain amount of biogas from the waste water treatment plant of Göteborg. The raw biogas is then mixed into the 'town gas' grid. The 'town gas' is a mixture of 50% methane and air and the share of raw biogas is limited to a maximum of 40%, because of quality aspects. Göteborg Energy sells green gas credits to Fordonsgas Väst, a supplier of gas as transport fuel, which was allowed to sell a corresponding amount of CNG fuel from the NG grid as green gas. Revenues of this project in combination with national funding should contribute to the realisation of an upgrading plant planned for 2006 (Miljoinfo, 2001-ongoing) (NICHES, 2011).

Advantages

- Does not require direct link between transport and biogas production.
- Removes biomethane from being a potential barrier.
- Investments do not have to be arranged directly. This type of projects makes it possible to test the demand for biomethane in a region before actually investing in a more comprehensive development scheme.
- Although this specific measures might not be applied in France, generating funds somewhere before actually investing might also be applied in a different way.
- Might help to make the link between local biogas production and local consumption of biomethane more visible to the public and to raise awareness without a physical link.

Disadvantages

- Can only be used if you have raw biogas and town grid. This measure will not be helpful in case biomethane production and grid injections are sufficiently developed.
- A well-working system of green certificates make these kinds of measures unnecessary and a national market might be preferred over local initiatives.

Assessment of the transferability to the French context

The system of Green Gas credits might be hard to transfer to the French context and other EU Member States, because it is mostly not possible to inject raw biogas into an existing grid. Most cities do not have a town grid, such as in Göteborg.

However, this example shows the feasibility of one import aspect: the option to pre-finance developments in biomethane production. Pre-financing will enable generating investments before actual investments are made to link biogas production to application in the transport sector. Therefore, this example might provide as inspiration to generate funds before the realisation of biomethane conversion plants in an area.

To make it more specific: in case successful projects have led to more natural gas filling infrastructure in a region selling biomethane might be an option as well. This can be done through green certificates, but this will only cover existing biogas/biomethane production. In case there is a desire to realise

more biogas production/biomethane upgrading in the region itself, investments in production capacity can be stimulated by pre-financing. A system can be set up to let users pay a premium which can be invested in regional biogas/biomethane production.

4.5 Conclusions

The transferability of the identified measures to the French context has been assessed as follows:

- Including biomethane in the blending obligation does not seem to be feasible on the short term, but might be part of any reforms on the medium term as part of the new post-2020 EU policy framework.
- Fuel tax differentiation, including lower taxes for bioNG compared to NG seem to be the most effective way to stimulate the uptake of biomethane in transport. Due to the shortage of green certificates and in order not to harm the natural gas market it is recommended to implement this gradually or at least announce it pre-emptively before actual implementation.
- Low-interest loans for vehicles, as is the case in Egypt, seem to be a risk-free option that can be complementary to other measures. A pilot project can be started in a large city like Paris, which already has natural gas infrastructure for transport, to see whether this measure also works in France.
- Depending on the type and size of tenders, requiring the realisation of filling infrastructure in public procurement seems to be a good option. However, attention has to be paid to the amount of vehicles that will make use of this filling infrastructure and the location and distribution of filling stations in an area. Filling stations need to add value to the current system.
- Establishing a direct link between filling stations and biogas plants and understanding among consumers and to increase the visibility of biomethane in a municipality.
- The extent to which the Green Gas system in Göteborg would be helpful remains opens for further analysis: it seems to be more helpful to realise a better market for green gas certificates and to increase the availability of these certificates.

5 Conclusions and recommendations

Based on the case study comparison in this study the following conclusions can be drawn:

Measures are not necessarily ineffective, but might take some more time

First of all, the further development of both the natural gas market in transport as well as the uptake of biomethane in transport will take time. France does not yet have a strong natural gas market in transport and only very limited biomethane consumption in the transport sector. Regarding the development of the natural gas market France has implemented many measures, which have also been implemented in other countries.
The countries with a far higher share of natural gas vehicles and natural gas consumption in transport, like Sweden and Italy, have in general been promoting natural gas use in transport for a longer period of time. For example, the history of biogas in Sweden goes back to biogas production at municipal wastewater treatment plants since 1960's.[17] The main reason for this was to reduce sludge volumes. After World War II Italy took an early lead in utilizing gas resources, resulting in a strong national natural gas market and consequently a stronger role for natural gas in transport.[18]

This implies that the measures that France is currently taking are not necessarily less effective or ineffective, but might require some additional time.

Improve the system of green certificates/guarantees of origin

Secondly, increasing the share of biomethane in transport gradually would also allow the further growth and development of the market for green certificates. The current shortage of green certificates should be solved, because it is one of the main barriers mentioned for the current uptake of biomethane in transport. Any to be introduced policy incentive for biomethane will be hindered due to a shortage of green certificates and thus will require to further stimulate biomethane production or to either improve the system of certificates

Make the link between biogas production and biomethane in transport more visible to the public

Thirdly, based on the interviews the link between biogas and actual consumption by vehicles seems to be hard to understand by the general public, especially when it is arranged in an administrative way through green certificates. Although linking direct biogas plants to a filling stations and specific fleets in a city seems to be more costly than arranging biomethane uptake in an administrative way, a direct link might contribute to the visibility and better understanding of the supply chain.

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17 Swedish Gas Association, 2011, Biogas in Sweden.

18 Hayes, 2004, Algerian gas to Europe: the transmed pipeline and early Spanish gas import projects.

Integrate biomethane more in the decarbonisation strategy of the transport sector and create a level playing field between biofuels and biomethane

France does not have many measures that focus on the link between biogas production and natural gas and/or biomethane in transport. Not many options promote the integration of both sectors. Although bioNGV targets have been set at the national level, the measures that are implemented to realise these targets focus either on biogas production or on the transport sector. In case bioNGV should contribute to long term GHG reduction in the transport sector, it is recommended to work towards an integrated approach, which will provide an incentive to use biomethane in the transport sector in a structural way. Of the identified measures, extending the scope of the blending obligation seems to be the best option in order to increase the level playing field between biofuels and biomethane, like is also the case in for example the Netherlands, Italy, Germany and the United Kingdom. Although this does not seem to be feasible or of any impact under the *current* system, the role of biomethane could be better taken into account in any revision of the system, for example as part of their revision of the post-2020 legal framework. Note that the blending obligation should also be compared to the overall BioNGV target (20% of all NG should be made up of biomethane by 2023), but it is important that stakeholders, like fuel suppliers are held responsible for this target. A national target like the BioNGV target therefore requires further implementation.

Introduce measures gradually

From the interviews it became clear that it is important to first develop the NGV market further, before biomethane can play a significant role. In addition to this, the total cost of ownership has been mentioned several times as the indicator which determines whether companies will decide to invest or not. These two reasons require for a long term policy approach in which measures are announced in advance and are guaranteed for a certain amount of years: a long enough period of time on which to base investment decisions on.

Fuel tax differentiation between NG and biomethane can be an enabler for other policy measures

Sweden and Switzerland show that fuel tax differentiation between NG and biomethane can result in significant shares of biomethane in transport. Italy has shown the impact changes in natural gas fuel taxes can have on vehicle sales. In France, a further differentiation can be gradually introduced, which will make biomethane cheaper compared to natural gas. Case studies (for example Sweden and Egypt) have shown that other policy incentives will also benefit from a fuel differentiation: for example, including a biomethane requirement in public procurement is more acceptable in case this does not increase costs significantly. For example, in case of procurement of buses in Sweden.

Strengthen the natural gas market further

Because France has a fuel tax differentiation between diesel and petrol and natural gas, low-interest loans for vehicles paid back with a similar structure as the one implemented in Egypt might further help to increase the vehicle uptake without considerable government support. This will require various stakeholders from the supply chain to work together. Projects like these do also seem to be feasible for local governments and can complement projects realising infrastructure and vehicle fleets at the same time. Increasing vehicle penetration any further in the region might help to make the filling stations profitable on the short term.

Maintain the focus on HDV

France is a frontrunner in specifically targeting heavy duty vehicles, which seems to be justified from an environmental perspective and in light of the potential of other decarbonisation options, like the electrification of passenger cars. While other vehicle market segments face competition from electro-mobility (especially in Germany), this might be less the case in France. It is therefore recommended to maintain this approach.

Overall, the case study countries have shown that a high share of biomethane in transport is mostly the result of a combination of various policy measures used together. This list is therefore non-exhaustive and more detailed information can be found in the annexes.

Follow the front runners

Altogether, Sweden can be identified as front runner in biomethane uptake and Italy in terms of the NGV market. It is therefore recommended to keep a specific eye on the development of NG and bioNG in transport in Sweden and Italy, since the policies and underlying strategy of these two countries seems to fit best to the French situation. One has to keep in mind that the policy measures in these countries form part of a broader long term strategy build also on national circumstances. These policies are, for example, not only driven by decarbonisation policy objectives, but are also linked to issues, like energy diversification and waste management.

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Annex A EU policy context

A.1 Introduction

Many of the supporting measures on the national level are a consequence of the wider EU policy framework on renewable energy in transport, at least in the case of the EU case study countries. Therefore, this section describes the most relevant directives at the European level.

The Renewable Energy Directive (RED) will be discussed in Annex A.2, followed by the ILUC Directive in Annex A.3 and the Fuel Quality Directive (FQD) in Annex A.4. Note that the RED and FQD have already been in place since 2009 setting targets for 2020.
It is not clear yet what the policy framework will be after 2020, but the EU winter package contains the first proposals for 2020-2030, which are depicted in Annex A.6 after a short description of the Clean Power for Transport Directive in Annex A.5.

A.2 Renewable Energy Directive

20% target

The RED sets a 20% overall binding target for renewable energy use by 2020 for the EU and individual targets for the various Member States. Besides this target, the RED also regulates various issues concerning the use of renewable energy in the electricity, heating and cooling and transport sectors.

Article 3(4)

The Articles most relevant for the transport sector are Articles 3(4) and 17-21. According to Article 3(4), each Member State shall ensure that the share of energy from renewable sources in all forms of transport in 2020 is at least 10% of the final consumption of energy in transport in that Member State. This 10% target can be met by all types of renewable energy, including biofuels, biogas, electricity and hydrogen (see Figure 1). In practice, it will be met mostly by an increase in biofuel consumption and by renewable electricity in railway transport.

Sustainability criteria

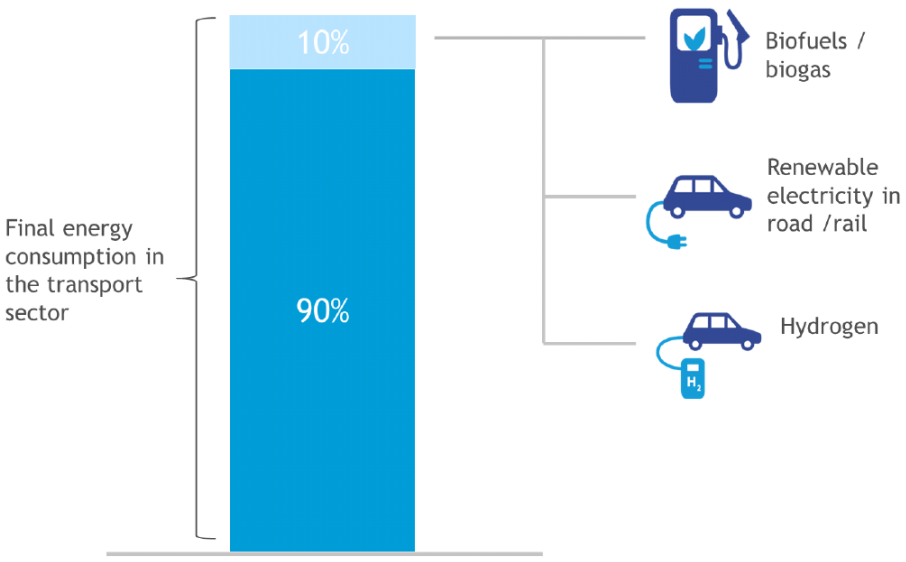
Only biofuels that meet the sustainability criteria for biofuels and bioliquids as laid down in Article 17 of the RED may count towards the 10% target.
These sustainability criteria include minimum requirements for the reduction of GHG emissions and the exclusion of environmentally vulnerable areas for biofuel production, such as areas with high biodiversity value or high carbon stocks. These criteria address direct effects caused by biomass cultivation and biofuel production. Indirect effects, such as indirect land use changes, are not covered in the original Directive of 2009. The same sustainability criteria are laid down in the Fuel Quality Directive.

Double counting provision and multiplication factors

Article 21(2) of the RED defines that the contribution made by biofuels produced from wastes, residues, non-food cellulosic material and ligno-cellulosic material shall be considered to be twice that made by other biofuels. Furthermore, the electricity from renewable energy sources consumed by electric road vehicles shall be considered to be 2.5 times the energy content of the input of electricity from renewable energy sources

(RED Article 3(4)), to account for the higher energy efficiency of electric vehicles compared with vehicles with an internal combustion engine. However, these multiplication factors have been amended by the Indirect Land Use Change (ILUC)Directive (see 2.3) from 1 to 2.5 for the energy consumed in electrified rail transport, and from 2.5 to 5 for renewable electricity use in road transport.

Figure 9 **Schematic overview of the 10% transport target of the RED**



A.3 ILUC Directive

The ILUC proposal of 2012

The ILUC Directive is the result of years of debate between Member States and market actors. In the RED of 2009 the Commission was obliged to submit a report to the European Parliament and the Council by 31 December 2010 reviewing the impact of indirect land use change on greenhouse gas emissions and addressing ways to minimise that impact. This report was to be accompanied, as appropriate, by a proposal on how to factor in the emissions deriving from such indirect land use changes. This proposal was delayed several times, and was eventually published on 17 October 2012.
The proposal's main elements regarding the RED were:

- a 5% cap on food-based biofuels similar to average 'current consumption' levels in the EU;
- quadruple counting for biofuels from certain wastes and residues;
- increase of the minimum greenhouse gas saving threshold for biofuels and bioliquids produced in new installations with effect from 1 July 2014;
- introduction of ILUC factors for three feedstock groups to be used in the Member State reports to the Commission, shown in Table 1.

Table 11 **ILUC factors proposed in the ILUC proposal of October 2012**

Feedstock group	Estimated indirect land use change emissions (gCO_2-eq/MJ)
Cereals and other starch-rich crops	12
Sugars	13
Oil crops	55

The ILUC Directive (2015/1513/EC)

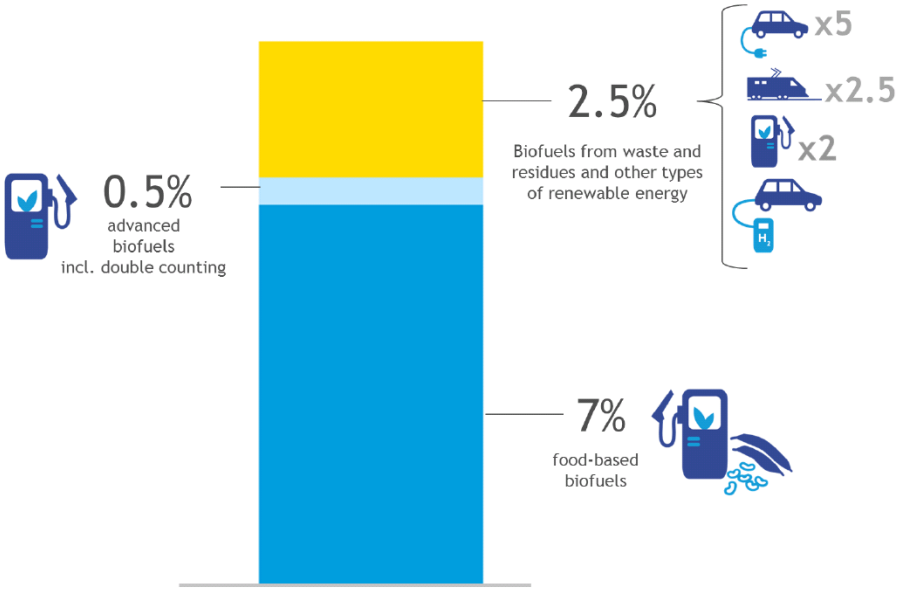
After publication of the proposal in 2012, the discussion resulted in several changes to this original proposal. It took almost three years before a final vote on ILUC was taken in April 2015, with publication of the ILUC Directive following in September 2015 (EU, 2015b)and amending Directive 98/70/EC (the original version of the Fuel Quality Directive) and Directive 2009/28/EC (the Renewable Energy Directive).

Under this Directive, Member States finally agreed to introduce a cap on the contribution to the RED targets that can be made by biofuels from food crops and certain energy crops, quantified as 7% of transport energy. Member States are also required to set a target for advanced biofuels, with a reference value of 0.5%.

Implementation by Member States

To what extent these provisions will result in a shift from food-based to advanced biofuels depends on their implementation by Member States. Because Member States have various implementation options, in practice significant differences may arise. For example, as Member States are allowed to set a lower cap on land based biofuels, they may also choose to apply this target to the FQD. They may also set a sub-target for advanced biofuels lower or higher than the reference value, although reasoning must be provided. They could also decide to lower their biofuels incentives (e.g. lower the levels of the biofuel obligation) in response to the higher multiplication values for renewable electricity, but they may also aim for a higher level of renewable energy sources in transport than the 10% target.

Figure 10 How the 10% can be met taking the provisions of the ILUC Directive into account



A.4 Fuel Quality Directive

Two objectives

The FQD has a double role in relation to the consumption of biofuels in the transport sector: Article 7a of the FQD provides an incentive for biofuel consumption by means of a GHG reduction target, but, on the other hand, Article 3 and 4 limit the maximum biofuel content of diesel and petrol. Although this may seem contradictory, standardized fuel specifications benefit the level of harmonization across Member States.

Scope

This Directive applies to the fuels used by road vehicles, non-road mobile machinery (including inland waterway vessels when not at sea), agricultural and forestry tractors and recreational craft when not at sea. This definition differs slightly from the scope of energy consumption applied in the Renewable Energy Directive.

Obligation for fuel suppliers

Concerning the GHG reduction target, the FQD requires fuel suppliers to gradually reduce the average life cycle GHG emissions of the transport fuels they market in the EU (Article 7a (2)). 'Suppliers' are, in most cases, defined as the entities responsible for passing fuel or energy through an excise duty point.

The 6% target

Member States must oblige fuel suppliers to reduce the life cycle GHG emissions per unit of energy of their supplied fuels by up to 10% compared with the fuel baseline (of 2010). This 10% consists of:

- a 6% mandatory target;
- a voluntary 4%, which can be met by the use of carbon capture and storage (2%) and credits purchased through the Clean Development Mechanism of the Kyoto Protocol (2%), for reductions in the fuel supply sector; note that it is considered unlikely that this voluntary 4% will be implemented.

Calculation methodology

The targets were set in the Directive of 2009, but at that time no decision had been taken regarding the methodology to be used for calculating the contribution of fossil fuels and potential upstream GHG mitigation measures towards the target. This methodology was only defined for biofuels (and equivalent to the calculation methodology laid down in the RED, thus also without ILUC emissions), but not for the upstream emission reductions in the fossil fuel chain.

Implementing rules in Directive 2015/652

Directive 2015/652 (EU, 2015a), adopted in April 2015, also includes implementing rules for the fossil fuel reductions. Member States are required to implement this amendment to the FQD by 21 April 2017 (Department for Transport, 2015). These implementing rules give fuel suppliers the option to count the contribution of emission reductions occurring prior to the crude oil entering a refinery towards the 6% target (the so-called upstream emission reductions, UERs). Examples of these kinds of emission reductions are the reduction of flaring and venting emissions.

Although this Directive has been adopted, there are still provisions that require clarification. To further clarify these implementing rules, the European Commission is to publish non-legislative guidelines in the coming months.

Link between the FQD target and the ILUC Directive

The ILUC Directive applies to both the RED and FQD, but the changes to the FQD are relatively limited. The changes to the RED may, however, increase the relative importance of the 6% target. In theory, if the average GHG intensity of biofuels decreases as result of the ILUC Directive, the FQD target could also be met more easily. However, the higher multiplication factor for renewable electricity in rail and road transport and the increasing use of double counting biofuels reduces the biofuel volume required to meet the 10% RED target. This may effectively reduce the contribution of the RED policy measures towards meeting the FQD target (where double-counting does not apply), and additional efforts are likely to be required to achieve the 6% GHG intensity reduction in 2020.

In this context, it should also be noted that there is a difference between implementation of the ILUC Directive, the RED and the FQD: the RED obliges Member States to take responsibility directly for meeting targets, while the FQD requires Member States to oblige fuel suppliers to meet the FQD target. This means that a Member State that had implemented the FQD in an appropriate way would not be held accountable if targets were nevertheless missed.

A.5 Clean Power for Transport Directive

The Clean Power for Transport Directive (or the Directive on the deployment of alternative fuels infrastructure) focuses on the build-up of an EU-wide network of recharging and refuelling points, interoperability (by means of standards and technical specifications) and clear consumer information to raise awareness. The Directive contains minimum requirements to be implemented through Member States' national policy frameworks. This includes electric vehicles, natural gas (LNG and CNG) and hydrogen.

A.6 Clean Vehicle Directive

The Clean Vehicle Directive (EC, 2009c), or the Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles aims at the broad market introduction of environmental-friendly vehicles on the market. This includes that the energy and environmental impacts over the entire lifetime of a vehicle should be taken into account in all purchases of road transport vehicles covered by the Directives regulating public procurement and the public service Regulation. These impacts can be monetised for inclusion in the purchasing decision and requires the specific calculation rules for calculating the lifetime costs and are laid down in the Directive. (EC, Mobility and Transport, n.d.)

A.7 EU winter package

On November 30th, 2016, the European Commission published the so-called Winter Package. This package included several proposals for the post-2020 policy framework. Regarding renewable energy in transport the main aspects of this new Renewable Energy Directive are:

- 1.5% share of renewable energy in transport in 2021 growing to 6.8% in 2030.
- No extension of the double counting.
- A cap on land based biofuels of 3.8% in 2030. Note that the current market share of land based biofuels is approximately 4.9% (in 2014).
- A sub-target for advanced biofuels of 3.6% in 2030 (now 0.5% for 2021).
- An additional reward for biofuels in aviation and maritime shipping (their energy content is accounted for 20% more).
- Biomass fuels should also meet the sustainability criteria rather than only being obligatory for biofuels and bioliquids. Biomass fuels do also include the biomass used in the heating and electricity sector.