

Biogas in the natural gas grid as support for the change in energy policy, part 1

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In Germany the role of renewable energies is subject to statutory regulation in many areas. In accordance with the energy concept of the German federal government regenerative energies will be responsible for generating at least 80 percent of the country's electricity by the year 2050. The aim is to cut energy consumption in half by the year 2008 and reduce emissions of environmentally harmful gases by up to 95 percent compared with the year 1990. In addition to wind and solar installations, gases produced from regenerative sources (e.g. biogas, hydrogen from power-to-gas) are to make a substantial contribution toward meeting these targets. Thus, for example, up to ten billion cubic meters of bio-natural gas are to be supplied to the existing gas grid by the year 2030.

Grid operators such as ONTRAS are obliged by law to connect biogas installations to the grid and give preference to the transport of bio-natural gas. To this end the raw biogas is processed to natural gas quality and then supplied to the gas grid by means of a corresponding feed-in facility. Allocation of the costs for the treatment and supply of the biogas as well as construction and operation of the corresponding plants are regulated by law. Thus far, however, there are no incentives for consumers to purchase bio-natural gas. Moreover, changing framework conditions and diminishing acceptance of biogas facilities on the part of the general population make new investments more difficult. This development has put the aim of achieving climate policy targets with the aid of biogas at risk.

LEGALLY REGULATED EMPLOYMENT OF REGENERATIVE ENERGIES IN GERMANY

The framework for energy policy in Germany is prescribed by EU regulations and directives. For the gas industry the Domestic Gas Market Directive, the Regulation on Conditions for Access to the Natural Gas Transmission Networks, the Regulations Concerning Measures to Safeguard the Security of Gas Supply as well as the Directive on Promotion of the Use of Energy from Renewable Sources are relevant in particular. The guiding principle for future development of the energy supply in Germany is defined in the federal government's energy concept from 2010 and in the concept on the change in energy policy from 2011. The German federal government has set ambitious goals for itself with regard to the change in energy policy. The role of fossil energy sources such as natural gas and renewable energies is concretely regulated in

a set of laws and regulations. Particularly crucial in this regard are the German Law on the Fuel and Electricity Industries [EnWG], the Renewable Energy Sources Act [EEG], the Gas Grid Access Ordinance [GasNZV] and the Gas Grid Fee Ordinance [GasNEV]. Thus the Renewable Energy Sources Act from 2012 provides that renewable energies constitute at least 35 percent of gross electricity consumption by the year 2020; by the year 2030 at least 50 percent, and by 2050 at least 80 percent of electricity is to come from renewable sources. By this time energy consumption compared with the year 2008 should also be cut in half. Emissions of environmentally harmful gases will then be 80 to 95 percent less than in the year 1990. Gas-fired power stations are to substitute as backups if wind and solar plants fail to supply electricity due to weather conditions. In many areas gas from regenerative sources is to increasingly replace natural gas from fossil sources.

GAS FROM REGENERATIVE SOURCES SUPPORTS CLIMATE PROTECTION AIMS

In the German Law on the Fuel and Electricity Industries regenerative gases such as biogas, gas from biomass, landfill gas, digester gas and methane as well as hydrogen produced by water electrolysis are put on an equal footing just as synthetically produced methane from this hydrogen if the carbon dioxide used for methanization stems primarily from renewable energy sources. Due to their many possible uses on the thermal energy and fuel markets through conversion into electricity in installations with combined electricity and heat production, these gases are able to assume an important role when it comes to the change in energy policy on the one hand. On the other hand substantial quantities can be supplied to the gas grid as so-called bio-natural gas – biogas processed to natural gas quality – instead of natural gas and thus improve the latter's already favorable carbon dioxide balance even further. In light of this the German federal government sees an annual biogas potential of up to ten billion cubic meters by the year 2030. With the help of specially designed statutory provisions this quantity is to have priority access to the gas grid. Thus since 2008 gas grid operators are obliged to give priority to the connection of biogas facilities to their grids and preferentially transport biogas that has been processed to natural gas quality. The same applies to hydrogen and synthetic methane from so-called power-to-gas installations. With surplus wind or solar electricity they generate electrolytically produced hydrogen and feed it directly into the gas grid. However, the feed-in quantity is limited because the natural gas quality in the grid changes with the increasing share of hydrogen. Alternatively synthetic methane is created with carbon dioxide from largely regenerative sources which, similarly to natural gas, can be used anywhere in the grid without restriction.

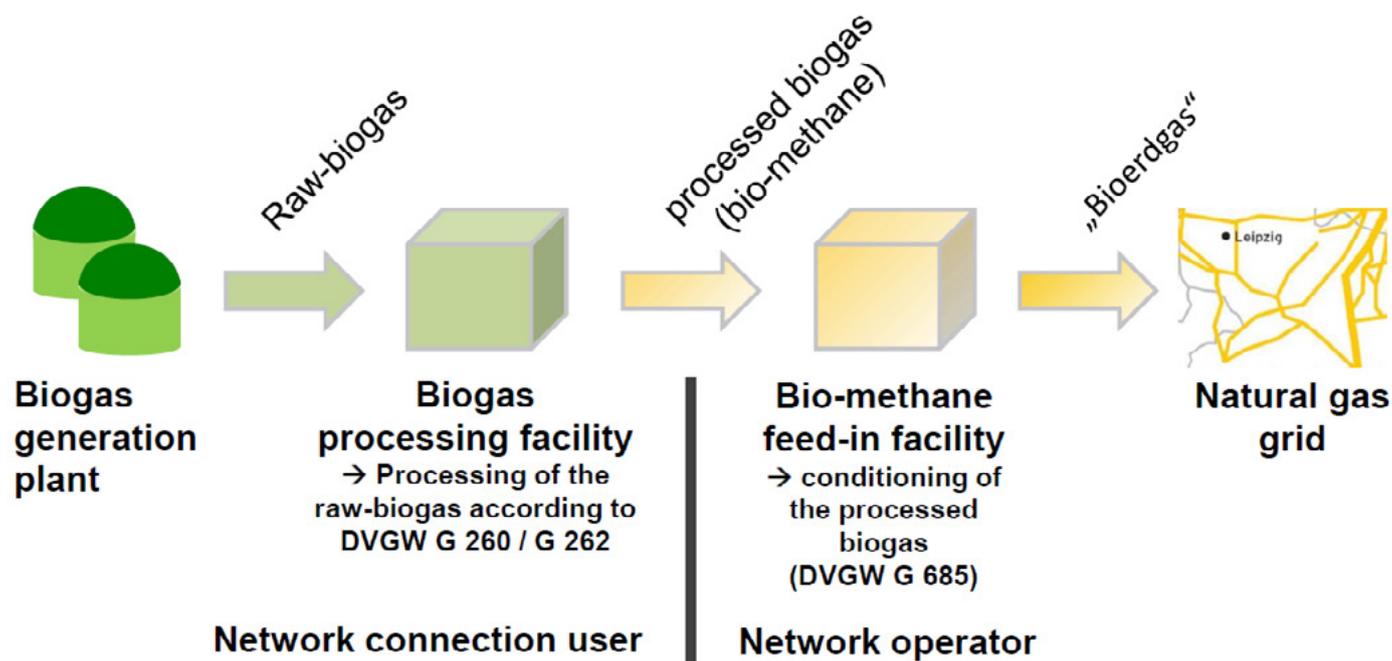
GAS CUSTOMER PAYS THE COSTS FOR BIOGAS IN THE GRID

Every connection of a biogas facility to the existing gas grid requires a substantial investment. Regardless of the maximum feed-in quantity, two to five million euros must be calculated for the planning and construction of a corresponding feed-in facility, depending on the connection parameters. Since amendment of the Regulation on Conditions for Access to the Natural Gas Transmission Networks in 2010 the power recipient and/or the operator of the biogas processing plant is only responsible for 25 percent of the connection costs; however, a maximum of EUR 250,000 for the biogas feed-in facility and the first kilometer of the connecting mains. The operator must completely assume the costs as of the tenth kilometer only for connecting mains longer than ten kilometers. Thus the grid operator initially bears the principal share of the connection costs. In addition, the operator is responsible for ongoing operating and maintenance costs and provides for operation of the feed-in facility. In this case 96% availability must be ensured. Feeding bio-natural gas into the grid takes place free of charge because the grid operator is not allowed to charge for this. However, according to the intentions of legislators the supply of biogas is ultimately not supposed to generate any additional costs for grid operators. That is why the statutory provision provides that these costs be allocated to the exit points to end consumers in Germany in accordance with defined rules. The annual biogas costs are calculated from the sum of the investment and operating costs for feeding in biogas in the preceding year as well as the corresponding costs forecast for the subsequent year reported by all of the grid operators. Up to now the resulting so-called biogas redistribution levy was allocated to all of the exit points of a market area with the exception of the

exit points to storage systems, border region and market area transition points. In the final analysis the political intention is that the community of gas consumers in the two German gas market areas of NetConnectGermany (NCG) and GASPOOL are responsible for the costs incurred for feeding in biogas.

redistributed within a market area. The significantly higher connection density of biogas feed-in facilities in the market area of GASPOOL thus result in a one-sided increase in the gas transport costs and thus to competitive distortion vis-à-vis customers in the NCG market area. This effect is amplified by the fact

The way from biogas to bio-natural gas (schematic)



COMPETITIVE DISTORTION BY BIOGAS ELIMINATED

As a result of its geographical and agricultural structure more biogas feed-in facilities have been planned and realized in the northern and eastern federal states in Germany – thus in the market area of GASPOOL – than in the remaining federal states (NCG market area). With the plants in Güstrow (max. 5,750 m³/h under normal conditions, ONTRAS) and fSchwedt (max. 7,000 m³/h under normal conditions, EWE) these include the currently most productive plants on the grid. Up to now the costs borne by grid operators for biogas feed-in facilities have only been

that this higher amount is allocated to fewer exit points in relation to the NCG market area. For end consumers and downstream grid operators this means that they have to pay EUR 0.26/kWh/h/a in the NCG market area, in the GASPOOL market area on the other hand EUR 0.75/kWh/h/a in addition to the regular grid fees for biogas feed-in. In this case ONTRAS took over responsibility for determining the redistribution amount for the transmission system operators in the GASPOOL market area. As the transmission system operator with the largest number of biogas feed-in facilities in

operation and/or under construction or in the planning, ONTRAS warned about this competitive distortion caused by biogas on several occasions and at the political level pushed for a uniform regulation that would be valid throughout the entire country. After several efforts, in particular on the part of the federal states in the eastern part of the country, corresponding amendment of the gas grid fee ordinance has come into force. Thereafter there will be a nationwide uniform redistribution amount as of the year 2014.

GRID OPERATOR RESPONSIBILITY: CONNECTION OF BIOGAS INSTALLATIONS TO THE GAS GRID

All applications for installation of grid connections are processed in accordance with Section 33 of the German Regulations for Gas Grid Access (Gasnetzzugangsverordnung [GasNZV]). Provided the network connection request has been positively answered, ONTRAS concludes a Network Connection and Use Contract with the biogas which not only defines the technical and operational terms, but also includes a time schedule (realization schedule) for planning and construction of the grid connection as well as the subsequent operation and maintenance. This legally prescribed realization schedule is firmly coordinated between the operators of the biogas processing and the feed-in facility into the gas grid. In the event that a grid operator fails to adhere to the dates of this timetable, then loss of the entire power recipient share in the amount of EUR 250,000 threatens – unless the grid operator is able to prove that circumstances prevail for which the grid operator may not be held responsible (e.g. the absence of official permits). The only task that remains for the operator of the biogas processing plant is to provide a constant gas flow in accordance with the contract with a minimum gas quality as defined in DVGW Worksheets Gas G 260 and G 262. The reason is that compared with conventional

natural gas, raw biogas still contains, among other things, components such as sulfur, carbon dioxide and nitrogen. Apart from the drying, cleaning and desulfurization of the biogas an essential step in the processing – for which a number of different processing methods have been established on the market – consists in the separation of carbon dioxide from the raw biogas (methane enrichment). The share of carbon dioxide in the raw biogas varies between 30 and 50 percent depending on the biomass used and the installation type. The operator of the biogas processing plant examines whether the gas quality corresponds to the prescribed minimum standard and as a rule also measures the gas quantity which is to be delivered before the processed biogas is delivered to the feed-in facility of the grid operator. However, what is important for billing is the energy quantity that is determined by means of a process chromatograph, myonveto detector and volume flow measurement at the ingress point of the biogas feed-in facility

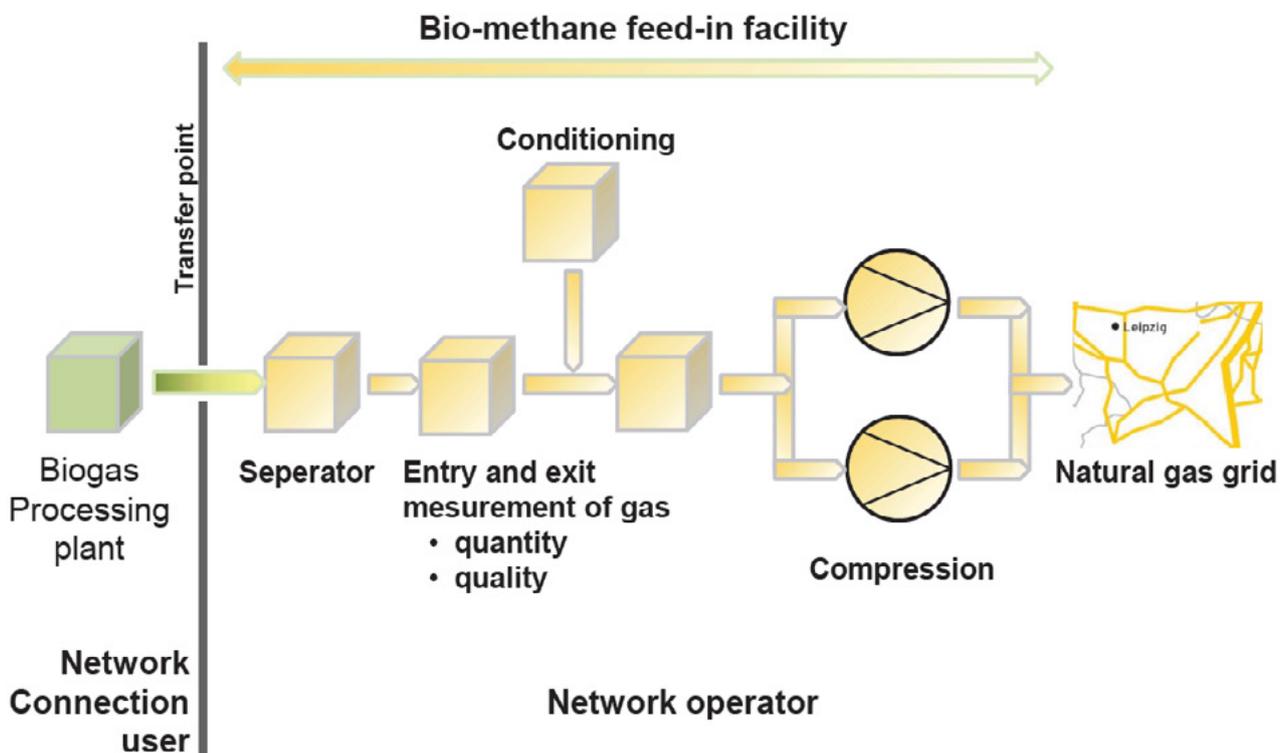
GRID OPERATOR RESPONSIBILITY: OPERATION OF THE FEED-IN FACILITY

ONTRAS set up standardized project management in the grid service division for the planning and construction of biogas feed-in systems. Planning, construction and scheduling take place in close cooperation with the power recipient on the basis of the jointly specified realization schedule. A number of parameters are variable depending on the design of the biogas processing plant when it comes to the feed-in quantity, pressure, composition of the processed biogas, etc. as well as the requirements of the respective feed-in grid, e.g. location of the processing plant in relation to the gas grid, pressure level and nominal width. Every connection of a biogas processing plant to the gas grid thus represents an individual project despite extensive standardization.

With each individual project the efficiency of the plant as well as its availability over the entire service life of the plant stand at the center of attention for the grid operator. The grid operator's responsibility for the biogas begins at the output flange of the biogas processing facility. From there the biogas is introduced into the biogas feed-in plant. This essentially consists of a measuring and control line with an upstream filter and separator combination, the conditioning plant, the compressor plant and peripheral components for the production of technological heat, for the production of control air and for closed-circuit cooling. In the measuring and control line gas quality and gas quantity are measured at different points of the plant and the energy quantity that is relevant for billing is thus determined. As a rule a conditioning plant then follows in order to adjust the calorific value of the bio-natural gas delivered in minimum quality to the prevailing calorific value in the gas grid using liquid

gas (LPG) in accordance with the specifications of the DVGW Worksheet G 685 The latter regulates gas measurement as well as the calibration capability of gas measurements and thus sets quality standards that deviate from the minimum standard of the DVGW Worksheets G 260/G 262. After that the gas is compressed to the required grid pressure depending on the delivery pressure made available by the biogas processing. Up to three compressor stages are required depending on the final pressure that is to be achieved. Since biogas feed-in facilities are usually operated without personnel, extensive automatic control technology is installed for fully automatic plant operation. The minimum requirements for the planning, production, construction, inspection and commissioning of a biogas feed-in plant are specified in DVGW Worksheet VP 265-1. Moreover, through DVGW Worksheet G 265-2 there are minimum requirements to be met by the operation and maintenance of these plants.

Major components of a bio-methane feed-in facility



NATURAL GAS GRIDS "BIO-READY" ALREADY TODAY

As of July 2013 a total of 12 biogas facilities feed their gas into the ONTRAS grid. By the end of the year 2013 there will be presumably already be 16 plants. ONTRAS then annually transports up to 115 million m³/a of bio-natural gas in the grid under normal conditions – a quantity with which more than 100,000 households can be supplied for over a year. And then there is the bio-natural gas of numerous biogas feed-in facilities on the downstream grids of ONTRAS. At the end of the year 2012 there were 107 biogas facilities connected to the gas grid altogether with an annual feed-in potential of 580 millions m³ of bio-natural gas under normal conditions. According to estimates for the year 2013 from the German Energy Agency and the BDEW there will be approximately 170 plants with an annual feed-in potential of 900 million m³ under normal conditions. That would correspond to approximately 15 percent of the quantity planned by the German federal government for 2020. In the future power-to-gas plants will also be connected to the gas grid that then feed hydrogen or synthetic methane into the gas grid. An initial plant with a feed-in potential of up to 350 m³/h of hydrogen under normal conditions will be put into service already in August 2013 and feed into the ONTRAS grid. With such power-to-gas plants it will be possible in the future to use surplus wind and solar electricity, which up to now had to be throttled because of a lack of capacities in the transmission networks (electricity), for producing hydrogen or methane and to feed the regenerative gases into the gas grid. Transformed in this manner electricity will become capable of storage on a long-term basis. Power-to-gas will not replace expansion of the electricity grids, but used on a regional basis it could contribute to their system stability. However, the prerequisite is that policymakers coordinate cooperation among all of the parties involved, plant, electricity and gas grid operators as well as implementation of a reasonable economic model for the market.

BIOGAS CONTRIBUTION TO CLIMATE PROTECTION AT RISK

The future development of the biogas supply will be negatively affected by several factors. On the one hand the framework conditions for biogas facilities in Germany have changed several times, so that an investor today often does not have sufficient long-term planning security and therefore dispenses entirely with the construction of a plant or at least no longer considers a potentially possible feed-in of biogas into the gas grid. And the acceptance of biogas facilities is increasingly meeting with resistance among the population. Odor nuisances, unnecessary heavy transports and the competition of the energy plants for the cultivation of food and fodder are the most frequent topics of discussion. On the other hand policymakers have done a lot in order to get bio-natural gas into the gas grid; however, up to now there has been a lack of incentives for consumers to purchase bio-natural gas. While the users of green electricity enjoy financial advantages, the employment of bio-natural gas does not provide a benefit to gas customers. Here is where policymakers must improve, not least of all in order to meet the important climate protection targets. Each cubic meter of bio-natural gas instead of natural gas in the network improves the already good carbon dioxide balance: The burning of bio-natural gas produces only as much carbon dioxide as the plants consumed during growth. And it further reduces Germany's dependence on gas imports.