Urban waste for biomethane grid injection and transport in urban areas

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Biomethannutzung: Netzeinspeiszung und Transport in Graz (Österreich)

/

Biomethane use for cities: grid injection & transport in Graz (Austria)

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Authors: Sabine Eggenreich, Graz Energy Agency
Ernst Meißner, Graz Energy Agency
Daniel Schinnerl, Graz Energy Agency
Eva Stadtschreiber, Graz Energy Agency

Editors: Robert Bošnjak, EIHP
Ernst Meißner, Graz Energy Agency
Eva Stadtschreiber, Graz Energy Agency

Contact: Ernst Meißner
Graz Energy Agency
Kaiserfeldgasse 13
8010 Graz, Austria
Tel.: +43 316 811 848 15
Fax: +43 316 811 848 9
meissner@grazer-ea.at

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Abkürzungen / Abbreviations

CHP	Combined heat and power
TFC	Total final consumption
TPES	Total primary energy supply
m	million
b	billion
Nm^3	standard m^3

1. Einleitung / Introduction

Seit 1970 ist der Gaskonsum in Österreich um das 3,5-fache gestiegen. 2011 wurden 8.6m^3 Erdgas verbraucht. Obwohl Erdgas (das hauptsächlich aus Russland kommt, die nationale Produktion liegt bei 15%) den Markt dominiert, gibt es bereits einige Biogasanlagen in Österreich. 2011 wurden 363 Biogasanlagen mit einer Gesamtkapazität von 105.41 MW registriert, sieben davon sind Biomethan-Aufbereitungsanlagen (die erste Biomethan-Aufbereitungsanlagen ging 2005 in Betrieb).

Die Gassituation in Österreich ist sehr dynamisch und bietet viele Möglichkeiten für verschiedene Nutzungsarten. Der folgende Bericht bietet dem Leser Hintergrundinformationen zum Gassektor in Österreich und besonders zur Situation in Graz. Der Bericht hat folgende Struktur:

- Kapitel 2 stellt eine Übersicht über Erdgas und Biogas (Angebot und Nachfrage) in Österreich dar
- Kapitel 3 behandelt den Transport von Erdgas und Biogas im Detail
- Kapitel 4 liefert Hintergrundwissen zu technischen Anforderungen für die Verwendung von Biogas
- Kapitel 5 behandelt ökonomische und organisatorische Aspekte
- Kapitel 6 präsentiert rechtliche Anforderungen bezüglich der Nutzung von Biomethan
- Kapitel 7 stellt die wichtigsten Stakeholder der Biomethanversorgungskette in Graz dar, und
- Kapitel 8 und 9 haben den Fokus auf Lösungsansätzen und Vorschlägen wie Biomethan idealerweise in der Zielstadt Graz grenutzt werden soll

Gas consumption in Austria has increased by 3.5 times since 1970, resulting in a consumption of 8.6bm^3 of natural gas in 2011. Even though natural gas (which mainly comes from Russia, national production accounts only for 15 %) dominates the market, there are already quite a number of biogas plants in Austria. In 2011, 363 biogas plants have been registered with a total capacity of 105.41 MW, seven of those plants are upgrading plants (the first upgrading plant went into operation in 2005).

The gas situation in Austria is highly dynamic and offers great opportunities for various types of utilisation. The following report provides the reader with background information on the gas sector in Austria and the city of Graz in particular. The report is structured as follows:

- Chapter 2 gives an overview of natural gas and biogas (supply and consumption) in Austria
- Chapter 3 deals with transmission of natural gas and biogas in detail
- Chapter 4 provides background knowledge on technical requirements for biogas use
- Chapter 5 covers economic and organisational aspects
- Chapter 6 is about legal requirements regarding the use of biomethane
- Chapter 7 outlines the main actors in the biomethane supply chain in Graz
- and chapter 8 and chapter 9 focus on solutions and proposals regarding the question of how biomethane should ideally be used in the target city of Graz.

2. Overview of biogas and gas supply

2.1. Total natural gas supply in Austria

Austria's natural gas reservoirs are located mainly underneath the Vienna Basin and among the foothills of the Alps. In Austria, natural gas is explored and produced in Lower Austria, Vienna, Salzburg and Upper Austria (at a depth of 500 to 6.000 meters). All natural gas fields are named after the communities where they are located. The most important ones are:

Lower Austria: Matzen, Schönkirchen, Zwerndorf, Höflein, Mühlberg, Wildendürnbach, Aderklaa, Breitenlee, Fischamend, Roseldorf, Teufelsgraben

Upper Austria: Haidach, Schwanenstadt, Lauterbach und Voitsdorf

Salzburg: Nussdorf

Vienna

In Austria, natural gas has been produced for the very first time in Oberlaa in the year 1931. In 1952, the first important natural gas field has been discovered near Zwerndorf. A continuous successful natural gas production has started in the year 1955 (in that year a transfer of the legal rights from the Soviet mineral oil administration (Mineralölverwaltung) SMV to the Austrian mineral oil administration (Mineralölverwaltung) ÖMV took place). The ÖMV first started to produce natural gas at Zwerndorf and from the year 1970 onwards also in Matzen.

There has been an increase in the natural gas production in Austria from 700m^3 in 1955 to 1,6b m^3 in 2011. Austria thus covers approximately 1/6 of its overall natural gas demand (8.6b m^3) with the production of domestic natural gas. The rest of the gas demand is covered by imports. The biggest part of the imported gas comes from Russia (the western part of Siberia provides more than 1/3 of the worldwide resources). Furthermore, Austria imports natural gas from Norway and other countries. The Austrian natural gas application from imports and domestic production (before deduction of exports and without transits) in 2011 looked as follows (http://www.gaswaerme.at/beg/themen/index_html?uid=2662):

Russia: 49%
Others: 24%
Norway: 12%
Austria (Domestic production): 15%

The share of domestic gas production in comparison to the natural gas imports from the year 2006 to 2010 is shown in Figure 1.

Erdgasimporte nach Österreich 2006 bis 2010

in 1.000 m³n	2006	2007	2008	2009	2010
GUS	6.105.000	5.411.000	6.058.000	5.339.000	5.536.000
Norwegen	1.272.000	1.417.000	1.341.000	1.321.000	1.345.000
Andere	1.835.000	1.912.000	2.380.000	2.803.000	3.039.000
Gesamt	**9.212.000**	**8.740.000**	**9.779.000**	**9.463.000**	**9.920.000**

Erdgasaufbringung in Österreich 2006 bis 2010

in 1.000 m³n	2006	2007	2008	2009	2010
Inlandsförderung	1.819.000	1.848.000	1.532.000	1.532.000	1.704.000
Import (ohne Transit)	9.212.000	8.740.000	9.779.000	9.779.000	9.920.000
Export (ohne Transit)	-1.369.000	-1.849.000	-1.900.000	-1.900.000	-2.787.000
Gesamt	**9.662.000**	**8.739.000**	**9.411.000**	**9.411.000**	**8.837.000**
Speicherbewegung	-752.000	-304.000	-422.000	-422.000	709.000
Fernleitungsverluste, Messdifferenzen und Eigenverbrauch	-454.000	-496.000	-598.000	-598.000	-441.000
Abgabe an Verbraucher	8.456.000	7.939.000	8.391.000	8.319.000	9.105.000

Figure 1: Domestic production compared to natural gas imports (source: FVMI, 2011, p.22)

2.2. Final natural gas consumption in Austria

Gas consumption in Austria has increased by 3.5 times since 1970. As mentioned above, in 2011, 8.6bm³ natural gas have been used in Austria; main consumers are industry and commerce as well as businesses dealing with the production of electricity and district heating. In 2011, there was a small decrease of natural gas consumption (4.4% compared to 2010) due to increasing temperatures as well as a reduced usage of natural gas in plants for electricity and heat production.

The final energy consumption in Austria looks as follows (2011, http://www.gaswaerme.at/ufile/9/2619/zasp_gas2012_hi_corr.pdf). As can be seen in the graph below, natural gas is on the third place regarding the final energy consumption in Austria, contributing to the overall consumption with 23 %. Natural gas therefore is an essential component of Austria's energy supply.

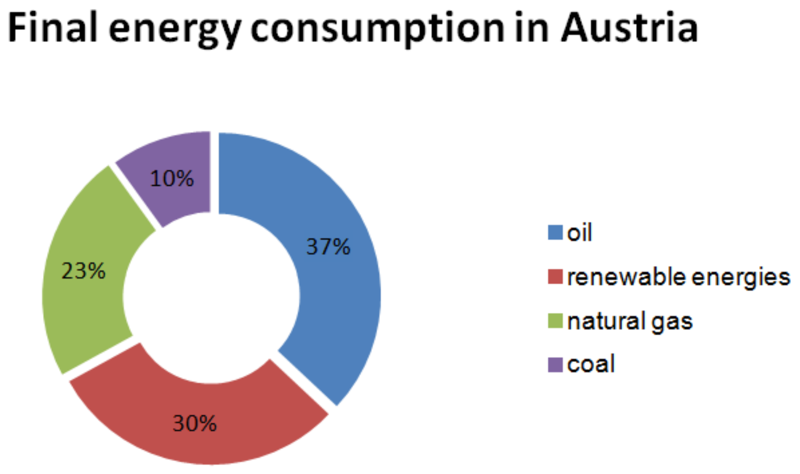


Figure 2: Final energy consumption in Austria (2011)

As shown in figure 2, the main customers of natural gas in Austria are power stations, district heating power stations, heating stations and the production sector

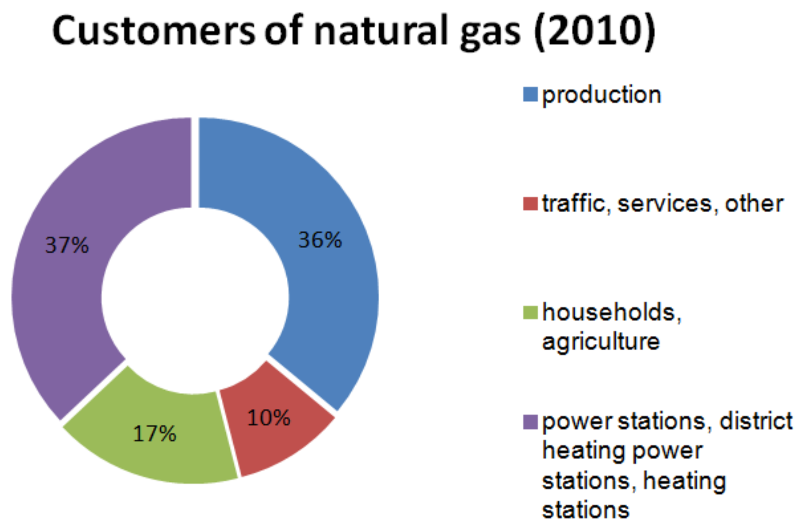


Figure 3: Customers of natural gas in Austria (2010)

As can be seen in the figure above, the two biggest customers of natural gas in Austria are the production sector and power stations, district heating power stations and heating stations. Main use of natural gas in Austria in 2011 therefore was the production of electricity and district heating. Regarding the households (including the agricultural sector), the main fields of application are heating, hot water production and cooking (2011; http://www.gaswaerme.at/ufile/9/2619/zasp_gas2012_hi_corr.pdf.

The Austrian Office for Statistics (Statistik Austria) published following numbers regarding the final natural gas consumption in Austria in 2011 (Statistik Austria http://www.statistik.at/web_de/statistiken/energie_und_umwelt/energie/energiebilanzen/):

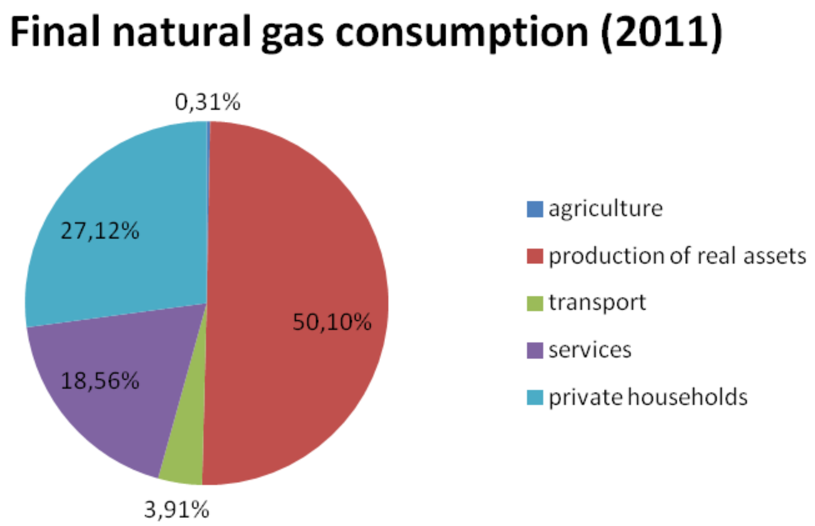


Figure 4: Final natural gas consumption (2011)

Austria's final natural gas consumption amounts to 185.699 Terajoule, whereas the production of real assets (manufacturing) makes up 50% of the total amount, followed by private households (27.12%) and services (18.56%). The transport (3.91%) and agriculture (0.31%) sectors are quite small users. The absolute numbers are shown in Table 1 (Statistik Austria http://www.statistik.at/web_de/statistiken/energie_und_umwelt/energie/energiebilanzen/):

	Natural gas	Total energy sources

Production of real assets	93.042 TJ	312.084 TJ
Private households	50.354 TJ	260.689 TJ
Services	34.475 TJ	134.896 TJ
Transport	7.257 TJ	358.788 TJ
Agriculture	571 TJ	22.727 TJ
	185.699 TJ	1.089.184 TJ

Table 1: Absolute numbers of natural gas consumption

The total final energy consumption amounts to 1.089.184 TJ, thus the natural gas consumption amounts to approx. 17% of the whole final energy consumption. The total final energy consumption is also subdivided into transport (32,9%), production of real assets (28,7%), private households (23,9%), services (12,4%) and agriculture (2,1%). The comparison of the consumption of natural gas and the total energy shows that in the transport sector lots of energy is needed, but just a very small part of the needed energy is covered by natural gas (http://www.statistik.at/web_de/statistiken/energie_und_umwelt/energie/energiebilanzen/):

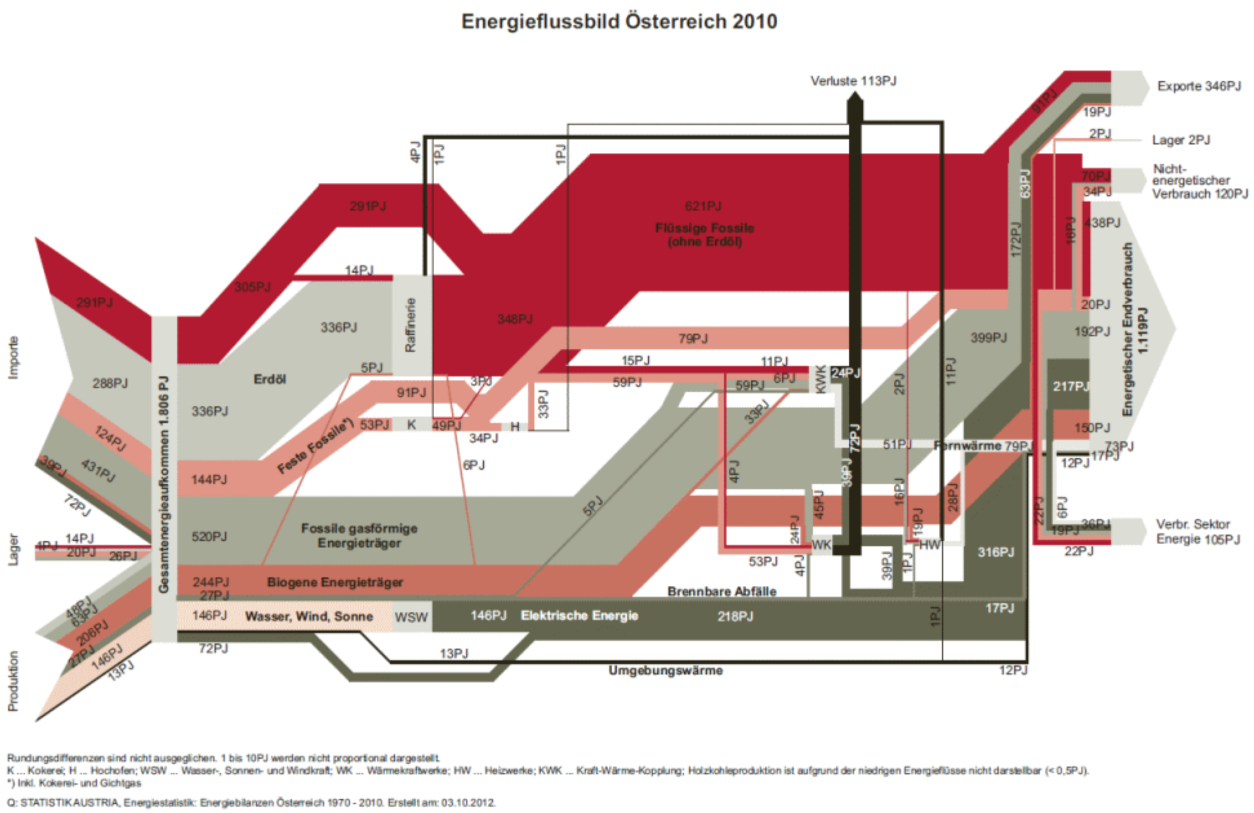


Figure 5: Energy flow chart Austria 2010 (source: Statistik Austria)

2.3. Natural gas in transport – country and target city (detailed)

2.3.1 Natural gas and biogas fuels in theory

The European Community aims at reducing CO_2 emissions and the dependency on oil by specifying that alternative fuels must power more than 20% of traffic by 2020 (BMVIT, 2008, p. 24).

Against the background of imminent climate change and increasing dependence on energy resources from politically unstable regions, policy makers are setting ambitious goals to reduce greenhouse gas emissions, including those from the transport sector. To reach these ambitious targets, a wide range of technical options is available. Apart from compressed natural gas (CNG) and liquefied petroleum gas (LPG), alternative fuels include biodiesel, ethanol, biogas and second generation fuels, as well as advanced fuels like dimethyl ether (DME) (BMVIT, 2008, p. 10ff.).

Regarding the issue of natural gas, CNG (which consists of 98 % methane) is the most relevant fuel. It has already been in use as a fuel for many years. World-wide there are 14.4 million CNG vessels in use today. Compared to the year 2002, in which there were only 1.2 million CNG vessels, this is a growth of more than 20 % per anno (ÖAMTC, 2013).

CNG has about 25% less CO_2 emissions than petrol, significant lower emissions of air pollutants and the combustion process causes no particulate emissions. In Austria, also the construction of a nationwide gas-fuelling infrastructure to support the use of CNG is in progress (BMVIT, 2008, p. 10ff.). Following comparison gives an impression of the emission saving potential of CNG:

Natural gas fuelled vehicle vs. petrol driven passenger car following EURO 4 standard:

- 80% less carbon monoxide (CO)
- 20% less carbon dioxide (CO_2)
- 80% less non-methane hydrocarbons (NMHC)
- 20% lower global warming potential and 40% lower ozone generation potential

Natural gas fuelled vehicle vs. diesel driven passenger car following EURO 4 standard:

- 10% less carbon dioxide (CO_2)
- 90% less nitric oxide (NO_x)
- 60% less non-methane hydrocarbons (NMHC)
- Virtually no particle emissions
- 10% lower global warming potential and 80% lower ozone generation potential

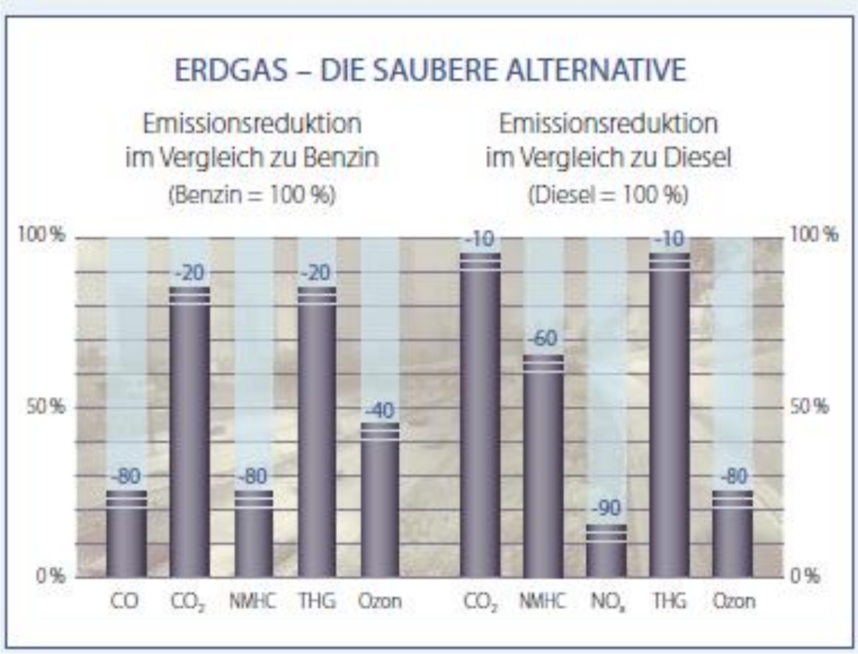


Figure 6: Comparison of emission reduction (natural gas vehicles vs. petrol/diesel vehicles) (source: FGW, 2007, p. 9)

Biogas (upgraded to biomethane, so that it has the same quality as natural gas) and CNG can be distributed through the existing natural gas grid to regular gas filling stations, compressed and sold onsite. If no gas grid is available, additional logistic is needed. Austria supports the introduction of a methane gas system for transport use through bio-CNG products. The setting up of filling stations – which is described below – is directly connected to the applications of such a fuel (BMVIT, 2008, p. 22).

Apart from CNG, natural gas can be used as a fuel in the transport sector in two additional ways:

LNG (liquefied natural gas) consists mainly of methane (such as CNG) and is natural gas, which has been liquefied in order to facilitate transport. LNG is stored either in pressure tanks or it is stored in special tanks which allow the liquefied gas to be kept at a temperature of – 161°C. LNG is mainly used for the transport of natural gas, when there are no pipelines available and for fuelling trucks (while CNG is mainly used for fuelling passenger cars).

GTL (gas-to-liquid) is also made of natural gas and is the result of a process during which the natural gas is converted to gasoline or diesel fuel.

LPG (liquefied petroleum gas) is also in use as a fuel, especially in bus fleets (e.g. in Vienna). It offers advantages such as lower CO_2 and air pollutant emissions and is cheaper than petrol or diesel. LPG is a mixture of hydrocarbon gases. It consists mainly of propane and butane, with minor amounts of propylene and butylenes. The exact composition depends on climate conditions and engine modifications. It is formed during refining crude oil and occurs also naturally in gas and oil fields.

2.3.2. Natural gas in the Austrian transport sector

In Austria, there are currently about 8.000 gas-driven vehicles in use which are powered with natural gas (ÖAMTC, 2013). However, many of those vehicles are not passenger cars, but commercial and utility vehicles. Compared to an overall stock of more than 6.3 million motor vehicles, gas as a fuel is therefore still a niche product. Most of the new natural gas vehicles are registered in Vienna, Upper Austria, Salzburg and Tyrol (http://www.erdgasautos.at/fahrzeuge/41/).

Generally, the acquisition costs of gas-powered vehicles are a bit higher than for conventionally powered cars. However, as there are fewer taxes on gas-driven cars than on conventionally fuelled cars, acquiring a gas-powered car can be economically beneficial for the owner after a short time (see also chapter 6 for detailed aspects on economic considerations).

Also the situation regarding the gas station might leave potential customers sceptical. Across Austria, there are approximately 175 public filling stations for gas-powered cars operating (plus a number of privately operated filling stations). The density compared to regular fuelling stations is therefore rather low. Even though there was an increase in the last few years, the number of natural gas filling stations should be further increased (http://www.erdgasautos.at/tanken/45/#). The figure below illustrates the location of the gas filling stations in Austria. Large symbols indicate locations with 3 or more public natural gas filling stations; small symbols indicate locations with 2 or less stations:

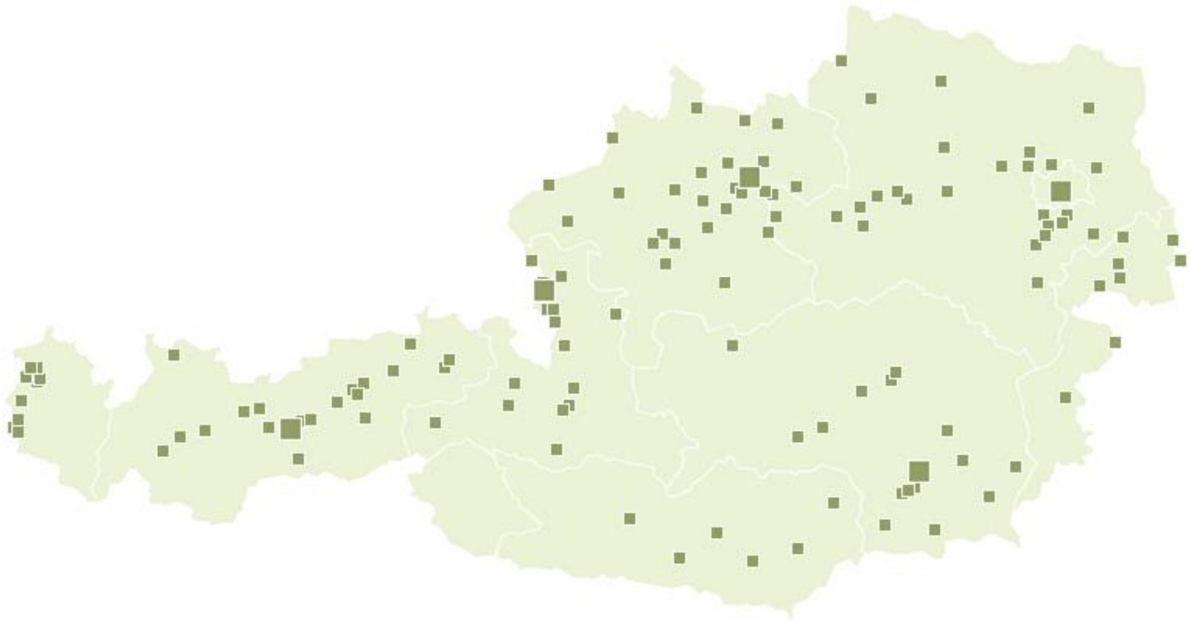


Figure 7: Location of natural gas filling stations in Austria

Also worth mentioning is that some Austrian bus fleets, especially in cities, are natural gas powered. Already in 1995, the city of Basel – though not Austrian – ordered natural gas powered busses and is therefore regarded as a pioneer. One of the Austrian pioneer cities is St. Pölten. Since the end of 2007 they use 23 natural gas fuelled low-floor busses. http://www.erdgasautos.at/fahrzeuge/43/. Another Austrian pioneer is Linz AG, which operates 88 CNG-powered busses in Linz (of a total fleet of 107 busses). Partly, the busses are fuelled with biomethane produced in a biogas plant located near Linz. A third city which switched to natural gas powered bus fleet in Austria is Salzburg. The bus company which processes the public transport in Salzburg (ALBUS) uses 37 busses, which are fuelled with biomethane.

2.3.3. Natural gas in the target city of Graz

The main users of natural gas powered vehicles in Graz are the Holding Graz Linien, the Energie Graz, the Energie Steiermark and Saubermacher AG:

- The Holding Graz Linien operates 4 CNG busses (of a total fleet of about 150 busses). They also operate 33 CNG passenger cars and several vehicles powered with natural gas are used as refuse collection vehicles.
- The Energie Graz has about 15 CNG powered cars in use (mostly VW Caddy).
- The Energie Steiermark operates 37 CNG-powered vehicles
- Saubermacher AG has started to integrate CNG powered trucks into their fleet of refuse collection vehicles; the first one is now in use in the city of Graz.

Situation regarding the financial support in the target city of Graz (see also chapter 6 for details on financial public support for gas-fuelled vehicles):

The city of Graz offers a funding of € 500 for taxi operators, social services and food delivery services if they switch to CNG cars. However, less than 5 businesses have made use of this financial support during the last year.

Also the Energie Steiermark supports private people who buy a CNG powered car with € 600, customers from the commercial trade and industry sector with € 800 and taxi operators as well as driving school operators with € 1.050.

Local situation regarding e-mobility:

As Graz is the centre of a test region for e-mobility, called "Modellregion Elektromobilität Großaum Graz" (www.emobility-graz.at), there seems to be a trend towards e-mobility when it comes to changing fleets, a trend which also a lot of public entities currently follow.

2.4. Further Austrian Success Stories

Apart from successful gas powered bus fleets, following Austrian companies have switched to natural gas powered vehicles:

IKEA: Converted 23 of its rental transporters to natural gas fuelled vehicles

Taxi Company Horn, Vienna: Uses 10 CNG powered taxis

SK Rapid, Vienna: Conversion of the whole fleet to a natural gas powered fleet

Coca Cola Austria: More than 100 company-owned vehicles were converted into natural gas powered vehicles

Post AG: In 2008, additional 50 natural gas powered delivery vehicles were obtained (40 had already been in use before that)

City of Vienna & energy supply companies of Vienna: The department of the city administration of Vienna (Nr. 34) converted their whole fleet to a natural gas powered fleet.

2.5. Biogas production and consumption in Austria (detailed)

There was a considerable increase in the number of biogas plants from 2002 to 2005 in Austria. Attractive tariffs for feeding green electricity into the grid (10.5 to 16.65 €Cent/kWh) and low costs for energy crops (2004: 16 to 25 €/t for maize) motivated quite a lot of farmers to install biogas plants with a CHP. After 2005 the number of biogas plants remained nearly stable. One reason was the increasing price-level for substrates (2012: 25 to 40 €/t maize) but also stronger legal requirements, barriers from neighborhood etc. were reasons for this development. In the year 2011, 363 biogas plants with a total capacity of 105.41 MW were registered. The figures 8 to 10 and Table 2 show the development of biogas plants in Austria:

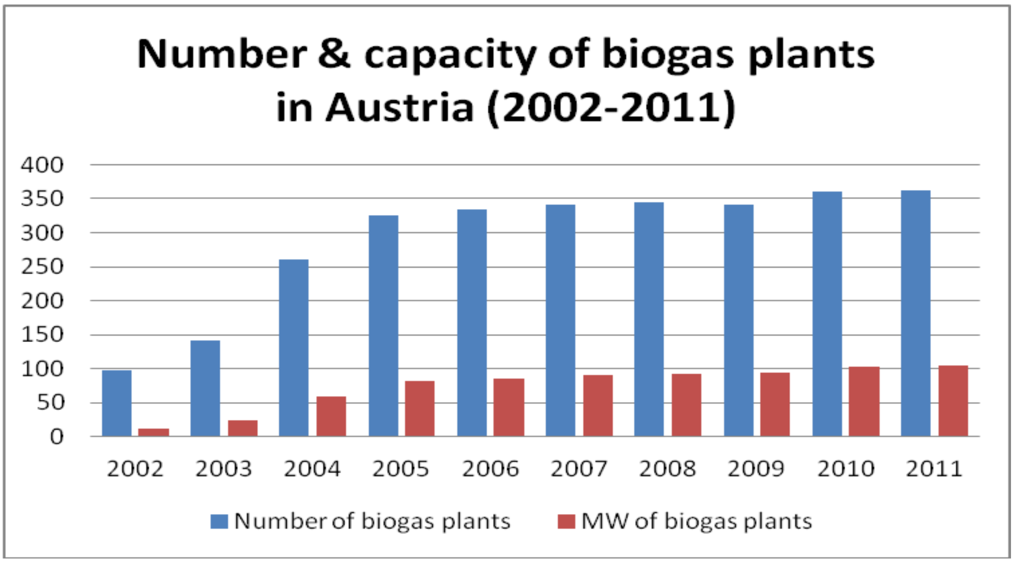


Figure 8: Number and capacity of biogas plants in Austria (2002-2011) (source: E-Control, 2012, p. 82)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number	97	141	261	325	334	341	344	341	360	363
MW	12,19	24,15	59,66	81,01	84,49	90,12	92,07	94,45	102,59	105,41

Table 2: Number and capacity of biogas plants in Austria (2002-2011) (source: E-Control, 2012, p. 82)

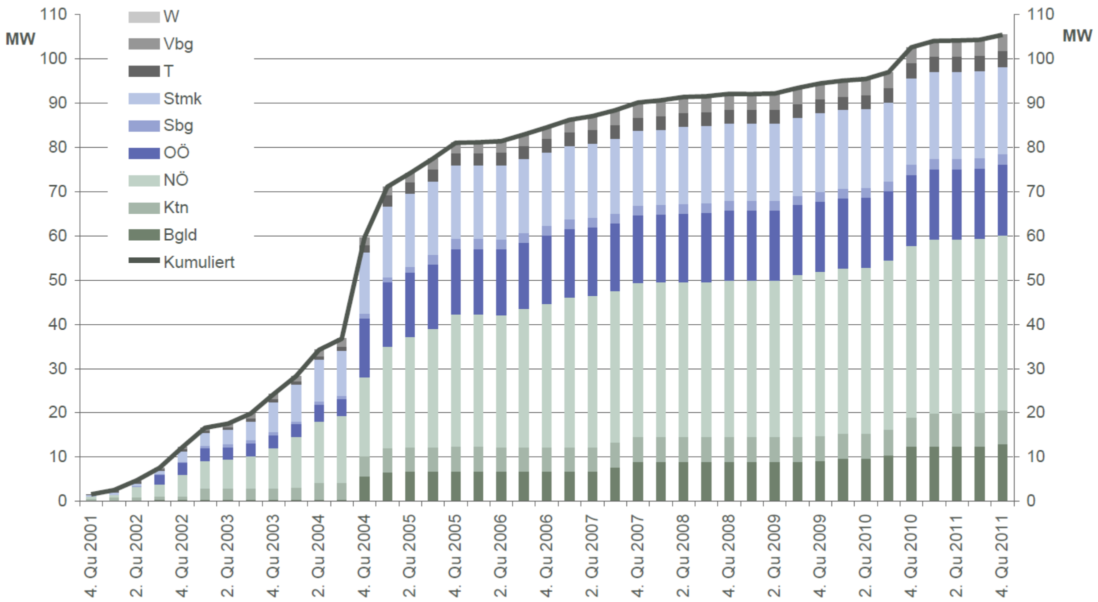


Figure 9: Capacity of biogas plants in Austria (2001-2011) by provinces (source: E-Control, 2012, p. 116)

Figure 9 shows, that nearly one third of the biogas plants (102 plants; 39.47 MW) is situated in Lower Austria, followed by Upper Austria (79 plants; 16.09 MW) and Styria (53 plants; 19.61 MW).

Figure 10 shows the development of the biogas plant capacities in Austria in the different federal states in Austria. Figure 11 depicts the quantity of biogas plants across Austria. In June 2012, 329 plants were in operation across Austria.

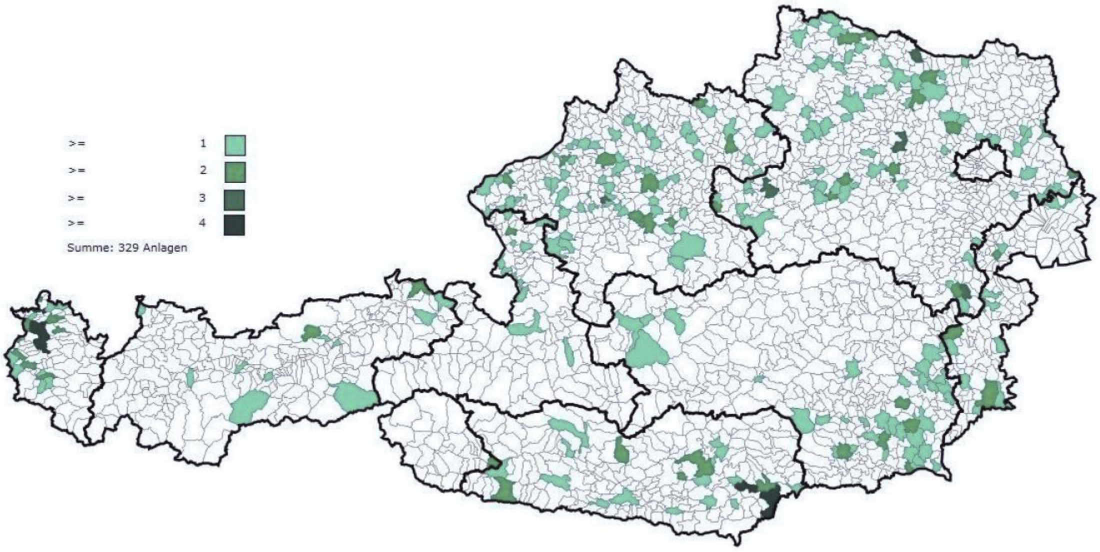


Figure 10: Location of biogas plants in use (329) in Austria (June 2012) (source: E-Control, 2012, p. 119)

The average capacity of a biogas plant in Austria accounts for 288 kW. 90% of the biogas plants have a capacity < 500 kW. Those plants provide 69% (72 MW) of the total capacity. In Austria there are just 3 plants located with a capacity > 1 MW. (E-Control, 2012, p. 117)

About 15% of the total capacity comes from plants with biomethane grid injection. The rest of the plants use the biogas (at least in most cases) in local CHP-plants (in 2010 about 540 GWh of green electricity was fed into the grid).

The upgrading from biogas to biomethane in Austria started in 2005 with a plant in Pucking in upper Austria. This plant feeds purified and refined biogas from cattle breeding into the existing natural gas grid. The plant is operated by Erdgas OÖ and OÖ Ferngas AG in cooperation with the chamber of agriculture in Upper Austria.

In 2006, a very important and innovative research project from the Styrian Gas Wärme GmbH about fermentation tests, laboratory experiments and the analysis of different upgrading technologies for grid injection was completed. This was the basis for the biogas and biomethane upgrading plant in Leoben.

In the biogas plant in Bruck an der Leitha, biogas is produced from grass, beet silage, maize silage and other residual materials from the food industry. The main part of the produced raw gas is used in a CHP plant. In June 2007 a pilot scheme for the upgrading of the raw gas and the feed-in into the grid of the EVN AG, was launched.

At the end of 2011, 7 active upgrading plants were in use (Asten/Linz, Bruck an der Leitha, Engerwitzdorf, Pucking, Schwaighofen bei Eugendorf, Steindorf and Wiener Neustadt). The plant in Leoben was out of operation at the end of 2011 and in 2012 but it started to operate again at beginning of 2013. Furthermore, there are 3 biogas upgrading plants that don't feed into the public gas grid, but supply public filling stations (St. Margarethen am Moos, Rechnitz and Güssing). There is a plant expansion currently going on at the plant in Margarethen am Moos and this plant is also going to feed into the gas grid in the future. The construction of a micro biogas/biomethane grid in Güssing is in planning status right now. Biomethane from the local biogas plant should then be fed in that micro grid.

Table 3 and Table 4 give an overview over the biogas upgrading plants in Austria:

Location	Year of installation	Technology	Operator	Capacity	Note
Pucking	2005	PSA	OÖ Gas-Wärme GmbH	6 Nm3/h	1st biomethane upgrading plant in Austria
Bruck an der Leitha	2007	Membrane technology	Energiepark Bruck/Leitha	100 Nm3/h	
Schwaighofen bei Eugendorf	2008	PSA	GRASKRAFT REITBACH/Salzburg AG	40 Nm3/h	
Asten/Linz	2010	Water scrubber	Linz AG	342 Nm3/h	Fuel for the own car fleet and 2/3 of the busses of Linz
Engerwitzdorf	2010	Amine scrubber	Naturgas Engerwitzdorf GmbH/OÖ Ferngas AG	125 Nm3/h	
Leoben	2010	Amine scrubber	LE Gas/Steierische Gas-Wärme GmbH	160 Nm3/h	

Steindorf	2011	PSA	Salzburg AG	150 Nm3/h	
Wiener Neustadt	2011	Membrane technology	EVN	120 Nm3/h	

Table 3: Overview of the biogas upgrading plants in Austria feeding into the gas grid (source: ARGE Kompost und Biogas, 2013)

Location	**Technology**	**Operator**	**Note**
Margarethen am Moos	Membrane technology	EVM	CHP + filling station; at the moment plant expansion with feed-in
Rechnitz	PSA	Entsorgung Stipitz	CHP + filling station
Güssing		Biogas Strem	CHP + filling station; micro grid planned
Utzenaich		Bioraffinerie Forschungs- u. Entwicklungs GmbH	Research and demonstration plant

Table 4: Overview of the biogas upgrading plants in Austria without feeding-in the public gas grid (source: ARGE Kompost und Biogas, 2013)

The production capacity of the upgrading plants feeding into the natural gas grid is about 1.050 Nm^3/h which approximately results in 9m Nm^3/a (methane content > 98%). The biggest plant is located in Asten/Linz (approx. 342 Nm3/h, 3.328.800 Nm3/a).

The injected biomethane is used for transport (public transport in cities like in Linz; company cars and vans; private cars), for feeding CHP-plants and for heating (mainly in private households as there is an “Ökobonus” when green gas is used).

3. Gas transmission and distribution

3.1. In Austria (short)

The taking over of the Russian natural gas takes place near the Slovakian border in Baumgarten. Baumgarten is one of the most important natural gas platforms in Europe. From Baumgarten the gas is distributed to the federals states of Austria and the neighboring countries. A further takeover station, especially for Norwegian and German natural gas, is located in Oberkappel (Upper Austria).

For the transport in and through Austria five big natural gas pipelines are available: TAG, WAG, HAG, SOL and PENTA. Altogether they are approx. 2.000 km long. Furthermore, there are additional natural gas grids to distribute the natural gas to the customers, which have a length of approx. 34.000 km.

<u>TAG (Trans-Austria gas pipeline):</u> From Baumgarten (Upper Austria) to Arnoldstein (Carinthia) - 380 km, it provides natural gas for Italy, Slovenia and Croatia and the southern and eastern federal states of Austria

WAG (Western Austria gas pipeline): From Baumgarten (Upper Austria) to Oberkappel (Upper Austria) – 245 km, it brings natural gas to France, Germany and the federal states of Vienna, Lower and Upper Austria and Salzburg

HAG (Hungarian Austria gas pipeline): From Baumgarten (Upper Austria) to Deutsch-Jahrndorf (Burgenland) – 46 km, it offers a connection to the Hungarian natural gas grid

SOL (South-East gas pipeline): From Weitendorf (Styria) to Murfeld (Styria) – 26 km (branch of TAG),

PENTA: From Oberkappel (Upper Austria) to Burghausen (Bavaria) – 95 km, (source FVMI, 2011, p. 25f.)

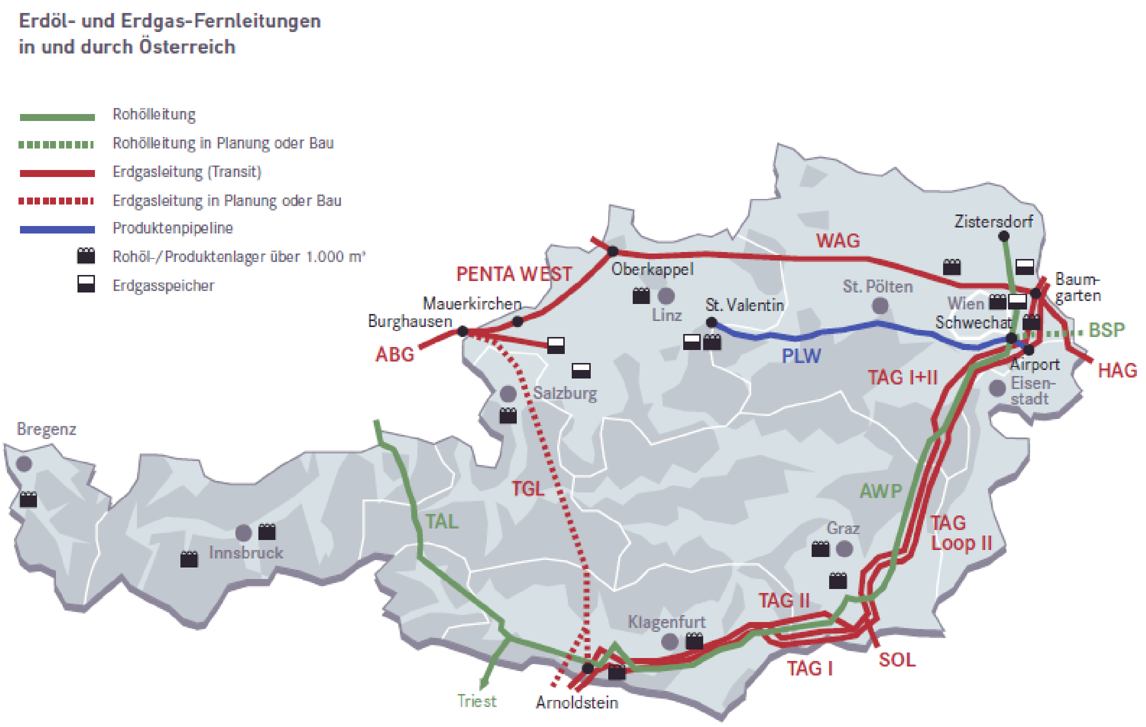


Figure 11: Natural gas long-distance lines in Austria (source: FVMI, 2011, p. 26)

“Nabucco” was the biggest and most complex pipeline project outside of Russia. On June 26, 2013 official representatives of involved gas companies declared that the project was dead (at least in its original version; “Nabucco west” is still on the agenda). The main target of “Nabucco” would have been to decrease the dependency on Russia. The construction start had been planned for 2013 and the pipeline should have been finished by 2017. “Nabucco” would have reached from the eastern border of Turkey to Baumgarten. It would have passed Bulgaria, Rumania and Hungary and would have been about 3.900 km long. The operators of the Nabucco would have been OMV Gas & Power (Austria), MOL (Hungary), Transgaz (Rumania), Bulgarian Energy Holding (Bulgaria) and RWE (Germany).

The density of the Austrian transport and distribution grid reflects the increase in importance of natural gas. In contrast to 1988 the length of it tripled until now. (http://www.gaswaerme.at/beg/themen/index_html?uid=2662#a3)

3.2. In Styria (detailed)

The “Gasnetz Steiermark” (subsidiary of Energie Steiermark, responsible for natural gas grids) operates a more than 3.700 km long distribution network and is therefore an important investor and infrastructure creator in Styria. Nearly the whole local industry, a lot of business operations and private customers are connected to the natural gas grid. (http://www.gasnetzsteiermark.at/de/leitungsnetz/). The “Gasnetz Steiermark” came into being due to the liberalization of the gas market (due to new legal requirements it was necessary to detach the network operator and the energy distributor).

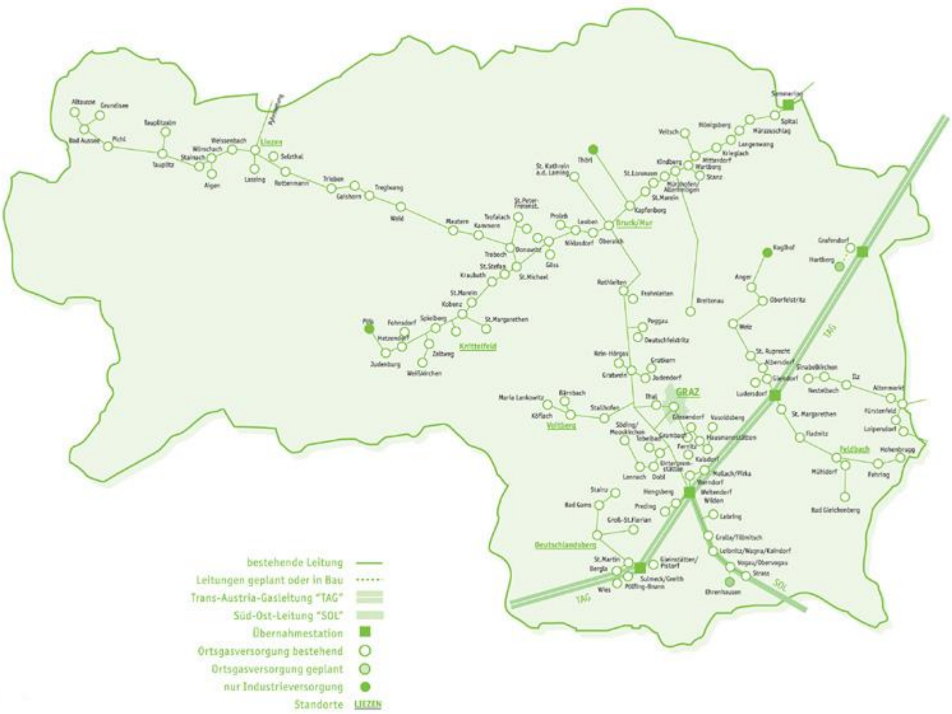


Figure 12: The Styrian natural gas grid (source: www.gasnetzsteiermark.at/de/leitungsnetz/)

The figure below shows the gas grid in the inner city of Graz, the complete plan for the city of Graz can be found in the annex.

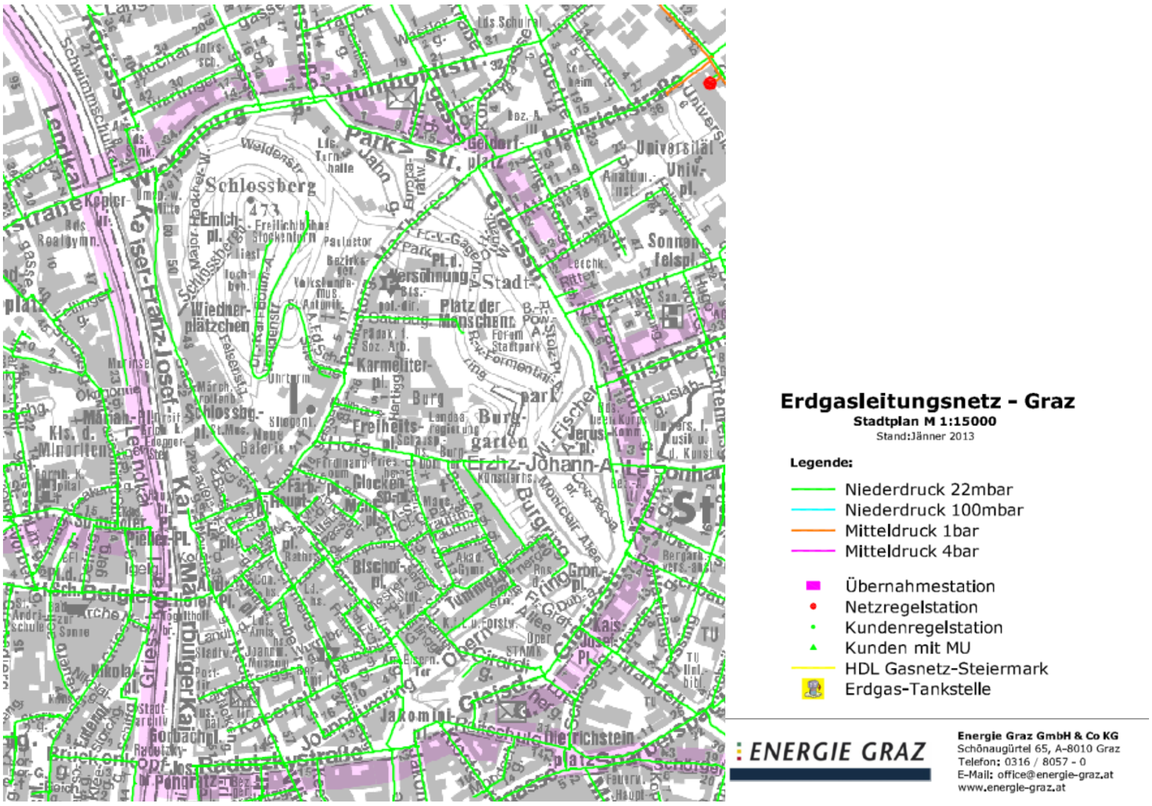


Figure 13: Extract from the gas grid plan for the city of Graz

3.3. Public transport in target city

The public transport in the city of Graz is operated by the Holding Graz Linien (HGL), comprises a network of routes of ~ 380 km and employs more than 800 people. In 2003, the vehicles operated by vehicles owned by the HGL covered a distance of 19.9 Mio km.

- HGL transports 280.000 passengers every day, which results in far more than 100 million passengers per year
- At the Jakominiplatz, which is the public transport hub in the inner city of Graz, 1.373 tramways and 1.417 busses depart daily.
- 52.3 % of the passengers use the tramway.
- 46.9 % of the passengers use the bus.
- 0.8 % of the passengers use the elevator and the furnicular to the castle hill in the city center.
- HGL operates eight tramway lines and 29 bus lines. Additionally, there are eight so-called nightlines.
- The most frequently used tramline is number 7, which transports about 41.000 passengers per week (2011)
- The least frequently used tramline is number 3, which transports about 20.000 passengers per week (2011).

As already mentioned in chapter 2, HGL operate 4 CNG busses (of a total fleet of about 150 busses). Currently, it is not planned to extend the CNG fleet. Current trends show that newly acquired busses will rather correspond to the EURO VI requirements for diesel vehicles, which are – according to representatives of the HGL– comparable (regarding their environmental impacts) to busses powered by natural gas.

Regarding CNG filling stations, there are seven CNG filling stations in the city of Graz.

4. Technical requirements for biogas use

The technical requirements for biogas plants are presented in the „Technische Grundlage für die Beurteilung von Biogasanlagen 2012“ (bmwfj). This document is updated annually by the Federal ministry of economy, family and youth (bmWfi). The document contains actual requirements concerning technology and processes, dangers, information concerning operation and maintenance, an overview of the needed approval documents and an overview of relevant directives and guidelines.

With regard to legal requirements, a biogas plant in Austria represents a typical cross-sectional matter. A biogas plant might be seen as an agricultural plant, an industrial plant or a waste treatment plant. The legal appraisal depends on the legal status of the operator, the used material and the type of energy production. Furthermore, the size of the plant and the quality of the basic products are important. The approval process of such a plant depends on the criteria mentioned above. There is no standardized process. Depending on the plant, the following departments might be affected:

Land use planning, civil engineering, fire protection, engine construction, process engineering, electrical engineering, explosion prevention, groundwater protection, protection of waters, air pollution control, noise protection, waste management, chemistry of waste, waste engineering, hygiene, industrial safety, traffic engineering.

The main aspects about technical requirements are also defined ÖNORM S 2201 “Organic waste - Quality requirements”, ÖNORM S 2207-1 “Fermentation plants – part 1: terms and definitions” and ÖNORM S 2207-2 “Fermentation plants – part 2: technical requirements for process technology”.

4.1. Grid injection

For feeding gas (natural gas or biomethane) into the natural gas grid, specific legal norms must be considered.

Distributors are obliged to come up with „General conditions regarding the distribution grid“. These have to be approved by the so-called e-control commission. In these general conditions, the decisive quality requirements for the feed-in and the transport of biogenic gases and possible feed-in points are to be determined.

If the determined quality requirements are met, the distributor has to grant a connection and access to the grid. The biogas producer is then entitled to grid access and at the same time it is ensured that the quality requirements for the feed-in of the biogas are met.

Natural gas grid operators have to allow the access to the grid for the feed-in of biogas, if the produced biogas complies with the ÖVGW-guideline G 31 (ÖVWG-guideline G31, 2011). If the quality specifications according to the other specific market rules chapter 6 or the necessary delivery pressure are not met, the operator of the distribution grid has the right to refuse the take-over of the natural gas.

The other specific market rules also refer to relevant regulations specified in other ÖVGW-guidelines. Therefore, also regulations of the ÖVWG-guideline G B220 are to be met.

The operators of the distribution grid invoice the plant operator those expenses, which occur during the first-time connection of the biogas plant with the distribution grid. The invoice corresponds to the grid access fee. These costs are fully carried by the one feeding in the biomethane. Financing this “grid extension“ through user fees, as it is the case for the expansion of the Austrian gas grid, is currently not planned.

ÖVWG-guideline G31:

The guideline defines the quality requirements for the injection into the grid and the requirements regarding the transport of natural and biogenic gases in the grid.

Within the ÖVWG-guideline G31, the quality requirements for gas are defined. Those requirements shall ensure a safe transport of gas within the Austrian gas grid.

It is crucial that the quality requirements within the guideline G31 solely relate to entry points and not to the quality of the gas when it reaches the end consumer. That means that the gas to be injected into the grid needs to fulfill all quality requirements at the point of feed-in, even if only very small amounts of gas are to be fed-in.

Tabelle: Qualitätskriterien der ÖVGW Richtlinie G 31 [ÖVGW 2001]			
Brenntechnische Daten			
1.	Wobbe-Index	13,3 – 15,7 kWh/m³	
2.	Brennwert	10,7 – 12,8 kWh/m³	← **Calorific value**
3.	Relative Dichte	0,55 – 0,65	
Gasbegleitstoffe			
4.	Kohlenwasserstoffe: Kondensationspunkt	maximal 0° beim Betriebsdruck	
5.	Wasser: Kondensationspunkt	maximal -8° bei einem Druck von 40 bar	
6.	Sauerstoff (O2)	< 0,5 Vol. %	
8.	Kohlendioxid (CO2)	< 2 Vol. %	
9.	Stickstoff (N2)	< 5 Vol. %	
10.	Wasserstoff (H2)	< 4 Vol. %	
11.	Gesamtschwefel	10 mg S/m³ (auf Dauer) 30 mg S/m³ (im Schnitt)	
12.	Mercaptanschwefel	< 6 mg S/m³	
13.	Schwefelwasserstoff (H2S)	< 5 mg/m³	
14.	Kohlenstoffoxidsulfid (COS)	< 5 mg/m³	
15.	Halogenverbindungen>	0 mg/m³	
16.	Ammoniak (NH3)	technisch frei	
17.	Fest-und Flüssigbestandteile	technisch frei	
Andere Bestandteile, welche die Betriebssicherheit und den Bestand des Netzes gefährden, dürfen nicht enthalten sein			

Table 5: Quality criteria according to ÖVWG-guideline G31

ÖVWG-guideline G B220:

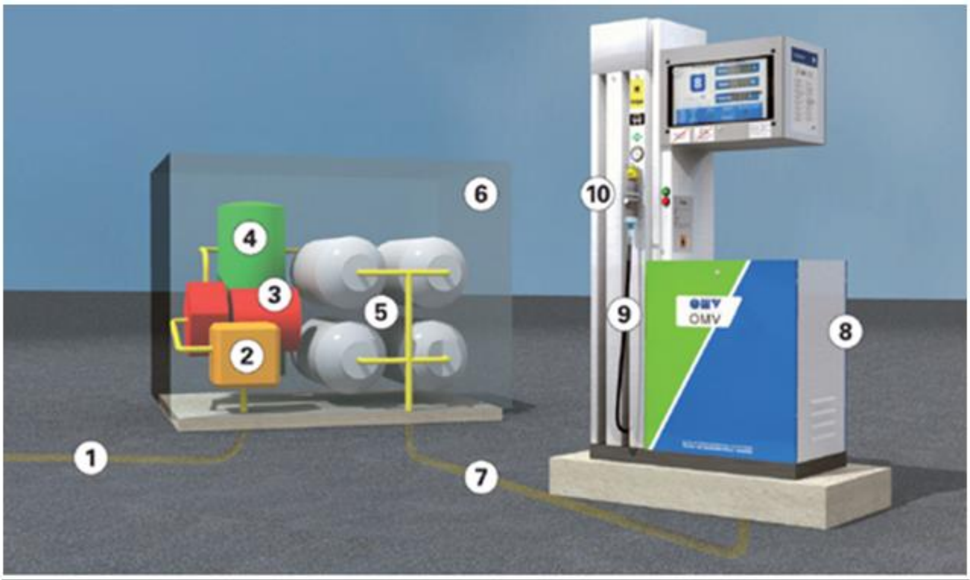
This ÖVGW guideline is applicable for the injection of biogas from renewable processes as biomethane in the gas grids of the operators.

Guideline G B220 describes the minimum requirements and quality controls for the injection and distribution of renewable gases in the natural gas grids of the operators. Through the injection of renewable gases the safety of the downstream natural gas pipeline facilities must not be impaired. The operational requirements of the distribution grid operator must be met, and the proper functioning of the distribution grid must be guaranteed. In contrast to Guideline G 33, this revised version provides a new regulation for the use of sewage mud.

4.2. Public transport

Technical description of a gas filling station:

The CNG filling stations works as follows: The gas is drawn from the grid and then passes a compressor, which compresses the gas. In order to avoid icing, the gas is dried and stored in a temporary tank. As the gas directly goes from the temporary tank into the petrol pump, the fuelling process with gas is as quick as the fuelling process with gasoline ("fast fill"). Safety measures ensure that gas is only passed on if all technical appliances are correctly adjusted and locked. It filling process ends either automatically or it can be cancelled prematurely by hand. For filling with a different nozzle (e.g. for a modified car), an adapter is needed. However, if an adapter is used, only qualified staff from the filling station is allowed to fuel the car. The following figure shows how a CNG filling station is set-up:



The graph above shows how a CNG filling station is set up:

1. Gas pipeline
2. Gas meter
3. Compressor
4. Dryer
5. Storage cylinder
6. Metal or concrete casing
7. Connecting pipe
8. Petrol pump
9. Tube
10. Coupling

All elements are connected to each other by high-pressure hoses and high pressure pipes accordingly.

Figure 14: Set-up of a gas filling station

5. Economic and organisational considerations

The costs of a biogas/biomethane plant consist of costs for the production/purchase of the input material, investment costs, infrastructure costs (connection fee for the public grid), current costs (maintenance, repair) and costs of the plant operation. In contrast to that there are revenues from the selling of biomethane (or in case of operating a CHP at site the selling of electricity and heat) and possible further revenues due to the treatment of co-substrates.

More information about the economic considerations of biogas/biomethane plants are included in the biogas & biomethane production concept (D4.3). When operating a CHP at the site of the biogas plant from an ecological and as well as an economical point of view, the use of the produced heat should also be considered (in addition to the feed-in of electricity) - especially the use of the heat during the summer.

5.1. Grid injection

Biomethane – grid injection

Currently, there are no tariff models for the biomethane grid injection in Austria.

At the moment (May 2013) the market price for 100% biomethane is at about 5,5 to 6,5 €Cent/kWh from urban waste and 6,5 to 7,5 €Cent/kWh from NAWARO (energy crops).

In the following table shows a summary of an overall assessment (economical and ecological) of the biomethane production and grid injection with different raw materials in comparison with natural gas:

Generation path [performance biomethane, description raw material mix]	**Raw material and fermentation process**	**Economics**	**Ecology** (total)	**National econmoy** (total)	**Market effect total**	**Energy policy**	**Social science**
	Agricultural potential	**full production costs**	**GHG + + dust ...**	**GDP + employment + net effect**	**GHG-reduction costs**	**Eligibility**	**Land use conflict with food production**
800 Nm³/h energy crop rotation	++	-	+	+	0	++	-
600 Nm³/h energy crop rotation	+	-	++	+	0	+	-
800 Nm³/h integrated crop rotation	++	-	+	0	0	+	-
500 Nm³/h waste material	- -	+	0	++	0	++	+
400 Nm³/h waste material	- -	+	+	++	0	++	+
400 Nm³/h catch crops&straw	- -	0	+	++	0	++	+
250 Nm³/h corn	+	- -	+	-	0	-	-
300 Nm³/h corn&crude glycerin	- -	+	++	++	+	++	-
250 Nm³/h integrated crop rotation and straw	0	- -	+	-	0	-	-
130 Nm³/h integrated crop rotation and straw	-	- -	++	- -	-	- -	-
27 Nm³/h grass	- -	- -	++	- -	- -	- -	+
22 Nm³/h grass	- -	- -	++	- -	- -	- -	+
27 Nm³/h cattle&pig slurry	-	- -	++	- -	+	-	+
20 Nm³/h cattle&pig slurry	-	- -	++	- -	+	- -	+
7 Nm³/h chicken manure & pig slurry	- -	- -	++	- -	- -	- -	+

Table 6: Overall assessment of biomethane production (GEA 2011, Biogas Gesamtbewertung)

The result of the economic calculations of the production costs of the biomethane from different raw materials and in plant sizes is shown in the following figure:

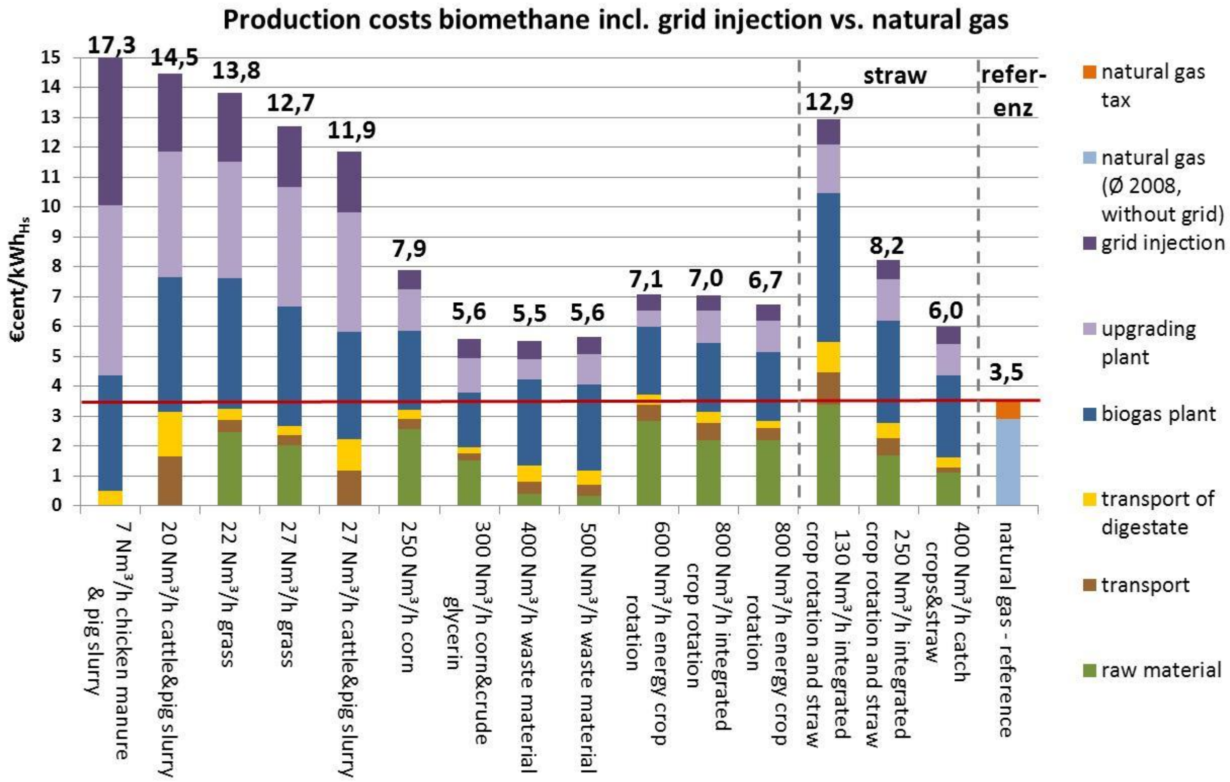


Figure 15: Production costs of biomethane incl. grid injection versus natural gas (GEA 2011, Biogas Gesamtbewertung)

Although the study is based on the market prices of 2011 the figure above shows quite good the huge differences between different raw materials and plant sizes. The lowest production costs are for the larger biogas and biomethane plants using (urban) waste material as raw material. The highest production costs are at the smaller plants using slurry or energy crops.

Concerning the organisational way of feeding biomethane into the grid, the following aspects are relevant:

The **OeMAG** is the clearing and settlement company for the Austrian green energy. The tasks of the OeMAG are:

- Financial management of the annual funding budget
- Verification of Green Energy providers during the registration at OeMAG
- Funding of the injected energy for existing and new green energy plants

AGCS has developed the biomethane Registry Austria together with the market experts (www.biomethanregister.at). As a result a transparent and targeted generation for biomethane certificates in Austria has been realised - the biomethane Registry Austria.

The biomethane Registry Austria

The tasks of the biomethane Registry Austria are:

- Transparent registration of market participants
- Standardised issuance of certificates for injected biomethane
- Generation for secured transmission of biomethane certificates

- Activation of the biomethane certificate database and support

Functionality of the certificate system:

- Gas amounts and certificates are separated
- Central database for certificates with electronic interface to gas clearing system
- Monthly generation of certificates after clearing
- Transfer of ownership and retirement

The biomethane registry covers all distribution areas in Austria, like distribution area east, Tyrol and Vorarlberg.

Participants and parties of the biomethane registry Austria:

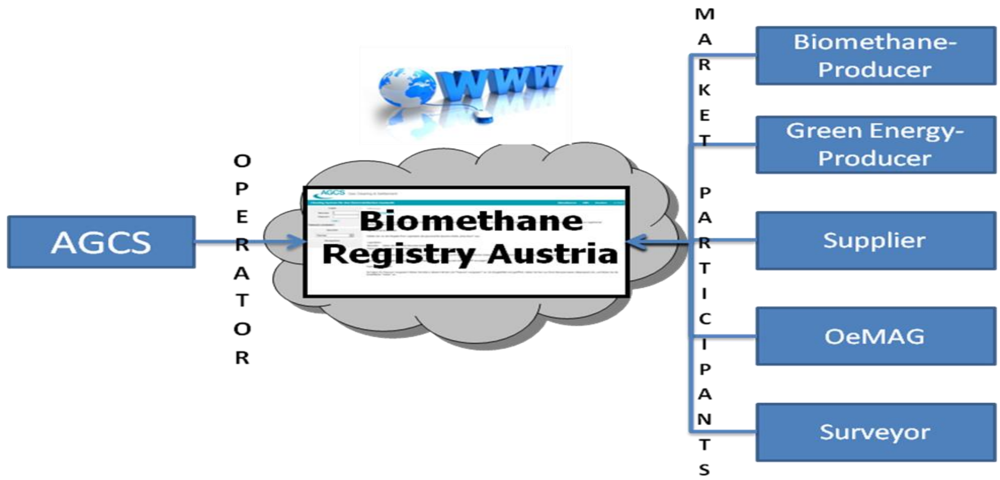


Figure 16: Biomethane Registry Austria - Participants & Parties (source: Biomethane register AGCS, 2013)

Functional principle of the registry:

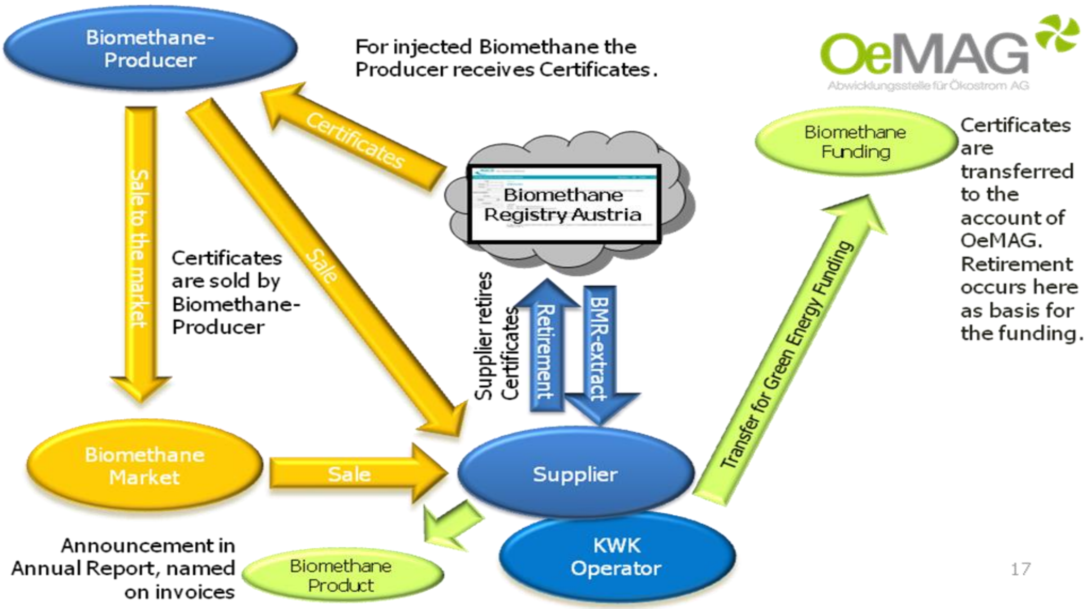
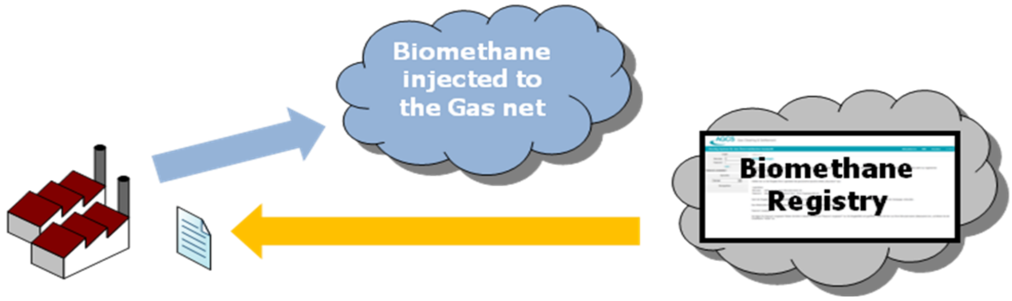


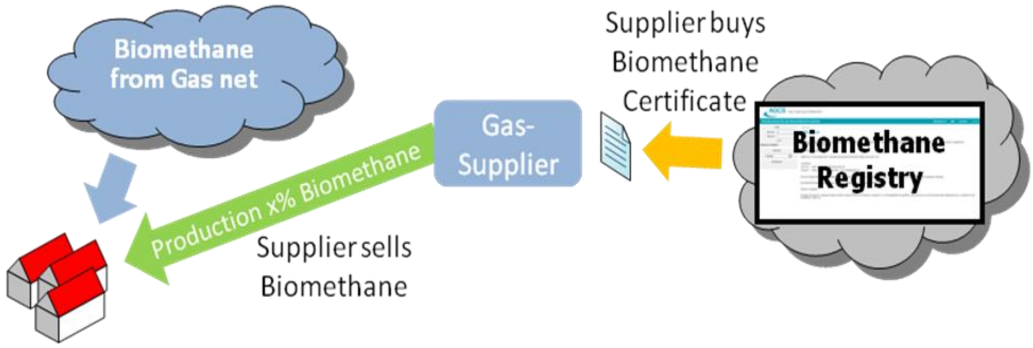
Figure 17: Functional principle of the registry (source: Biomethanregister AGCS, 2013)

Application possibilities for market participants

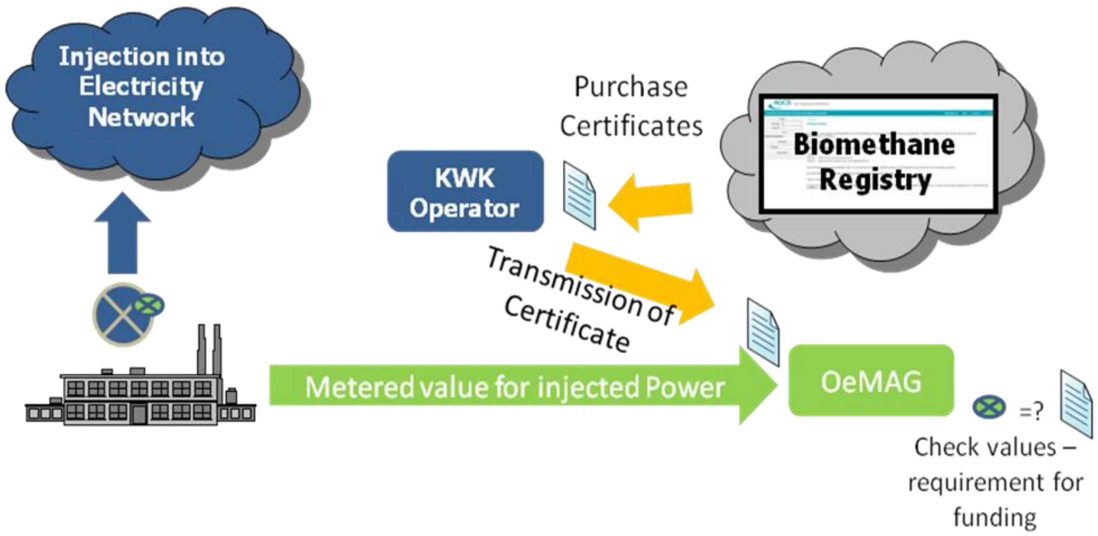
Biomethane -Producer:



Gas Supplier:



Gas user - conversion into electricity:



In March 2013 the following market participants were part of the biomethane registry Austria:

Alias	Company Name	ROLE
TIGAS	TIGAS-Erdgas Tirol GmbH	Biomethane-Producer
TIGAS	TIGAS-Erdgas Tirol GmbH	Biomethane-Conversion
MASTERMIND	Mastermind Ingenieurbüro GmbH	Surveyor
OE-GAS-WAERME	OÖ. Gas-Wärme GmbH	Biomethane-Producer
TÜV AUSTRIA	TÜV AUSTRIA SERVICES GMBH	Surveyor
PRESCON	Prescon technische Überprüfungs GmbH	Surveyor
EVN-WAERME	EVN Wärme GmbH	Biomethane-Producer
ENERGIEALLIANZ	ENERGIEALLIANZ Austria GmbH	Certificate Trader
BIOGAS-BRUCK	Biogas Bruck/Leitha GmbH	Biomethane-Producer
EVN-VERTRIEB	EVN Energievertrieb GmbH & Co KG	Certificate Trader
WIENENERGIE	WIEN ENERGIE Vertrieb GmbH & Co KG	Certificate Trader
SALZBURGAG	Salzburg AG für Energie, Verkehr und Telekommunikation	Biomethane-Producer
SALZBURGAG	Salzburg AG für Energie, Verkehr und Telekommunikation	Biomethane-Producer
SPIEGLTEC	SPIEGLTec Tech. Büro für Maschinenbau GmbH	Surveyor
STFG	Steirische Gas-Wärme GmbH	Biomethane-Producer

The average monthly feed–in quantity to the biomethane Registry Austria in 2012 was approximately 4.400 GWh. The following figure shows the feed-in quantities from January to March 2013 and also the issued certificates.

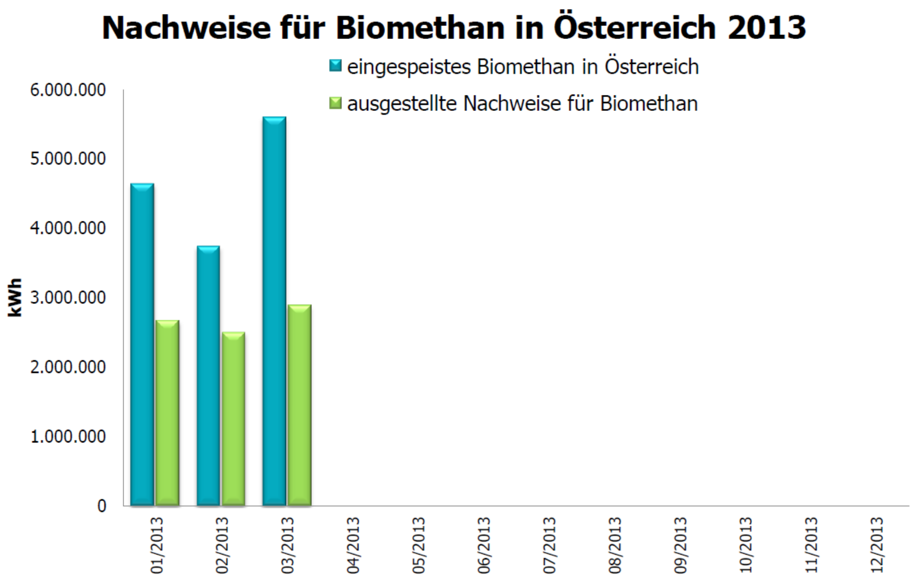


Figure 18: Certificates for biomethane in the Austrian biomethane registry for January to March 2013 (source: Biomethanregister AGCS 2013)

In some Austrian federal states, new buildings must be equipped with solar panels. However, an exclusionary rule applies, if pure biomethane or a mixture with natural gas with a defined minimum level of biomethane are used for heating and warm water production. This can reduce the investment costs of new buildings. For gas producers, this is a welcome argument in favor of their product.

Green electricity – feed-in tariff

A crucial factor with regard to economic efficiency is the feed-in tariff, which compensates for the produced electricity. In Austria, electricity from renewable energies is boosted by the promotion system for green electricity, which is based on the green electricity act. Producers of green electricity sell their electricity to the central settlement agent for green electricity (OeMAG; also see above). The feed-in tariffs vary from year to year and depend on the renewable energy source. Generally, small plants are compensated with a higher tariff then larger plants. In a further step the OeMAG transfers the electricity to the electricity merchants. They have to pay the electricity at the stock price. The system is financed by the stock price (paid by the merchants) and the flat-rate meter charges (paid by the end users).

The actual tariffs for feeding the electricity from CHPs driven by renewable energies into the grid are defined in the "Ökostrom-Einspeisetarifverordnung 2012". Energy recovery is obligatory and there is also a bonus system for particularly efficient CHPs.

The Ökostrom-Einspeisetarifverordnung 2012 in detail:

§ 10 (1): Feed-in tariff for Ökostrom generated from biogas out of agriculturally substrates – direct convert into electricity - for plants build in 2013:

- Generation based on agricultural substrates
  - Up to 250 kW: 19,50 €Cent/kWh
  - 250 up to 500 kW: 16,93 €Cent/kWh
  - 500 up to 750 kW: 13,34 €Cent/kWh
  - more than 750 kW: 12,93 €Cent/kWh
- (2) Minimum of 30% animal manure
- (3) 20% reduction on above mentioned tariffs when using non-agricultural substrates
- (4) Additional bonus of 2 €Cent/kWh for CHP-plants operated exclusively with biogas and reaching special efficiency criteria (CHP-Bonus) – only for plants commissioned till end of 2013

§ 10 (6): Feed-in tariff for Ökostrom generated in CHP-plants driven by biomethane from biogas out of agriculturally substrates – convert decentralized into electricity (injected biomethane) - for plants build in 2013:

- Generation base on agricultural substrates
  - up to 500 kW: 16,93 €Cent/kWh
  - 500 up to 750 kW: 13,34 €Cent/kWh
  - more than 750 kW: 12,93 €Cent/kWh
- (3) 20% reduction on above mentioned tariffs when using non-agricultural substrates
- (7) Additional bonus of 2 €Cent/kWh for the quantity of electricity generated from gas which was fed into the gas grid based on the quality of natural gas (Technologiebonus)

As shown in the following figure, the feed-in tariffs for electricity produced in CHPs driven with biogas decreased from 2008 to 2011. That is due to the decrease in the biogas raw material surcharge (see table "Biogas-Rohstoffzuschlag" in the following figure). There might be a connection between the decreasing feed-in tariffs and the number of biogas plants in Austria. As shown in chapter 0, the number of biogas plants remained nearly stable in the last few years.

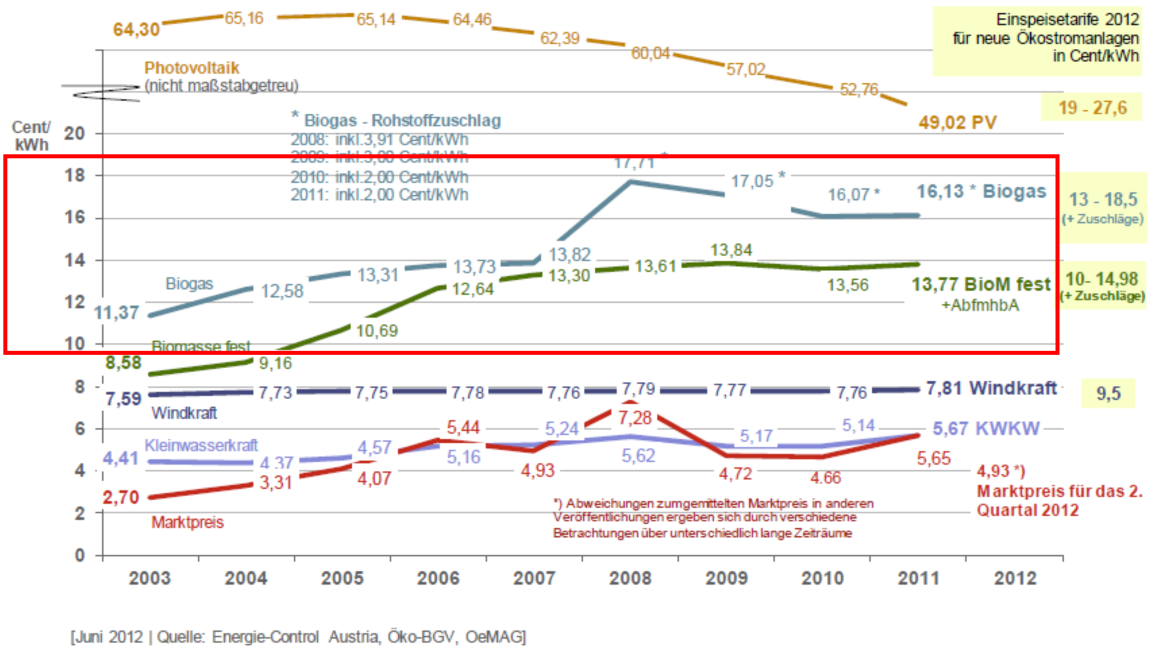


Figure 19: Development of feed-in tariffs for green electricity (source: E-Control, 2012, p. 44)

Additionally, plants used for the production of biogenic, liquid or gaseous fuels are financially supported by the Austrian government. The support depends on the achieved CO_2 reduction and makes up 25 % (maximum) of the eligible costs (source: http://www.publicconsulting.at/uploads/ufi_standardfall_infoblatt_bio_treib.pdf)

5.2. Public transport

Investment and operating costs of gas filling stations in Austria:

Investment costs for public gas filling stations depend on size, appearance and location and vary between € 220.000 and € 380.000. Most of the existing infrastructure in Austria has been set up by the gas suppliers. In order to operate a gas filling station economically at least 200.000 Nm³ to 300.000 Nm³ need to be sold anually. This means at least 200-300 gas powered cars per filling station are needed (www.gashighway.net).

Comparison of fuel consumption between conventional and natural gas fuelled cars

The price of 1 kg of natural gas at a filling station accounts for € 1,031 (September 2012), the price of 1l of gasoline (super) accounts for € 1,474 and the price for 1l of diesel € 1,384. CNG is a cheap alternative to conventional fuels (gasoline and diesel) because 1 kg CNG has an energy content of 1,5l gasoline and 1,3l diesel. Furthermore the price for natural gas is constantly low. The costs of acquisition are in accordance with them for conventional cars. (Wien Energie, 2013) Figure 20 shows the energy contents of the different types of fuel.

Figure 20: Energy contents of different types of fuel (source: Steirische Gas-Wärme GmbH, n. y.)

Additionally, since 2008 environmentally friendly vehicles (which includes gas-fuelled cars) do not need to pay the Austrian car registration tax (NoVA – Normverbrauchabgabe), which accounts for ~ € 500 per car. This tax relief has recently been extended until the end of 2014.

In order to further increase the amount of gas-fuelled cars in Austria, there are also various different financial promotion programs available. Enterprises and municipalities which want to convert their fleets can apply for funding at the KPC (Kommunalcredit Public Consulting). Funding accounts for up to 30 % (enterprises) / 50 % (municipalities) of the investment costs. Additionally, the federal funding program klima:aktiv supports the acquisition of gas-fuelled cars with up to €1.000 per vehicle. Apart from those federal funding schemes, there are also different funding opportunities in the Austrian province. The Austrian province of Styria, for example, private owners of gas-fuelled cars receive a so-called "CNG-bonus" of € 600, for enterprises the funding accounts for up to € 1.050, depending on the object of a company.

Promotion of the city of Vienna and Vienna Energy

The city of Vienna and Vienna Energy promote the transition from a conventional car to natural gas fuelled car. Since 1st June 2008 car users receive € 1.000 if they buy a new natural gas fuelled car. This special offer was now extended until 31st May 2013. Furthermore the NOVA decreases by € 300, due to the decrease in CO_2 emissions. Moreover, natural fuelled car users can obtain € 200 if they are below certain limits of nitrogen oxides (Wien Energie 2013).

5.3. Organizational aspects

The availability of raw material – long term contracts necessary

One of the most important elements concerning the planning of the biogas plant is the availability of the raw material. Especially the long term availability of the raw material at steady prices (costs) is a crucial factor. Figure 21 shows the main raw materials used in a biogas plants in Austria. The most important input materials are agricultural materials (57%), followed by other materials (24%) and slurry and manure (19%). Concerning the input materials it can be distinguished between agricultural materials and biogenic residues. For agricultural materials, costs for seeds, staff and equipment have to be considered. Regarding biogenic residues, usually revenues can be achieved. In every case the long term availability of the raw material, concerning quantity and quality, has to be considered. (LEV, 2012, p. 9)

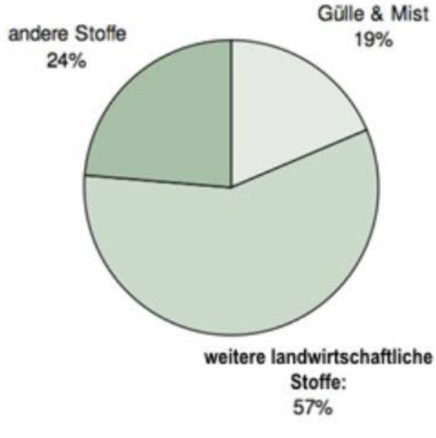


Figure 21: Raw material used in a biogas plant (source: LEV, 2012, p. 9)

For most Austrian biogas plants the raw material costs represent the highest expenditure. This especially applies to plants operated by energy crops. Through increasing food prices (e.g. maize), input materials for biogas plants become more expensive. In 2004, the price made up between €16 and €25 per ton of fresh matter; in 2012 it amounted to €25 to €40 per ton.

Contracting models for upgrading plants in Austria are currently being developed.

Tax regulation for gas/biomethane:

According to the Austrian Erdgasabgabegesetz (Erdgasabgabegesetz, online 2013) there is a tax of 6,6 €Cent/m³ on each m³ gas delivered to a customer. If the biomethane is fed into the natural gas grid it is handled like natural gas and the tax of 6,6 Cent/m³ has to be paid (Erdgasabgabe). If the biomethane is used on site of the biogas/ biomethane plant for refuelling cars (without feeding into the natural gas grid), there is no tax on this gas.

If the gas (natural gas or biomethane) is used in a CHP-plant there is a chance to get the Erdgasabgabe for the part of the gas which is needed to produce electricity back (Erdgasabgabenrückvergütung), because there is also a tax on the produced electricity. If the heat produced in the CHP plant is used, then the Erdgasabgabe for the part of the gas which has been used for producing this heat has to be calculated.

6. Legal requirements for biomethane use

Since Austria has entered the European Union, it is obliged to several rules and commitments when it comes to biomethane use. Within the European Union, one of the most important ecological targets is the reduction of greenhouse gas emissions. Furthermore, the increase in renewable energies should be promoted. The biogas technology serves both targets. The national target in Austria is to increase the use of renewable energies to 34% (baseline 2005: 23,3%) by 2020. That means that in 2020, 34% of the gross final energy consumption has to be produced by renewable energies. In 2010, the share of renewable energies amounted to 30,8% of the gross final energy consumption. This increase in renewable energies is shown in the guideline 2009/28/EG - the promotion and use of renewable energies. Furthermore, Austria enrolled the Kyoto protocol and committed to reduce 8% greenhouse gas emissions compared to 1990 until 2012. Unfortunately, even though Austria has signed the Kyoto protocol, that there was no reduction, but even an increase in greenhouse gas emissions by 2,4%. The major increase could be observed in the transport sector (54,4%). (LEV, 2012, p. 4)

There are no separate strategic documents regarding the biomethane grid injection in Austria up to now. The following aspects draw a picture of the current situation in Austria:

- In the Energy Strategy 2007 (Energie Strategie Österreich, 2010), biomethane is an important issue:
  - The energy strategy explicitly points out biogas / biomethane due to its "substantial potential" regarding the future energy supply. Grid-injection is mentioned as one means to fulfill this potential.
  - Additionally, biomethane is mentioned regarding its usage for fuelling cars. By doing so, the European goal of 10 % renewable energies in the transport

sector by 2020 shall be achieved. The proclaimed aim is to have 200.000 gas-powered cars by 2020.

  - The Austrian government strives to establish a stable market for biogas by using various instruments. It is also mentioned that a biogas and biomethane strategy will be developed by 2011. So far, this official strategy has not been published.
  - The workgroup also discussed an expansion of the biogas production in Austria to 10% of the whole natural gas demand which would result in 800 Mio. Nm³. This aspect is also included in the list of measures of the Energie Strategie Österreich 2010 (Austrian Energy Strategy 2010).

- The Austrian government has recently published a bill regarding a new energy efficiency law, which does – so far – not contain any aspects regarding the biomethane grid injection (status June 2013).

With regard to legal requirements, a biogas plant represents in Austria a typical cross-sectional matter. A biogas plant might be seen as an agricultural plant, an industrial plant or a waste treatment plant. The legal appraisal depends on the legal status of the operator, the used material and the type of energy production. Furthermore, the size of the plant and the quality of the basic products are important.

The approval process of such a plant depends on the criteria mentioned above. There is no standardized process.

Depending on the plant, the following departments might be affected:

Land use planning, civil engineering, fire protection, engine construction, process engineering, electrical engineering, explosion prevention, groundwater protection, protection of waters, air pollution control, noise protection, waste management, chemistry of waste, waste engineering, hygiene, industrial safety, traffic engineering.

As already mentioned in this report he main aspects about technical requirements are defined in ÖNORM S 2201 “Organic waste - Quality requirements”, ÖNORM S 2207-1 “Fermentation plants – part 1: terms and definitions” and ÖNORM S 2207-2 “Fermentation plants – part 2: technical requirements for process technology”.

More details about legal requirements concerning the approval process of biogas/ biomethane plants**,** operation of biogas plants, training of the staff etc. are mentioned in the biogas-production-concept for Graz (D4.3).

6.1. Grid injection

The basic principles regarding the injection of biogas into the Austrian gas grid are defined in the Austrian Natural Gas Act (Gaswirtschaftsgesetz GWG 2011), which is thus the most important law regarding this issue.

Following extracts from the 107th federal law (Gaswirtschaftsgesetz GWG 2011) help to understand the current situation in Austria:

§ 4.5 *The defined aim of this federal law is to establish a basis for the increasing usage of the potential of biogenic gases for the Austrian gas supply.*

§ 7. (1) Terms and definitions:

9. *Feeder (i.e. person injecting the gas): A natural or legal person or a registered business partnership passing on natural or biogenic gas at the feed-in point for further transport.*

12. *Remover (i.e. person who takes over the gas): A natural or legal person or a registered business partnership who/which takes over the natural gas at the exit point.*

4. *Balancing group: A compilation of grid users in a virtual group among whom a balance between feed-in and usage of the gas takes place.*

§ 28. The requirements for the grid access to the gas grid have to include …

3. *… those quality requirements, which are valid for the feeding-in and the transport of natural gas and biogenic gases;*

4. *… the possible entry points for natural gas and biogenic gases;*

9. *… within a period of 14 days maximum the operator of the distribution grid has to respond to the request of a feeder concerning a potential grid access.*

Refusal of access to the grid:

§ 33. (1) *The access to the grid can be denied due to the following reasons:*

2. *Insufficient grid capacity or insufficient grid network*

Duties of the operator of the distribution grid:

§ 58.10. *The operators are obliged to connect the producers of biogenic gases, which correspond to the quality criteria determined in the general grid conditions, to the gas grid*

Grid user fee in the distribution grid:

§ 73. (6) *The grid user fee for the feed-in into the distribution grid from the production/generation of biogenic gases relates to the capacity per entry point and has to be paid by the producer/generator of biogenic gases as agreed by contract*

Access authorization to the grid:

§ 122. *(2) … producers of biogenic gases (biogas or wood gas) can demand, on behalf of the customers, access to the grid provided that the interoperability of the grids is not affected.*

Labeling:

§ 130. *(1) suppliers which provide Austrian consumers with natural gas and/or biogas, landfill gas or with gas from purification plants, are obliged … to clearly indicate the supplier mix for the consumer.*

The specific norms for the quality criteria for grid injection are defined in the ÖVWG-guideline G31 and guideline G B220 (see chapter 4.1).

If the determined quality requirements are met, the distributor has to grant a connection and access to the grid. By doing so, the biogas producer is entitled to grid access and at the same time it is ensured that the quality requirements for the feed-in of the biogas are met.

6.2. Public transport

Following **legal registrations** are relevant for the use of biomethane in the public transport sector:

- The Austrian fuel regulation 2012 (Österreichische Kraftstoffverordnung 2012) defines the quality of fuels and the sustainable use of biofuels. The biomethane used at Austrian filling stations must correspond to the fuel regulation 2012
- The Shipping container regulation (Versandbehälterverordnung 2011) defines that the drivers of gas-powered vehicles can fill the vehicles themselves
- Additionally, drivers of gas-fuelled vehicles in Austria need to carry along an operator's log, which contains technical data of the vehicles, behavior guidelines in case of smell of gas, etc.
- Entry into public garages with gas-powered vehicles is principally allowed. Older regulations in Austria which prohibited entry related to LPG (liquefied petroleum gas), which is heavier than air and therefore potentially dangerous if the garage is not ventilated accordingly. Several Austrian federal states, including Styria, have already adapted their regional legislation. However, private owners of garages can prohibit the entry with gas-fuelled cars.

6.3. Recommended amendments

6.3.1. Grid injection

- Clear statement of the policy to biomethane grid injection in energy strategic documents and papers (targets and plan to reach these targets)
- Better promotion of the already existing Austrian biomethane Registry to bring biomethane producers and potential customers together
- Elimination of the tax ("Erdgasabgabe") for biomethane fed into the grid
- Fair sharing of the access costs to the gas grid between producer and gas supplier
- Easier and secured access to gas grid for producers – transparent plans of gas-network with capacity-profiles for the different pressure levels to find out ideal positions for biogas/ biomethane plants
- Feed-in tariff for the green electricity should be available immediately after submitting the application to the authority
- Transparent and attractive follow up tariff system for green electricity feed-in tariff

6.3.2. Public transport

- More attractive subsidies and/or tax-benefits for CNG cars/busses
- Promotion of use of CNG cars/busses in cities for (public) transport – municipalities, authorities, etc. should be an ideal for the population
- There are already quite a lot of manufacturers and models of gas fuelled cars on the market but they are not promoted well. The communication about natural gas fuelled vehicles, the presentation of good practice examples of companies using such cars etc. should be increased in the public which would result in a higher public acceptance.

- Currently, there is a hype – especially in the public sector – which focuses on e-mobility. The public representatives need to be made aware that it is not either gas or electricity, but that it should be gas as well as electricity, as both modes of propulsion have their unique advantages and disadvantages.

7. Actors involved in the biomethane supply chain in Graz

Figure 22 shows the main stakeholders of the potential biomethane supply chain in Graz. Confidential is responsible for the production of the biogas; another company – Confidential – is responsible for the upgrading to natural gas quality. The biogas is then used by Confidential

Confidential

Figure 22: Main actors of the biomethane supply chain in Graz

The potential owners of the biogas plant Graz, shown in Figure 22, are – confidential part:

Confidential

Figure 23 shows the stakeholder landscape.

Confidential

Figure 23**:** Stakeholder landscape

Beside the companies which are directly involved in the “consortium Graz” (green circle), there are several other parties which have to be involved. In the following list also the main function(s) of the respective party is/are listed:

- Authorities: increase acceptance for biogas plant Graz among their own group and among the population; positive push for good concept; fundings; permissions; etc.
- Utilities (like local gas supplier, public transport company): trading, promoting and using the product biomethane;
- Citizens’ committee: increase know-how regarding the product biomethane and the positive effects concerning climate protection etc.; increase acceptance for biogas plant in Graz; function as a positive multipliers in the population;
- Waste disposal services: suppliers of feedstock (long-term contracts); promoters for good waste separation of organic urban waste;
- Filling stations: promoter of gas for mobility; product biomethane at their filling stations;
- Investors: financial participation;
- Plant builders and operators: consolidation of local companies to ensure acceptance at the market; create more jobs in the region;
- Households and car drivers: supplier of the feedstock – good waste separation in the households increases the quality of the organic urban waste; increase know-how regarding the product biomethane, how it can be used in the households and in transport; using the product biomethane in CHP plants, for heating, for filling their CNG cars, etc.

8. Vorschlag für optimale Lösungen zur Nutzung von Biomethan in der Zielstadt / Proposal of best solutions of biomethane use in target city

Die Hauptvorteile für Graz und die Steiermark durch die Nutzung von Bioabfall in Biogasanlagen in der Nähe von Graz sind:

- Nutzung von Müll als Rohstoff
- Nachhaltiges Abfallmanagement – geschlossener Materialzyklus
- Verringerung von Importen von fossiler Energie und geringere Abhängigkeit
- Reduktion von Treibhausgasemissionen
- Schaffung von neuen Arbeitsplätzen
- Ersatz von Diesel durch Biomethan im Transportsektor und Reduktion der Treibhausgase, des Feinstaubs und des Lärms

Das produzierte Methan sollte in das Erdgasnetz eingespeist werden, um den Anteil an Biomethan im System zu erhöhen. Der zweitgrößte Nutzen ist die Verwendung von Biomethan als Treibstoff für den Transportsektor. Die empfohlene Nutzung umfasst:

- Vermehrte Nutzung im öffentlichen Sektor, besonders:
    - in öffentlichen Autos
    - im Sektor des öffentlichen Verkehrs
- Nutzung von Biomethan in Firmenflotten, besonders:
    - In kleinen und mittleren Unternehmen mit hohen Fahrleistungen (Taxiunternehmen, etc.)
    - In Logistikzentren
    - In Unternehmen, die große Flotten mit vielen Fahrzeugen betreiben (z.B. Saubermacher)
    - In Unternehmen, die ihren Fokus auf Lieferservices haben
- Nutzung von Biomethan in Unternehmensflotten mit hoher Wiedererkennung oder Unternehmen die als Energieversorger oder Vorbild dienen.

The main advantages for Graz and Styria resulting from the utilization of organic waste in a biogas plant near Graz are:

- Use of waste as a resource
- Sustainable waste management – closed material cycle
- Decrease in fossil energy imports and thus decrease dependencies
- Decrease in GHG emissions
- Creation of jobs
- Replace diesel with biomethane in the transport sector and therefore decrease GHG emissions as well as particle emissions and reduce noise.

The produced biomethane should be fed into the natural gas grid in order to increase the amount of biomethane in the system. The second most important usage is the utilization of biomethane as a fuel in the transport sector. Recommended usage includes:

- Increased use by the public sector, particularly
    - in official cars

  - in the public transport sector
- Use of biomethane in corporate fleets, especially
  - in small and medium enterprises with a high mileage (taxi operators, etc.)
  - in logistics centers
  - in enterprises which operate large fleets with a lot of vans (e.g. Saubermacher)
  - in businesses with a main focus on delivery services
- Use of biomethane in fleets of enterprises with a high public recognition, enterprises which function as role models and energy providers.

9. Die Strategie für ein Biomethanprojekt in der Zielstadt / Strategy for a biomethane project in target city

Die Bildung und Erhaltung einer nachhaltigen Nachfrage von Biomethan ist von zentraler Bedeutung wenn man Unabhängigkeit vom importierten Gas anstrebt. Deswegen:

- Besteuerung: Die derzeitige Besteuerung von Diesel und Benzin könnte die Nutzung von Biomethan als Treibstoff forcieren, solange Biomethan nicht besteuert wird.
- Einspeisetarife: Momentan sind die Einspeisetarife für Strom aus Kraft-Wärme-Kopplung, die durch Biomethan betrieben werden, sehr attraktiv. Für potentielle Kunden ist es ausschlaggebend, dass genug Biomethan auf dem österreichischen Markt verfügbar ist so dass der Preis für das Produkt akzeptabel bleibt und eine ökonomische Möglichkeit besteht, Kraft-Wärme-Kopplungsanlagen zu betreiben. Außerdem sollte der Einspeisetarif für grünen Strom sofort verfügbar sein, nachdem der Antrag bei der zuständigen Behörde vorgelegt wurde.
- Erhöhtes Engagement: Langzeitverträge, besonders mit Nutzern des öffentlichen Verkehrs
- Informationskampagnen: Das Wissen bezüglich der Produktion und der Nutzung von Biomethan sollte gesteigert werden. Dabei sollten sowohl die positiven Auswirkungen dieses Energieträgers (z.B. Schutz des Klimas etc.) als auch die negativen (Konkurrenz zu Nahrungsmitteln, Monokulturen, Anpassung von Pflanzen) aufgezeigt werden. Die Kampagnen sollten zielgruppenspezifisch sein und sollten sich der neusten Erkenntnisse über Verhaltensänderung und Nutzermotivation bedienen. Relevante Zielgruppen für solche Kampagnen sind:
  - Anlagenbetreiber
  - Gaskonsumenten
  - Flottenbetreibende Unternehmen (es gibt bereits einige Hersteller und Modelle von gasbetriebenen Autos auf dem Markt, aber diese werden schlecht beworben; die Kommunikation von Erdgasbetriebenen Fahrzeugen, die Präsentation von Vorzeigeunternehmen, die diese Autos nutzen etc. sollte in der Öffentlichkeit erhöht werden. Dies würde in höherer öffentlicher Akzeptanz resultieren)
  - Behörden
  - Betreiber von öffentlichem Verkehr

Creating and maintaining a sustainable demand for biomethane is of central importance if we strive to reduce dependency on imported gas. Therefore:

- **Taxation**: The current taxation of diesel and gasoline may enforce the use of biomethane as fuel, as long as biogas and accordingly biomethane is not charged with a tax, too.
- **Feed-in tariffs**: The feed-in tariffs for electricity from CHP plants driven by biomethane are quite attractive in Austria at the moment. For potential customers it is essential that there is enough biomethane on the Austrian market so that the price for this product is acceptable and there is a chance of an economic way of operating CHP plants. Additionally, the feed-in tariff of the green electricity should be available immediately after submitting the application to the authority.
- **Increase commitment**: Long-term contracts, particularly with users of the public transport sector

- **Information campaigns**: The knowledge regarding the production and the use of biomethane must be increased. When doing so, the positive effects of this type of energy (climate protection etc.) as well as the negative effects (resource providing – competition to food; monocultures; adaptions of plants) should be pointed out. The campaigns need to be target-group specific and should make use of the newest insights regarding behaviour change and user motivation. Relevant target groups for such information campaigns are:
    - Plant operators
    - Consumers of gas
    - Companies which operate fleets (there are already quite a lot of manufacturers and models of gas fuelled cars on the market but they are not well promoted; the communication about natural gas fuelled vehicles, the presentation of good practice examples of companies using such cars etc. should be increased in the public which would also result in a higher public acceptance)
    - Public authorities
    - Operators of public transport systems

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ANNEX

Overview of the gas grid in the city of Graz: