GAS WORKS

The Future Role of Gas Distribution Networks

Delivering Gas to Consumers

GEODE Working Group Gas

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GEODE

The Voice of local Energy Distributors across Europe

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Foreword

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Gas is used in the production of goods or services used by everyone on a daily basis. Examples include cooking, steel, electricity, space heating and hot water. In addition to this, in the future there will still be industrial processes where only gas can be used. Similarly transport is an area where the potential for gas to be used has barely been realised.

The traditional role of the gas Distribution System Operator (DSO) is changing as operators move from being solely gas transporters to providing innovative services to consumers and enabling interoperable solutions to all market participants. Natural gas is efficient and has the potential to be environmentally friendly, as well as complementary to the emerging renewable technologies.

The DSO has an essential role to play in the development of these future energy markets. When the future design of the energy market is discussed, the role of the gas market and in particular gas DSOs, is often neglected.

Also overlooked is the fact that there is significant disparity between Member States as to how developed their networks are. It is essential that the European Commission offers support and guidance to bridge that gap.

Gas DSOs distribute gas efficiently and safely to the consumers. Secure and robust gas networks are essential for the continued operational improvement of the European gas distribution grid.

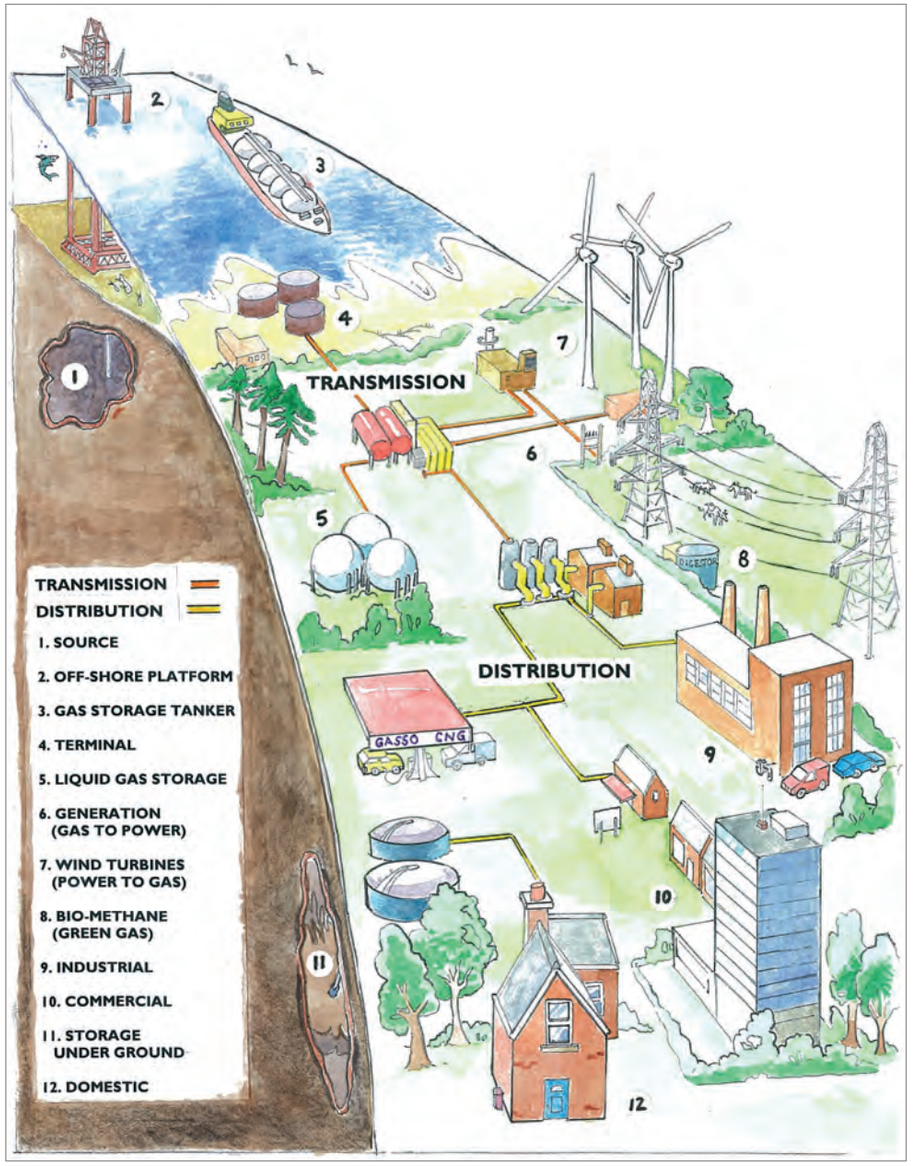
DSOs are the responsible for both the distribution network infrastructure which allows the flow of both energy and information between all market participants as well as the development of new services and the operation of the grid.

Furthermore the gas grid can be used for the storage and transportation of renewable energies.

DSOs are getting ready for the future and **GEODE** believes that local and regional gas networks have the potential through their infrastructure to deliver the benefits of smart

energy markets and new technologies such as power to gas, injection of biomethane into the grid and gas vehicles.

Gas, when used in partnership with modern energy efficient technologies such as cogeneration (CHP), can contribute significantly to meeting CO2 reduction targets.



Source: GEODE

As smart gas grids develop, DSOs are responsible for the operation of the grids, ensuring gas quality and making sure the grid runs safely. The DSO has a key role to play through its operational activities to ensure it meets the needs of gas suppliers and their customers.

It is essential that national regulators provide DSOs with fair and adequate tariff structures which allow DSOs to make the investment in the grid that is needed.

Through this report "Gas Works", **GEODE** will demonstrate the significant role the DSOs have to play in the design of the energy market of the future.

A final point to note is that this report uses the term "gas" to refer to gas in all its forms – natural, green synthetic etc.

Christian Held

DSOs AND THE GAS MARKETS

In 2011, the consumption of natural gas in the 27 EU Member States amounted to approximately 224 Mtoe, a slight reduction in comparison to approximately 261 Mtoe consumed in 2010[1]. Of this consumption approximately 140 Mtoe was produced in the EU, compared to 156 Mtoe in 2010[2].

Although consumption has decreased, the share of natural gas in the EU-27's energy mix rose between 2007 and 2010 by 2.3%, representing 25.1% of the EU-27's gross inland consumption by 2010. This seemingly contradictory evolution may be explained by energy efficiency measures and the development of green energy sources.

Gas travels through the high-pressure transmission system, before continuing its journey through the medium and low pressure **distribution** networks to reach the consumer. Gas distribution, the activity **GEODE** members undertake, is the final step in delivering gas to consumers.

In Europe there are almost 4000 gas DSOs (3,714 according to CEER[3]) which serve 118 million gas customers. This represents circa 270 million EU citizens and 7 million commercial/industrial consumers, all of whom enjoy the benefits of gas. The gas DSOs operate 2.1 million kilometers pipes[4] across Europe.

In light of this huge infrastructural asset, **GEODE** believes that gas (in its various forms) has a key role to play in Europe's future energy plans.

[1] Source: Eurostat, January 2014.
[2] Ibid.
[3] CEER Status Review on the Transposition of Unbundling Requirements for DSOs and Closed Distribution System Operators – C12-UR-47-03 – 16 April 2013.
[4] Eurogas Statistical Report 2013.

In a nutshell, gas (natural, green, synthetic):

- can be environmental friendly
- is the cleanest of the fossil fuels and should be replacing coal for generation (with CCS where possible)
- can offer security of supply and is affordable
- is safe and reliable
- is the fuel of choice for many consumers and user friendly
- is essential for those industries where high temperatures are needed to carry out certain processes
- has the potential to be decarbonised though the promotion and use of biomethane and hydrogen
- backs up renewable energy production and offers flexibility when the wind stops blowing or the sun fails to shine

The EU's energy system faces major challenges, which have been reflected not only in the European Commission's infrastructure package and the Energy Roadmap 2050 but also in the latest Commission Communications on the internal energy market[5].

MARKETS

A well-functioning market will not only give positive price signals to market participants where gas can be used most efficiently, but also create an investor-friendly climate which provides incentives to investment throughout the gas value chain.

In the medium term, greater interconnectedness of currently rather separate national markets must take place, together with the creation of a functioning internal market, where gas can move according to demand and supply.

GEODE believes that creating a functioning market would form a single European energy champion – the European Energy Market

[5] European Commission Communication "Making the internal energy market work", 15.11.12, and European Commission Communication "Delivering the internal electricity market and making the most of public intervention", 5.11.13.

ENERGY EFFICIENCY / RENEWABLE ENERGY

Building on the **Energy Efficiency Directive**, greater emphasis must be placed on improving energy efficiency, both in the gas and electricity sectors.

A key challenge for the energy industry is to decarbonise the sector. Renewable energy sources (RES, ie. solar and wind) play an important part, but the EU and national governments must take steps to deal with the economic problems and issues associated with intermittency.

Natural gas has a key advantage over renewables and nuclear energy because it does not need subsidies.

Gas also remains essential as back-up power when the wind does not blow.

- In effect the gas distribution network is a huge storage system for energy
- GEODE emphasises the role of gas in the decarbonisation of the energy sector

INFRASTRUCTURE

Security of supply has become a crucial topic for Europe. European countries need to improve their gas emergency preparedness since gas supply shortages can arise for a variety of reasons.

Europe is well placed to import gas from many diverse sources, including North Africa, the Middle East, Central Asia, Norway, Russia, as well as via liquefied natural gas (LNG). However to make this happen, there needs to be substantial investment right through the supply chain in new upstream production, new long-distance pipelines, and facilities for LNG liquefaction and re-gasification. These will contribute to reduce Europe dependence on gas imports.

Gas storage is also essential. It was especially important during the gas dispute between Russia and the Ukraine in January 2009. Many countries may lack suitable geology for large-scale storage, and stored gas must be moved around by an efficient, high-performance pipeline grid.

INVESTMENTS

The key areas for investment in the gas sector are:

- new internal pipelines to move gas around in response to supply and demand
- gas storage, to meet seasonal demand increases as well as short-term surges
- market reforms to stimulate the investment and the flexible market structures that will enable markets to respond if there are supply problems and demand increases

GEODE believes that investments in both electricity and gas networks are crucial for the completion of a single European energy market

WHAT DSOs DO

The gas DSOs play a fundamental role in the operation of the European gas network. They are the key link between the transmission system and the end customer. In addition to this they have a critical role as market facilitators for gas suppliers, making sure the gas is transported safely and efficiently.

As a central player in the gas supply chain, the DSOs are often overlooked, as the emphasis is placed upon the network at transmission level, or the creation of a single gas market, which is a priority for suppliers.

It is important to note that DSOs are neutral, are well regulated by Governments which gives them a non-commercial purpose and so are trusted partners for policymakers.

GEODE is keen to highlight the function the gas DSOs have in making sure the gas gets to consumers.

Due to way in which the gas distribution systems have evolved differently in Member States, the exact set of responsibilities and functions the DSOs have varies from country to country.

With that in mind, the gas DSOs do some, if not all of, the following things:

GRID MANAGEMENT

This is the central function of the DSOs and covers the operational activities which ensure the gas gets to where it needs to be. This includes:

- investing in infrastructure and innovative projects to maintain and enlarge the grid,
- ensuring the efficient day to day running of the grid, including maintenance, environmental/corporate social responsibility and security of supply,
- making safety the number one priority.

CUSTOMER SERVICE

Another critical role for the gas DSO is as the public face of the gas industry. As well as being the link between transmission and the end user, the DSO provides a series of key services including:

- providing advice and information for consumers/customers,
- acting as the gas emergency services,

- giving energy efficiency and safety counselling,
- promoting the use of gas,
- marketing and facilitating new connections to the grid.

MARKET FACILITATION

The third crucial function of the gas DSOs is to facilitate the market, acting as a fundamental link in the gas supply chain. This role will only become more important as smart grids and the single market develops. This includes:

- ensuring the safe delivery of gas to the end user,
- bearing responsibility for the customer moving and switching process,
- providing information to end users and upstream customers,
- marketing and facilitating new connections to the grid,
- metering and data management including installation, operation and maintenance, meter reading and allocation,
- managing billing activities including tariff calculation, invoicing and receivable management.

• The gas DSOs play a fundamental role in the operation of the European gas network making sure the gas is transported safely and efficiently

• The function the gas DSOs have in making sure the gas gets to consumers can be split in three main areas: grid management, customer service and market facilitation

CHALLENGE: BUILDING A SMART GAS GRID

The European Commission Smart Energy Agenda[6] will have an impact on the transformation of Europe's energy systems and the achievement of the 20/20/20 EU goals. Smart Grids will have a key role in transforming the functionality of the present energy supply system.

The Directive 2009/73/EC on the internal market in natural gas required the implementation of smart gas metering systems subject to an economic assessment of all the long-term costs and benefits to the market and individual consumers. The European Commission is currently examining the analyses submitted by the Member States. Gas smart meters roll out is at an earlier stage compared to electricity. However, a smart gas grid can be developed independently to the roll-out of smart gas meters.

The definition and significance of a smart gas grid differs from the electricity equivalent. Gas consumption is more predictable than electricity and therefore gas grid security is likely to be easier to achieve.

The gas grid has significant storage capacity for gas in all its forms. This will become increasingly important as the range of sources for sustainable gas develop. Thanks to its flexibility, reach and capacity, a smart gas grid offers strategic infrastructure potential and could facilitate the integration and opening-up of crucial markets in electricity, heat and transportation.

Power to Gas and gas storage technologies are essential for the delivery of a smart gas grid and to ensure security of supply. The development of a functioning market for biogas is also fundamental. In addition to this, gas has a key role to play in transport, where it can help to decarbonise the sector.

Linking gas to the electricity and heating grids through the use of smart tools and smart meters in the gas grid as well as implementing energy efficiency initiatives in the gas sector will contribute to a reduction in overall energy consumption. Only by building a smart gas grid alongside the smart electricity and heating grids can a secure and reliable energy market be assured.

A smart gas grid offers the necessary key infrastructure and allows the integration and opening-up of crucial markets: electricity, heat and transport

[6] European Commission Communication on Smart Grids, 14.4.11.

1. RENEWABLES: BIOGAS

Biogas has a number of practical applications in electricity, heat and transport. Biogas can be produced from waste or organic materials and has a methane content of 50 to 60%.

It can be used for the production of electricity or heat, or processed to achieve a methane content of over 96% which can then be fed into the gas grid.

Biogas trends

The biogas sector is increasing on a worldwide basis and particularly in Europe. Biogas is produced in different ways in each Member State: Germany, Austria and Denmark mainly use energy crops, agricultural by-products and manure, whilst Italy, Spain and France use landfill gas[7].

With nearly 7,500 biogas power plants producing around 3,350 MW and 120 processing plants by the end of 2012, Germany is in the vanguard amongst EU Member States. By 2011, Germany had produced slightly over 100,000 m^3/hour of biomethane. In comparison, Sweden, Europe's second largest producer, achieved 30,000 m^3/hour.

Furthermore, German biogas production continues to grow: an increase by 200 power plants and 60 processing plants is expected by the end of 2014.

Similarly, thanks to its pioneering energy efficiency policy, Denmark has developed the use of biogas for the purpose of producing electricity and heat in CHP plants.

New technologies for biogas production are also being developed. There are now gasification plants which allow biogas production on an industrial scale.

The role of the DSO

Gas DSOs are affected in several ways by the development of the biogas and biomethane production. They are responsible for maintaining the stability of the gas distribution grid; it is therefore in their interest that the quantity and quality of the biogas used remains stable.

DSOs have the responsibility for the connection of biogas plants to the distribution grid. This includes extending the network and installing appropriate technologies. In general, this represents a significant investment for DSOs.

[7] Source: EurObserv'ER 2008.

What needs to be done

GEODE welcomes the expansion of biogas and biomethane use in Europe. Biogas is a key sustainable energy source which has an essential role to play in helping Member States meet their carbon reduction targets.

GEODE encourages the European Commission and the Member States to take steps to remove barriers to the use and production of biogas, in order to create a level playing field for those entering the market. Measures should be adopted to simplify and facilitate biogas injection into the grid.

Regulators should ensure that gas DSOs do not bear any risk regarding the connection of biogas power plants to the grid by ensuring adequate mechanisms for cost compensation.

GEODE believes that the successful deployment of grid-connected biomethane requires not only good energy policies but also a complementary agricultural and waste policy.

So GEODE supports:

- the use of biogas as a key sustainable energy source
- compensation mechanisms for DSOs regarding the connection of biogas plants to the grid
- the adoption of measures to facilitate biogas injection into the grid
- joined-up policy-making between energy and agriculture

2. ENERGY STORAGE AND POWER TO GAS

One potential solution for Europe's long-term security of supply issues is to use gas not only as a way of storing energy to meet peak demand and to bridge supply gaps, but also to use gas as an efficient means to move energy to where it is needed. Innovative solutions for gas storage would then lead to a more flexible gas market. Biogas and the use of Power to Gas have the potential to provide greater security of supply and an improved capacity management.

GEODE believes that the role of long-term storage should be realised by means of natural gas storage rather than electricity storage, since gas power plants are efficient, highly flexible and produce less CO_2 emissions. Moreover, the European Union should

ensure that storage capacities in the network are maintained as they will become a critical resource for security of supply when Power to Gas advances as a technology.

A storage solution: Power to Gas

Given the development of renewable energies and the unpredictable nature of their production, it is essential to develop alternative ways to use the surplus in renewable electricity produced at times of low demand. A viable solution is provided by Power to Gas technologies, where hydrogen is produced from electricity in a process of electrolysation. The gas produced can be transformed into methane by adding carbon monoxide. It can be stored for later use, injected into the gas grid or converted back into electricity at a later date.

The development of the Power to Gas technology represents an opportunity for DSOs, insofar as it is a means to ensure the stability of both the gas and the electricity grids. By the end of 2013 in Germany there were 18 operational Power to Gas plants and 5 more at the planning stage.

A technology in need of support

GEODE calls on the European Commission and Member States to support the research and development of technologies which would make the production of gas from electricity more economical and efficient.

GEODE also calls for regulatory incentives in favour of Power to Gas technologies. One practical example of this is the tax exemption policies in France and Germany, where electricity used in electrolytic processes is not subject to taxation.

Alternatively, the balancing rules could be amended so that the gas produced with excess green electricity would be treated in the same way as biogas. This is the case in Germany where, if hydrogen or methane produced is more than 80% from renewable electricity, it is considered as biogas, and so has the same benefits.

GEODE stands for:

- decision makers to ensure that storage capacities in the network are maintained as they will become a critical resource for security of supply when Power to Gas advances as a technology
- support for R&D to make the production of gas from electricity more efficient
- regulatory incentives to support Power to Gas technology

3. TRANSPORTATION – GAS VEHICLES

Although ecological in use, electric vehicles are not suitable for haulage, buses and other larger forms of transport. An alternative option is offered by natural gas vehicles (NGVs), which operate on compressed natural gas (CNG) or liquefied natural gas (LNG). These vehicles can also run on compressed biogas (CBG) or liquefied biogas (LBG).

In the EU27, the NGV market increased from 400,000 to 1.1 million vehicles between 2004 and 2013[8]. Alongside this development, the number of NGV filling stations has increased to over 3000 facilities across Europe. Meanwhile just 43 stations provide LNG.

Sweden is particularly active in this area, where in 2012, gas accounted for more than 1,400 TWh / year of the fuel used by vehicles with more than 41,000 NGVs on the road. In 2014, there are 195 filling stations for gas vehicles, mostly in the southern third of the country. Similarly there is an emerging market for LNG, with LNG storage being built in five harbour areas across the country as well a number of LNG filling stations for HGVs and buses.

In the same year in Germany, natural gas accounted for only 0.5% of vehicle fuel, whilst biomethane amounted to less than 0.1%.

A current issue relating to the use of natural gas in the transport sector is the exploration by some Member States of the use of shale gas. This would increase the quantity of natural gas on the EU market.

However concerns have been raised concerning the environmental impact of this. On this matter, **GEODE** agrees with the recommendation of the European Commission[9] that the Member States should prepare a strategic environmental assessment of the potential impact and risks to health and the environment of the exploration and/or production of shale gas, particularly with regards to the use of high-volume hydraulic fracturing (fracking).

[8] Source: NGVA Europe.
[9] Commission recommendation on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing of 22 January 2014.

DSOs' task: Connecting filling stations to gas grids

In order to encourage this alternative form of transportation, the number of gas filling stations needs to be increased. In the EU there are currently approx. 3000 CNG filling stations, the majority of which are located in Italy and Germany, and approximately 50 LNG filling stations.

The installation of a gas filling station is possible wherever natural gas pipelines lines exist; a network of filling stations can therefore be created by utilising the gas DSO infrastructure which is already in place. It would be the DSOs' role to connect the gas filling stations to the distribution grid.

Creation of a legal framework

GEODE supports an increasing market penetration of gas powered vehicles. For this to be achieved, it is essential that individuals and companies are encouraged to switch to natural gas vehicles. One very important step is the creation of an adequate infrastructure of filling stations for natural gas vehicles. The connection to the distribution grid should take place without any technical or financial complications for DSOs.

GEODE supports the adoption and ambitious transposition of a directive on the creation of an alternative fuels infrastructure[10].

GEODE urges the creation of regulatory incentives for the use of gas as a vehicle fuel.

- GEODE supports the development of natural gas transport
- The number of gas filling stations needs to be increased to support the development of natural gas transport

4. LINKING THE GAS, ELECTRICITY AND HEATING GRIDS: CHP

The use of cogeneration (CHP) is a cornerstone of the European energy efficiency policy. Electricity can be generated through the input of gas or other energy sources on both large and small scales. The heat produced in the process is saved and used in the nearby heating grid. In this respect, CHP is essential for the design of future smart gas and electricity grids. **GEODE** recommends the adoption of national heating and cooling plans at a regional and municipal level.

[10] COM(2013) 18 final: Proposal for a Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure.

Some CHP plants use locally produced biogas, which do not need to be connected to the gas distribution grid. However, it is not unusual for small local DSOs to be responsible for both the gas and electricity/heating grids. Some CHP plants also use natural gas from the gas grid and therefore require a connection to the gas grid.

It is necessary to ensure legal security for DSOs regarding the increasing challenge of grid stability and the handling of priority rules for the feed-in of electricity. With regards to the implementation of the provisions on CHP of the Energy Efficiency Directive[11], clear feed-in priority rules between green electricity and electricity generated by high-efficiency CHP must be established by the Member States.

Furthermore, **GEODE** supports the use of biogas in CHP power plants as a sustainable alternative to conventional fossil fuels. To realise this, regulatory incentives for electricity and heat from biogas CHP are necessary.

- CHP is essential for the design of future smart gas and electricity grids
- GEODE recommends the adoption of national heating and cooling plans at local level, for example among municipalities and communes
- It is necessary to ensure legal security for DSOs as regards the increasing challenge of ensuring grid stability and the handling of priority rules for the feed-in of electricity

5. SMART GAS GRIDS

Flexibility

The gas grid is more flexible than its electricity equivalent due to its storage potential and the predictability of peak demand.

This flexibility has advantages for both gas and electricity as stored gas can be used to produce electricity at times of scarcity whilst excess electricity from renewables can be used to create gas through Power to Gas technologies, which can then be efficiently stored for later use.

This smarter, cooperative link between the gas and electricity grids offers the potential for a more secure and flexible energy system in Europe and **GEODE** supports its development.

[11] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

Gas safety

The safety of the gas networks is a top priority for the DSOs but it must be delivered in a cost-effective manner.

To achieve this, **GEODE** recommends the development of a smart gas grid with technologies such as enhanced automation systems and real-time information.

The introduction of smart tools will be a great asset for the management of a smart grid. **GEODE** therefore recommends Member States incentivising research and innovation activities which will improve the key safety features of the gas grid. Examples of this include pressure regulation, traceability and gas odorisation.

Smart metering

The collection of precise data is key to the effective management of the gas grid. To this end, **GEODE** supports the roll-out of smart gas meters as proposed in the Third Energy Package, Directive for the Internal Gas Market and underlines the need to guarantee secure data communication and ensure customer privacy is respected.

The injection of non-conventional gases such as biomethane, hydrogen or LNG into the grid is also essential for the realisation of a smart gas grid. In order to support their use within the smart gas grid, **GEODE** recommends the improvement of the monitoring and control mechanisms for gas quality and pressure.

Energy efficiency

Energy efficiency services for consumers are a key component for the successful introduction of smart energy grids. To ensure this, the potential of smart meters should be realised. **GEODE** believes it is essential that there is a level playing field for energy efficiency services. As neutral actors in the energy system, it is **GEODE**'s view that gas DSOs should be able to participate in this activity.

- GEODE supports the provision of flexibility services between the electricity and the gas grids
- To support the use of non-conventional gases within a smart gas grid, the improvement of gas monitoring mechanisms is essential
- GEODE believes it is necessary to ensure the creation of a fair market for energy efficiency services which allows the participation of gas DSOs

RECOMMENDATIONS

There are tangible actions that can and should be taken by the Commission and regulatory bodies for gas networks to play a key role in the design of the energy market of the future.

Creating a functioning single European energy market including a level playing field for biogas production.

• • •

Assuring that sufficient investments in both electricity and gas networks take place.

• • •

Encouraging the use of biogas through adoption of measures to facilitate biogas injection into the grid, joined-up policy-making between energy and agriculture and adequate compensation mechanisms for DSOs.

• • •

Promoting funds for R&D and providing regulatory incentives to support Power to Gas technology.

Supporting the development of gas transport and assuring the necessary increase of the number of gas filling stations.

• • •

Providing legal security for DSOs as regards the increasing challenge of ensuring grid stability and the handling of priority rules for the feed-in of electricity.

• • •

Supporting flexibility services between the electricity and the gas grids.

• • •

Creating a fair market for energy efficiency services which allows the participation of gas DSOs.

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