D6.1 | Mapping the state of play of renewable gases in Europe

Deliverable:	Mapping the state of play of renewable gases in Europe
Author(s):	Mieke Decorte (EBA), Sam Tessens (Biogas-E), David Fernández , Francisco Repullo (AEBIG), PJ McCarthy , Brendan Oriordan (RGFI), Lorenzo Maggioni, Carlo Pieroni (CIB), Mindaugas Protas (Amber Grid), Magdalena Rogulska (UPEBI), Tomislav Pukšec (CBA), Jan Stanbasky (CzBA), K. Alexandridis (HABIO), Alexey Mozgovoy (GBA), Toni Reinholz, Milenko Matosic (Dena), Kristine Vegere (LBA), Georgii Geletukha, Yuri Matveev (UABIO), Linus Klackenberg (Energigas Sverige), Petra Medved (CCIS-CAFÉ), Michael Schmid (VSG), Jeppe Bjerg (Energinet.dk), Ahto Oja (EBAMTU), Anna Virolainen-Hynna (FBA), Jesse Scharf (REAL), Grigoris Papageorgiadis (ARBIO), Nina Križnik (CCIS-CAFÉ)
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Coordinator:	Stefano PROIETTI, ISINNOVA
Tel:	0039 06. 32.12. 655
Fax:	0039 06. 32.13. 049
E-mail:	sproietti@isinnova.org

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REGATRACE in a nutshell

REGATRACE (REnewable GAs TRAde Centre in Europe) aims to create an efficient trade system based on issuing and trading biomethane/renewable gases Guarantees of Origin (GO) with exclusion of double sale.

This objective will be achieved through the following founding pillars:
- European biomethane/renewable gases GO system
- Set-up of national GO issuing bodies Integration of GO from different renewable gas technologies with electric and hydrogen GO systems
- Integrated assessment and sustainable feedstock mobilisation strategies and technology synergies
- Support for biomethane market uptake Transferability of results beyond the project's countries

The network of issuing bodies will be established by including existing national biomethane registries (Austria, Denmark, Estonia, Finland, France, Germany, The Netherlands, Switzerland and UK) and by creating issuing bodies in the Target countries of the project (Belgium, Ireland, Italy, Lithuania, Poland, Romania and Spain).

Moreover, REGATRACE will prepare the ground for setting-up national biomethane registries in other 7 Supported countries (Croatia, Czech Republic, Greece, Latvia, Slovenia, Sweden and Ukraine).

Using a participatory process involving several stakeholders, REGATRACE will develop strategic visions and national roadmaps to boost the biomethane market.

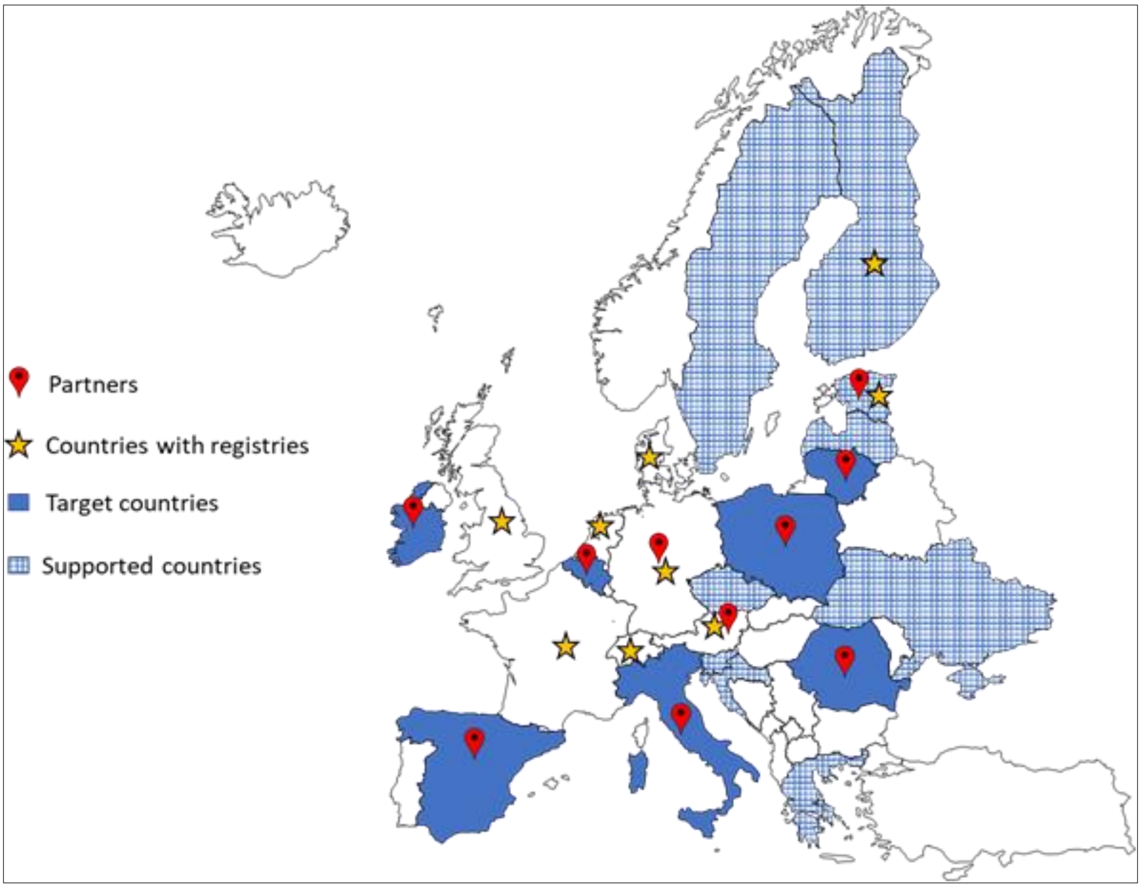

Figure 1: REGATRACE countries and partners

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1 Introduction

The goal of this report is to map the state of play of the renewable gases market in Europe. The countries under investigation are formulated by the REGATRACE project and include target countries (Belgium, Spain, Ireland, Italy, Lithuania, Poland and Romania), supported countries (Croatia, Czech Republic, Greece, Latvia, Ukraine, Sweden and Slovenia) and countries already having registries (Austria, Switzerland, Germany, Denmark, France, Estonia, Finland, the Netherlands and United Kingdom). A general European overview is presented together with an in-depth mapping at country level. This report will serve as basis to set-up a harmonized biomethane market throughout Europe. The review is focusing on biomethane. But, when relevant, also biogas and other renewable gases are discussed. The wording renewable gas is used for production of gas from gasification, power-to-methane and anaerobic digestion (AD), whereas biomethane refers to production of gas from AD only. In this document, the general wording of biomethane certificate is adopted. Guarantee of Origin (GoO) is mentioned only when strictly referring to the RED II Article 19.

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2 Methodology

The European overview and the in-depth mapping at country level are based on both a literature review and an online survey.

2.1 Literature review

The literature review was realized by biomethane experts in each country. The review is focused on biomethane production from anaerobic digestion, but when relevant, also issues related to biogas production are explained. The review covers regulation directly and indirectly effecting the biomethane market (production and/or demand). Next, the market environment and feasibility of biomethane projects, biomethane use as biofuel, preferential access for the domestic biomethane producers to the gas grid and grid connection investment cost are discussed.

2.2 Online survey

The state of play of the renewable gas market in Europe is supplemented by results of the online survey. The survey was distributed in target countries, supported countries and countries already having registries by the partners and LTPs (Linked Third Parties) in the REGATRACE project.

The survey has two target groups: (potential) biomethane producers and (potential) biomethane consumers. Depending on the target group, questions are different.

The questions related to the **(potential) biomethane produces** mainly complement the literature review in each country involved in the project. The questions related to the **(potential) biomethane consumers** are focused on the readiness to pay for renewable gas and which attributes of the renewable gas play important roles.

The readiness to pay was examined with a choice experiment. A choice experiment allows to analyze individual aspects or characteristics of a product and hereby allows to monetize a change in one or more characteristics of a product. For biomethane, this could be for example the change in readiness to pay a price premium depending on the GHG emission reduction performance or input materials of the biomethane.

Following attributes are used in the readiness to pay a premium price for biomethane:

- Length of the contract
- Security of supply
- GHG emission reduction performance of the biomethane
- Input material
- Origin of the gas (locally produced, European, outside of Europe etc.)
- Price increase

In the choice experiment, respondents must make several choices between types of biomethane with different levels of attributes. An example is shown below.

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Step 1 of 6

Length of contract	1 year	1 year
Reliable delivery of renewable gas*	100 % reliability	70 % reliability
GHG reductions compared to natural gas	0 % GHG reduction	0 % GHG reduction
Input materials	Waste and residues	Energy crops
Origin of the renewable gas	Domestic	Domestic
Cost additionally to the cost of natural gas	EUR 5 / MWh	EUR 10 / MWh
	◉	○

Figure 2: Example question in choice experiment

The survey was made available in following languages: English, Croatian, Czech, Danish, Dutch, Estonian, Finnish, French, German, Greek, Hungarian, Italian, Latvian, Lithuanian, Norwegian, Polish, Spanish, Swedish and Ukrainian. Ultimately, the survey was completed by 137 (potential) producers and 64 (potential) consumers.

The full surveys for (potential) biomethane producers and (potential) biomethane consumers are given in Annexes 1 and 2.

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3 European overview

3.1 Production and consumption of renewable gases in Europe

Figure 3 shows the renewable gas production for the countries involved in the REGATRACE project in GWh/year. Most recent available data are shown on the map. For most countries this was data from 2018, for some countries this was either 2017 or 2019. Countries with the biggest production of renewable gas are Germany (10,018 GWh in 2018), United Kingdom (3,300 GWh in 2018), the Netherlands (2,226 GWh in 2018), Denmark (1,425 GWh in 2017), Sweden (1,281 GWh in 2018) and France (1,207 GWh). Apart from Sweden and Germany, no country reported production of renewable gas via gasification or power-to-methane plants. The vast majority of renewable gas is thus currently produced via the anaerobic digestion process and referred to as ‘biomethane’ in this report. Sweden noted a gasification production of 15 GWh in 2018, the renewable gas production in Germany via gasification or power-to-methane is close to zero.

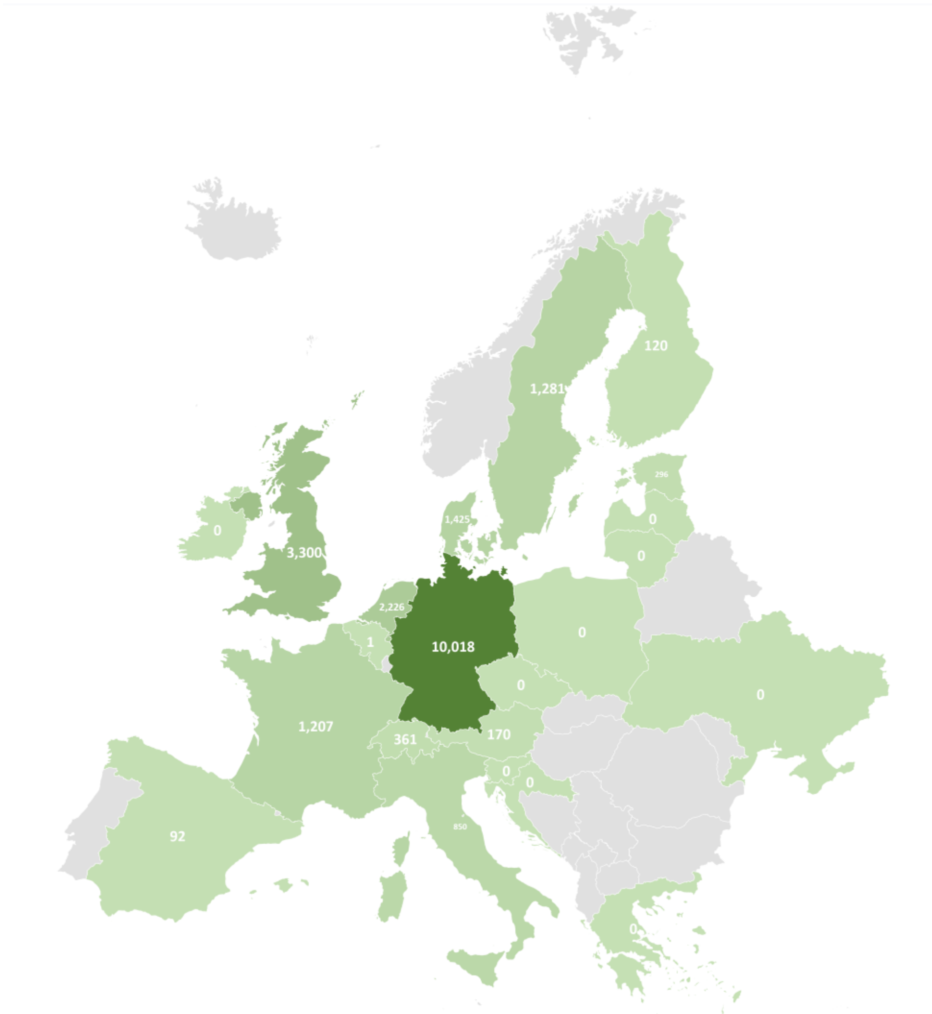

Figure 3: Biomethane production per country (GWh/year)

In Figure 4 production and consumption of biomethane are compared. In this report, consumption in a certain country means that the biomethane end-use application was in this specific country. The graph is only

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showing the countries were biomethane production takes place and were data on consumption is available. For most countries production and consumption are well balanced. However, Denmark is producing more biomethane than it consumes whereas Sweden is consuming more than double the amount it is producing. This is mainly because in Sweden, incentives are focused on the consumption side, of which tax exemption is the most important one, whereas in most other member states, subsidies are focused on the production or injection of the biomethane. This means imported biomethane in Sweden can be double subsidized. In 2016, Sweden imported 200 GWh from Denmark, which increased to 1,132 GWh in 2018. In Germany, the production of biomethane in 2018 was 1,498 GWh higher than its consumption. Germany exported a small part of this biomethane to the Netherlands and Switzerland, but the biggest part of the biomethane isn't consumed so far. This means, the gas biomethane is stored in the gas grid and the volume can be used next years.

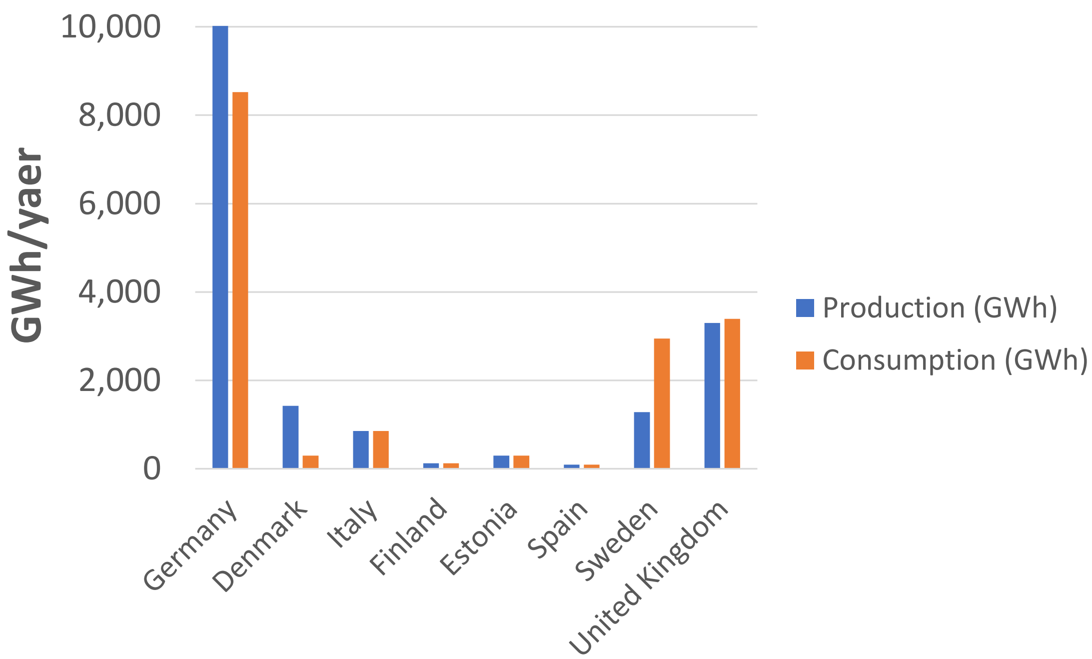

Figure 4: Total biomethane production compared to total biomethane consumption per country

Figure 5 gives an idea on the distribution of different end-use applications for biomethane in Europe. The graph makes a distinction between use in transport sector, use in heating & cooling applications, use in industry (both process heat in industry as using methane as a raw material in chemical industry), biomethane consumption for electricity production and other applications. It must be noted that most countries do not have reliable data on the end-use application of their biomethane and counting methods can be different between countries.

For some countries, end-use pathways are quite clearly defined and regulated, e.g., in Sweden and Italy, the main end-use application is transport, whereas in the United Kingdom this is heating & cooling. Most of Sweden's biomethane is used in the transport sector due to a favourable support system. In Italy, the use of biomethane in the transport sector is facilitated by the fact that there is already both infrastructure and methane vehicle fleet. In 2014, the Italian government introduced the first obligation for the use of biofuels in the transport sector. In Germany, most biomethane is used for electricity production in CHP units. The use of biomethane for electricity production is favoured in Germany by the Feed-in Tariff, which is only granted to the biomethane plant when electricity is generated from the biomethane. In total 2,602 GWh of electricity and 3,608 GWh heat was produced in Germany in CHP units. On the other hand, in Germany, the usage of

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biomethane as transport fuel is indirectly supported through its inclusion into the list of fuels accepted for the reduction of GHG footprint for fuel distributing companies.

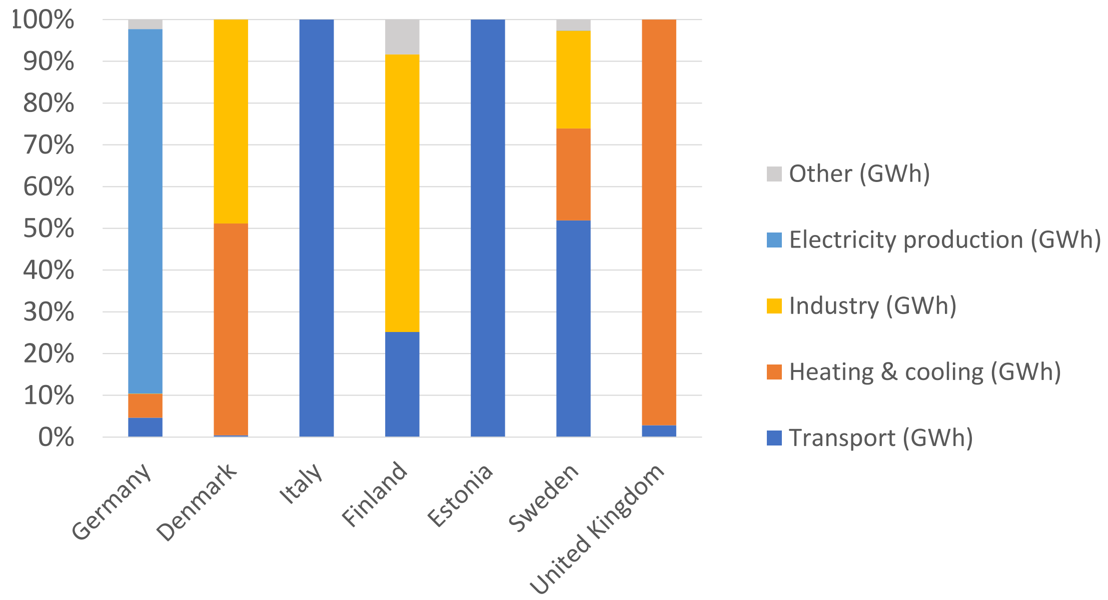

Figure 5: Consumption of biomethane per sector and per country (for countries where data is available)

3.2 Support schemes for biomethane in Europe

In this section, first, the different types of support schemes in place in Europe are explained. Next, an overview of the type of the support schemes and the height in different countries are given.

3.2.1 Type of support schemes

This report applies the definition below for the different types of support schemes.

Feed-in Tariff (FiT)[1,2,3] = A Feed-in tariff is a technology-specific support scheme providing a technology-specific remuneration per unit of renewable energy. Public authorities define and guarantee the tariff for a specific time period. Typical advantages are:

- Long-term contract with producer (often 10 -20 years)
- Guaranteed grid access
- Payment levels based on the renewable energy generation costs

Feed-in premium (FiP)[1,2] = A Feed-in premium is a bonus to be paid above the prevailing, pre-specified benchmark market price. It is a technology-specific subsidy level per unit of renewable energy at a pre-set, fixed or floating rate. The premium can be designed to estimate the avoided externalities of renewable energy generation, or to cover energy generation cost by the total payment. The two typical FiP designs are either a

[1] Couture, T. D., Cory, K., Kreycik, C., & Williams, E. (2010). A Policymaker's Guide to Feedin Tariff Policy Design. NREL/TP-6A2-44849.
[2] EurObserv'ER. (2015). Country Policy Profile Croatia. EurObserv'ER barometer
[3] Menanteau, P., Finon, D., & Lamy, M. (2003). Price versus quantities: choosing policies for promoting the development of renewable energy. Energy Policy, 31, 799-812.

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constant (fixed and predetermined) price or so-called sliding price allowing variations of the premium as a function of the prevailing price.

Quota/green certificates scheme (GC)[1,3] = In a quota/GC system, the production of renewable energy is encouraged by an obligatory target stating a specific share of renewable energy in the mix of producers, consumers or distributors. Often compliance is tracked by the trade of renewable energy certificates, which provide an additional supplementary revenue to electricity sales. Renewable energy generators benefit by selling their energy to the grid at market price and by selling certificates on the green certificates market.

Fiscal incentives[4,5] **=** Tax exemptions or reductions are usually additional (and minor) support systems. Renewable energy generators receive certain tax exemptions (e.g. carbon taxes) as compensation for the competitiveness of the renewable energy market and its development. The impact of fiscal incentives is dependent on the applicable tax rate.

Investment support = An investment support is a fixed amount received before, during or shortly after the building phase of the plant. It is independent of the amount of renewable energy production.

3.2.2 Support schemes in Europe

The support schemes in place with the biggest impact on the biomethane market in each country are summarized in Figure 6. Currently, the most often applied support scheme for biomethane in Europe is a Feed-in Tariff.

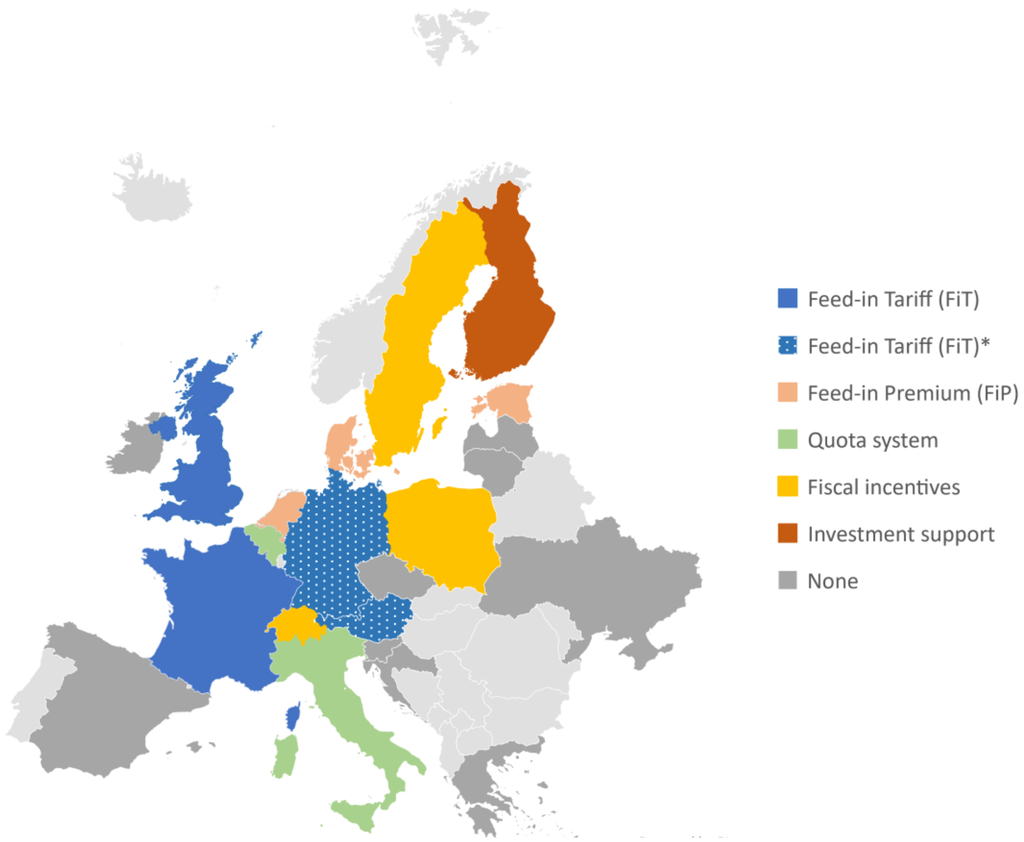

Figure 6: Support schemes in place per country

[4] EurObserv'ER. (2015). Country Policy Profile Croatia. EurObserv'ER barometer
[5] International Energy Agency. (2008). Deploying Renewables - Principles for Effecitive Policies. OECD/IEA.

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***In Austria and Germany, the support schemes apply only if the end-use of the biomethane is electricity production. In Belgium, the support scheme is only applicable in Wallonia.**

In Flanders, there is currently no operational support for biomethane. There is however a minor investment support in place.

In Figure 7 the preferred support scheme throughout Europe according to the REGATRACE survey is depicted. With 65 % of renewable gas producers and potential producers having a preference, a Feed-in Tariff is by far the most preferred support scheme, followed by a Feed-in Premium (15%) and a Quota/obligation certificates (14%).

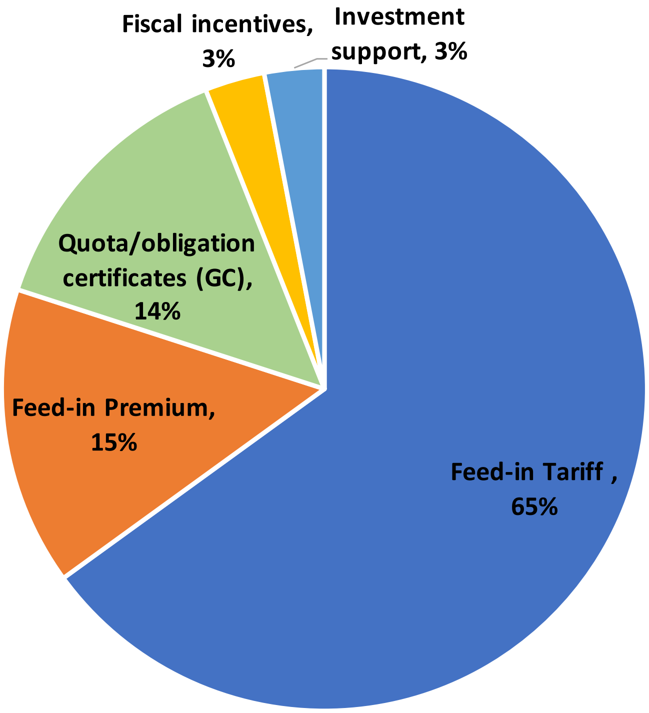

Figure 7: Preferred support schemes for Europe according to the REGATRACE survey

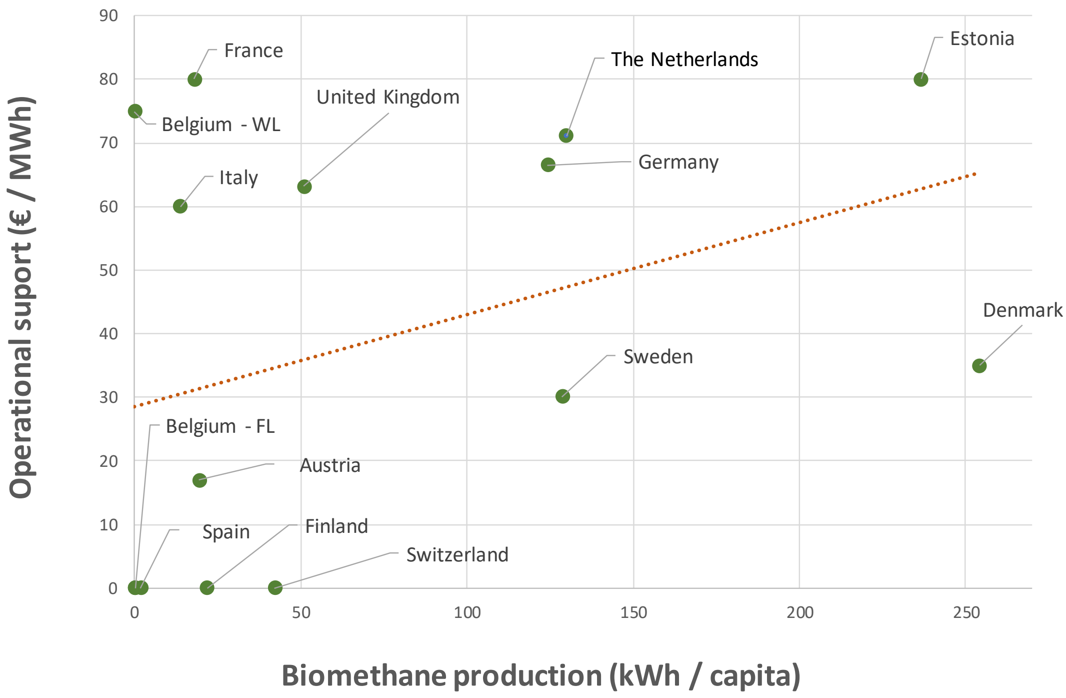

Figure 8: Height of operational support for biomethane per country set out against the amount of biomethane production in the corresponding country

Figure 8 sets out the height of the operational support for biomethane per country against the amount of biomethane produced in the corresponding country per capita. Although countries with high operational support are more likely to have higher biomethane production, this is not a 1-to-1 relation. Moreover, there are several countries (Spain, Finland and Switzerland) having no direct operational support in place and do have biomethane production. In Finland investment support for biomethane plants is in place. In Spain, there is one biomethane plant injecting into the grid, which was established via co-financing by the EU.

A trendline is given in red. Countries above the trendline have relatively low biomethane production compared to the height of the operational support in place. Countries below the trendline have relatively high biomethane production compared to the height of the operational support in place.

For Austria and Germany, the operational support indicated in figure 7 only applies when the end-use of the biomethane is electricity production. The plotted values for France, Germany and the Netherlands were calculated as the average values reported in Table 1. The operational support in Germany was calculated using the data from the Renewable Energy Act 2012 and considering an efficiency of 35%.

Table 1 summarizes the height of the operational support per country and the duration of the support.

Table 1: Height and length of support in countries having operational support for biomethane

Country	Operational support for biomethane (€/MWh)	Duration of the support (years)
Austria (1)	17	15

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Belgium – Wallonia (2)	75	20
Denmark	35	20
Estonia	80	5
France	60-120	20
Germany (3)	56-77	20
Italy	60	10
Sweden	30	Depends
The Netherlands	49-92	12
United Kingdom	63	20

(1) Austria: There are Feed-in tariffs for renewable electricity from biogas, according to the Austrian Renewable Electricity Act (ÖSG, Ökostromgesetz). Indirect support to biomethane was paid out in 2012 for the first time, following the concept that biomethane is injected into the grid, changes ownership from a biomethane plant operator to an electrification plant operator who provides renewable electricity. The FiT is thus paid to the electrification plant operator and NOT to the biomethane plant operator.
(2) Belgium - Wallonia: A new biomethane plant can only apply for operational support if the biomethane, produced via anaerobic digestion, is valorised in a new CHP-unit or multiple CHP units. A close mass balance between the production facility and the CHP-units valorising the biomethane, must ensure the single use of biomethane.
(3) Germany: The operational support for biomethane under Renewable Energy Law is only applicable when the biomethane is used for electricity production. The range of operational support for Germany was calculated using the data from the Renewable energy Act 2012 an considering an efficiency of 35%.

Overall, 13% of the (potential) producers of renewable gas in Europe report to be satisfied with the market situation in their country, 25% reports to be satisfied with the current support scheme in place.

3.3 Importance of different aspects of renewable gas for consumers

The choice experiment conducted in the online survey allows producers and potential producers of renewable gas to identify consumer preferences. The attributes and attribute levels used in the experiment are shown in Table 2. The experiment was conducted as explained in chapter 2: methodology. The relative importance in the decision-making process of different attributes of renewable gas are given in Table 2 and visualized in Figure 8. GHG emission reduction compared to natural gas is the attribute with the highest impact on consumers choice (29 %), followed by cost additionally to natural gas (27%), origin of the renewable gas (17%) and reliable delivery of the renewable gas (14%). The type of input materials (9%) and the length of the contract (4 %) play only minor roles in the decision-making process.

Table 2: Results of the choice experiment

Attribute	Relative importance	Attribute Level	Utility Value
GHG reductions compared to natural gas	29 %	0% GHG reduction	-0.94
		50% GHG reduction	0.56
		100% GHG reduction	0.37
Cost additionally to natural gas	27 %	EUR 5 / MWh	0.66
		EUR 10 / MWh	0.06
		EUR 20 / MWh	-0.73
Origin of the renewable gas	17 %	Domestic	0.44
		European	-0.44
	14 %	100 % reliability	0.40

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Reliable delivery of renewable gas		95% reliability	-0.05
		70% reliability	-0.35
Input materials	9 %	Energy crops	-0.22
		Waste and residues	0.22
Length of contract	4 %	1 year	-0.12
		3 years	0
		5 years	0.12

The utility value given in the last column of Table 2 expresses the relative influence of the specific attribute level on the consumers decision. Attribute levels with high positive values will influence the decision in a positive way. Consumers will be more likely to choose for a type of renewable gas when the gas has this specific attribute level. Contrary, attribute levels with large negative values will have a negative influence on consumer decisions. Attributes levels with small utility values will only play minor roles in consumers decisions.

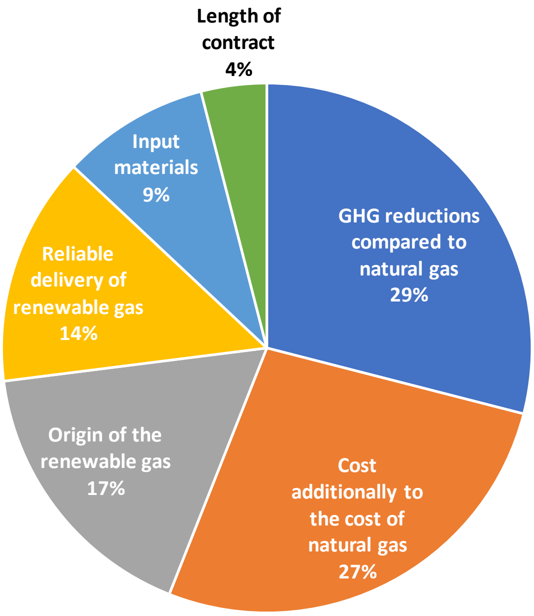

Figure 9: Attributes importance in consumers decision-making process for types of renewable gas

An excel sheet “Consumer preferences for types of renewable gas” is available. The sheet allows to make predictions of consumers decisions based on two profiles of renewable gas. An example of such a prediction is given in Figure 10.

Attribute	Importance	Level	Utility Value	Profile 1	Profile 2
GHG reductions compared to natural gas	29%	0 % GHG reduction	-0.94	100 % GHG reduction	0 % GHG reduction
		50 % GHG reduction	0.56		
		100 % GHG reduction	0.37		
Cost additionally to the cost of natural gas	27%	EUR 5 / MWh	0.66	EUR 10 / MWh	EUR 5 / MWh
		EUR 10 / MWh	0.06		
		Eur 20 / MWh	-0.73		
Origin of the renewable gas	17%	Domestic	0.44	Domestic	Domestic
		European	-0.44		
Reliable delivery of renewable gas	14%	100 % reliability	0.4	95 % reliability	100 % reliability
		95 % reliability	-0.05		
		70 % reliability	-0.35		
Input materials	9%	Energy crops	-0.22	Energy crops	Waste and residues
		Waste and residues	0.22		
Length of countract	4%	1 year	-0.12	1 year	1 year
		3 years	0		
		5 years	0.12		

Score profile 1	0.48
Socre profile 2	0.66
Best profile	Profile 2

Figure 10: Print screen of excel sheet "Consumer preferences for types of renewable gas"

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4 State of play of biomethane per country

4.1 Austria

Introduction

In Austria the first plant was installed in 2005, followed by other plants in 2007 and 2008. Today, there are 15 biomethane plants in Austria in other words biogas plants with an upgrading unit to provide biomethane of natural gas quality for grid injection. All biomethane plants are connected to the gas grid. Since there is no (direct) subsidy scheme available for the provision of renewable gas (status Q1 2020), the number of plants has only slowly increased in recent years and has not further increased since 2017. Although the biomethane sector has been stagnating, the producers and stakeholders have been active, also beyond the national borders in order to establish a European market of which Austrian producers and consumers of renewable gases could profit from. There are more than 400 biogas plants installed, providing renewable electricity from biogas. Their national subsidy contracts (Feed-in tariff for electricity) are running out continuously and the respective operators are hoping on a change in the subsidy scheme whether it is an extension of renewable electricity Feed-in tariff or an incentive to switch to the provision of biomethane upgrading and consequent grid injection.

Currently, there are no direct national incentives for biomethane production. There are Feed-in tariffs for renewable electricity from biogas, according to the Austrian Renewable Electricity Act (ÖSG, Ökostromgesetz). Indirect support to biomethane was paid out in 2012 for the first time, following the concept that biomethane is injected into the grid, changes ownership from a biomethane plant operator to an electrification plant operator who provides renewable electricity. The FiT is thus paid to the electrification plant operator and NOT to the biomethane plant operator. Also, such financial subsidies have to be monitored closely which is only possible via tracking the movement of renewable gas, in reality tracking the title transfer of the green value of gas.

Recently, in Q4 2019 the Austrian tax law was adapted allowing to receive a tax remuneration for renewable gas volumes consumed within Austria for different purposes from January 1st, 2020 onwards. Still, an implementing regulation is pending to specify the procedures, quality criteria of renewable gases and organisations facilitating the tax remuneration.

AGCS Gas Clearing and Settlement AG, in its role as balance group coordinator for the Austrian gas market, has been operating the Biomethane Registry Austria since 2012, as requested by the Austrian Renewable Electricity Act (ÖSG, Ökostromgesetz). The main purpose is to create Certificates to be accepted by the national Renewable Power Settlement Agency (OeMAG, Abwicklungsstelle für Ökostrom) which manages the national subsidy budget/scheme for renewable electricity.

The AGCS Biomethane Registry Austria counts 42 account holders:

- 14 biomethane production plants
- 10 electrification plants
- traders (registry users)
- 10 auditors
- 1 Subsidy scheme agency, national Renewable Power Settlement Agency (OeMAG)
- 1 foreign registry (German Biogas Registry, operated by dena, German Energy Agency)

Austria depicts the example of having different competent authorities according to the respecting application of biomethane interacting on the national market to cover different specific purposes of biomethane end

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uses. Apart from the Biomethane Registry Austria, the Environmental Agency (UBA, Umweltbundesamt) operates the national registry for sustainable biofuels. The energy regulator (E-Control) is responsible for issuing Guarantees of Origin for the purpose of labelling according to Article 19 RED II. Each registry operates based on a separated IT-system, which requires interconnection via sophisticated processual and technical solutions as any possibilities for double counting must be prevented.

Regulatory framework and subsidy scheme

As mentioned above, there are no direct national incentives for biomethane. There are Feed-in tariffs for renewable electricity from biogas, according to the Austrian Renewable Electricity Act (ÖSG, Ökostromgesetz). This Act was implemented in 2012 and revised several times. Two important revisions for the biogas/biomethane sector took place in 2017 and in 2019. The 2017 revision, provided a three-year prolongation of then-current Feed-in tariffs only to plants of the following criteria: plants which would run out of the FiT within the next 60 months and plants with the ability to fulfil certain (sustainability) criteria: i) cap on use of grains/cereals and maize at 60% of the substrate mix, ii) 60% conversion efficiency/fuel efficiency, iii) concept for raw material supply for the next five-year-period, iv) economic concept to operate the facility without national subsidies after 20th year of operation, v) Heat/heating meter device count of heat, vi) off-site controlling of the facility must be possible.

The most recent revision in September 2019 provides the prolongation of current Feed-in tariffs only until a newly developed Austrian law, the Renewable Energy Expansion Act (EAG, Erneuerbare Ausbau Gesetz), will be implemented. This law is considered to be a corner stone for Austria to reach its 2030 climate and energy targets but not yet published (status Q1 2020). The Austrian NECP (national energy and climate plan) focusses on 5 main dimensions being i) decarbonisation, ii) energy efficiency, iii) security and energy supply iv) domestic energy market, v) research, innovation and competitiveness.

The draft of the expected Renewable Energy Expansion Act is already being prepared and its implementation will be responsibility of the government, to be formed after national elections end of September 2019. The new government, compiled of the Austrian Peoples Party (ÖVP, die neue Volkspartei) and the Austrian Green Party (die Grünen), starts its work in early January 2020. In the governmental programme, the target “Combating climate change and compliance with Paris climate goals” is listed as the 2nd of eight official targets indicating Austria’s commitment to tackling climate change.

There are yet no details available on the law but the ÖSG revision mentions coming incentives for biomethane in order to fulfil a national “greening the gas” strategy.

The recently published (11.09.2019) Gas Labelling Regulation (G-KenV, Gaskennzeichnungsverordnung) covers the request of RED II for gas labelling (Article 19). It requests the identification of the source of gases by energy suppliers in the form of a percentage breakdown of the natural gas, renewable and other gas energy sources for end consumers on their energy bill and empower the Austrian regulator (E-Control) to be issuing body for Guarantees of Origin. The regulation is effective as of January 1st, 2020 but only on a voluntary basis until the newly Renewable Energy Expansion Act is in place or the deadline to implement the REDII is reached.

Regulatory framework on imported biomethane

No biomethane imports into Austria have been conducted. Exports to Germany were conducted on the basis of a bilateral agreement between AGCS and the German biogas registry (operated by dena).

In 2016, AGCS, operator of Biomethane Registry Austria, has established a bilateral cooperation agreement with dena (German Energy Agency, operating the German Biogas Registry) which was the first of its kind at date of establishment. The goal is to exchange certificates for renewable gases between both registries, thus between both markets. With this cooperation agreement and the establishment of the necessary interface

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and required processes, the Biomethane Registry Austria enables the Austrian stakeholders to sell their product on the German market or to purchase German renewable gas respectively. Such exchanges can be operated on a book and claim or mass balancing base, although the interconnection of registries/markets via the ERGaR RED MB Scheme will allow the harmonised exchange on basis of mass balancing of gas consignments along the European gas grid.

Market environment and feasibility of biomethane projects

There is no well-developed market of biomethane in Austria due to limited number of volumes and production plants. Hence, the produced volumes are used for various purposes such as FiT for electricity, transport, labelling and free market (Marketing purposes). The gas suppliers and fuel supply companies as well as industrial companies are aware of renewable gas, but the benefits have not yet been established to produce and use renewable gas in Austria widely.

Biomethane for use as biofuels

There are no counted volumes of sustainable renewable gas/biomethane used in the transport sector in Austria. The national quota on biofuels is covered via liquid biofuels. Hence, several fuel stations for gas exist, also at location of or located next to a biomethane production plant. But these volumes are only sold for marketing purposes without the necessity to audit them based on the requirements to count it towards the national biofuel quota.

However, preparations are finalised for the first biomethane consignment to be counted towards the national biofuels sector. The Austrian Environmental Agency (UBA, Umweltbundesamt) operates the national registry for sustainable biofuels and has entered an agreement with AGCS, the operator of the Biomethane Registry Austria, to prevent any double-counting or double-sale by creating an interface between both organisations. The agreement is titled “Exchange of information on volumes of biomethane injected into the gas grid and subsequently uses as biofuel in the transportation sector”.

Grid connection investment costs

There is no law to approve shared cost for grid access. The operator must cover such costs. However, local subsidies might be accessible in specific cases. There might be differences in how regions deal with the grid connections.

4.2 Belgium

Introduction

The biomethane sector is still premature in Belgium. However, a lot started moving when the first, and for now only, biomethane plant began production and injection of biomethane at the end of 2018. A new subsidy scheme for biomethane production was installed in Wallonia, together with the development of a registry system for guarantees of origin for renewable gases. In turn, the Flemish government decided in 2019 to expand the existing registry system for renewable electricity to renewable gases. Meanwhile, a voluntary registration system for renewable gases was created by Gas.be, the association of gas distributors in Belgium. There are no specific targets for biomethane, and the current subsidy systems are likely not enough to create a large expansion of the biomethane sector in the coming years.

Regulatory framework and subsidy scheme

<u>FLANDERS</u>

Anaerobic digestion: quota system

The operational support for biomethane is an expansion of the regulation that was already in place to produce biogas. A new biomethane plant can therefore only apply for operational support if the biomethane, produced via anaerobic digestion, is valorised in a new CHP-unit or multiple CHP units. A close mass balance between the production facility and the CHP-units valorising the biomethane, must ensure the single use of biomethane.

New biogas installations with an upgrading unit, in combination with a CHP, can apply for an operational support for the production of green electricity and heat. The main goal of the operational support is to overcome the production cost of renewable energy in comparison to fossil energy. For the production of green electricity, the owner of a biogas plant can apply for 'groenstroomcertificaten' (GSC – green electricity certificates). For the reduction of primary energy use, achieved due to the use of a CHP engine, the owner can apply for 'warmtekrachtcertificaten' (WKC – CHP certificates). The operational support is only available for biogas installations with feedstock limited to agricultural waste, organic industrial waste, and organic waste from households. Biogas production from wastewater treatment is not supported.

To increase the use of renewable energy, each energy supplier in Flanders is obliged to fulfil certain quota, imposed by the government. The quota for GEC increases each year with as final goal a 20,5% share of renewable electricity in the energy suppliers' portfolios by 2020. For CHP the quota is a fixed percentage of the total electricity demand of each supplier. For the period 2017-2019 the quota is 11,2%, starting from 2020 it is decreased to 9.3%. After 2020 the quota is fixed on 7%. A biogas operator can also present his certificates to the local DSO, who is obliged to purchase these certificates at a fixed minimum price.

The minimum price per MWh renewable electricity produced is 74.4 €/MWh. The total subsidized electricity production is topped off. Over a period of 17 years 108.000 to 116.550 production hours are supported. The number of production hours equals the average electricity production of the existing biogas pool over a period of 15 years. With this regulation the Flemish government wants to stimulate the flexible production of electricity. The minimum price for the reduction of primary energy use is 31 €/MWh for a period of 10 years. The subsidy can be renewed for another 10 years when the CHP is replaced.

Starting from 2020, no new applications for the operational support of a biomethane installation were granted by the Flemish authorities. It is still unclear if this situation will change over time. In the coalition agreement of the new Flemish government (2019 – 2024) an alternative support scheme for biomethane was promised, but no further steps were taken to this date. To conclude, it is theoretically possible to receive operational support for biomethane, but in practice no new subsidies were granted after the first (and for now only) biomethane plant.

Biomethane production: investment support

Enterprises who are willing to invest in the production of biomethane, either from anaerobic digestion or gasification, in the Flemish region, can apply for an investment support. The Flemish government organizes at least every 12 months a call during which applications can be submitted. The accepted applications are evaluated and ranked according to cost-efficiency and the predicted CO_2 reduction over a 10-year production period. The available grant amount is divided under the accepted projects according to the ranking until the budget of the call is spent.

Depending on the size of the enterprise, only a certain percentage of these costs is applicable for the investment support: 65% for small enterprises, 55% for middle size enterprises and 45% for large enterprises. The total budget per call for biomethane projects is €1,000,000.

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The investment support can be combined with the operational support if the upgrading unit is part of a new biogas installation with the valorisation of the biomethane in a CHP-unit. For gasification there is no operational support.

Gas vehicles: tax benefit

The owner of a gas vehicle is exempted from the annual traffic tax and the registration fee of the vehicle until the end of 2020. Any tax benefits after 2020 are still undecided. The height of the tax and registration fee depend on the type of vehicle and other characteristics such as the environmental impact and age of the car.

Companies investing in light duty gas vehicles for professional use can apply for an eco-bonus of 15% to 30% of the investment costs of the vehicle.

WALLONIA

Operational support for biomethane (anaerobic digestion, P2G, gasification: quota)

The operational support for renewable gases in Wallonia became only operational last year (2018). The support scheme is based on a system of guarantees of origin (GO's), issued by the regional regulator for gas and electricity, CWaPe. Only renewable gas from a biomethane plant situated in Wallonia and injected into the gas grid can apply for these GO's.

Operators of biomethane installations can sell their GO's to CHP-units working on natural gas and situated in the Walloon region. The CHP-units receive extra green certificates (GC) for using renewable gas. The number of extra GC depends on the environmental impact of the renewable gas, the share of renewable gas used and the market conditions (e.g. natural gas price).

The system of green certificates is similar to the system in Flanders. The GC are issued based on the production of electricity from high-efficiency CHP or renewable sources. Per technology there is a fixed number of GC available. At the start of a project, each producer must reserve the number of GC based on an estimation of the production volume over a period of 20 years. The subsidy will only be granted if there are still enough GC available.

The producer can sell the GC to energy suppliers or to the TSO. Each energy supplier in Wallonia is obliged to fulfil certain quota, imposed by the government. Alternatively, the GC can be sold at minimum price (€60/MWh) to the TSO. The number of GC is based on the net electricity produced, multiplied with two factors considering the profitability of the project and the impact GHG reduction.

This operational support is only applicable for fossil CHP operators, purchasing gas from a biomethane/biogas installation. This excludes P2G and/or gasification units. Currently it is unclear if Power-to-Methane, using a biogas reactor to convert green hydrogen to biomethane, is considered equivalent to a classic biogas/biomethane plant. In that case, it would be applicable for the operational support.

Investment support

To encourage the use of sustainable energy, enterprises in Wallonia can apply for an investment support when investing in the production of renewable energy or high-efficiency cogeneration. The investment support is only applicable for a certain percentage of the total investment. The percentage diminishes according to the size of the enterprise. Small enterprises receive 27.5% for project with an installed capacity below or equal to 600 kWe, and 22.50% above 600 kWe. For large enterprises the percentages are between 9% and 16.5%, according to the size and the area.

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When investing in a biogas installation, an extra investment support can be received. Depending on the installed capacity the extra investment support counts for 8.25% (≤600 kWe) or 6.75% (>600 kWe) of the eligible costs.

BRUSSELS

No support mechanism in place for biomethane production

Market environment and feasibility of biomethane projects

The biomethane market is still in a developing phase in Belgium with only one small producer in Flanders. There is a slow development of new biomethane projects, because of the strong dependency on operational support. The support schemes in Belgium resulted from existing support schemes for the production of renewable electricity from biogas. The current development of the biomethane sector is closely linked to the boundaries set by the support schemes. These boundaries prevent to realize the full biomethane potential in Belgium.

In Flanders as well in Wallonia, this support is linked to the valorisation of biomethane in a CHP. The high production cost is compensated by green electricity certificates granted to the CHP-owner. Therefore, a close and steady collaboration between the biomethane producer and the CHP-owner is essential for a fair retribution. This limits the outlets for biomethane and therefore limiting the development opportunities.

The only available Belgian biomethane is sold B2B via a voluntary registry system (Green Gas Registry). In Flanders and Wallonia both gas regulators (VREG and CWaPe) are developing a registry system for renewable gases, based on recent regulations. The impact of these registry systems is difficult to predict, because both systems are not operational yet.

Based on these observations new biomethane projects will probably arise on existing biogas installations, expanding their activities with biomethane, existing biogas installations at the end of their support time willing to invest in thorough renovations or new large-scale developments fitted to the existing support scheme. Since there are no specific targets for biomethane currently in place, there is no radical change expected of the current subsidy schemes to boost the production of biomethane.

Because of the limited supply of biomethane in Belgium, some enterprises buy foreign guarantees of origin for biomethane, mainly from the Netherlands and United Kingdom. There are no numbers available on the price of this transactions or the amount of biomethane traded.

Biomethane for use as biofuels

Currently, the domestic produced biomethane is not used as a transport fuel in Belgium.

Nevertheless, the first CNG station with 100% bio CNG recently opened, using foreign GO's.

Preferential access for the domestic biomethane producers

Yes, the injection of biomethane has a preferred access on the grid. It is injected on a higher-pressure level than the existing pressure level in the local gas grid. This is a voluntary decision of the grid operators and not regulated.

Grid connection investment costs

FLANDERS

There are no regulated agreements yet on the investment costs for grid connection in Flanders. Nevertheless, the local DSO wants to stimulate the production and injection of biomethane. Therefore, they manage an arrangement to support pilot projects. The investment cost for the injection point is for the account of the producer, except for the components for gas control and odorization. If the gas grid must be expanded to connect the biomethane facility, the investment cost is charged to the producer. Because these arrangements are not yet regulated, modifications are expected soon.

WALLONIA

The injection point with quality control is installed by the local DSO. The investment cost is charged to all users of the distribution network. The operational cost is charged to the biomethane producer.

BRUSSELS

No information available.

4.3 Czech Republic

Introduction

Biomethane sector is not yet present in the Czech Republic. It is foreseen as a potential tool enabling compliance with 2030 EU targets on advanced biofuel quota (3.5% in transportation fuels). There is no strategic governmental target explicitly mentioning biomethane or any other renewable source of energy. Renewables are supported by ad-hoc strategies only to the extent of fulfilling EU bounding targets.

Regulatory framework and subsidy scheme

There is no subsidy scheme related to biomethane production. There is a general investment support available to farmers under the scope of Rural Areas Development Program. This program is accessible to farmers, supporting projects diversifying their economic activity beyond agriculture (breweries, tourism, renewables, etc.). Maximal support is set to 4,500,000- CZK, approximately 175,000- Euro.

Market environment and feasibility of biomethane projects

There is no biomethane market in the Czech Republic. The only financial sources are private equity risk ventures, who may possibly invest in biomethane production facilities, aiming at exporting biomethane abroad.

Biomethane project feasibility is clearly bound to market opportunities abroad, where motivated customers may be supplied.

The Czech government is targeting strong development of nuclear energy throughout the 21st Century. The only possible market niche available to biomethane may be in post-2020 EU targets on advanced biofuels, since biomethane can, under certain circumstances, fulfil the required definition of an advanced biofuel. However, since the double-counting is allowed, there will be a natural cap of 1.75% share in transportation fuels only.

Biomethane for use as biofuels

Biomethane may be used as an advanced biofuel in post-2020 scenarios, thus fulfilling the EU binding quotas. Since double-counting is allowed, biomethane will only reach share of 1.75% (double-counted reaching the required 3.5%).

Preferential access for the domestic biomethane producers

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No, there is no preferential access for domestic biomethane. Any preferential access conditions would be treated as a non-fair business advantage in line with EU business regulation legislation.

Grid connection investment costs

The Biomethane producer would invest all what is related to the grid connection. The grid operator would invest all what is related to the grid update.

4.4 Croatia

Introduction

In the draft of the *Energy Development Strategy of the Republic of Croatia until 2030 with an outlook for the period until 2050, October 2019* strategic goals for the biomethane sector are not specifically mentioned. It does not say how much biomethane should be in a natural gas mixture or its share in transport or anything similar. Biomethane / compressed biomethane (CBG) is continuously referred to in the text as part of natural gas.

Generally speaking, according to the Strategy proposal, biomethane will be used, but it is not clearly defined when, or where or what the economic background is. It is only clear that biomethane is "drowning" in natural gas in the document.

Regulatory framework and subsidy scheme

Biomethane as a separate component in the Strategy is not covered, nor are the premiums, incentives, etc. However, when it comes to security of supply and distribution (chapter Security of energy supply) it is stated that it is necessary to diversify gas supply routes and increase gas storage facilities. There is no specific reference to natural gas, although it is to be assumed.

Market environment and feasibility of biomethane projects

According to the document, biomethane should go into the gas network and be sold with natural gas. To what extent, quantities, etc. - is not stated.

Biomethane for use as biofuels

According to the text of the document, in the period until 2030, in the transport sector, the emphasis will be on the construction of new infrastructure for the use of liquified natural gas (LNG), compressed natural gas (CNG) and CBG, electricity and hydrogen.

Preferential access for the domestic biomethane producers

The Strategy states that, through local self-government, in terms of mobilizing biomass potential, farmers would become part of the biomass supply chain (which they are now) and increase the participation of utility companies, establish biomass collection and logistics centres, or create biogas cooperatives. This would boost biogas production. This is probably clear without a strategy. On the other hand, what this biogas / biomethane will be used for is not emphasized, nor what would be the position of "domestic" biomethane relative to natural gas.

Grid connection investment costs

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Construction of energy infrastructure for gas includes the construction of a pipeline for the transportation of natural gas and biomethane and its storage in facilities. Of course, it is not specifically stated how much biomethane is expected in the grid, nor how much it will cost.

4.5 Denmark

Introduction

Denmark started to promote biogas and electricity from biogas production in the mid 70'ies, early after the first oil crisis. The first farm-scale biogas plant was established in 1975, while the first centralized biogas plant was built in 1984. In June 2018 the Danish Parliament adopted a new energy agreement backed up by all political parties. The agreement states that Denmark, in line with the Paris agreement, will work to reach zero net emissions in 2050 and 55% renewable energy in 2030.

Regulatory framework and subsidy scheme

Up until now the biogas sector in Denmark has been supported with subsidies for upgraded biogas (biomethane), combined heat and power, transport and process industry. The current biogas subsidy scheme will be closed for new plants in 2020. Biogas plants in operation will, however, be guaranteed until 2032 or at least 20 years from commissioning for each plant. New biogas production for electricity production can only get the same subsidy as solar power and wind based on tenders. Biogas in Denmark is exempted from CO_2-taxes, and upgraded biogas, which has been injected to the grid, is tax wise regarded as natural gas and taxed with CO2 and energy taxes (Danish Energy Agency: Support to biogas & Production of biogas). Gasification is subsidized the same way as combined heat and power and there is currently no subsidy for power-to-methane, however it might receive support from future support scheme decided by the energy agreement.

Furthermore, there is a scheme in place in Denmark for biomethane certificates. These certificates are issued to the biomethane upgrading plant and when sold allows the gas supplier to document to a gas consumer that renewable gas has been injected to the gas grid and has substituted natural gas. The system has been a voluntarily agreement since 2011 and are made so that it can handle all RE-gasses but are currently only running for biomethane. The certificates fulfill the criteria described in art 19 of REDII (Energinet: Biomethane certificates).

Market environment and feasibility of biomethane projects

Historically investment subsidies have been a key factor regarding feasibility of biomethane projects. In the 80's, such grants could go up to 40% of the plant building costs. Later, such subsidies were reduced to 30%, 20%, and completely ended in 1997. Investment subsidies were later revived in 2009 (maximum of 20%) and increased in the 2012 Energy Agreement (30%). The various iterations of the Danish legal framework towards biogas production helped to sustain the growth in production of biogas energy and in the period 2011 – 2017 a clear shift from biogas plants to biomethane plants was observed. Investment subsidies was phased out since 2012 with introduction of the current FIP scheme. With the new support scheme, the increase in biogas projects might stagnate (Danish Energy Agency: Support to biogas). New projects will be in competition for the subsidy pool as this will be put out to tender. New biomethane projects will therefore have to look for financing in other places, e.g. by selling biomethane certificates to increase the value of the gas.

Biomethane for use as biofuels

It is statutory in Denmark to add a minimum of 5.75% (energy percentage) biofuels in fuel sold for transportation on land. Biofuels are bioethanol mixed in gasoline, biodiesel mixed in diesel and biomethane mixed in natural gas. Biofuels based on waste and residue, so called 2nd generation, counts double regarding

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meeting the requirement. To document the share of biofuels the before mentioned guarantees of origin are used. Furthermore, the biofuels must meet the sustainability criteria set by the EU. Most Danish biomethane plants are certified to produce REDII compliant sustainable biomethane for use in transport under biofuel quotas. (Danish Energy Agency: Biofuels).

Preferential access for the domestic biomethane producers

Gas grid operators are obliged to connect biomethane plants upon request. But the injected gas has no preferential use as compared with domestic natural gas production and import.

Grid connection investment costs

All direct costs related to grid connection are paid by the biomethane plant owner. Net reinforcement and other net related costs are paid by the grid operator via tariffs.

4.6 Estonia

Introduction

Biomethane sector started to develop 10 years ago in Estonia, when EC IEE co-funded GasHighWay project "Promotion of methane based gaseous fuels in transport" (2009-2012) has organized 6 awareness building events, several CNG vehicles test drives and published successful case studies from other countries.[6] Ministry of Economic Affairs and Transportation of Estonia (MKM) is responsible also for Energy, including renewable energy. MKM prepared and Government of Estonia adopted the Estonian Long-Term Energy Strategy till 2030 in 2018, where biomethane plays an important role in achieving the national target of usage of 10% renewable fuels in transport by 2020. MKM estimates, that biomethane will ensure 5-8% of this target by 2030. Currently the regulation is adopted, which support the biomethane use is public buses, investment support for building CNG stations with obligation to sell biomethane and feed-in-premium for biomethane producers. Biomethane is also tax-exempted and in long term biomethane certificates are tradeable with biofuel 10% blending obligation of liquid fuels. The first biomethane plant Green Gas OÜ started to produce biomethane in annual capacity of 5-6 million Nm3 from aspen pulp wastewater in the first quarter of 2018. The second biomethane plant Biometaan OÜ started to produce biomethane in annual capacity of 1.3 million Nm3 from agricultural residues and biomass in June 2018. Few next biomethane plants will hopefully start to produce biomethane after 1 year, in 2020.

Regulatory framework and subsidy scheme

The regulatory framework supports almost all parts of the value chain of the AD based biomethane production and consumption in Estonia. Currently gasification and power-to-methane production is not taking place in Estonia, even though on pilot level these technologies have been introduced and feasibility assessments have been elaborated. However, according to the knowledge of Estonian Biogas Association, any investment decisions have not been made concerning gasification and power-to -methane production.

Regarding the biogas policy development, The Ministry of Economic Affairs and Transportation of Estonia (MKM) has adopted the new regulation to support biomethane producers until 2023 with feed-in premium in order to cover the price gap between biomethane and natural gas on 13.09.2017. To ensure the feasibility of

[6] During the GasHighWay final conference the vice minister made statement, that biomethane is one of the governmental priorities and this statement was supported from EU energy sector structural funds, among 4 energy sector priorities' one was „Biomethane in transport" in Estonia during 2014-2020.

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biomethane production in the long term the biomethane certificates can be traded with liquid biofuel mixing obligation.

A Feed-in premium is used in Estonia to pay a bonus to the biomethane producers with floating rate, which depends on the natural gas price in Baltic Natural Gas Spot. So-called sliding price allowing variations of the premium as a function of the prevailing natural gas price. Conditions and procedures for the use of support for the development of the biomethane market are stated in MKM Regulation nr 50, adopted at 13.09.2017. FiP is based on a biomethane certificates system. Estonian Transmission system operator (TSO), Elering, will issue the producer a biomethane certificate, which certifies that the gas biomethane, has been produced from renewable energy sources. The biomethane registry, which is managed by Elering, is the system, where certificate issuance, certificate transfer and certificate cancellation takes place.

The manufacturer can sell the biomethane molecule and certificate separately. The biomethane producer will receive a FiP based on consumption of the biomethane certificate in transport at € 100 per MWh minus the average market price of natural gas during the previous month in Baltic GET. The FiP from a certificate on non-transport consumption is € 93 per MWh minus the average market price of natural gas during the previous month in Baltic GET. The FiP is paid to the biomethane producers during 01/2018 - 12/2023). It is expected to pay out nearly 43 million euros to biomethane producing companies, the funding for which will be sourced from carbon credit revenues.

The MKM Regulation nr 135 was adopted 24.11.2015 and includes the investment support for methane public buses. Up to 30% from total investment cost is supported, not less than 400 000 euro and not more than 4,000,000 euro. The first positive case was implemented by the Pärnumaa Public Transport Centre.

The same Regulation nr 135 also states the support to CNG filling stations. Eesti Gaas has built 5 CNG stations before this CNG filling station support started during 2009-2015. The investment support conditions are following: (1) CNG filling should be fast filling station and opened to the public access; (2) 35% support to CAPEX, maximum 350,000 euro per project. During the first round in 2016 3 CNG filling stations received the support and built 3 new CNG stations. By 2019 the number of CNG stations has increased till 16, one of them is 100% compressed biomethane filling station in Koksvere, operated by the Biometaan OÜ. Next 10 CNG filling station projects are under development, so by the end of 2022 we hope to have around 26 CNG/CBM filling stations in Estonia.

Regulatory framework on imported biomethane

Biomethane is not imported physically to Estonia. According to the current knowledge the import of biomethane requires bilateral agreements between import-export countries in order to ensure equal possibilities for companies.

Market environment and feasibility of biomethane projects

The market environment is favourable to biomethane producers and consumers via FiP, as explained above. The main financing source for FiP is national carbon credit fund in Estonia, which makes biomethane production feasible. After 2023, when FiP system ends, the biomethane certificate can be trade with fuel companies, which have 10% renewable fuel blending obligation and they can fulfill this obligation also with biomethane certificates. Thus, the price of a certificate after 2023 will be similar to the price of renewable liquid fuels. This ensures the long-term feasibility of biomethane production.

A consortium of Estonian (Balti Biometaan OÜ), Swedish (Energiforsk) and Dutch (ECN and Energy Valley) companies completed the study “Development of Biomethane Based Fuel Market in Estonia” in 2016. Several policy measures and incentives were described in this study and selection of measures are implemented in

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Estonia since then (FiP, biomethane certificate trade with liquid renewables, investment support to biomethane buses and filling stations, Biomethane Council and awareness campaigns etc).

All biomethane is used in the transport sector in Estonia. City after city e.g. Tartu, Pärnu, Kuressaare and Tallinn will use CNG buses in public transport. There are 16 CNG stations in Estonia. 70% of CNG consumption in transport is biomethane.

Biomethane is marketed in blend with natural gas, but in practice the biomethane molecules reach to filling station only in one place (Koksvere biomethane filling station) in Estonia, in other cases the biomethane molecule is used in natural gas pipe system in food industry and in heating sector and biomethane certificates are cancelled in transport.

Biomethane for use as biofuels

Sustainable biomethane is used and reported as biofuel for transportation in Estonia via biomethane certificates cancellation. Compressed biomethane is sold in one dedicated biomethane Koksvere filling station.

Biomethane can be supplied to the motorists in bled with natural gas in any blending ratio in future, as biomethane has the same calorific values, as natural gas. The quality of biomethane is stated in governmental degree.

Preferential access for the domestic biomethane producers

Domestic biomethane production has no preferential access as compared with domestic natural gas production and import. Natural gas is not produced in Estonia. Natural gas import via pipeline takes place from Russia and in LNG mode from Russia and from Lithuania. The Baltic Connector will be built in coming years, which is pipeline between Estonia and Finland under Gulf of Finland in Baltic Sea. Also, the LNG terminal will be built in Paldiski, in Estonia in coming years. Biomethane access to pipe is regulated only via biomethane quality control. If biomethane fulfils the requirements, then there is neither restrictions nor preferences to the assess to natural gas pipe.

Grid connection investment costs

The grid connection investment costs are shared between the grid operator and biomethane producers in following way: the biomethane producer will pay the grid injection cost (project design, pipes, safety, etc) in 2 steps. First step is directly the injection related cost till the border of its property plot. Grid operator provides the technical requirements for this. Secondly, biomethane producer pays to the grid operator the gas pipeline network connection fee according to the agreement between biomethane producer and grid operator. Then grid operator builds the connection from producer’s property till gas pipe network, installs the measuring equipment and requires the installment of biomethane on-line quality control (gas chromatograph) or access to the gas chromatograph data, if the chromatograph is installed to the producers site in distance in the case of virtual pipeline.

4.7 Finland

Introduction

The Finnish biomethane sector is at its early stages in its development curve, but its future looks promising. The national biogas action plan (published in January 2020) defines the measures for the sector until 2024. The action plan was drafted together with all the relevant ministries and stakeholders. In 2020 starts most likely the work to set the 2030 targets for the sector and to define also the measures to reach those targets.

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There are currently no government strategic targets in place for biogas or biomethane, but there is a target for the number of gas vehicles: 50 000 passenger cars by 2030. The Finnish biogas sector aims at raising up the targets in the context of revising the national energy and climate policies by 2022.

There is natural gas network only in the southern part of Finland. The gas network, LNG terminals and off-grid biogas production constitute the Finnish gas infrastructure. Only three biogas plants locate along the gas grid, hence the role of off-grid biogas production is crucial.

Regulatory framework and subsidy scheme

The most important subsidy schemes are the investment aid and that biogas/biomethane is exempt from excise duties. The subsidy scheme is currently under development.

Biogas and biomethane in all end-use applications (electricity, heating, transportation) are exempt from excise duties. Finland has not notified the subsidy scheme to the European Commission so far; Finland is currently estimating whether to continue with current system or replacing it with another subsidy scheme.

Energy aid is a state grant for investment projects that promote the use or production of renewable energies, advance energy efficiency and reduce the environmental effects caused by energy production and use (not applicable for farms). The support allocated to investments in renewable energy production facilities and can make up to 30% of the project’s overall cost, 40% for the projects with the use of new technology. The grant is available between 1.1.2018-31.12.2022. In 2019 there has been an additional call for investment aid application for large-scale demonstration projects on new energy technology. In 2019, the ministry allocates 40 € million for this call.

There is a separate investment aid scheme for agriculture (the grant period is 2014-2020): A farm or consortium of farms producing energy for its own use can apply for investment aid of maximum 40 per cent, or maximum 30 per cent investment aid when selling the energy for customers outside the farm.

Additionally, between 2018-2021 there is investment aid for filling stations investments and converting passenger cars to gas (1,000 € per car).

Regulatory framework on imported biomethane

Imported biomethane is exempt from excise duty and custom fees. Natural gas is duty free when coming from outside the EU, but the VAT and excise duties shall be carried.

Market environment and feasibility of biomethane projects

The subsidy scheme is currently under development, e.g. transportation and energy taxation systems are under estimation. Also, the utilization of the manure-based biogas subsidy scheme is currently being discussed. Of course, the new agriculture policy for 2027 (CAP) will have its role to play when it comes to the agri-biomasses, and it is not yet clear how the CAP27 actually treats biogas projects in the future. The key elements of the subside scheme entity will hopefully be decided by the end of 2020.

The Finnish gas market will be opened to competition at the beginning of 2020 and at the same time Finland, Estonia and Latvia constitute a common gas market. In 2018, only about 10% of the biomethane was injected to the gas grid in Finland.

In 2018 about 1 TWh of biogas was produced of which biomethane represented about 0.10 TWh. According to the many studies, the techno-economical biogas production potential of Finland is about 10 TWh, and the theoretical production potential up to 25 TWh. By 2030 the biogas production could be about 4 TWh in Finland. Currently most of the biogas is produced from biowaste and sewage sludge. Landfill gases represent

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one third of the biogas production. Agri-biomasses and manure are only marginally treated in biogas plants, but they are considered being the input with most potential for the new biogas plants in Finland.

The mid-term and long-term market conditions of biogas and biomethane look very promising; however due to the unclear subsidy policy, in 2019 many investment plans are put on hold until the conditions are clearer and set. Political decisions have a big impact on the market conditions, because the markets are still in the very early developing phase.

The Finnish government gives its support for the development of the national biogas sector. Biogas, biomethane and nutrient recycling are indeed well present in the government program for 2019-2023 (published in June 2019). The biogas has been linked with the tasks aiming at de-carbonizing transportation and agriculture sectors, and with improving competitiveness of the Finnish food production amongst others.

When it comes to financial issues, state aid will play a significant role until the demand in biomethane from transport sector and industries will raise up above the critical level of the profitability. This is expected to take some years. The development of markets for organic fertilizers also matters, but this will most likely take more time. The investment potential of biogas and biomethane are very good, and the investors are looking for competitive financing solutions.

In the coming years, there will be more focus on safety and quality issue along the whole value chain of biogas and biomethane. Additionally, the treatment of digestate and development of organic fertilizer products is gaining more and more attention, not only because of environmental reasons but also from the financial terms.

Biomethane for use as biofuels

In 2019, 53% of the gas used for traffic fuel is biomethane. Biomethane is currently marketed separately with certificate system of one operator or straight from other biogas producers, so it’s not in blend; however, this can change in the context of the national implementation of the RED II. Sustainable biomethane is used (and reported) as biofuel for transportation in Finland. In order to get investment grants the applicant must show that the sustainability requirements are met.

In June 2019, there were a total of 43 CNG filling stations. Biomethane is available in all the stations, in most of the station there is an option to choose biomethane or methane (natural gas). Finland's first LNG refuelling station was opened Helsinki, in August 2016. In June 2019, there were a total of 6 LNG stations.

According to the national policy framework for the development of an alternative transport fuel market and deployment of a related infrastructure (based on the Directive 2014/94/EU), there should be 50 CNG filling stations in Finland by 2020, and enough capacity for liquefied natural gas and biogas (LNG, LBG) filling stations. Finland will meet the targets sets, but most likely there is need for more stations as the number of gas vehicles continues to grow. The role of biomethane in the national transportation policy will be defined by the end of 2021, as Finland is updating not only the transportation policy but the climate and energy policy in general. It looks promising that the target for 2030 for the number of gas vehicles will be raised up from the current 50 000 of passenger cars and additionally there will be a new target for the number of heavy-duty gas vehicles.

Preferential access for the domestic biomethane producers

Domestic biomethane production has preferential access as compared to domestic natural gas production and import. This is according to the Natural Gas Market Act (587/2017). According to the same act, the system operator shall, upon request and at reasonable cost, connect to its network renewable gas installations. The terms and conditions for the connection shall be transparent, fair, non-discriminatory and consider the conditions necessary for the interoperability and security of the natural gas transmission system and the network, and the efficiency of the natural gas transmission system.

Grid connection investment costs

When injecting biogas to the transmission system, a biomethane producer must pay the connection fee and the transfer fees. The grid operator is responsible for the rest of the investments.

4.8 France

Introduction

The French biomethane sector is very dynamic. France is one of the few countries to have set specific biomethane targets, namely, to produce 1.7 TWh biomethane by 2018 and 8 TWh biomethane by 2023. Since biomethane was granted access to the gas grid in 2011, and the ambitious biomethane targets were set, growth has been considerable, with the number of new biomethane plants going from 7 to 107 between 2015 and September 2019. Over 1,000 registered projects are currently in the pipeline, meaning France is expected to become a leader in the European biomethane sector.

Regulatory framework and subsidy scheme

France started to subsidize its biogas sector with the "Renewable Energy Feed-in Tariffs (I)" in 2001, making revisions in 2002, 2006, 2011 and 2016. The development of a favourable regulatory framework spanning over two decades means that France's biogas sector continues to reap the rewards in terms of growth. Biogas producers in France can receive subsidies from the French Environment & Energy Management Agency (ADEME) as well as from local authorities for studies and investments. Projects are also exempted from local taxes.

Currently, a Feed-in Tariff (FiT) is the main support scheme for biomethane. The French Act on Energy Transition for Green Growth, effective from August 2015, fully committed France to transition to a renewable energy system in the 21st century. The Act includes the goal of 10% biomethane in the grid by 2030. A distinction between a FiT and tender is made for subsidizing biogas and biomethane. Biogas plants producing electricity and having an electric capacity lower than 500 kWe, together with all new biomethane plants receive a fixed Feed-in Tariff (FiT), which is guaranteed for 20 years. The FiT varies according to the size and type of the plant, between €60/ MWh and €120/ MWh. A premium can be added for manure for example. Since 2016, large-scale digesters to produce electricity from biogas with a capacity above 500 kWe have been supported by a tender system.

Incentives for the purchase of clean vehicles are made available. The Act will lead to the roll-out of a single permit for wind energy, biogas production and hydro power, and, over 3 years, will support the development of 1,500 biogas and biomethane production plants using agricultural waste.

In January 2019, however, the French government, through its Pluriannual Energy Programme (PPE or Programmation Pluriannuelle de l'Energy), announced its intention end the FiT for the biggest biomethane plants. The threshold between FiT and tender is not decided yet, and this uncertainty has been the driver for the projects to move forward this past year, passing the milestones before the new rule is published. Among the measures announced, the 2030 target for the share of renewables in gas in France's total gas consumption is to be lowered from 10 to 7%, sending mixed signals to the anaerobic digestion sector. It remains to be seen how these measures will impact the French biogas landscape and whether the biogas and biomethane sector will manage to reverse this unfavorable course of action.

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Market environment and feasibility of biomethane projects

Biomethane is sold and injected directly into the gas grid, without a specific "blending" condition. Some energy providers sell to private and corporate consumers a "green" energy offer, where electricity is 100% renewable (usually through guarantees of origin), and gas can be from 5 to 100% renewable.

For the biogas plants, there is little difference between biomethane and cogeneration plants regarding financing sources. Subsidies represent more or less 10% of the investment, bank loans (and sometimes crowdfunding) being heavily used at 70%, and the rest made up by own financing from the plant owner(s). A couple investment funds started operating in the sector in 2019.

Grid connection investment costs

The grid investment costs were until November 2019 borne by the first producer to ask for the new connection to be made. A new scheme is being enforced, where other ongoing projects are considered to share the cost between them. Since 2018, the grid operator takes 40% of the cost.

4.9 Germany

Introduction

Germany has a long tradition of production and utilization of biomethane. The start of biomethane production was given in 2006, when the first biogas upgrading plant was taken into operation in Bavarian Pliening, near Munich. Since then, the number of biomethane plants and the total annual production capacity have been growing constantly and, in the year of 2018, reached 213 units and approx. 10 TWh accordingly.

Regulatory framework and subsidy scheme

The incentive scheme for the biomethane utilization is different depending on the specific market. The usage of biomethane for electricity generation will be supported by the Renewable Energy Law (Erneuerbare-Energien-Gesetz - EEG), which was initially introduced in 2000 and since then was revised many times. In terms of promotion of the power generation from biomethane, the EEG 2004 and 2009 (years of the entry into force) provides the so-called technology bonus and the EEG 2012 – the gas upgrading bonus. So, according to EEG 2004, the CHP units with the production capacity in the range between 0 to 5 MW, which utilize biomethane, receive additionally 2 ct/kWh_{el}. In the EEG 2009 the biomethane plants will be separated into two groups with 350 m^3/h and 700 m^3/h biomethane production capacity. They receive additionally 2 and 1 ct/kWh_{el} accordingly. The support scheme was adjusted with the EEG 2012, which guaranteed the biomethane upgrading bonus in the amount of 3 ct/kWh_{el} in case of 700 m^3/h and less, 2 ct/kWh_{el} for 1,000 m^3/h and less and 1 ct/kWh_{el} for 1,400 m^3/h and less installed upgrading capacity.

The usage of biomethane in the heat generation market will be pushed by the Renewable Energy Heat Act (Erneuerbare-Energien-Wärmegesetz - EEWärmeG), which will be applied in all the 16 German federal states and is in force since 2009. According to it, the usage of biomethane for the heat supply of buildings will be recognized as a way of increasing the renewable energies' share only in case its application is in CHP units. This clause shortens the number of suitable applications. Apart from the federal Act, there is also the Renewable Energy Heat Act of the Federal State of Baden-Württemberg, which is in force since 2015 and foresees an active usage of biomethane in order to fulfil the heat generation requirement from the renewable sources. Unlike the federal Act, this one recognizes the usage of biomethane even in the gas boilers, which opens much more opportunities for its utilization due to the lower heating unit prices and a bigger share of boilers amongst the heating systems.

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The application of biomethane in the transportation sector is enabled through the Federal Pollution Control Act (Bundes-Immissionsschutzgesetz - BImSchG), which demands from the fuel companies the reduction of their carbon footprint. As one of the possible options, the physical usage of biomethane produced from a certain list of feedstocks is allowed. Alternatively, the greenhouse gas (GHG) certificates, generated from the biomethane, can be applied. Each ton of $CO2_{eq.}$ surplus will incur in a 470 EUR penalty. The usage of liquefied biomethane has been remaining not attractive until now. Through the removal of the last regulatory barriers, such as the recognition of liquefied biomethane as a way of fulfilling the carbon reduction requirement and the energy tax reduction (booth took place in 2019), the real market prospects for liquefied biomethane are possible.

The tax reduction is another effective support mechanism for establishing the biomethane utilization. The tax debtor is in these cases the biomethane supplier. If biomethane usage takes place for power generation (i.e. CHP units) and heat production (i.e. boilers), the energy tax is 5.50 EUR/MWh. However, there are several opportunities for the energy tax relief or its reduction. The complete energy tax relief is possible in case of the combined power and heat generation. If biomethane will be used for the heat supply of the production industry and of the forestry and agricultural sector, stakeholders can apply for the energy tax reduction. For the usage of biomethane as a transportation fuel, the energy tax will be at 13.90 EUR/MWh until 31.12.2023. From that date onwards, the tax is planned to increase and become 31.80 EUR/MWh. The reason for the phase out of this tax reduction in the transportation sector is the expectation that, some years after establishing the tax reduction, the market will be mature enough to survive without this measure.

Regulatory framework on imported biomethane

In Germany, the imported biomethane will be used primarily for the heating purposes. Its application in the transportation fuel market will not be recognized in terms of the carbon footprint reduction requirement. Germany itself belongs to the biomethane export nations. Thus, in the last years, the biomethane export amounts fluctuated between 150 and 200 GWh.

Market environment and feasibility of biomethane projects

After the change of the incentive policy through the adoption of the EEG and the removal of the upgrading bonus, the number of new biomethane projects sank in the last years down to four new units in 2018. With the implementation of the Renewable Energy Directive (RED II) into the national law as well as after the increase of the GHG reduction requirement in the fuel market in 2020, it is expected, that the share of biomethane in the fuel market will increase. Furthermore, the establishing of the share for the so-called advanced biofuels with the start in 2020 will give an additional impulse for the biomethane produced from bio waste and certain residues. The RED II sets the framework for the growth of the market share of advanced biofuels until 2030.

The environmental advantages of the biomethane usage as a transportation fuel and their combination with the economic benefits will be recognized by the fleet operators, especially in the business of the public transportation. Many utilities have implemented this approach in their fleets so far, i.e. in the city of Augsburg.

In Germany there is a clear understanding, that the fuel gases will play a significant role in the economy, especially against the background of the upcoming nuclear and coal phase out. This will be clearly underlined in the frame of the actual political discussion “Dialogprozess Gas 2030” on the status quo and the vision of the future of fuel gases. Renewable gases including biomethane are considered to become an important part of the future energy mix.

The coming phase out of the EEG subsidies will push many operators of biogas plants towards the exploration of new markets. In this respect, the switch to the biogas upgrading with the marketing of biomethane as a transportation fuel might be an interesting opportunity, especially for the biogas plants utilizing the feedstock listed in the Annex IX, Part A of the RED II. Anyway, with respect to the size and location of biogas plants, the

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technology of biogas upgrading and the philosophy of the biomethane distribution must be revised. For biogas plants with a relatively small production capacity like under 100-150 m^3/h biomethane, the upgrading units must be downsized and established in the German biogas sector. On the other hand, the implementation of smaller units leads automatically to the growth of specific production costs. The latter can be avoided through the connection of many biogas plants with an upgrading unit through a collector pipe.

Biomethane for use as biofuels

Biomethane for the fuel market will be distributed mainly through the gas grid connected CNG filling stations. There are approximately 900 CNG filling stations in Germany, 250 of them provide biomethane share in CNG. However, there are also a limited number of projects dedicated to the local biomethane refuelling without a gas grid access. Experience collected in those projects shows a need of investment incentives in order to accelerate the establishing of such kind of applications.

The requirements to biomethane as a transportation fuel will be set by the standard DIN EN 16723-2:2017 “Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network - Part 2: Automotive fuels specification; German version”, which is going to be implemented into the technical codes of the German Technical and Scientific Association for Gas and Water's (DVGW).

The usage if liquefied biomethane in Germany as a transportation fuel has not been established jet because of missing regulatory framework.

Preferential access for the domestic biomethane producers

Biomethane production in Germany has preferential access as compared with domestic natural gas production and import in order to promote the energy transition. This applies both to the gas grid connection of the biomethane plants and to the biomethane injection.

Grid connection investment costs

Practically, the whole amount of biomethane produced in Germany will be injected into the gas grids. Technical codes DVGW G 262 and 260 will be applied in order to adjust the biomethane quality to the gas grid requirements.

The costs for the biomethane injection into the gas grid will be shared between the plant operator and the gas grid operator in the proportion 25%/75% accordingly. In case, the length of the connecting pipe is less than 1,000 m, the share of the biomethane plant operator must not exceed 250,000 EUR. If the connecting pipe if longer than 10 km, the plant operator bears the additional costs. The connecting pipe including the injection unit is the property of the gas grid operator.

4.10 Greece

Introduction

Biomethane is unknown as an energy source or carrier in all sectors of energy in Greece. This is reflected in the current status, where no biomethane production takes place.

The biogas sector is still in the pre-2010 era, where the main issue was production of electric power. The current regulatory framework and subsidy scheme are only relevant to electricity production where, despite of favourable incentives, the progress has been slow.

Regulatory framework and subsidy scheme

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There is a lack of an existing regulatory framework and subsidy scheme for biomethane. In the draft NECP prepared for submission by Greece in December 2019, the proposed policy regarding contribution of bioenergy in energy production is still focused to electricity generation, proposing the following development (p. 107 of NECP):

Electricity generation [GWh]	2020	2022	2025	2027	2030
Biomass & Biogas	400	500	800	1,000	1,600
H/E	5,500	6,200	6,300	6,300	6,400
Wind farms	7,200	10,000	12,500	14,300	17,100
P/V	4,600	6,300	8,500	10,000	12,100
CSP	0	0	300	300	300
Geothermal	0	0	0	300	600
Total	17,700	23,000	28,400	32,200	38,100
Bioenergy % of Total	2.26	2.17	2.82	3.10	4.20

The contribution of bioenergy in the electricity generation is scheduled to rise by 86% between 2020 and 2030.

In the other sectors of energy there is hardly any mention about biogas having a share in the energy contribution:

For heating / cooling only solid biomass is considered, along with solar, heat pumps and Geothermal

For transportation, the main issue is electricity, with biofuels not being among the main measures and RES gaseous fuels proposed for 'pilot actions'

Reference to biomethane is only made, directly or indirectly, in the policy measures indicated in the table below. Notably, the measures have no quantitative estimates on production levels and the respective impact of the measures in the decarbonization of the respective sectors.

Name of policy measure	Objective	Sector affected	State of implementation
Development and optimization of licensing framework and of technical specifications for RES district heating networks, injection of biogas into the natural gas network, exploitation of geothermal fields	Increase in electricity generation from RES Increase of RES for heating-cooling	Electricity generation Heating-Cooling	Adopted, Update-Reform
Development of support scheme for thermal energy from RES and, in particular, biomethane in the natural gas network	Increase of RES for heating-cooling	Heating-Cooling	Regulatory
Usage of Guarantees of Origin	Increase of RES production in electricity, heating-cooling-transportation	Electricity generation Heating-Cooling, Transportation	Regulatory, Financial
Pilot actions for the use of RES gaseous fuels in the transport sector.	Increase of RES in transport	Transport sector	Envisaged

Market environment and feasibility of biomethane projects

There is no real biomethane market and it is estimated that, under the current regulatory framework, there will be no existing biomethane market for at least the next 2 years. However, a big potential exists for supply of Bio-CNG on the Greek Islands, where natural gas will take long time to be commercially available, if at all.

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Biomethane for use as biofuels

There are about 10 CNG stations throughout the country, with a rate of increase of 3-5 new ones per year. Those stations could serve for biomethane supply in the future. Currently, they do not supply biomethane and there are also no defined standers in this regard.

Grid connection investment costs

Discussion will start shortly with the HP pipeline operator to determine connection cost, minimum specs, measurement accuracy requirements and transmission charge policy.

A premature consideration of the pipeline usage regime can be considered prior to the development of the biomethane market. It is related with the possibility of energy transfer by means of a pipeline at areas where the electricity network is remote, and/or has limited capacity. This would involve biogas upgrading and pressurization, delivery of natural gas equivalent to the already injected biomethane at a remote location, CHP at that location for production of electricity under the ruling high tariffs, full exploitation of the cogenerated thermal energy. This prospect will boost negotiations with the pipeline operator.

Lately, the developments in the transportation of NG in LNG state is a promising solution in the use of natural gas at remote locations, especially the Islands, as complementary/ alternative solution to electricity. This will open a privileged market for locally produced Bio-NG (CNG, LNG) as complementary / alternative / RES equivalent to fossil natural gas.

4.11 Italy

Introduction

At the beginning of 2018 the Italian government published the Decree 02 March 2018 that encouraged the production of biomethane. In the previous years, seven small demonstration plants (< 50 m^3 biogas/ h), not connected to the natural gas grids, had been built. Now in Italy there are eight full-scale plants (the largest one is 3.750 m^3 biomethane/ h, close to Milan). Fifteen more are under construction.

In 2030, according to CIB, a maximum technical potential of 8 billion m^3 biomethane/y is estimated. According to other studies about energy evolution in transport a realistic production of biomethane of 2.7 billion m^3/y by 2030 has been estimated.

Regulatory framework and subsidy scheme

The biomethane promotion scheme is based on the allocation of certificates of release for consumption ("Certificati di Immissione in Consumo di biocarburanti", better known as "CIC") to be provided to those subjects who release non-renewable fuels for consumption. The number of CIC that these subjects are obliged to hold must be enough to cover the share of energy corresponding to the obligation to release for consumption of biofuels, which is determined every year.

As a basic rule, one CIC is assigned every 10 GCal of biomethane produced and released for consumption to the producers; the CIC is assigned every 5 GCal if the biomethane derives from biogas produced by specific matrices (Annex 3 to the Ministerial Decree of 10 October 2014). Once an installation has entered service and has successfully passed the qualification process at the designated public company (GSE - Gestore Servizi Elettrici), the CIC allocation period is not subject to time limits and is available until the compulsory quota mechanism for biofuels is operational.

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The biomethane is considered “advanced” if it derives from specific types of biomass (organic fraction of municipality solid waste; manure; agricultural by-products, etc.). A special favourable tariff is foreseen for the advanced biomethane: for the first ten years of operation, at the request of the producers of "advanced biomethane", the GSE will withdraw the advanced biomethane at price equal to that of the MPGAS (Spot Market for Gas) reduced by 5 % and the GSE will recognize the value of the corresponding CIC, assigning each certificate a value of € 375. The biomethane producers have also the possibility to choose another type of subsidy: they can decide to sell the CIC and the bio-methane on their own.

In the support scheme there are other bonuses if the producer uses selected biomass like cover crops or manure and for producers that build their own filling station and produce bio-LNG. The biomethane also includes the fuel produced through gasification and the hydrogen methanation processes obtained from renewable sources and the CO2 present in the biogas destined to produce biomethane.

Regulatory framework on imported biomethane

Currently, it is not possible to import biomethane in Italy from foreign countries because the biomethane decree indicates the need to sign bilateral agreements between the nations that intend to carry out the transaction and now there are no agreements.

Market environment and feasibility of biomethane projects

Although in Europe CO_2 emissions into the atmosphere have decreased over the last 25 years, the opposite has happened in the transport sector (according to European Environment Agency, +18% from 1990 to 2016). In Italy the same trend was recorded.

With the aim of reducing negative impacts and moving toward a green economy model, sustainable mobility is quickly growing as a strategic target for Italy. Considering private cars and light transportation vehicles, gaseous methane and biomethane, together with electric and hybrid engines, are low impact technologies that can help to bridge the gap towards lower air pollution in cities.

Liquefied natural gas and its renewable counterpart (liquefied biomethane) will probably be the fuel alternative to diesel for heavy transportation in the next decade, as it is an economically and environmentally sustainable solution.

In 2014, the Italian government introduced a first obligation for the use of biofuels in the transport sector. The Biomethane Decree 02 March 2018 changed the obligation quotas. At present it is necessary to reach these goals:

- year 2019 = 8.0% of biofuels compared to the total quantity of petrol and diesel released for consumption; 0.8% of advanced biofuels;
- year 2020 = 9.0% of biofuels; 0.9% of advanced biofuels;
- year 2021 = 9.0% of biofuels; 1.5% of advanced biofuels;
- starting from the year 2022 = 9.0% of biofuels; 1.85% of advanced biofuel.

The use of biomethane in the transport sector in Italy is facilitated by the fact that there are already both infrastructures and methane vehicle fleets. In fact, currently, there are around 1.05 million CNG vehicles; around 2,100 LNG trucks; around 1,350 CNG filling station stations; 47 LNG filling stations. Every year in Italy around 1 billion m^3 of methane is used in the transport sector.

Biomethane for use as biofuels

In Italy, biomethane receives public incentives only if it is used in the transport sector as a biofuel. To prove that this happens, the manufacturer has several options:

- to produce “advanced biomethane”, to inject it into the natural gas grids and to sell it to a public body (GSE - Gestore Servizi Elettrici) which will sell it to the oil companies.
- to build one or more new filling stations (directly connected to the biogas plant, supplied by trucks, or connected to the gas network)
- to liquefy biomethane and to sell it either in its own filling stations or in the filling stations of other companies.

If biomethane meets the quality standards set by the law, there are no blending limits between biomethane and natural gas.

Preferential access for the domestic biomethane producers

In Italy the biomethane does not have preferential access into the natural gas grids as compared to domestic or imported natural gas. Regarding its injection into the grid, the biomethane that respects the technical, qualitative, and flow characteristics provided by the legislation is considered as if it were natural gas.

Grid connection investment costs

The costs of connection to the national natural gas network are mainly charged to the biomethane producers. The costs are calculated both according to the distance of the biomethane production plant to the natural gas network and according to the delivery pressure. The producers must install a biomethane quality control system at their own expense. The grid operators provide, if necessary, for the odorization of biomethane.

4.12 Republic of Ireland

Introduction

Currently 1 biomethane plant in the Republic of Ireland (ROI) is completing its commissioning works and expected to inject into the ROI grid in November/December 2019. There are up to 100 connection applications from biomethane producers to inject into the ROI grid. Waste-based plants are expected to progress even without a subsidy or government support, but plants using substrates from agriculture will require a support before they progress.

The Irish Government published a climate action plan in June 2019 and in it they committed to:

- Develop an updated feasibility study by Q4 2019 on the availability of sustainable feedstock for the AD industry
- Set a 2030 target for the level of energy to be supplied by indigenous biomethane injection by Q1 2020

Regulatory framework and subsidy scheme

There is currently no subsidy or support scheme in ROI for biomethane production where that is to be injected into the grid. There is a government support scheme for biogas/biomethane from AD to be used directly to heat buildings or factories but not grid injected. Waste based AD is viable where the producer charges a gate fee and generates electricity from biogas which qualifies for a tariff subsidy.

The energy regulator has set the network charge at biomethane entry points at 1/3rd of the level at all other entry points and this can provide a support to the industry.

Biomethane is not being imported into ROI: some gas suppliers have procured Green Gas certificates issued by the 2 registries in the UK. This was to assist their customers in meeting their ‘soft’ decarbonisation targets.

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Market environment and feasibility of biomethane projects

There is an active biogas/biomethane industry in ROI: the sector is dependent on support and direction from government before it can progress.

Biomethane for use as biofuels

There is a biofuel obligation scheme in ROI: petrol and diesel suppliers must meet a biofuel target. The relevant legislation includes gaseous fuels in its preamble, but the obligations do not extend to gaseous fuels yet. A government consultation on biofuels is anticipated which could be a trigger to extension of the current obligations to gas in transport.

GNI, the gas grid operator, has 2 private gas filling stations operational. There is 1 public station in Dublin Port with a number of forecourt operators are in the process of signing connection agreements. GNI has targeted a network of 170 CNG fuelling stations with 40 being public access stations.

Preferential access for the domestic biomethane producers

Currently, biomethane producers are treated on the same basis as a producer of indigenous gas or the importer of gas across an interconnector. The grid entry tariffs are more favourable for biomethane producers.

Grid connection investment costs

Where a biomethane producer wants to connect to the GNI grid, the Connections Policy (as approved by the national regulator) applies. This treats the biomethane producer on the same basis as an end-user seeking a connection to consume gas. An economic appraisal is completed with 30% of the costs paid by the party seeking the connection and the balance recovered through tariffs over the life of the connection.

4.13 Latvia

In Latvia there is currently no biomethane production facility. Between EU countries Latvia has one of the lowest shares of energy from renewable sources in transport with a use of less than 4% of energy from renewables. Still government strategic targets for usage of biomethane for 2020, 2030, 2050 are missing. However, the importance of renewables in gross inland consumption is relatively high in Latvia and exceeded one third of inland consumption (42.5 %) thanks to hydroelectricity from stations build during Soviet Union times. Also, Latvia has high biogas installed electric capacity per 1 million head of population, generated in 58 biogas stations, build during 2009-2015. However, there has been a steady slow-down in development: the 2011-2013 NREAP targets were comfortably exceeded; the 2014 and 2015 targets were just met; and since 2016 Latvia has lagged further and further behind its goals. 5 biogas plants during this period were shut down after they lost their FiT on administrative grounds. Already 8 years (since 2012) no biogas building permission was issued.

The legal framework in Latvia is quite complex and is also changing rapidly. The coexistence of regulations 221 and 262 gives rise to a degree of confusion in the market, by making it possible for two identical stations to receive different support. Also, transition to production of electricity from biogas to biomethane production is still under many questions as a result of an unclear framework.

There are no standards or use of biomethane as biofuel. A first public CNG filling station was opened in 2019.

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4.14 Lithuania

Introduction

Currently there are around 40 biogas plants producing heat and electricity in Lithuania but no biomethane producers. It is expected that first biomethane plant with ~ 12 GWh total annual production (potentially ~ 41 GWh from 2023) will be connected to Lithuanian gas transmission system in the second part of 2020.

In the National Energy Independence Strategy action plan, it is foreseen to provide financial support for producing biomethane for the transport sector from agriculture waste and other non-communal waste. From 2022 it estimated to produce 11.63 GWh of biomethane per year for consumption in the transport sector. As well it is foreseen to apply regulatory measures that would increase biomethane usage in transport.

Regulatory framework and subsidy scheme

Feed in Tariff was proposed by Lithuania to the EC in 2012, but it was never put in practise as the tariff scheme has not yet been agreed with EC as part of renewable support scheme. Consequently, there is no support scheme for biomethane production in Lithuania, except for 40% discount for connection fee. Some other support elements might be applied in coming years. Currently, the drafting process of support schemes is in initial phase and not available for consultation with stakeholders, yet.

Regulatory framework on imported biomethane

Imported biomethane is treated equally as domestic biomethane. There are no regulatory barriers for importing biomethane to Lithuania.

Market environment and feasibility of biomethane projects

Currently without subsidy and support schemes for biomethane production, the viability of biomethane projects is low. However, projects, where biomethane would be used as a source for producing subsidized green electricity, could have more economic potential.

Biomethane for use as biofuels

Currently, there is no biomethane used as biofuel for transportation. There are no restrictions and standards for blending biomethane with natural gas. If biomethane is allowed by connected operator of the grid to be injected in the grid, that means that it is compatible with gas quality requirements.

Grid connection investment costs

The investment cost of grid connection is covered 40% by the grid operator and 60% by biomethane producer. The connection costs include constructing connecting pipeline and valve station. While gas upgrading, compression, gas metering and gas quality measurement facilities must be installed by biomethane producer.

4.15 The Netherlands

Introduction

The Dutch biomethane market was one of the pioneering biomethane markets in Europe. Also, the Netherlands have their own national renewable gas registry. Operated by Vertogas, the green branch of Nederlandse GasUnie, since 2009, the Netherlands' renewable gas registry has been mandated by the Dutch Ministry of Economic Affairs and Climate ("EZK") since January 2015. Registering and certifying via Vertogas is mandatory.

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In 2018, there was a total of 46 biomethane plants in the Netherlands, nearly half of which (47%) were running on agricultural substrates. Considering the country's extensive livestock farming, it is hardly surprising that anaerobic digestion technology plays an important role for farmers in treating animal manure. Energy crops are not used for biomethane production in the Netherlands.

Regulatory framework and subsidy scheme

The Dutch government started the SDE (stimulering duurzame energie – Renewable energy and CHP production aid scheme) in 2008, a modified FiT. The SDE subsidy was later revised and named the SDE+ subsidy scheme. The SDE+ scheme support the development of renewable energy in the Netherlands in 6 categories: biomass, geothermal energy, water, wind (on land, lakes and wind on water defence walls) and sun. For the production of biomethane and the injection into the gas grid, a subsidy with a duration of 12 years can be awarded. The subsidy compensates for the difference between the cost price of fossil gas and renewable gas. The subsidy does not make a distinction of the valorisation of biogas for electricity production or the valorisation via upgrading and injection into the gas network.

The support is awarded via a tender system. Plants, who fulfil the requirements can submit their request for support when government opens a tender. Both plants valorising biogas in a CHP and valorising biogas via upgrading and injection are eligible for the subsidy. The projects are ranked based on the tender amount submitted in € / kWh. The tender amount for renewable gas applications is divided by a factor of 0.706 when ranking, as renewable gas counts for 70.6% of the renewable energy target for 2020. Each tender, a maximum tender amount is fixed. The SDE+ spring 2020 tender has 3 phases, each with a maximum tender amount. First phase 1 will open with a max amount of € 49 / MWh, next phase 2 (max 56 € / MWh) and phase 3 (max 92 € / MWh).

The SDE + spring 2020 is the last opening round in its current form. After the spring round, the scheme will be expanded under the name Sustainable Energy Transition Incentive Scheme (SDE ++). The SDE ++ scheme will stimulate the roll-out of renewable energy and CO2-reducing technologies by compensating the unprofitable top of these technologies. This is done through an operational support.

Biomethane for use as biofuels

The RED prescribes the share of Renewable energy in the transport sector. To fulfil this requirement, the Netherlands imposes a blending obligation on companies that uses benzine and diesel or bring it to the market. A part of these transport fuels needs to be sustainable. This can be achieved by, amongst others, blending with bio-CNG or bio-LNG. This selling of bio-CNG and bio-LNG as transport fuel, can thereby generate additional income.

A specific fee is available for each GJ transport fuel supplied which is the same for all transport fuels where only a distinction is made in the feedstock used: food and feed crops, feedstocks listed in Annex IXA or Annex IXB of the Renewable Energy Directive (RED). The latter category counts double. A GJ bio-CNG from a corn fermenter therefore delivers the same amount as a GJ bio-LNG from the same digester, while a GJ transport fuel from a waste digester yields double.

Trading in these fees takes place via HBEs (Hernieuwbare Brandstof Eenheden). The price of these units is determined by the supply and demand for renewable transport fuels and the price difference with fossil transport fuels. In contrast to the SDE+ contribution it fluctuates quite a bit. Another difference is that these HBEs only arise at the end of the chain (at the pump). The consequence of this is that the revenue from the trade in HBEs will have to be shared with other chain parties.

In 2018 about 9% of the grid injected biomethane was used in transport. In addition, supply of biomethane to transport via direct pipelines takes place. Nearly all biomethane supplied to transport is sustainable in accordance with the sustainability requirements of the EU renewable energy directive and Dutch regulations. This is demonstrated by 'green gas' certificates. Each certificate represents actually produced biomethane elsewhere in the Netherlands. At the gas station, which is connected to the gas network, the upgraded biomethane becomes compressed (bio-CNG) and pumped into the tank of a vehicle under high pressure. The gas must be of at a minimum of 82% methane. The number of public service stations where compressed natural gas and upgraded biomethane are offered in The Netherlands is over 170 and still growing. At more than half of all CNG filling stations also 100% upgraded biomethane is available.

4.16 Poland

Introduction

There is growing interest in new directions in biogas development in Poland such as:

- energy clusters and energy cooperatives with biogas plant as a key;
- stable supplier of energy;
- biomethane to gas grid (local, national);
- biogas/biomethane in transport.

Due to unclear legislation and lack of financial support (both investment and operating costs) to biomethane production, there is no biomethane plants built in Poland. There are several projects under development, however.

Working groups cooperating with Ministry of Energy and Ministry of Agriculture are preparing proposals of different measures to speed up the deployment of biomethane projects.

Regulatory framework and subsidy scheme

The discussed support scheme in Poland is mainly concerning biomethane from anaerobic digestion. Drivers for biomethane development relate to problems with the decarbonisation of transport and difficulties with fulfilment of EU requirements concerning share of RES in transport in RED (10% in 2020) and RED II (advanced biofuels).

Moreover, the use of biomethane in transport or injection into the grid may be an interesting alternative for biogas plants with uncertain/ finishing support system for "green energy". Changes in waste management are a chance to obtain energy from raw material (circular economy). The agri-food sector, especially poultry industry, are interested in usage of green gas, both from the grid and direct in transport. The sector could reduce its GHG emissions from their production. Also, the energy and fuel sector are interested, which are planning investment in g-mobility and e-mobility.

The demand for biomethane on the Polish market is pushed by following regulations, of which the Biofuel Act is regarded as the most important one.

- National Framework for Alternative Fuel Infrastructure Development Policy (2017) including
    - Definition of alternative fuels including natural gas CNG (biomethane), LNG, hydrogen etc.
    - Requirements concerning location of alternative fuels infrastructure
- The Act on electromobility and alternative fuels (2018)
- The Act on biocomponents and liquid biofuels – amendment 19-07-2019 introduced biomethane as new biofuels for fulfilment of national indicative target (NCW)

- RES Act – proposed support system for biomethane production similar to green electricity (auction, FiT, FiP) postponed to next amendment in 2020 (new parliament after 13 October 2019 election will start to work in November 2019)

On 14 August 2019 a zero-excise tax for CNG, LNG, biomethane, biogas, hydrogen was introduced. Next, the Fund for Low Emissions Transport foresees investment support for alternative fuels infrastructure, NGV and support for local authorities investing in clean public transport.

4.17 Romania

Introduction

The biogas industry in Romania is in the early stage of development and the market is stagnating. Merely 15 biogas producing installations are in operation with an installed total electrical capacity of 16,4 MW. These investments relied on a support system, where generators of electricity from renewable sources were entitled to receive and sell “green” electricity certificates. The system with „green” certificates has expired on 31.12.2016. Since then only the already commissioned projects can benefit from support (until 31.12.2031).

Regulatory framework and subsidy scheme

Presently there is no financial support for upgrading biogas and injecting biomethane into the natural gas grid - although Romania has a very well-developed natural gas industry based on domestic production. The national natural gas pipeline network is dense and could offer an attractive way for distributing renewable energy (produced in form of biomethane) all through the country.

Presently no legislation is being drafted which would support the injection of biomethane into the natural gas grid of Romania.

Market environment and feasibility of biomethane projects

In lack of financial incentives, no investment into biomethane production has taken place and no investment projects are known.

In order to enable the injection and transfer of biomethane anywhere within the national natural gas pipeline network new regulations would be needed in Romania. The national legislation should secure the rights of the biomethane producer to access the natural gas network in a non-discriminatory way. It is preferred that the legislation regulates sharing the costs of the injection facility between the natural gas grid operator and the biomethane producer.

Biomethane for use as biofuels

In Romania biomethane is not considered among the biofuels which are counted towards meeting the national biofuel quota targets. Correspondingly, no financial incentive is provided to biomethane usage in transportation.

Preferential access for the domestic biomethane producers

No information is available on importing biomethane into Romania. It can be assumed that presently no import is taking place, neither through physical transport nor through purchasing biomethane Guarantees of Origin.

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4.18 Slovenia

Introduction

In Slovenia there is no support scheme for biomethane and no biomethane production. There is also no legislation regarding the use or production of biomethane but The National Energetic and Environmental plan (NEPN), which is in time of writing in public hearing, puts down a goal for upgrading the biogas production to biomethane for the purpose of decarbonisation of the supply with natural gas. Until NEPN is not confirmed and their is no legislation for the upgrade from biogas to biomethane, the production in Slovenia is limited to biogas only.

Biogas production started in Slovenia at the end of 1980th. First two biogas plants were for the anaerobic digestion on municipal plants – central wastewater treatment and big pig farm. Energy utilization of biogas from the anaerobic digestion sewage, manure or agricultural wastes and landfill gas is present in Slovenia, but it has at this moment a negligible impact on energy balance, while the important impact is the reduction of emission of greenhouse gases.

There are currently 23 biogas plants or power plants that work on biogas that are in the national support scheme. We do not dispose of the exact amount of plants in Slovenia, but this are the large ones that produce the majority of biogas.

Small number of biogas plants on Slovenian farms can be explained by several reasons: no interest in investment in biogas plants (cheap energy from fossil fuels), no possibilities for investments in new technologies due to lack of money (small size farms), lack of state subventions in past for biogas plants on familiar farms, lack of equipment supplies and know how on the Slovenian territory in biogas technologies, lack of awareness and information by farmers, local authorities, agribusiness players.

However farming represents the main biogas production potential in Slovenia.

Regulatory framework and subsidy scheme

The Slovenian energy policy gives priority to the use of renewable energy resources in all strategic documents. Currently The national energetic and environmental plan is in public hearing, but there is hardly any mention of biogas and no mention of biomethane at all.

Market environment and feasibility of biomethane projects

Main goal of biogas production development in Slovenia is an increase of production and energy utilization of biogas in agricultural sector. Pre-feasibility and feasibility studies made within the Biomethane Regions project have revealed the threshold of viability for complete biogas plants on farms to be from 75 to 100 BCS. Livestock population smaller than that would require a lot more added substrate from energy crops which is not desirable because of government tariff incentive limitations. On smaller scale farms the best solution would be transporting the substrate (slurry) to joint biogas plant via pipelines or tractor transport or farm aggregation could be carried out - in case of larger amount of substrate (slurry) the solution would be to build individual bioreactors with associated equipment on farms and transport the captured biogas to joint cogeneration and/or upgrading stations via gas pipelines. Other possibility is also to upgrade biogas to biomethane and inject it in the national gas grid. Above the threshold mentioned above construction of full individual biogas plants (bioreactors, gasholders, corresponding tanks, gas upgrading units, cogeneration units…) on farms would be viable but aggregation should still be necessary in case of desired upgrading of biogas to biomethane because of costly gas cleaning technology. According to livestock population in Slovenia, their is a potential to produce aproximatelly 100 milion cubis meters of methane annually. Biogas potential from organic household waste should also not get ignored. Expected annual amount of 70000 tones is a large quantity of biomass for anaerobic fermentation process and has a potential of producing 7,8 million cubic meters of methane annually.

Biogas could be used for different purposes:

- Cogeneration: Currently the only use of biogas in Slovenia is for cogeneration of electrical and thermal energy. Cogeneration unit produces more thermal (~60%) than electrical energy (~35%) but only a small fraction of about 5% of thermal energy is being used. In case of cogeneration thermal energy utilization is very important for financial efficiency of the whole biogas plant operation. Thermal energy can be used for heating/cooling buildings on the farm itself and also for other houses in the village/town via a haet network. Other options are also drying of various farming products (grain, wood chippings…). Because thermal energy utilization can be very costly (construction of heat network) it is very necessary that this investment is covered also by local government or other private investors. Local heat network is in great interest of local inhabitants as it leads to low heating costs. Villages and small towns can therefore benefit greatly with biogas technology.
- Biomethane for national gas grid injection: There are no natural gas sources in Slovenia and all requirements have to be met with importing (mostly from Russia and Algeria, source: Energy Agency of the Republic of Slovenia). Annual natural gas consumption in Slovenia is 1,1 billion cubic meters. Biogas can be upgraded using appropriate technology to more than 98% content of methane. As such it can be injected in the national gas grid and sold as a renewable fuel. Biomethane in gas grid mixes freely with natural gas. Natural gas grid injection is also a great option because most of biogas plants are located on farms or wastewater treatment plants which are mostly on remote locations away from bigger cities. This represents an obstacle in utilization of surplus thermal energy from cogeneration units and gas grid injection would therefore transport energy from renewable sources to every grid user. National gas grid in Slovenia is coincidentally well developed in parts where there is also the largest percentage of biogas plants. A good option for the future when cogeneration equipment on this large plants (>1MW) expires is replacing this equipment for biogas to biomethane upgrading technology and continue the operation as a renewable source gas supplier. Because most of this large plants only produce electrical energy and therefore achieve only up to 35% efficiency implementation of biogas upgrading would lift their efficiency up to 90%.
- Biomethane as vehicle fuel: When prices will drop for biogas upgrading technology it will be possible to produce biomethane on a larger scale and use it for vehicle fuel for tractors and other farming equipment. It is also possible to sell compressed biomethane for use in public transport or other consumers (Source: Agricultural Institute of Slovenia, 2010).

As mentioned in Slovenia there is no legislation regarding the production of biomethane and also no support scheme. The only strategic document, which is currently topical and includes the use of biomethane as a renewable energy source, is The National Energetic and Environmental plan, which is in public hearing. But for the the development of the renewable gas sector in Slovenia, action plans and strategic documents are not enough. There is a need for legislative measures, economic and financial measures, technical and organizational measures, informing and education and acceptability of biogas in public eye.

4.19 Spain

Introduction

Spain started its promotion of renewable energy in 1997, with the ‘General Electricity Law 54/1997’. The biogas production rose significantly due to the incentives (feed–in tariffs, premiums) for electricity generated

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from renewable sources, especially in the wastewater treatment and municipal waste treatment sectors. Nevertheless, agriculture biogas remained underdeveloped.

In 2007, with Royal Decree RD-661/2007, the FiT and premium started to differentiate clearly between biogas from anaerobic digestion and landfill gas recovery. The commission of new plants has been very scarce since 2012 because a moratorium on renewable energies was put in place (Royal Decree-Law 1/2012), which removed all incentives (feed-in tariffs, premiums) for electricity generated from renewable sources and combined heat and power. In 2014, Royal Decree RD-413/2014, ended the moratorium only for those plants already built before 2012. For new plants, there is no financial support at all. Only 10 agricultural plants have been built since 2012, mainly for self-consumption.

The first (and only) biomethane plant injecting into the grid was inaugurated in 2009: P. T. Valdemingómez (Madrid). There are other demonstrative projects of biomethane, mainly pilot projects associated to R&D EU funded initiatives, such as Life, H2020 or CEF programs.

Regulatory framework and subsidy scheme

The Government presented a proposal/draft of the Climate Change and Energy Transition in November 2018. In this proposal/draft of the Draft Law, some lines of the framework of action for the promotion of renewable gas are established:

- The Government is empowered to approve support mechanisms for renewable gas. These support mechanisms may be financed with the regulated revenues of the natural gas sector within the limits determined by regulation.
- The Government is empowered to approve support mechanisms and regulations that allow the injection of renewable gases into the natural gas network.
- Within one year, the Government shall approve a system of registration of guarantees of origin for renewable gases injected into the natural gas network.

At present there is no incentive in place to support new biogas or biomethane plants in the country. Next, in Spain there's no entity mandated by the government to set-up the registry neither any scheme for developing the GoO's; so, there is no specific biomethane treatment (importation/domestic, biofuel for transportation, etc.).

Market environment and feasibility of biomethane projects

In Spain, there is no Governmental incentive to develop the Spanish biomethane market. The only new biogas projects built are based on a waste treatment needs (environmental driven) rather than energy production-based projects.

A change is needed. This development (production and consumption) must be supported by:

- political and legislative support
- economic/financial mechanisms to support and promote Renewable Gas,
    - possibility of economic incentives for producers of Renewable Gas to compensate for the difference between the cost of producing Renewable Gas and the cost of conventional natural gas (Feed-in tariffs, Feed-in premiums; Fiscal incentives; Direct subsidies).
- The gas sector tax revenues are implemented for environmental protection (example: green cent in Spain), but they should be used to decarbonize the sector itself, instead that be directed to the electricity sector, as it happens today.
- Quotas

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More than this, GoO's represent a market incentive mechanism where the most interested users can purchase biomethane for their energy and environmental use.

AEBIG is preparing a proposal for this "voluntary GoO's scheme":

- seeking commitment to comply with the ERGaR scheme
- analyzing the key attributes
- ECO-GATE European Consortium: it will be a GoO's real-life trial by biomethane pilot in Butarque
- REGATRACE European Consortium: it will be a key development vector of GoO's.

Biomethane for use as biofuels

In Spain there is no entity mandated by the government to set-up the registry neither any scheme for developing the GoO's; so, there is no specific biomethane treatment as biofuel for transport.

Preferential access for the domestic biomethane producers

The gas grid access for biomethane producers has a bonus of 100% in respect for natural gas access. This "bonus" is currently under discussion as biomethane developers want a cost exemption for access, as a way to enhance the first projects.

Grid connection investment costs

Currently in Spain, the grid connection investment costs are supported by the biomethane producer: all these costs should be shared between the biomethane producer and co-funded by the Gas System Mechanisms.

History and forecast

Spain has a very complex biomethane environment, as there is a combination of lack of incentives, absence of a government mandate for creation of a certificate system and a weak biogas industry. Being a country with a very strong food, agricultural and livestock industry, the potential of production of biogas and biomethane is very high, but there is a total lack of support policies.

Spain started its promotion of renewable energy in 1997, with the 'General Electricity Law 54/1997', followed by the introduction of a Feed in Tariff (FiT) for small scale cogeneration/renewable electricity production in 1999. The tariff had a direct impact on biogas production in the country, which rose significantly from 2000 to 2004. In 2004, however, the support scheme was adapted to include a bonus option according to the 'Special Regime for the production of electricity from RES', and biogas production in Spain has since failed to achieve any consistent growth.

In 2007, with Royal Decree RD-661/2007, the FiT and premium started to differentiate clearly between biogas from anaerobic digestion and landfill gas recovery: landfill was awarded up to 84.6 € per MWh (for the first 15 years, total duration of 25 years), with a premium of 44.7 € per MWh. For agricultural the FiT was 141.1 € per per MWh (> 500 kW) and 104.5 € per MWh (< 500 kW). In the period from 2007 till 2012, only 39 agricultural plants were built.

The commission of new plants has been very scarce since 2012 because a moratorium on renewable energies was put in place (Royal Decree-Law 1/2012), which removed all incentives (feed-in tariffs, premiums) for electricity generated from renewable sources and combined heat and power and put a damper on the subsequent development of the biogas. In 2014, Royal Decree RD-413/2014, ended the moratorium only for those plants already built before 2012. For new plants, there is no financial support at all. Only 10 agricultural plants have been built since 2012, mainly for self-consumption.

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A remuneration for two concepts was put in place for biogas plants that had received the FiT up to 2012 (a total of 39 plants):

- Fixed amount payment based on the CAPEX and commissioning year of the plant, aiming to get a 7.35% return on the investment
- A payment aiming to offset the maintenance and operational costs, OPEX, in order to ensure the profitability of the investment

There is no incentive in place to support new biogas or biomethane plants in the country, which means that new plants need to achieve profitability based only on electricity market prices. Projection of the growth rate in the biogas sector in Spain prior to the introduction of the FiT in 1999 lead to a biogas production of 128.0 ktoe in 2016, suggesting a 109% increase attributable to this support scheme. According to the NREAP submitted to European Commission in 2010 for the period 2011-2020, the objective of installed capacity of biogas was 400 MW. However, up to September 2019, the installed capacity of 300 MW has not yet been reached.

Nonetheless, the new government's statement of its commitment to renewable energy in 2018 has given cause for cautious optimism. Hopefully, the tide will turn sooner rather than later, allowing Spain to tap into its sizeable agricultural and food industry potential, estimated at around 1,400 ktoe/year (source: IDAE).

4.20 Sweden

Introduction

The Swedish biomethane market is to a large extent off-grid with several small local and regional grids or stand-alone biogas gas plants and filling stations. The gas pipeline infrastructure is limited to the south-western part of Sweden where the transmission network is connected to European gas network via Denmark. There is also a regional gas network in Stockholm, fuelled with locally injected biogas and shipped LNG. A significant part of the biomethane in Sweden is transported on the road as compressed gas and to a small but increasing extent as liquefied gas (LBG). Local and regional gas grids gain more attention aimed to connect industries, cities and biomethane production plants with an LNG-terminal at the coast. There are some large industries off grid that are using LNG today, interested in LBG in the future.

Most of the biogas (63%) is upgraded of which 87% is used for road transport due to favourable support system. The market for methane as transportation fuel is now rather developed in Sweden but is highly dependent on increased policy incentives and long-term support systems to take the next step since the volumes is not increasing.

The interest and use of biomethane in industry and for heating have, however, increased rapidly the last years and is expected to increase further. The last years' rapid increase of imports of biomethane (1.6 TWh in 2018), mainly subsidised biomethane from Denmark, has pressed down the biomethane price and is thus more competitive with natural gas in sectors where tax exemption is not very effective, such as industry.

Of the total biogas production in Sweden (2 TWh) about 1.25 TWh was upgraded to biomethane 2018. About 0.5 TWh of this is injected to the south-western gas grid (connected to the European gas grid) and in the Stockholm gas grid, the rest is used locally or trucked to filling stations.

In Sweden, general fiscal incentives in terms of high CO_2 and energy tax on fossil fuels and tax exemption for renewables has been the main driver for decarbonising since the 1990-ties and is still the main driver for biomethane, accomplished with investment support schemes for plants and filling stations. Some other policies, especially in transportation, also potentially stimulates biomethane. There is so far no official

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strategy or goals for biomethane in Sweden, but ambitious overall national GHG emission targets for 2030 and 2045 are set in the climate law. However, the Swedish biogas industry 2018 launched a proposal for a National Biogas Strategy with a specific target of 15 TWh biomethane/biogas use in 2030, of which 12 TWh in the transport sector and 3 TWh in industry. The ongoing government Biogas Market Investigation (Biogasmarknadsutredningen) will suggest a national goal for biogas/biomethane production, along with a new long-term support scheme for biogas/biomethane from 2021, a combination of tax incentives and production support.

Regulatory framework and subsidy scheme

New climate act sets long-term ambitious GHG targets for 2030 and 2045

From 2018 the climate law sets ambitious long-term climate and energy goals: a climate-neutral energy sector in 2045, 100% renewable electricity production in 2040, 63% GHG emission reduction in non-EU ETS sector in 2030 and 75% 2040 compared to 1990 and 70% GHG emission reduction in domestic transport 2030 compared to 2010. A climate policy council will analyse the current clime policy and make recommendations every year. The government is also committed to present a climate policy plan every 4 years.

Fiscal incentives - CO_2 and energy tax exemption

Main policy: Tax exemption based on the biomass content, thus technology independent (valid for all bioenergy).

- **Transport:** Exemption from CO_2 and energy tax for biomethane as transportation fuel until the end of 2020. Natural gas for transportation is exempted from energy tax and only pay CO_2 tax. The CO_2-tax rate 2020 corresponds to ~21 €/MWh. The value of the biomethane tax exemption can be estimated with the corresponding tax for petrol ~44 €/MWh.
- **Heating fuel (including industrial use):** Exemption from CO_2 and energy tax for biogas until end of 2020. Corresponding tax on natural gas is ~31 €/MWh.[7]
- **Heat or CHP plants:** Exemption from CO_2 and energy tax for biogas or biomethane.[8]

Production support/premium

- Production support for biogas and biomethane from manure ~37 €/MWh until 2023.
- Biomethane production support corresponding to ~20-24 €/MWh biomethane. It is a temporary support granted so far for production Oct 2018 until May 2020, as a response to the disturbed competition situation for domestic biomethane due to double subsidises for imported biomethane.

Quota/green certificates (GC)

- Green electricity certificate scheme: A joint electricity certificate market between Norway and Sweden since 2012 with rising target until 2030. Certificates are given to new renewable electricity production for 15 years and electricity consumers must purchase certificates in relation to their total use. The GC

[7] Fossil fuels used in industrial manufacturing processes are exempted from 70 % of the energy tax, and if included in EU ETS, such use is also exempted from 100 percent of the CO_2 tax.
[8] Natural gas and other fossil fuels, for such use within the EU ETS, are exempted from 9 percent of the CO_2 tax.

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stimulation on new biogas CHP has been weak, mainly since co-distributed biogas from the gas grid is not accepted.[9]

Investment support

- Local climate investment programme (Klimatklivet 2015-2023): Investment support (up to approx. 45 %) for all types of GHG reduction measures, including support to biomethane plants and filling stations. The budget for 2020 is ~0.21 Billion €/year.
- 200 MSEK support for establishing an LBG innovation cluster 2018-2021. Within the project Drive LBG investment support is granted to various LBG investments, including biomethane liquefaction plants, filling infrastructure and long-haul HDVs.

Some other incentives for low emission road transport, including biomethane

- A new "Bonus-Malus" taxation system for light vehicles from July 1st 2018. Bonus up to ~5,700 € when purchasing new low emission cars. Gas vehicles is granted a bonus of ~915 €. Malus in terms of increased CO_2-based vehicle tax first three years for high emission cars (gasoline and diesel cars).
- 40% reduction of income tax for use of company NGVs.
- New legislation for environmental zones in cities. From 2020 cities can ban polluting vehicles to enter the zones. Only new gas vehicles (NGVs), hydrogen and electric vehicles are allowed in all three zones.
- Larger filling stations must provide also a renewable fuel (pumplagen [10]) since 2005, such as E85 or CBG.
- Environmental information for transport fuels must be displayed at the filling station, including origin and CO_2 reduction from 2020.

Ongoing processes and coming policies

- The government initiated biogas market investigation proposes new long-term policies and measures for biogas from 2021. Based on an evaluation of the social and environmental benefits of biogas it suggests a national goal for biogas to fully utilise biogas as a resource and measures to achieve long term competitive conditions for increased use and production of biogas and biomethane. The current exemption from energy and CO_2 tax is suggested to be prolonged and to be complemented with a production support scheme (for 10 years) with a premium for biogas from manure (~37 €/MWh) + a biomethane premium (20-30 €/MWh) + a liquefaction to LBG premium (10-15 €/MWh). A dedicated premium for renewable gas from lignocellulose (i.e. gasification) should be investigated, according to the draft proposals.
- Bonus for low carbon HDVs: A vehicle purchasing bonus scheme for low carbon/alternative HDVs is under preparation by the government, which supposedly includes CBG and LBG HDVs.
- Guarantees of Origin for renewable gases: A national biogas registry/Guarantees of Origin system will probably be implemented by the Swedish Energy Agency by 2021, and investigations are ongoing.

Some policy barriers for further development

- Long-term conditions and a biogas strategy from the government are missing. It is still not clear what the long-term support system will be for biomethane after 2020.

[9] Certificate price has varied between 11-17 €/MWh_e , but the price is expected to drop to less than 2 €/MWh from early 20-ties since new production (mainly wind) will exceed the 2030 target of the quota system already around 2022.
[10] Lag (2005:1248) om skyldighet att tillhandahålla förnybara drivmedel

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- Not harmonising support systems between member states leads to double subsidised imported biomethane and has resulted in a disturbed competition situation for domestic biogas production. The biogas use has increased rapidly the last years, but the production has levelled out.
- The green gas concept (that the biogas share in gas purchased through the gas grids is based on agreements and mass balance principle) is not accepted or applicable in important support systems such as EU ETS, green electricity certificate system and climate investment programme (Klimatklivet).
- Some general reductions of energy tax and/or CO_2 tax for fossil fuels in some sectors make the general tax exemption for biomethane not competitive enough.

Regulatory framework on imported biomethane

If biomethane is imported physically (e.g. by trucks or ships) or via the natural gas network, it is granted the same treatment as domestic production. In general, there are no regulatory barriers for importing biomethane into the country.

Market environment and feasibility of biomethane projects

In Sweden general fiscal incentives in terms of high CO_2 and energy tax on fossil fuels and tax exemption for renewables has been the main driver for decarbonising since the 1990-ties and is still the main driver for biomethane. Since the taxes are highest in the transportation sector, most of the biomethane has been used for road transport, but also to some extent for heating. In other sectors, such as industry with high natural gas use, the tax advantage for renewables are generally much lower. It is only during the last 2-3 years that the biomethane demand in industry has risen dramatically, mainly due to subsidised imported biogas which has been rather competitive with natural gas.

The biomethane production has increased steadily since 2005, mainly driven by investments by municipalities and regions in biomethane driven public transport (busses) and new biogas plants (often with upgrading) for recycling of organic household waste (co-digestion plants). Biogas production has occurred for several decades in many sewage plants but since 2005 the share of plants with biomethane upgrading has increased. There have been investment support programmes that have facilitated this development. In the recent years a large part of new production is run by private companies mainly focusing on industrial organic waste such as manure, waste and residues from agriculture, food industry and slaughterhouses. It is also in the private sector where most of the additional production capacity investments are foreseen in the future, even though further investments are expected also by public companies and municipalities.

Most (or all) natural gas suppliers can offer biomethane, mostly at requested share (blends). Many suppliers, especially of methane for transportation, offer mainly or only biomethane. Tax regulation accept a mass balance approach to determine biomethane share from gas grids (based on purchase contracts). Most LNG suppliers can also offer LBG, but normally at small volumes.

Increased biomethane import presses Swedish producers but opens for increased biomethane market

The last years' increasing imports of biomethane, i.e. subsidised biomethane mainly from Denmark, has pressed down the biomethane price and biomethane is thus more competitive with natural gas in sectors where tax exemption is not very effective, such as industry.

At the same time, the Swedish biomethane producers now are facing a margin pricing that often do not cover the production costs. In Sweden incentives are so far focused on the use of biomethane (of which the most important is the tax exemption), but in other member states often focused on production or injection. This means that imported biomethane can be double subsidised. 2016 the imports from Denmark was 0.2 TWh, which during 2018 increased to about 1.65 TWh. The difficult competition made the government to grant a temporary production support for biomethane since 2018.

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The investment climate in Sweden is, except for uncertain long-term policy conditions and the disturbed competition with imported biomethane, rather good: different policies are more and more favouring biomethane and politicians are starting to understand and value the benefits of biomethane. The demand for renewable gas in heating and industry is increasing and the national climate law with net-zero GHG targets for transport in 2030 and whole Sweden in 2045 is expected to be a driver for increased biomethane demand in all sectors. The administrative regulatory framework is working with no major obstacles, in terms of permission processes, excess to grids etc. The conditions for biomethane for electricity are, however, rather week.

Biomethane for use as biofuels

The market for methane as transportation fuel is now rather developed in Sweden. Almost 90% of the domestic biomethane production and 1/3 of imported biomethane was used for transportation as CBG in 2018. The use of methane in transport increased rapidly up to 2014 to have stabilized at around 1.5-1.6 TWh the last years. The average biomethane share has however continued to increase and was 94% in 2018. Biomethane is sold as a CNG/CBG blend (Fordonsgas) and the biomethane share differs but should never be less than 50% CBG (according to an industry agreement). At many stations 100 % biomethane is offered.

The number of gas filling stations has increased from less than 20 in year 2000 to about 185 stations end of 2018, plus 60 non-public stations. These are often co-located at multifuel filling stations but there are also dedicated CBG stations. September 2019 there was 12 LBG/LNG filling stations, and another 6-10 stations will open within a year.

The number of gas vehicles development has during the same period increased from just a few hundred to in total 54 352 in the end of 2018. 2 522 of these were buses (about 15 % of all buses) and 920 trucks (incl. approx. 50 LNG trucks) and the rest passenger cars and other light vehicles. Since 2018/2019 there are large investments in LBG/LNG long-haul HDVs going on (hundreds).

Preferential access for the domestic biomethane producers

Domestic biomethane production always has preferential access to the grid compared to import via the connection to Denmark. At local/regional grids there may be other procedure (up to the grid owner).

Grid connection investment costs

When connecting biomethane production to the natural gas grid, the biomethane producer bears the cost of the connection investment. If the producer pays the entire investment in connection fee, the transfer fee is zero. Alternatively, a part of the investment is paid as connection fee, and the transfer fee is applied. The TSO owns and operates the connection and the metering as a minimum, but could also take a larger responsibility of pressurizing equipment etc. The producer is responsible for gas quality measurements.

At local/regional grids there may be other procedure (up to the grid owner).

Regulation on sustainability criteria, mass balancing in gas grids and cross border trade

Green gas concept allows for mass balancing in gas grids for tax purposes

There is no biogas registry or independent certification system currently in place in Sweden, but mass balancing is possible for biomethane in gas grids since 2011 in the taxation regulation[11] as well as in the sustainability criteria scheme. The green gas concept means that biomethane users connected to the gas grid or in a local grid can buy and claim any share of biomethane even though it is a physical mix of NG and

[11] Lagen (1994:1776) om skatt på energi (Chapter 2, 2 a §)

biomethane. Biomethane from gas grids is eligible to full energy tax and CO_2 tax exemption. The biomethane content shall be decided by the purchasing contracts between the user and the supplier, and the supplier must assure that the same amount has been injected to the grid. Transmission capacity from the injection point must thus be booked. The green gas concept is applicable for both imported and domestic biomethane and is possible also between gas grids in Sweden that is not physically connected.

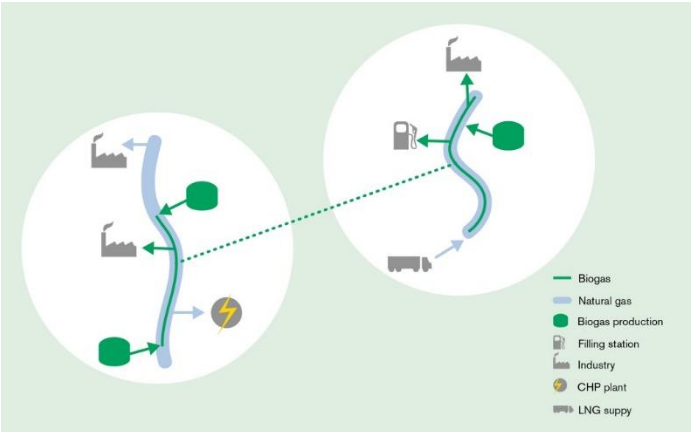

Figure 11 The green gas concept in Sweden. 100 % biomethane can be purchased and claimed as biomethane from the gas network or local gas grids through the mass balance principle and is eligible for exemption of energy and CO_2 tax. Full in-house documentation and a purchasing contract between the user and the supplier is required.

RED sustainability criteria and cross border trade

The national RED sustainability criteria scheme is regulated by the Sustainability Act (2010:598).[12] All suppliers of biofuels (including biomethane aimed for transport) to be eligible for tax exemption or be accounted for in other support systems must apply for a Sustainability Decision (Hållbarhetsbesked) by the Swedish Energy Agency (SEA). The sustainability decision is a proof that all routines required in the RED to comply with the sustainability criteria is in place, and the control system and actual volumes are verified regularly by third party audits and by the SEA. Certification by a RED Voluntary Scheme (VS) is also possible to be eligible to a Sustainability Decision. For biomethane export (which so far is very limited) and imports voluntary scheme certifications are normally used.

Just like the green gas concept in the tax regulation, mass balancing is recognised within the Swedish national gas networks and local grids, based on purchasing contracts and proves of injection of the same amount of biomethane into the grids. After the European Court of Justice sentence[13] in summer 2017, cross border mass balancing of biomethane in the gas network is possible both in the national scheme and through VS. Imported biomethane and domestic biomethane are treated in the same way.

4.21 Switzerland

Introduction

[12] Lag (2010:598) om hållbarhetskriterier för biodrivmedel och flytande biobränslen (hållbarhetslagen)
[13] the E.ON – Energimyndigheten case C 549/2015

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Switzerland has pioneered the production and injection of biomethane into the natural gas grid since the end of the 1990's. In 2003, gas distributors entered into an agreement with biomass suppliers, committing to the development of the CNG market while blending in at least 10% of biomethane to CNG used as motor fuel. Current legislation does not give specific targets for the development of biomethane, but Swiss gas distributors, organized in the Swiss association of Gas Industry (VSG), have set a target for a share of 30 % of biomethane for gas consumed in the heating market (excluding industry) by 2030.

Regulatory framework and subsidy scheme

A federal subsidy scheme is applicable only to biogas used to produce electricity, biomethane injected into the gas grid is not eligible. However, VSG has set up a fund to support new or expanded biomethane plants that comprises three elements:

- Investment grant per Nm^3/h
- Injection support for the first 36 months per kWh
- Grid operator support for the first 36 months per kWh.

Biomethane is exempt from the following taxes:

- CO_2-levy on fossil fuels (currently at CHF 96/tonne of CO_2, equaling CHF 0.01738/kWh
- Mineraloil-tax ("Mineralölsteuer", "MinöSt"): If used as motor fuel, CNG is currently taxed at CHF 222.20/1000 kg, while biomethane is exempt. This exemption was set to expire on June 30, 2020, but Parliament took the decision to extend it until the end of 2023. Further examination of the tax regime is ongoing in the context of the future legislation regulating greenhouse gas emission ("CO2-Gesetz").

Under the proposals made, the CO_2 levy may be raised to up to CHF 210/tonne of CO_2 and a part of the proceeds may be used to establish a new "Climate Fund" which could also support the injection of biomethane into the gas grid. The legislative process continues into 2020 and details of this new fund will still have to be worked out in government regulations.

Injection, trading and use of biomethane is tracked via the "Clearingstelle" of VSG, operated under a mandate of the customs authority.

The regulatory framework on imported biomethane is still under consideration as the federal authorities are adamant to exclude double counting in the country of production and consumption and seek solutions under the Paris Agreement to secure this. Currently, if biomethane is imported physically (where tracking is possible by molecule) it is granted the same tax treatment as domestic production. Thus, tax exemptions are granted provided the specific Swiss sustainability criteria are fulfilled. Biomethane imported through the natural gas network is currently not recognized in view of the above-mentioned considerations.

Market environment and feasibility of biomethane projects

The continuing debate on climate change is an important boost for biomethane projects. In an earlier phase, the market focused heavily on the transportation sector, while for the past ten years, the heating market became ever more important. Many gas distributors are now offering a "standard product" of a mix of biomethane and natural gas (usually between 5 and 20%), which may often be upgraded on customer request to up to 100% of renewable gas. The regulatory framework in most parts of the country does currently not yet recognize the use of biomethane for fulfilling energy requirements in the building sector (regulated by state law), but there is a tendency towards such recognition and the federal CO_2-law would explicitly provide for such a recognition in the building sector (Art. 9 of the proposed new law).

In view of attaining its goal for 2030, the gas industry has identified the biomass potentials that could be used for the production of biomethane and is supporting the construction of new plants. Power-to-gas is also

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explored, and some demonstration projects have been realized or are planned, although government projections currently do not see a need for P2G before 2035. These projections are contested, however, both by the industry and by the regulator, who view the security of supply during winter as a growing challenge.

Biomethane for use as biofuels

There are currently around 150 filling stations for 13,500 gas vehicles, most of which offer a standard (computated) blend of bio-CNG and natural gas, which can be upgraded to up to 100% at some stations. The reporting is made via the Clearingstelle. The legal prescriptions for new cars regarding energy efficiency and CO_2-emissions used to consider a biomethane ratio of 10% and this was raised by new government regulations to 20% at the beginning of 2020. Recently, the first LNG station was opened, as LNG may become more important for heavy duty transport.

Preferential access for the domestic biomethane producers

Currently, no grid use fee is due for the injection of biomethane. The specifics of grid connections for biomethane plants are subject to negotiation.

Grid connection investment costs

The specifics of grid connections for biomethane plants are subject to negotiation.

4.22 Ukraine

Introduction

At least 18 agricultural biogas plants were under operation in Ukraine in 2018 with more than 27 MW of total installed electric capacity. The individual projects ranged from 125 kW to 5.7 MW. Additionally, there were 20 landfill gas (LFG-to-E) projects with total electric capacity of 18.4 MW. However, up to now there are no examples of biogas-to-biomethane upgrading facilities in Ukraine, as there is no sufficient legal and regulatory framework for its production and use. By now there are no government strategic targets regarding biomethane in Ukraine.

Regulatory framework and subsidy scheme

So far, there are two incentives for bioenergy development in Ukraine: the feed-in tariff for power and stimulating tariff for heat produced from biomass/biogas. The FiT for electricity produced from biomass/biogas is fixed in euro until 2030 (0.1239 EUR/kWh without VAT). This tariff can be obtained according to the Procedure approved by The National Energy and Utilities Regulatory Commission (NEURC). NEURC converts the feed-in tariff into national currency in quarterly basis. Tariffs for heat produced from alternative energy sources by district heating utilities or entities financed from state or local budgets shall be at the level of 90% of the tariff established for heat supplier based on natural gas.

By now, there is no specific legislation to facilitate production and utilization of biomethane in Ukraine. All energy sector reforms – either already implemented or envisaged – concentrate in particular on the natural gas market and on electricity generation from renewable sources, including biomass and biogas. However, the prevailing regulation does not include biomethane, which – under the current incentive mechanism system - cannot compete with other renewable energy sources due to relatively high production cost.

National registry for biomethane production and consumption is not in place and the idea for development of such registry is not well known in Ukraine. However, the establishment of the registry is under discussion as soon as it is necessary tool for biomethane production or consumption, trade, import and export.

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Market environment and feasibility of biomethane projects

Ukraine has the largest area of agricultural land in Europe and one of the highest agricultural areas per capita, a significant part of agricultural land could be used for biomethane production replacing natural gas without affecting Ukraine's self-sufficiency for food and feed production. Further, the Ukrainian gas system is internationally connected potentially enabling biomethane exports from Ukraine to Western Europe.

Total potential of Biomethane production in Ukraine, based on animal breeding, agricultural waste and secondary product and energy plant's growing, is over 7.8 bln nm^3 CH_4 or 25% of domestic natural gas consumption, the possibilities for large-scale biomethane production are positive.

So far, biomethane production is not competitive with natural gas market price and need support in Ukraine similarly to all over the world. In Ukraine, there are prerequisites for the development of different biomethane support mechanisms: the country has introduced a system of FiT for electricity produced from renewable energy sources, there is urgent need to replace imported natural gas and regulate the electricity market due to the rapid growth of solar and wind power capacities and there is an infrastructure for using natural gas as a motor fuel.

Following mechanisms to encourage the production and consumption of biomethane are under discussion:

- Incentive electricity tariff for electricity produced from biomethane in cogeneration system in case at least 60% of the produced heat or electricity is produced from biomethane during peak load hours;
- Establishing a fixed incentive tariff for biomethane fed into the natural gas network;
- Support of compressed biomethane use as motor fuel for public transport and agricultural techniques.

Biomethane for use as biofuels

Ukraine is the country with traditional use of compressed natural gas (CNG) as a motor fuel. In 2011, more than 200,000 vehicles were running on CNG and the country offered a good network with about 300 gas filling stations, distributed all over the country. This infrastructure could be used for biomethane as motor fuel for municipal transport and agriculture techniques. This option allows substitution of fossil diesel and gasoline. This is an excellent opportunity for agricultural producers to obtain fuel by means of waste and secondary products of their own production. Using biomethane as a fuel for public transportation can significantly improve air pollution in large cities. However, so far there aren't any examples of biomethane use for transportation in Ukraine including both separately and blended with natural gas.

Preferential access for the domestic biomethane producers

Producers of biogas (biomethane) or other types of gases from alternative sources have equal rights to obtain access to gas transmission and distribution systems as well as gas storages and LNG facility. For that purpose, physical and technical parameters of biogas (biomethane) should conform to standards applicable to natural gas.

Grid connection investment costs

Ukraine has developed infrastructure for natural gas transport including both main pipelines and distribution pipelines network, providing gas access to 75% of the population of Ukraine. By now, there aren't any specific rules for biomethane supply to gas grid. Gas supplier should cover total cost of grid connection. It could be gas extraction enterprises, producers of biogas (biomethane) and other gas from alternative sources, who deliver their gas to the transmission system at the entry point. It is also the responsibility of the supplier to install all monitoring equipment and cover all the cost associated with measurement procedure.

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4.23 United Kingdom

Introduction

Since 2011 the UK government has provided a feed-in-tariff for biomethane injected into the gas grid. This has led to the construction of 93 biomethane installations. New applications for this feed-in-tariff will end in March 2021 and approximately 30 new installations may be built by this time.

Regulatory framework and subsidy scheme

The most important factor in the UK biomethane market is the support scheme called the Renewable Heat Incentive (RHI) which is a feed-in-tariff for biomethane produced from anaerobic digestion injected into the natural gas network. Biomethane installations are paid per kWh of energy injected at different rates depending on when they were commissioned and the volume of biomethane they produce annually. The subsidy lasts for 20 years. The RHI only applies to Great Britain (England, Wales and Scotland). Northern Ireland has a separate subsidy system for renewable energy that does not include a feed-in-tariff for biomethane.

For biomethane to be eligible for this subsidy the installation must show that certain sustainability criteria have been met including;

- That the lifecycle emissions of the production process including any emissions from energy crop cultivation are no more than 34.8gCOe/MJ (LCV)
- That any energy crops do not impact on land which acts as a carbon sink

Between 2011 and 2018 6.661 GWh of biomethane production has been supported by the RHI.

Biomethane use in transportation is supported by a Quota system called the Renewable Transport Fuel Obligation (RTFO). Obligated suppliers must show that a certain % of fuel they supply is renewable and they may do this by suppling renewable fuel themselves or buying Certificates generated from others that have.

Certificates can be generated by either physically supplying biomethane to vehicles or by mass balancing via the natural gas network. Because the level of support provided by the RHI has generally been higher, as well as bureaucratic and legal difficulties for installations registering less than 100% of their production for RHI support , there has been less than 5 GWh of domestically produced biomethane supplied to vehicles, while around 90 GWh has been imported.

While there have been examples of physical delivery of biomethane to vehicles in the past it is not believed to be currently taking place. There are no physical imports or export of biomethane into or out of the UK.

There is one gasification plant in construction however the commissioning date is unclear. The intention is for biomethane created from this installation to be injected into the natural gas network and be mass balanced to vehicles in order to generate Certificates for the RTFO.

Market environment and feasibility of biomethane projects

Since the first commercial connection in 2012 the biomethane market has developed rapidly in the UK due to the feed-in-tariff offered by the government. In 2014, 15 and 16 over 20 installations per year connected to the grid and it is believed at that point the UK was the “fastest growing biomethane market in the world” (REA, 2016). However, tariff levels within the RHI have reduced over time and when they felt below €50/MWh developers considered that new projects were not viable. In 2018 tariffs were reset to above €60/MWh which triggered around 30 new projects, currently in various stages of development.

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The RHI has allowed developers to secure finance from various investment funds, although some projects have not proven to be profitable due to limited production volumes. Others have experienced significant cash flow problems because of bureaucratic problems with claiming the feed-in-tariff. This has led to consolidation as the industry has looked to establish economies of scale in plant operation and more experienced operators have taken over underperforming installations.

Politically, biomethane continues to receive good levels of support, as seen with the tariff reset. This is in contrast to support schemes for other types of renewable energy such as solar, onshore wind and biogas for electricity generation, where tariffs and obligations have been reduced or withdrawn.

While the RTFO will continue to provide an incentive for developers once the RHI closes to new entrants in March 2021, financing projects under this mechanism is more challenging. It is unlikely that another feed-in-tariff will be introduced, and industry is expecting that future support beyond the RTFO will be based around a feed-in-premium or obligation.

Aside from the feed-in-tariff level other important factors are;

Feedstock supply - developers have been successful in negotiating supplies of energy crops however the government has moved to reduce incentives for these projects.[14] Sourcing reliable and secure waste and residue streams e.g. domestic and commercial food waste collections is a challenge and projects have had to adjust their expectations of income generation via gate fees.

Domestic food waste collection is mandatory in Scotland and Wales but not in England which is limiting the supply of waste feedstocks. The industry strongly supports moves to make collections in England mandatory by 2023.

Environmental permitting - this restricts the ability of plants using wastes and residues to dispose of digestate which can become a significant cost. Schemes that allow installations to certify their digestate as a product[15] are growing in popularity.

Grid capacity – New plants must find sites where there is enough capacity in inject their gas which is particular problem on parts of grid which have very low demand in the summer. There is a plant in development that will inject into the transmission system to overcome this problem.

Income from Biomethane Certificates - there are two Schemes which issue Certificates to installations, allowing them to market their gas to consumers and secure an additional income stream. As neither Scheme has been designated as the issuing body under RED II then these Certificate's cannot technically be described as Guarantees of Origin however they perform the same function i.e. consumer disclosure. There is no reported price for the sale of Biomethane Certificates, but plant owners have released data showing that they make up 3-4% of total income.

Biomethane for use as biofuels

As described above, Biomethane use in transportation is supported by a quota system called the Renewable Transport Fuel Obligation (RTFO). Any biomethane used within the RTFO is reported by the UK government against its targets for renewable fuel.

There are 20 stations offering bio-CNG in different blends although most are currently not supplying any biomethane due to lack of customer demand or difficulties with securing supply. Only two are public access

[14] installations commissioning since 2018 cannot claim the feed-in-tariff on any production of biomethane from crops, above 50% of their total production.
[15] Biofertiliser Certification Scheme - http://www.biofertiliser.org.uk/

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stations offering only 100% bio-CNG although, there are plans for seven new 100% bio-CNG stations to open in 2019-2020.

Preferential access for the domestic biomethane producers

The RTFO does not distinguish between domestic and foreign production apart from the requirement for foreign production to show appropriate gas flows at interconnectors (with Northern Ireland treated as part of the gas network of the island or Ireland not Great Britain).

Grid connection investment costs

Biomethane installations must pay for the full cost of connecting to the natural gas network. The cost is determined on a site by site basis and varies considerably between different grid operators. The industry is pushing for this process to be standardized and costs reduced.

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5 Conclusions

- The status of biomethane markets in member states and their current legislative frameworks are scattered in Europe. Each Member State has a different view on the subsidy and use of renewable gases.
- More and more countries are shifting from subsidy for biogas to biomethane and in addition, biomethane producers are more likely to become independent from subsidies than biogas producers, as the end-use applications and thus market opportunities are broader. Some countries are implementing market systems instead of direct subsidies, e.g., Germany implements obligations for fuel companies to meet GHG emission reduction targets set by European policies. The targets can be fulfilled with sustainable produced volumes from biomethane plants. A similar system is in place in the Netherlands, where fuel companies can buy HBE (Renewable fuel unit) from biomethane producers to comply with renewable energy blending obligation in the transport sector form the RED.
- Different countries have implemented different subsidies schemes for biomethane. The most common support scheme for biomethane in Europe is a Feed-in Tariff, followed by Feed-in Premium and fiscal incentives. Quota systems and investment support are less popular. Several countries have more than one type of subsidy schemes in place, which either complement each other or differentiate in the end-use application of the biomethane.
- Although one of the biggest advantages of biomethane is the wide range of end-use applications, still two countries (Austria and Germany) focus their subsidy scheme for biomethane on electricity production only. Where other end-uses are only supported to a minor extent.
- Many countries mention biomethane as an interesting alternative for existing biogas plants, as they can decarbonize the natural gas grid.
- The cross-border trade of biomethane is still limited. For most countries, production and consumption are well balanced. Awaiting European harmonization, bilateral and multilateral cooperation are set-up to transfer minimal volumes of biomethane cross-border.
- GHG reduction compared to natural gas is the aspect of the renewable gas with the highest impact on consumers choice, followed by cost additionally to natural gas, origin of the gas and the reliable delivery of the renewable gas. The type of input materials and the length of the contract play only minor roles in the decision-making process.
- Issuing bodies for end consumer disclosure (so called GoOs) according to RED II Artcile 19 are slowly being established in European Member States (Q4 2019).

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6 Attachments

6.1 Attachment 1: online survey for (potential) producers

Is your company currently a producer of renewable gas?

- Yes
- No

The price for renewable gas is split in three components in the question below.
1. governmental operational (OPEX) support
2. the price for the gas itself, meaning the price you would receive if it was natural gas, without the added green value.
3. the market price for the added green value of the renewable gas, sold as renewable as certificates/GoO

What price does your company receive for its renewable gas in terms of governmental operational support? (in €/MWh)

What price does your company receive for its sales of the gas? (in €/MWh)

What price does your company receive for its sales of any renewable gas certificate/GoO ? (in €/MWh)

What is the current renewable gas production of your company (MWh/year)?

What would be the total required price for the renewable gas for your company to invest in a new renewable gas production plant? (in €/MWh)
Include government support, sales of gas & sale of any renewable gas certificate in the price.

What type of support scheme for renewable gas would you prefer?

- Feed-in Tariff (FiT)
- Feed-in Premium (FiP)
- Quota/obligation certificates (GC)
- Fiscal incentives
- Investment support

If you would decide to invest in a new renewable gas production plant, which technology would you choose?

- Anaerobic digestion
- Gasification
- Power2methane
- Other
- Don't know

Are you satisfied with the current market situation in your country?

- Yes
- No

Explain

……………………………………

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Are you satisfied with the current support scheme in your country?

- Yes
- No

Explain

……………………………….

6.2 Attachment 2: online survey for (potential) consumers

What is the current natural gas consumption of your company? (in MWh/year)

What is the current renewable gas consumption of your company? (in MWh/year)

If you are a consumer of renewable gas, what price does your company pay for the renewable gas? (€/MWh)

What is the volume of natural gas that you would be interested in replacing with renewable gas? (in MWh/year) ***If none, indicate "0"***

What gas application(s) does your company have?

- Transport
- Heating & cooling in buildings (excluding process heat in industry)
- Chemical industry (including both process heat in industry & methane as green raw material)
- Generate electricity
- Other

If you could choose between two types of renewable gas, with characteristics as listed below, which of the two options would you prefer/choose?

- Security of supply: This is the certainty of which you know renewable gas will be available. Assume here that when no renewable gas is available, you have access to natural gas.

Attribute	Attribute level
Length of contract	a. 1 year b. 3 years c. 5 years
Reliable delivery of renewable gas	a. 100% security b. 95% security c. 70% security
GHG reductions compared to natural gas	a. 0% reduction b. 50% reduction c. 100% reduction
Input materials	a. Wastes and residues b. Energy crops
Origin of the gas	a. Domestic b. European
Cost additionally to the cost of natural gas	a. EUR 5/MWh b. EUR 10/MWh c. EUR 20 /MWh

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