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Summary of the national reports

Authors

Andrea Haas/Heinz Kastenholz

IBBK Fachgruppe Biogas GmbH/WFG Schwäbisch Hall

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0. General Notes

- The document provides information for people thinking about building and operating a biogas plant who want to inform themselves about the main aspects that have to be considered in the participating countries (France, Belgium, Denmark, Sweden, Germany, Austria, Italy, Hungary, Slovenia, Croatia, England and Wales).
- For more detailed information concerning a specific country it is advisable to read the country report. The full version of the respective country report is written in the respective language and there is an English summary for each country, too.
- **It is important to note that legislation and policy surrounding anaerobic digestion is changing quickly and some of the information in this report will quickly become out-of-date. Users will have to check for up-dated information.**

1. European Legislation

There are several regulations in the agricultural, waste and environmental sector in the European Union concerning the production of biogas. To be mentioned:

- White Paper on Renewable Energy Sources, EU Commission (1997)
- Kyoto Protocol, Obligations to the EU nations, 1997
- EU Commission paper on Security of Energy Supply COM (2000) 769
- Directive 86/278/EC on sewage sludge in agriculture
- Directive 1999/31/EC on landfills
- Directive 2001/77/EC on RES-e
- Directive 2008/98/EC on waste
- Directive 2003/30/EC on the promotion of bio-fuels for transport
- Directive 2004/8/EC on cogeneration for heat and power
- Directive 96/61/EC on Integrated Pollution Prevention and Control
- Directive 2010/75/EC on industrial emissions repealing 2008/1/EC
- Directive 2003/87/EC on establishing a trading scheme for greenhouse gases
- Directive 91/676/EC on nitrates
- Regulation EC 1069/2009 repealing EC 1774/2002 on animal by-products
- Best Available Techniques (BREF 96/61/EC)
- The upcoming European End of Waste Criteria for the digestate will also impact on AD and biomethane plants implementation.

2. Corporate Structure of Plant Owners

In all countries different corporate structures are possible, e.g single farmers, co-operations of farmers, power companies owning and operating a biogas plant, waste or wastewater management companies owning and operating a biogas plant. The number of partners and their liability is depending on the legal form.

In recent years in Germany it became prevalent for larger biogas plants to establish different corporate structures for one biogas plant, one for the substrate delivery, one for the operation of the biogas plant including the utilisation of the biogas in CHP plants (combined heat and power plants) and one for the marketing of the heat.

3. Training and Education of Operating Personnel

a) General information

It has been identified that even if not compulsory, training for the operating personnel is good practice, always useful and helpful to minimize risks and to increase the efficiency of and, by implication, the income from the biogas plant.

b) Austria

In Austria the qualification of the operating personnel has first priority for a safe and compliant work of the biogas plant. Four functions are distinguished:

- The operations manager is referred to the licensing authority as the responsible person and must be provably informed about possible dangers of the biogas plant. In addition the operating staff should have completed a training including testing.
- The operating attendant (gas engines or gas turbine) must meet the requirements of the relevant legislation
- The requirements for the management and supervision of power plants are depending on the province.
- The fire protection supervisor must be trained.

c) Belgium

In Wallonia there is no training required for the management of the biogas plant.

d) Croatia

In Croatia experience in operating a biogas plant is desirable but not conditional as long as the equipment supplier guarantees the performance of the plant and provides education for the biogas operator/owner. To minimize chemical and biological risks a specific training is needed. As to waste management there is no compulsory specific training. There are voluntary certifications but no other specific directives for the training operation of biogas plants.

e) Denmark

At this stage, Denmark has no practical and theoretical training centre. If biomethane production is to be developed in the future, training courses would be necessary. The availability of trained and experienced biogas technicians in Denmark is very limited, and the opportunities for training activities are currently hardly existing. However, many plant manufacturers offer training on the running and maintenance of their installations. Especially the operating of 23 industrial scale biogas plants has provided skilled labourers and some of these are servicing new biogas plants or plants that need to be optimized in order to become profitable or in order to sort out specific technical or biological problems. Technical support is available from a number of organisations.

f) Germany

In the past there have been a few serious accidents in Germany caused by insufficiently trained operators. At the moment there is no general compulsory safety-training for plant operators but it is under discussion and expected to be implemented. Only in some special cases there is a training according to the DVGW (Deutsche Vereinigung des Gas- und Wasserfaches) necessary.

However in most cases the approval authorities only grant the permission to build a biogas plant on condition that two people have undergone a training according to the safety rules. There are several institutions offering such training courses, some even offer training courses in English. Some laboratories offer biological assistance for biogas plants.

g) Hungary

There are no specific directives in Hungary for the training of operating personnel of biogas plants. Also the availability of trained and experienced biogas technicians in Hungary is very limited and the opportunities for training are currently very restricted.

h) Italy

Training and information regarding occupational safety and health in the workplaces are compulsory in Italy for all the employees. To minimize chemical and biological risks a specific training is needed. As to waste management there is no compulsory specific training. There are voluntary certifications but no other specific directives for the training operation of biogas plants.

i) Slovenia

In Slovenia operators of biogas plants must meet the legal requirements in accordance with the size of devices. There are also prescribed professional trainings and examinations for workers involved on energy installations.

j) Sweden

In Sweden training must be carried out and instructions found on production site in appropriate languages before the operations start. Instructions have to cover all the routines. Training can e.g. be arranged when the plant becomes operational. The Managing Director has the utmost responsibility for the operations and the maintenance of the plant. He or she will appoint a trained person responsible for gas at the plant. All the documents concerning maintenance, controls and former instructions must be saved.

In case of emergency, there must be instructions that are so easy to access that even persons that normally don't work at the plant can prevent or reduce the impact of a damage.

k) UK

The availability of trained and experienced biogas technicians in the UK is limited and the opportunities for generic training are currently delivered by a relatively limited number of service providers. Most AD plant manufacturers do, however, offer training on the running and maintenance of their installations and thus the situation will change as new plant comes on-stream. There is, therefore a reasonable prospect that the current shortage of skills and training will be overcome relatively quickly. The very limited experience in the UK outside of the waste water industry is not mirrored in the whole of the EU and opportunities do exist to learn from the very considerable knowledge and experience in the likes of Germany and Austria. The demonstration of the technical competence of the operator is a vital consideration in the granting of an Environmental Permit for the plant. As such the availability of trained personnel and strong environmental management systems is essential. Technical support in terms of laboratory analysis and studies is available from a number of organisations. In recent years there has been a growth in the provision of technical and consultancy services available on a commercial basis in the private sector. There are also a number of universities that provide relevant training for the sector at degree, master and doctorate levels. Also relevant research facilities and staff resources associated to universities are being utilised as knowledge transfer centres to various industrial stakeholders.

4. Choice of site

a) General information

In this chapter it is only pointed out, which factors have to be considered when someone is looking for a site for a new biogas plant and which permissions could be needed. For further information about the approval procedure, please see chapter 5 (Authorization Procedure).

b) Belgium

In the Walloon region a first pre-feasibility study is realized freely by the facilitator (the facilitator has been designated for advising industrials or farmers about biogas projects). This study includes the land use planning and sector conformity; the biogas, electricity and heat production estimation based on local and regional potential substrate (quantity, quality, conformity); the investment costs, the potential subsidies and the biogas plant profitability evaluation. The agreement of the local population must also be taken in account.

c) Croatia

The site must be chosen in accordance to the land use planning. In terms of building laws, location permit has to be synchronised with the physical plans of the town, municipality and county. In case of a town with population of >35000 inhabitants, the location permit can be obtained locally, otherwise it is obtained at county level. In case that the biogas plant is not synchronised with physical plans, the investor has to start the procedure of changing the physical plans that could be both costly and time consuming (exceeding one year). Biogas plants are recognised as energy objects and, as such, they can be built only on the construction land.

Biogas plants on agricultural feedstock are not recognized as buildings exclusively related to agricultural business activities and, therefore, they need to obtain location permit. The option where the biogas plant is an undetached part of a building for exclusively agricultural activities has not been investigated so far. By allowing this, one crucial step could be omitted in permitting procedure for biogas plants: change of land classification.

d) Denmark

The locations of biogas plants are regulated by the Danish Planning Act. This means establishment of a local development plan to ensure comments by surrounding citizens and professional bodies. In cases with establishment of biogas plants in farms in connection with animal husbandry, and if the plant only treats slurry from this particular farm, a rural area permit may be enough.

The optimal location of biogas plants would often be in the open land (rural area) in the centre of the "slurry area" and close to an energy purchaser. It is of vital importance to assess the potential localities compared to a high number of location criteria, in which transport and infrastructure, distance to neighbours and fitting into the landscape are key factors.

To assist the local councils, The Biogas Secretariat of the Danish Ministry of the Environment has made a list of criteria for the assessment of possible locations. The purpose of the geographical analysis is to place biogas plants appropriately in respect of the existing physical planning. The geographical analysis visualizes to the extent possible the relevant applicable considerations for location. The analysis shows by colour codes in a map how to influence biogas planning on the existing planning

By the end of 2013, the local councils must designate the rural areas, which are suitable for placement of large biogas plants in the town plans, but today, most local councils have not designated particular areas for the establishment of joint biogas plants in their town planning activities. In cases where someone wants to establish a biogas plant in the open land and outside the generally designated occupational fields, this requires planning and building regulations by the local council before launching the plant. In cases, where the local council has designated areas for joint biogas plants in their town planning and possibly have a local development plan, the originators of the project only “need” to have the EIA process and the environmental administration procedure implemented. Plants being an integrated part of a farm unit will be placed according to a rural zone permit instead of a local development plan.

The difference may be considerable between time schedules for farm biogas plants and large joint biogas plants. The time frame is often three years from the first application till start of the project. A thorough preparatory work together with a close dialogue with the participants and an openness in the process would often reduce objections and secure a better accept of the plant. It is possible to reduce the time schedules considerably, if the biogas plant can be placed within the areas, in which the local council has already resolved a town plan and local development plan with the possibility of establishing a biogas plant. In such cases, deadlines for EIA and the environmental approval of the plant should be approximately 12 months.

e) Germany

Due to new regulations since the 1st of January 2012 for new biogas plants it is important to have heat consumers near to the plant as plant operators have to use 60 % of the heat. 25 % is calculated for the own heat demand of the biogas plant, therefore at least further 35 % of the heat (as average through the whole year) have to be used otherwise you will lose the remuneration according to the Renewable Energy Act for the whole year and only gain the electricity price from the stock market. The approved heat utilisations are given by law.

Another important point is the availability of substrates, because long distance transports of substrates and, by implication, long distance transports of the digestate will make the project unprofitable.

Agricultural biogas plants that will be built in the outskirts directly next to the agricultural holding with a biogas production not higher than 2,3 Mio Nm³/year and a furnace thermal capacity that does not extend 2 MW are privileged. Thus, the biogas plant has to be permitted if the corresponding laws and guidelines are satisfied. For all other biogas plants that are not privileged and will be build in the outskirts it may be necessary to change the land development plan which has to be requested at the local authority.

In industrial and commercial zones it is normally possible to build biogas plants, but it has to be clarified with the local authority.

There are different protection areas where biogas plants are not allowed or only allowed with high (and expensive) requirements.

The distance from the housing development or some special facilities has to be considered.

For biogas upgrading plants it is also necessary that the distance to the gas grid is as short as possible and that the gas grid has enough feed-in capacity, therefore a consultation of the grid operator is necessary. The regulations foresees that the grid operator has to pay 75 % of the pipeline and the plant operator 25 %, but if the length is more than 10 km the plant operator has to pay 100 % of the exceeding length.

f) Hungary

In summary, regarding the choice of site have to taking into account:

- the raw material supply route would be as short as possible
- the possibilities of the using of the heat energy
- the possibility of the electricity network connection
- appropriate protective distance from residential areas

g) Italy

The site where to build the plant may have certain constraints such as environmental, archaeological, hydro geological, architectonic constraints. Depending on the kind of constraint the competent body will evaluate the project and give positive or negative answer. Plants for the production of renewable energy are useful for the community, it is therefore possible to expropriate the land where the plant will be built. Anyone who could be damaged by the expropriation procedure can take part in the procedure.

For site selection in the case of biomethane to be injected into the grid, the legislation at the moment does not set particular limitations. In general if the site has any constraints it is necessary to obtain authorization from the office in charge. Concerning the use of biomethane as a fuel each municipality must have a fuel plan. The municipal planning should take this into consideration in order to identify suitable areas or minimum authorization requirements.

h) Slovenia

The spatial strategy arises from taking into account social, economic and environmental determinants of spatial development. In accordance with the principle of sustainable spatial development the spatial strategy invoked the rational use of space and the safety of life and property. It also underlines the commitment to maintain awareness of space and strengthening the identity of Slovenia and its local and regional identities. Spatial strategy consists of verbal and cartographic works.

To set up a biogas plant is necessary to define the spatial planning document, setting out the type of plant and the terms for building in a certain area. It is therefore important that the investor examines what conditions are set in the field of spatial planning documents, where the biogas plant should be build. The site plan shall also determine on which network and public infrastructure facilities individual objects or surfaces are obliged to connect. If for the network or a particular object a location plan was drawn up, the process of issuing building permits is significantly shorter and simpler.

Location information is needed to determine the suitability of specific locations. It represents a document that contains the data and the conditions (requirements, obligations and prohibitions) relating to a specific plot of land or a number of land parcels. Location information for the construction of facilities in addition to data on land use of the land contains any conditions that must be taken into account in constructing various types of projects and information what types of approvals must be obtained prior to construction.

Besides the investor the property owner and holders on property can participate in the process of issuing the building permit in an area that is governed by spatial order.

i) Sweden

Planning and Urban Development matters deal with sustainable land use and regional development, town and country planning as well as development within the housing sector. The National Board of Housing, Building and Planning – Boverket – is the national agency for planning, management of land and water resources, urban development, building and housing. Boverket monitors the function of the legislative system under the Planning and Building Act (PBL) and related legislation and proposes regulatory changes.

The municipal comprehensive plans are important instruments when heading towards a sustainable management of land and water resources. The spatial development in growing regions as well as the municipal planning should adapt to a long term perspective on traffic and transportation infrastructure, urban development and social aspects. Boverket supervises how the planning legislation is handled by the municipal authorities and the county administrative boards.

A building permit is required for construction of a new biogas plant or if one wishes to increase the capacity of an existing plant or use it for a new purpose. Before applying for a building permit, it is recommended to contact the local building committee and ask if it is possible to build on the planned site and if the place is suitable for production of biogas or bio-methane. The committee can grant an advance notification that is valid for two years.

j) UK

The Town and Country Planning (General Permitted Development) Order describes certain categories of development that, under specific conditions and circumstances, do not require specific planning permission. It is just conceivable (but not very likely) that a small AD plant that does not require the importation of material (feedstock) into the site or farm and utilises most of the energy through onsite processes, would not require specific planning permission. This must always be confirmed with the relevant local planning authority (LPA) – usually the unitary or district council. The vast majority of plants will, however, require specific planning consent. There is very little experience of anaerobic digestion in most parts of the UK and it is rather unlikely that the local planning authority to whom any application is submitted will have any specific policies in its development plan.

Planning policy advice is available at a national scale through the Planning Policy Statements (PPS) in England and Technical Advice Notes (TAN) in Wales. The relevant documents are PPS22 and TAN8 – both entitled “Planning for Renewable Energy”.

The Department for Energy and Climate Change and the Department for Environment, Food and Rural Affairs have recently issued a joint document entitled “Anaerobic Digestion Strategy and Action Plan”. Within that document it states “The Government is reforming the planning system to ensure that the sustainable development needed to support economic growth is able to proceed as easily as possible. This embraces a range of measures which should make it easier to obtain planning permission for appropriately sited AD plants.” It is not clear when and how this might be expected to assist AD developers and whether this would come into force in Wales as well as England.

Adjoining landowners and neighbours do have rights and could conceivably challenge the proposal directly through private action but by far the most likely way in which they might influence the proposal is via the representations that they make during the consenting procedure. If the access to the site is other than directly off a public highway it is clearly of considerable importance that the right exists, or can be negotiated to cross all land in the ownership of any third parties. It is also important to check the requirements of the Highway Authority in respect of any improvements that might be required to public or private highways.

5. Authorization Procedure

a) General information

Depending on the plant the following departments may be affected for an authorization process:

- regional planning
- civil, mechanical, chemical, electrical, waste and traffic engineering
- fire and explosion protection
- water and groundwater protection
- air pollution
- noise
- waste management
- hygiene
- worker safety

b) Austria

A biogas plant can be an agricultural, industrial or a waste treatment plant. The legal determination depends on the legal status of the operator, on the used materials and on the type of energy generation. Moreover, the size of the plant plays a role and ultimately the quality of the starting materials.

Gas operators are obliged to provide the access to the national gas network for the supply of biogas, if the biogas corresponds to the quality requirements of the guidelines ÖVWG G31 (for imported gas) and G33 (for gas from regenerative processes).

The most common authorization processes in Styria are as follows:

- Construction law permits (Construction Law)
- Approval for Waste Management Act (AWG)
- Admission to Animal Materials Act (TMG)
- Water rights permit
- Legal trade authorization (Trade Regulation)

In other Austrian provinces the authorization processes are performed as well under

- Electricity Law

c) Belgium

In Walloon Region, there is a single permit, which includes the environmental permit and the urban permit (Decree of 11 March 1999, order of 4 July 2002 improved by order of 1st March 2007). If the quantity of animal by-products (effluent, ...) is over 100 tons per day or more than 500 tons / day in the case of waste other than animal by-products, an environmental impact study is required.

As a commercial structure, an identification tax number is required.

All green power generation units must submit a prior application to Walloon Commission for Energy (CWaPE) for the issuance of green certificates. A certificate of origin issued by an approved inspection body must be attached to this application. Once this preliminary application for certification has been accepted by CWaPE, the producer receives a given number of green certificates based on his quarterly energy metering statements.

d) Croatia

To set up a biogas plant is necessary to provide a number of licenses, this procedure is quite time consuming. In Croatia biogas is mentioned in more than 40 legal documents of different rank. Apart of energy legislation, biogas is separately mentioned in several policies and strategies. The main distinction of the perception of biogas between energy related laws and other sectors is that in the energy case, the accent is placed on biogas as energy source while in the others biogas production is a tool for achievement of some other goal.

The permitting process is highly centralised and most of the authorities responsible for permits are in the capital of Croatia, Zagreb. The main stakeholders in the permitting procedure are:

- MoELE: responsible ministry for RES, issues preliminary energy approval and energy approval
- HROTE: party to sign power purchase agreement with
- HERA: issues preliminary eligible producer status, energy license and eligible producer status
- HEP ODS: responsible for all permits related to grid connection
- MoEPPPC: responsible for physical planning and building permits

Energy Law recognises biogas as one of the renewable energy source (RES). Electricity produced from RES has priority purchase to the power grid and its purchase price is incentivised. Biogas is, either directly or indirectly, recognised as energy carrier in legal frameworks that define natural gas market, electricity market and thermal energy market and as biofuel. Nevertheless, only the Law on Electricity Market has implementation acts in force which means that only electricity produced from biogas is recognised in the support system.

According to the Law on Physical Planning and Construction location permit is a prerequisite for a construction permit. In some cases the construction is permitted upon issuing of the decision on the construction conditions, where both location and construction provisions are embedded. Procedures and conditions for issuing these documents are defined by the Law on Physical Planning and Construction, the Ordinance on Simple Constructions and Works and the ordinance on Determining the Constructions and Constructions for which the MoEPPPC issues the Location Permit and/or Construction Permit.

Location permit is issued if the following conditions are fulfilled:

- preliminary design in line with the physical planning documents and specific conditions regulated by other relevant laws and regulations
- all required documents for location permit issuing submitted
- assess to traffic infrastructure provided
- state of the construction plot in line with the urban physical plan
- in case that the project is subject to EIA: decision on environmental acceptability
- decision on integrated environmental protection requirements issued if required
- in the case that the project is subject to NIA3: decision on acceptability of the project

Construction permit is issued if the following conditions are fulfilled:

- final design in line with the location permit
- final design in line with the provisions of the Law on Physical Planning and Construction, its sub-laws and other relevant laws and regulations;
- state of the construction plot in line with the urban physical plan

All required documents to be submitted: three copies of the final design, copy of the location permit with all prescribed conditions, which are part of the location permit, report on the control of the final design, elaborate on the geotechnical and other investigations as well as technical, traffic and other elaborates if such are used for development of the final design:

- elaborate on parceling of the construction plot verified by the state verifier and the verification of the ministry, which issued the location permit, that the construction plot is in line with the provisions of the location permit is obtained and submitted
- evidence that the investor has the right to build on the plot

The whole process of obtaining an authorization can be divided in various phases, each phase comprising the basic legal acts resulting from activities carried out in a particular phase. These phases can be marked as:

1. Preparation phase - assembling and studying of input information and preparing of preliminary documents for facility construction
2. Procuring decision on registration of energy activity
3. Procuring preliminary energy approval for construction of energy facility
4. Procuring decision on environmental impact assessment of intervention and/or decision on integral environmental protection conditions
5. Procuring location permit and/or preliminary energy consent and/or concluding contract on connecting to energy network
6. Procuring energy approval for facility construction
7. Procuring decision and/or concluding concession contract
8. Procuring decision on expropriation and/or decision on entry in the land register
9. Procuring building permit
10. Procuring preliminary decision on acquiring the status of eligible electricity producer
11. Concluding contract on purchase of electricity (conditioned)
12. Procuring energy consent
13. Concluding contract on the use of the network
14. Procuring the use permit
15. Procuring water permit
16. Procuring the license for carrying out energy activity
17. Procuring decision on acquiring the status of eligible electricity producer
18. Procuring decision on determining of domestic component in the project
19. Procuring decision on entry of the building in the cadastral operate
20. Procuring decision on entry into land register

e) Denmark

Filing of the projected building activities is effected according to the building regulations. The local councils have developed a website with a form for this notification. The public opinion is an important aspect of the regulatory process. From a social viewpoint, a project may be very useful, however, if the public mind puts pressure on local politicians to have diverging opinions instead of strictly rational opinions, the project might fail. Therefore, the process concerning communication and involvement by the local society during the consultation periods is very important and not to be neglected.

Biogas in relation to the Danish Planning Act and subject to approval by the Danish Environmental Law. The legal framework on the regulatory processing of large biogas plants is quite comprehensive and not to be mentioned here. Only the most essential laws and directives are mentioned, which the planning affects.

- The Danish Planning Act
- The Danish Environmental Law
- The Danish Nature Protection
- Animal By-Product Regulations
- The Danish Tender Act
- The Public Procurement Act

The regulatory processing by the local councils of the biogas project has to fulfil the objects of the Danish Planning Act and the Danish Environmental Law. This means that the biogas plants are subject to approval by the Danish Planning Act and the Danish Nature Protection Law. When establishing a large stock of gas (more than 10 t consisting of methane and carbon dioxide), the plant will be subject to Council Regulation 96/82/EØF, Council Directive on the control of major-accident hazards involving dangerous substances.

The rural area permit grants permission for the establishment of small-scale plants in connection with farm buildings. Procedure of application for rural area permits will take place in conformity with the Danish Planning Act. The application should include a brief description of the impact of the development on the environment and a specific description of the elements of the plant. Developers should ensure a discussion on the content of the application with a local government employee in charge of rural area issues.

All biogas plants are subject to screening according to the EIA rules issued by the authorities, and all planning and building regulations for municipality/local authorities are subject to environmental assessment according to the environmental rules. To start the EIA process, the project group has to forward a notification of the plant in accordance with the EIA statutes. Subsequently, the local council determines if the establishment of the plant would require an EIA assessment or if building the plant should be effected solely in accordance with a local development plan.

When the project has to be considered according to the EIA statutes, the environmental conditions apply in a wide sense and not only within the cadastral plot for the biogas plant. The notification would therefore comprise the biogas plant and the areas for spreading, which would be necessary to attach to the plant in order to secure the handling of the degassed biomass. The EIA notification and application for environmental approval procedure requires a report on traffic, odour, emissions for air, soil and water, adaptation to the landscape and restrictions for the surroundings, if any, for the placement of the plant. Details on effects, possible risks and preventive measures, considerations for co-residents, school children, etc. should be presented.

As a minimum, the screening should be based on the relevant criteria of the EIA regulation.

Often, the council will apply a screening form enclosed in the EIR application instructions. Based on the AIE screening, the council will decide if an AIE statement should be prepared. If the council decides otherwise, the next step will be a local development plan and possibly an addendum to the town plan.

If a plant, based on the AIE screening, is considered having a considerable environmental impact, this requires an AIE statement. The preparation of this would normally lie with the biogas project group. The project group would normally prepare the statement, however, as the council is responsible for the content, they will also prepare the statement. It is important, in the first instance, that the operator and the local council will agree on the content of the statement and the procedure of implementation, including coordination with the local planning authorities. Afterwards, as an enclosure for the AIE statement, the draft application for environmental approval should be submitted.

If the establishment of a plant requires a change in the local town plan, i.e. an addendum, which would break with the existing town plan framework, this would require an environmental assessment. By and large, an environmental assessment is like an AIE statement, however, it is less detailed and directed towards the plan, not the specific plant.

Whether localization is already included in the town plan or not, a town plan addendum must be drawn up. This independent town plan addendum with guidelines for the town plan and the appurtenant AIE statement is the final and approved document, according to the AIE rules. An addendum normally includes a brief statement and the specific guidelines and framework of the council.

According to the Danish Planning Act procurement of a local development plan is obligatory before introducing large parcellization or large-scale building or construction work, by example a biogas plant. The local development plan lays down guidelines for the establishment of the plant, such as plot ratio, building area, height of buildings, choice of materials, plantation, access roads, etc. Odour and noise guidelines are subject to adjustments in the environmental approval, however, may also be included in the local development plan. The local councils normally have a framework for their local development plans, which should be applied in the process.

Biogas plants with a capacity exceeding 30 t biomass/day and/or with a gas production of more than 1MW are subject to the Danish Nature Protection Law and require an environmental permit. An environmental permit is a part quantity of the EIA statement.

f) France

A biogas plant is subject to authorization or registration statement under the protection of the environment.

g) Germany

As the whole procedure is very comprehensive and besides the Germany-wide regulations almost every federal state has some specific regulation it is depending on the state, where the plant will be build. This document points out the most relevant laws and regulations that have to be considered.

For the construction permission the size of the plant is important. If the biogas production does not extend 1,2 Mio Nm³/year a simplified permission according to the Federal Building Code can be gained. For plants with a biogas production of 1,2 Mio Nm³/year or more need a permission according to the Federal Immission Act regardless of the substrates. The permission according to the Federal Immission Act which is more expensive and has higher costs. Biogas upgrading plants upgrading 1,2 Mio Nm³/year (raw biogas) or more also need a permission according to the Federal Immission Act.

Also important is the size of the manure and the digestate storage. If the size of the storage is 6500 m³ or more, a permission according to the Federal Immission Act is necessary. If the biogas plant as a whole needs a permission according to the Federal Immission, the storage will be included in the approval procedure.

If the permission according to the Immission Act has to be done, then the threshold values of the technical instruction air and the technical instruction noise have not to be exceeded.

Depending on the needed permission and if the plant is privileged or not it may be necessary to change the land development plan which has to be requested at the local authority.

Over a heating value of 1 MW there might also an assessment of environmental impacts be necessary. In this assessment the impacts on landscape, water, soil, cultural goods, etc. are to be considered.

Furthermore the plant has to be built according to the Federal Water Act. Therefore the plant and the storage facilities have to be built in a way that hazards to water reservoirs are avoided. New, stricter regulations are expect within the next 2 years, the impact for existing plants is not yet foreseeable as for old plants it probably won't be possible (technical and economical) to adjust so that interim arrangements for considerable time would be necessary.

According to the Fire Protection Decree and the different Federal States Construction Acts certain requirements have to be fulfilled.

According to the Hazardous Material Decree all hazardous materials have to be marked and everyone working on the plant has to be informed about the hazards.

The Work Safety Act and the Operation Safety Decree demand that every worker on the building site has to be sufficiently trained and equipped and all machinery and components has to be at state of the art safety level to avoid impacts on health and environment.

For plants with large gas storage capacities (more than 10000 kg biogas if biogas is the only hazardous substance at the site, otherwise it could be less) the Major Accidents Ordinance has to be considered, too.

h) Hungary

The biogas plant construction and operation licensing process consists consists of four separate but not independent part.

1. Environmental Permitting
2. Building permit authorization
3. Network connection
4. Hungarian Energy Office (MEH)'s permit

The four separate procedures are required to initiate by the developer. However, some procedures at several points connected with the various procedures

To be mentioned:

- Electricity Act - Act No. 86 of 2007;
- Decree No. 273/2007. (X. 19.) on the implementation of the Electricity Act
- Decree No. 320/2010. (XII. 27.) on the competence of the Hungarian Trade Licensing Office
- Decree No. 314/2005. (XII. 25.) on the main rules concerning the environmental licensing process
- Decree No. 382/2007. (XII. 23.) on the main rules of construction licensing process of power plants
- Decree No. 117/2007. (XII. 29.) GKM on the financial and technical conditions of the grid connection
- Decree No. 8/2001. (III. 30.) GM on the Technical and Security Rules for power plants
- Act No. 53 of 1995 on the environmental protection
- Act No. 78 of 1997 on the main rules for building construction
- Act No. 140 of 2004 on the General Administrative Procedure
- Decree No. 347/2006 (XII.23.) on the designation of the authority responsible for environmental protection
- Decree No. 71/2003 (VI.27.) on the general health requirements for the treatment and utilization of animal waste
- Decree No. 91/2007. (XI. 20.) GKM on the administrative fees of the Hungarian Energy Office
- Act No. 43 of 2000 on waste management

i) Italy

In Italy, the Regional Bodies are in charge of granting the so called “Autorizzazione Unica”, the authorization for the construction and functioning of plants for the production of electric energy from renewable energy sources. This authorization also involves modifications, improvements, restructuring, maintenance and infrastructures and all those works which are fundamental for the construction and functioning. All the procedure takes 180 days at the most. The only exception are areas that should undergo the environmental impact assessment that needs to be done before the granting of the authorization. There are also other bodies involved in this procedure, for example the provincial administrations are in charge of emissions in the atmosphere and industrial water wastes. Depending on the location of the plant the provincial administration is involved.

The technical report to be sent to the regional body must include the following parts:

1. town and territorial planning
2. description and analysis of the type of activity involved: productive cycle, production of the plant and energy consumption
3. raw materials
4. water cycle
5. emissions in the atmosphere
6. wastes management
7. re establishment of the site
8. monitoring and control plan
9. conditions that differ from normal functioning

The Legislative Decree 28/11 introduced the Simplified Enabling Procedure PAS instead of the DIA / SCIA for plants for which the applicant establishes that he has availability on the property affected by the plant and by the associated works. At least thirty days before the start of the work the applicant has to give a statement to the municipality that is accompanied by a detailed report written by a designer and authorized by the appropriate construction documents, stating the project is compatible with the approved town planning and building regulations in force and with the adopted planning instruments and compliance with safety standards and the sanitation. Abruzzo Region has extended PAS to all plants from a renewable source with a power not exceeding 1 MW. Therefore for such plants the authorization is granted by the municipalities

The Legislative Decrees 164/2000 and 81/2006, respectively, provided that the rules on access to the gas market are also applicable to biogas and gas from biomass and from 1st January 2007 a minimum proportion of biofuels and other renewable fuels derived from biomass, must be placed in the conventional fuels used for transport. But at the moment in Italy it is not possible to use biomethane for transport or for the injection in the grid:

- For transport it is waited for that the legislator will introduce an excise.
- For the injection into the grid the Legislatives. Decree 28/2011 defines incentives for connecting biomethane plants to the grid. So far there are no technical and economic directives for the connection, but new guidelines are expected to establish the minimum characteristics of the biomethane and rules for the connection to the grid.

j) Slovenia

The most important state institutions responsible for issuing licenses are:

- Ministry of Economy of the Republic of Slovenia
- Energy Agency of the Republic of Slovenia
- Environmental Agency of the Republic of Slovenia (under the Ministry of Environment and Spatial Planning)
- Organizer of the electrical energy market, Borzen
- Distributor of electrical energy (under the auspices of the distribution system operator (SODO))

The most important regional institutions responsible for issuing licenses are:

- Veterinary Administration of the Republic of Slovenia (regional division)
- Administrative unit

Besides the above mentioned license it is necessary to provide a number of other licenses, in addition, this procedure is quite time consuming. In the case that potential owner decides to build a biogas plant for its own purposes, it is only necessary to obtain construction and operating license. When biogas plant uses organic waste for biogas production it is necessary to obtain the license for processing waste, etc.

Permission for biogas plants include:

- building permit
- energy permit
- energy License
- environmental approval
- approval by the Veterinary Administration
- operating permit
- consent to connect to the electrical grid

- declaration of the production unit and a certificate of origin
- decision to grant support

The following list shows documents needed for the authorization in Slovenia:

- technical description of the plant
- copy of the land utilisation plan highlighting possible hazard zones
- layout plan
- ground plan, elevation and sectional drawings
- substrate and gas flow diagrams
- concept for waste management
- details on the proposed safety equipment and the locking mechanisms
- explosion-zones plan and details on explosion prevention measures
- details on the exhaust emissions of the co-generation unit
- details on the measures to minimize smell emissions
- instructions for operation and possible malfunctions
- technical description of electric equipments
- single-line overview diagram of the electrical generator and from the electrical generator to the feed-in point
- transformer station and high-voltage power line equipments
- CE-marking and declaration of conformity
- proof that all installations, machines and plant components satisfy the national standards and legal requirements
- etc.

In accordance with the Law on Construction of buildings, new building construction, reconstruction, replacement facility construction and demolition can begin on the basis of a legal building permit. Procedures and conditions for obtaining building permits are defined by law. To obtain a building permit the investor must submit an application to the responsible administrative unit for construction affairs. The developer must provide the following information: the number of land plots and land cadastral municipality of the intended construction and number of the plot of land. Also, the owner must provide proof of right to build, if that right has not yet entered in the land register, as well as two copies of the project for construction permit (number of studies, projects and approval). On the basis of the municipal spatial planning documents, the applicant may obtain approval of new construction or major changes. Construction of biogas plants can be started only on the basis of the legal building permit. The competent authority for the building permit is an administrative unit.

The developer must obtain permission for the biogas plant, which produces electricity over 1 MWe. This application can be submitted at the same time as an application for planning permission. The competent authority for permission is the Ministry of Economy of the Republic of Slovenia. With the energy permission is defined:

- location of the biogas plant
- appliance
- conditions for carrying out energy activities
- conditions associated with the start-up device

The Energy Act provides that it is necessary to obtain a energy license to carry out energy-related activities for devices that produce electricity over 1 MWe, otherwise a license is not required. The license must be obtained before the operation and implementation of energy activities. Conditions for obtaining a license are specified in the Decree on conditions and procedure for granting and withdrawing licenses for energy activities. The licenses are granted by the Public Agency of the Republic of Slovenia for the Energy for 5 years and the license holder has the right to obtain a new license if it meets the conditions set by the Energy Act and the Decree on conditions and procedure for granting and withdrawing licenses for energy activities. An application for a license must be submitted to the Energy Agency. In the application for a license it is necessary to give basic technical information on the expected extent and manner of implementation of energy-related activities for which the applicant wishes to obtain a license.

Biogas plants operating on the basis of agricultural waste do not require environmental approval, if the thermal energy in plants for producing heat and electricity is less than 1 MWt. The Contractor shall conduct an environmental impact report (IPPC - Integrated pollution prevention and control of pollution) and obtain environmental approval from the Environmental Agency. The application must include a project report on environmental impact assessment and review of environmental impact assessment. Environmental impact assessment is obligatory for the various interventions that are laid down in regulation on the types of interventions in an environment that are subject to impact assessment and decree on activities and plants that cause extensive environmental pollution. Expert assessment of the biogas plant is needed for using up to 10 tons of plant biomass as an input medium per day. The environmental permit is required for biogas plants with a production capacity of more than 10 tons of biomass per day. The environmental permit is also required for biogas plants where the amount of plant biomass input is up to 10 tons or more and up to 10 tons per day of animal by-products. IPPC permit is required for biogas plants consuming more than 10 tons of manure and slurry per day or more than 10 tons of animal by-products per day. The procedure for obtaining the environmental approval may take place in conjunction with the acquisition of location information during the procedure for a building permit. The competent authority for environmental approval is the Agency for Environmental of the Republic of Slovenia.

Biogas plants can cause air pollution. Expert assessment of the effects of atmospheric emissions is required for biological treatment of waste, where the daily capacity is from 1 to 10 tons / day (only plant material). The environmental permit is required for installations for biological treatment of waste, where the production capacity is 10 tons / day and above (only plant material). The environmental permit is required for biological treatment of waste with plant material in any amount plus up to 10 t/day of animal wastes or for disposal or recycling of animal waste including facilities where animal carcasses or animal waste is collected or stored or processed prior to disposal or further processing. If the plant is using more than 10 tons of manure and slurry per day or recovery or disposal of animal carcasses and animal waste with a treatment capacity exceeding 10 tons per day, it is necessary to have IPPC permit. The investor has to submit a permit application to the Environmental Agency.

Regulation on air also discusses the prevention and reduction of air emissions. The operator of biogas plant must select a technique that is equivalent to the best available technique reference. The necessary steps are:

- regular maintenance of good technical condition of equipment
- sealing of the plants and the capture of waste gases
- effective use of raw materials and energy and other measures to improve the technological process
- covering outdoor storage areas and the use of partially or fully enclosed storage methods

- use of closed containers, tanks for transportation of raw materials
- manipulation of raw materials
- paths as short as possible
- arranged in a manner that prevents and reduces the diffuse emission to air
- etc.

In the case of using animal by-products for biogas production the operator must obtain a permit for processing waste from the Veterinary Administration of the Republic Of Slovenia (Ministry of Agriculture, Forestry and Food).

Operating Permit is the decision of the authority which issued the building permit on the basis of expert review. Expert review is necessary for permission to start operating the biogas plant. Request for issuing an operating permit shall contain the number and date of building permit data, data on the designer who prepared the project for construction and project work carried out and information on contractors who have built or renovated building for the biogas plant. Request for issuing an operating permit must contain a number of other project documents. The competent authority for the operating permit is an administrative unit.

The consent to electrical grid must be submitted in one of the companies for distribution of electrical energy (under the auspices of the Slovenian electricity distribution system operator SODO).

In the case that the owner of the biogas plant wants to sell produced electrical energy while receiving public assistance, the owner must submit an application for a declaration for a production facility and support. Biogas plant owners can choose between a guaranteed purchase price and operating support, which means the difference between production costs and market price of electricity for all net electrical energy generated. Based on the decision to grant such support, biogas plant operators will conclude an agreement with the Slovenian organizer of the electricity market - Borzen.

k) Sweden

Prior to building and operating a biogas plant in Sweden, special planning permissions and permits are required according to planning and environmental legislation and laws related to inflammable and explosive goods. There are guidelines for how to proceed in a publication called "Guidelines for operation of biogas plants BGA 2012" published by the Swedish Gas Association, Energigas Sverige.

In general the controls and inspections that must be made by authorities according to specific laws can be related to three different stages i.e. planning, construction and operation. The planning comprises even changes in an existing plant that require new permissions.

Following laws and authorities are related to the control of a planned biogas plant. The control is made by every authority separately. None of them are in charge of the overall control of the plant. The applicant is responsible to have all the permits needed. Following permits are usually required in the planning stage:

- Permit according to the Law related to inflammable and explosive goods (LBE) – granted by the Municipality concerned
- Planning and Building Act (PBL) – Application addressed to Building committee in the Municipality concerned
- Permit according to Environmental Code (MB) – Application to Environmental Committee, permit from County Council
- Permit according to a Law for Dangerous Chemicals (Sevesco) – Application addressed to County Council

In all operation that include gas, risk analysis according to LBE, AML (The Work Environment Act) and in some cases MB must be done when it comes to:

- Constructions of new plants
- Rebuilding of an existing plant
- Change in operations

I) UK

In the vast majority of circumstances, the land use planning authorisation would come via town and country planning legislation. It will be of key importance to determine at a very early stage whether or not a formal Environmental Statement will need to be submitted with the planning application. Such a statement is required where it is determined that an Environmental Impact Assessment will be necessary in compliance with the Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999.

Any development falling within Schedule 1 of those regulations will automatically require Environmental Impact Assessment (EIA), which is extremely unlikely for biogas plants. Schedule 2 of the regulations describes developments which may require EIA and it is rather more likely that a biogas plant proposal will fall for consideration under this section. "Schedule 2" developments include:-

- Industrial installations for the production of electricity, steam and hot water occupying more than 0.5 hectares
- Surface storage of natural gas or underground storage of combustible gases in a building or structure exceeding 500 sq m or lying within 100m of any controlled waters
- Gas pipeline occupying more than 1 hectare or operating at a pressure that exceeds 7 bar gauge
- Waste water treatment plants of over 1,000 sq m

Developments falling within one or more of the Schedule 2 categories must seek a screening opinion from the Local Planning Authority (LPA) as to whether EIA is required. If the view of the Planning Authority is that EIA is necessary then the developer must supply an Environmental Statement with the planning application. There is a right to appeal against the decision of the LPA.

The LPA is guided in its decision making by Schedule 3 of the regulations whilst schedule 4 provides guidance on the content of an Environmental Statement. It is considered to be worthwhile including the detail of the regulations in this document because there is a tendency for LPAs to call for EIA rather more often than is necessary. The regulations and the advice that accompany them make it clear that EIA is the exception rather than the rule.

Whether EIA is a formal requirement or not, the type of information required under the Regulations is likely to be requested by the LPA and developers should ensure that they submit it with the application or have adequate answers prepared should the questions arise. The information that is more specific to a biogas operation and likely to be required to satisfactorily negotiate a planning permission is:-

- detailed site plan
- plans, elevations and sections of the development
- full description of the processes
- description of the feedstock
- description of the solid and liquid digestate and the strategy for utilisation/disposal.
- estimated energy outputs and its utilisation.

- environmental advantages of AD – carbon emissions offset
- economic advantages to the area
- details of the safety regime and the strategy to avoid explosion
- details of all emissions even under worst-case conditions
- measures to avoid the release of odours
- noise minimisation technology and measures
- measures to avoid pollution to the air, ground and watercourses
- details of any off-site equipment that would be required
- details of any proposed mitigation measures

Many plants will require an Environmental Permit under the Environmental Permitting, England and Wales Regulations (2010). These regulations supercede the Environmental Permitting Regulations (2007) which replaced the Waste Management Licensing and Pollution Prevention and Control regimes that preceded them. Most AD plants are encompassed by the regulations because the current definitions of “waste” are wide-ranging and include most agricultural wastes. Whilst the regulator responsibility for the Regulations is split between the Environment Agency and the local authority, the Environment Agency will always be the relevant regulator for an AD plant. Unlike planning permission, where the permission goes with the land or building, the Environmental Permit goes with the Operator.

Operators should normally make a formal application when they have drawn up full designs but before construction work commences, however, as the requirements of an Environmental Permit can impinge on the plant design, early dialogue with the Environment Agency is advisable. Planning permission will be a pre-requisite for an Environmental Permit to be granted but the submissions can, to a large extent, run parallel to each other. In order to comply with the requirements an applicant must demonstrate that they fit with the following requirements:

- **Technical Competence:** Managers must have obtained the relevant Certificate of Technical Competence – this would usually involve training delivered by the Waste Management Training Board (WAMITAB)
- **Absence of Relevant Offences:** A license can be revoked if a license holder receives subsequent convictions.
- **Financial Provision/Security:** The applicant would need to demonstrate that it has sufficient finances to cover all eventualities that might arise as a result of failures etc.

It is possible in very large and complex cases that a permit would previously have been required under the Pollution Prevention and Control Regulations. Where such a permit has already been issued by the Environment Agency it automatically becomes an Environmental Permit.

Built into the Environmental Permitting Regulations is the ability of the Secretary of State, the Welsh Government and the Environment Agency to make “standard rules”. These have now been developed in respect of biogas plants and have simplified consenting procedures in respect of certain “standard” AD plants. Where these apply they significantly reduce costs to the plant operator and the time required to achieve award of Permit.

The Animal By-Product Regulations apply when a plant operator accepts feedstocks that could contain animal by products, e.g. municipal food waste & catering waste.

It is recommended that contact be made with the relevant local authority Building Control Officer in order to establish the extent to which the development will be impacted by the “Building Regulations”.

6. Components of a Plant

a) General information

An important issue is the full integration of the component parts in order that the system works efficiently, safely and as a reasonable “neighbour”.

The feedstock reception and processing facilities depend very much upon the nature of the operation and the type of substrate. Most biogas feedstocks have the potential to cause odour nuisances therefore the feedstock deliveries shall be handled correctly, probably happen within an enclosed space and often under “negative pressure”.

The digester is clearly the defining component of a biogas installation. It is critical that the digester is setup properly, maintained well and fed according to its design parameters and feedstock currently in use. It may be vertical or horizontal. Different materials are possible: reinforced concrete, steel, plastics, etc. Its size depends on the amount of substrate to be processed and the required retention time. The digester is for the constant production of biogas heated and equipped with an electric mixer (in some cases hydraulic mixing by means of pumps) and equipment necessary for removal of biogas. Often there is another post-digester. Additionally there is a storage tank for the digestate and often as well one for slurry storage.

The biogas is drawn off from the digester and as there is a theoretical potential for explosion because of an undue build up of gas/pressure as well as the ignition of the flammable gases, safety systems shall ensure that this does not happen. The gas storage may be an integral part of the digester, the post-digester and the digestate storage tank or a separate unit.

Where a significant quantity of hydrogen sulphide is anticipated to be produced within the digestion process, it is normal for the biogas to be cleaned prior to its utilisation.

All CHP plants are covered with the regulations on the field of mechanical engineering and the guidelines for the safety of machinery. Electrical generators are covered with the regulations on the field of mechanical protection and electrical regulations in the field against explosion and fire safety.

For the injection of biogas into the natural gas network it is necessary to remove carbon dioxide so that the biomethane contains about 98 % methane, while the rest are additions. The specific requirements are given by regulations or the gas grid operator therefore an early contact with the relevant grid operator is recommended.

Some examples for regulations that might apply:

- building regulations: e.g. digesters, tanks
- electrical regulations: electrical installations
- odour regulations: emissions into the environment from substrate treatment, digestion process, digestate treatment etc.
- guidelines for the safety of machinery (CE-marking and declaration of conformity for machines, devices and plant components), equipment and facilities (for example mechanical protection against persons falling into the basin, protecting against the dangers of electricity, etc.)

b) Austria

“Technical basis for the assessment of biogas plants in 2012” is a document regularly reviewed and updated by the Federal Ministry of Economy, Family and Youth. It is used by official experts when it comes to the technical evaluation of a biogas plant. The actual version takes into account current 6 demands (technology, processes, hazards, information on operation and maintenance, and a brief summary of the necessary approval documents and of relevant regulations and guidelines)

c) Belgium

The components of the plant are defined by the architect in accordance with the urban recommendation (permit). No specific regulations about construction and security exist for biogas plants. Anyway, the construction, operation and maintenance of the plant are subject to the local authorities recommendations about the security (DPA: authorization and prevention division, and/or fire department). The general work protection regulation and general electric facilities regulation must be considered. Before operating the plant, all the facilities must be controlled by a security representative of local authorities.

d) Croatia

Generally the applicable standards, norms and regulations as well as the practical aspects of the topics considered during the authorization procedure have to be considered.

e) Denmark

There are a number of components to any AD operation and each will require to comply with relevant standards and regulations.

Gas collection, control, storage and utilisation systems are designed in accordance with good engineering practice and, where appropriate, the technical and safety standards issued by the Danish Managing Regulative for Gasses (Gasregulativet), especially part B-4 (Bigger Gas fired Plants and B-41 Gas engines).

Good plant manufacturer’s designs are reviewed by a Chartered Gas Engineer.

There are exacting standards for bio-methane into the gas grid with only very low concentrations of gases other than methane allowed. The Department for Energy and Energinet.dk has produced a guide for producers of bio-methane into the gas network.

Should the gas be used to generate electricity then there are clearly important safety issues that need to be addressed with the generator itself and with the connections to the public network. Connections to the public network have to be undertaken by and through negotiation with the Energinet.dk.

f) France

There is no specific guideline or standard regarding the construction of a biogas plant. The construction of a biogas plant will have to be in line with the regulations: ATEX zone, fire fighting, animal waste storage... but also in line with the new orders/decrees concerning biogas (for installations subject to authorization or declaration) which impose technical and organizational requirements.

g) Germany

All parts have to be state of the art, concerning water protection even more than state of the art might be claimed. Concerning the individual parts there are different rules to be kept.

There are some technical requirements given in the Renewable Energy Act, e.g. new digestate storage tanks have to be covered gastight, a redundant gas utilisation facility has to be available in case that the CHP plant doesn't work anymore to avoid emissions. The grid operators must have the possibility to access the actual feed-in and to shut down the generator in cases of oversupply and so on.

Additionally there are e. g. DVGW (German Technical and Scientific Association for Gas and Water) regulations to be kept. They are not official laws or ordinances but the laws and ordinances refer to these regulations. There are requirements for components, requirements for the producers of these components and requirements for installers of these components and there are some requirements concerning the operation of these components.

Also some DIN or ISO regulations might be applicable as well as VDI directives (Association of German Engineers) or DWA directives (German Association for Water, Wastewater and Waste).

h) Hungary

Generally the applicable standards, norms and regulations as well as the practical aspects of the topics considered during the authorization procedure have to be considered.

i) Italy

Generally the applicable standards, norms and regulations as well as the practical aspects of the topics considered during the authorization procedure have to be considered.

UNI 10458:1995 - a specific norm for biogas plants - includes classification of plants, requisites, rules for the construction, offer, and start up. Because it has become inadequate for today's market it has been revised by a Group of researchers GC 904.

Progetto CTI E0209A420 defines classification of plants, requisites, rules for the construction, offer and start up of the plants for the production and use of biogas from anaerobic fermentation. This norm applies to any anaerobic digestion plant that use organic wastes such as biomass, organic wastes etc. It does not rule biogas captation plants from dumps.

Legislative decree 152/06 part V establishes limit values and monitoring frequencies

j) Slovenia

All system components must be designed and manufactured in accordance with standards and regulations in force in the country.

k) Sweden

Biogas plants can be designed in different ways. The design depends of the substrate used. AD plants can be very different. It is important to follow the legislation concerned. It consists of European decrees, national laws, regulations and standards. The rules and regulations are changing constantly. Up to date information can be found on each authority's webpage. The laws and authorities concerned are the same as mentioned in chapter 5 Authorization Procedure.

l) UK

There are a number of components to any AD operation and each will require to comply with relevant standards and regulations.

Gas collection, control, storage and utilisation systems are designed in accordance with good engineering practice and, where appropriate, the technical and safety standards issued by the Institution of Gas Engineers and Managers (IGEM). Good plant manufacturer's designs are reviewed by a Chartered Gas Engineer.

It is normal for the biogas to be cleaned prior to its utilisation. This process is designed to remove corrosive compounds of sulphur. It is clearly critical that this plant/process is notified as part of the authorisations for the operations and is noted as part of the pollution prevention measures.

If the gas is to be injected into the gas mains then the cooperation of the gas distribution network operator is required and early contact with the relevant organisation is recommended. Wales and West Utilities cover Wales and most of the SW of England whilst National Grid cover a very extensive area that includes the whole of the midlands. There are exacting standards for biomethane into the gas grid with only very low concentrations of gases other than methane allowed. The Department for Energy and Climate Change has produced a guide for producers of biomethane into the gas network entitled 'Biomethane into the Gas Network - a guide for producers'.

Should the gas be used to generate electricity then there are clearly important safety issues that need to be addressed with the generator itself and with the connections to the supply network (which could be "private wire" or the public network). Connections to the public network have to be undertaken by and through negotiation with the relevant electricity Distribution Network Operator.

7. Choice of Substrates - Input

a) General information

The main categories of substrates are:

- manure and slurry
- agricultural wastes, e.g. crop residues
- energy crops
- food leftovers
- biowaste from municipal household waste and from industrial waste
- waste from food processing industries
- sewage sludge
- etc.

b) Austria

In planning a biogas plant, the long-term availability of raw material at stable prices is crucial. In Austria, 75% of the raw materials are of agricultural origin. The biogas production takes place at 90% by agricultural small plants. This is one of the highest expenses for Austria's biogas plants. This concerns mostly plants operating with energy crops. Due to increasing food prices, suitable substrates for biogas plants like corn became more expensive.

c) Belgium

The substrate types approved for biogas process are mentioned in the environmental permit. All toxic organic matters are prohibited. Maize and grass grown on set-aside land are allowed.

No analysis is required for the owner's farm substrate. Substrate coming from others farm or industry must be mentioned in the environmental permit. Analysis of the content must be realized according to the permit and the Walloon waste office. The sludge from water treatment plant must be pre-treated by hygienisation before the digestion as mentioned by the waste treatment regulation. All over the digestion, the fermentation parameters (pH, T°, CH₄, CO₂, fatty acid, H₂S, H₂) must be reported.

All the agricultural exploitations settled in Walloon Region have to respect minimal norms concerning the storage of ranch effluent. So, storages of 6 months are required for the liquid effluents. The solid manure storages have to be dimensioned according to the type of manure produced. The Ministry of Walloon region imposes conditions of storage.

d) Croatia

Within the Energy Strategy of Croatia (OG 130/09) it is stated the aim of utilisation of agricultural resources with at least 20% of the total gross livestock units by 2020 in order to produce about 2.6 PJ of energy from biogas or about 100 millions m³ of biogas. Republic of Croatia will support production and utilisation of biogas, domestic production of biogas plants as well as implementation of distributed energy forms (to be utilised at the farm or at the local community) in order to take care of waste from agricultural production, saving GHG emissions and supporting development of agricultural husbandries.”

Therefore biogas potential stated in the Energy Strategy is based only on animal manure of 20% GLU and its inadequacy is proven already by practice. Namely, investors have already tapped more potential of biogas in agro-food sector through their investments than the Strategy delivers. From expert side and the fact that biogas is rarely based on monodigestion of manure, it is fair to assume that biogas potential stated in the Energy Strategy is at least three times larger than estimated.

Biogas potential from substrates deriving from wastewater treatment, landfills and waste management centers has not been evaluated so far. Croatia does not have set-aside land.

e) Denmark

The municipalities' responsibility is to ensure that household waste from private households is collected and processed in the most environmentally friendly way. All food waste is segregated. Private companies have a contract with the municipalities to collect the food waste and drive it to CHP where the heat is used in the district heating network. Some waste can be sorted and composted, so it becomes topsoil. Some municipalities have special bins for food waste. Then scavengers run this for composting or anaerobic digestion instead of burning it. There are not yet any food waste AD plants in Denmark.

Category 1 and Category 2 (except Digestive Tract Content) material from abattoirs cannot be processed via an AD plant and must be sent for high temperature processing but some of the material (Low Risk Category 3) is available. The waste from food processing including abattoirs waste is sent to DAKA there produce bio-ethanol. There are a number of other food processing operations that have the potential to provide significant feedstock for AD plants and, indeed, some of them now have operational AD plants of their own. There are a number of food processing operations, e.g. organic operations, that have enough potential feedstock to justify the construction of an AD plant but there are many more that could either cooperate with others or provide material to a third party facility.

The density of livestock across the project country varies quite significantly. All the pigs slurry is collected and about 80 % of the dairy farming slurry or manure are collected. The collection of slurries from housed animals is relatively restricted. AD plants utilising only animal slurries are not in the future economic profitable.

Most AD plants will use mixed feedstocks e.g. slurry, maize, grass and waste from food industry. Grass is used as part of a mix with other feedstock such as animal slurry and manure. The big AD plants are using sugar beet and straw. In 2011 and 2012 grass from roadside verges has been trialled at a small AD plant as a research trial.

f) France

There is an obligation for producers to sort waste at source and to recover bio-waste. In 2015, this requirement will concern producers over 20 tons / year.

g) Germany

For the use of all kinds of waste the Waste Recycling Act has to be considered. The new version of the law came into force in June 2012 and now digestate from manure is also considered as waste, before it was exempted as well as manure which still is exempted. Regarding the new Renewable Energy Act) biogas plants which utilise a share of 90% bio-wastes (only some biowaste with defined key numbers) receive a quite high feed in tariff of 16 €/kWhel (depending on installed capacity).

Another strong influence on the German biogas industry was the implementation of the energy crop bonus in 2004 which was increased in 2009. As a result of this a lot of plants, which are operating on field crops (mainly whole crop maize silage) were established.

In the new Renewable Energy Act (valid from 2012) the substrates are defined by two substrate groups with different bonuses. In general the bonuses for agricultural substrates are lower in the new law for middle size plants from 100 to 750 kW. Substrates that are not listed in one of the two categories gain the minimum tariff but no substrate bonus. Additionally there is now a restriction on the use of maize and corn silage, for new plants only 60 % is allowed. Recently the utilisation of grass and solid manure (especially horse manure) moved into the focus, research work in this field is actually going on.

Probably most wastewater treatment plants use the sewage gas to provide at least a part of their own energy demand, only few flare the gas without utilisation. It is expected that there will not be a significant change as most of the households are already connected to the wastewater system. The co-digestion of waste or remnants could be a possibility to gain a higher efficiency as most wastewater treatment plants have a higher digester capacity than they actually need.

On landfills both disused and operating the gas is also collected but as since 2007 only inert waste is deposited, the capacity of landfill gas will decrease within the next decades.

h) Hungary

The use of organic matter from animal husbandry (biogas) for energy purposes can enable productive waste management, increasing the competitiveness of the sector. The use of by-products and other solid wastes from agriculture and forestry (e.g. by-products from plough lands, cuttings from orchards and vineyards) for local energy purposes, and their conversion into end-products will result in additional income for farmers and producers and can significantly reduce the need of communities for fossil energy sources.

The most commonly used raw materials for biogas production are:

- Manure
- Whey
- Abattoirs waste
- Industrial organic waste
- Agricultural waste
- Source separated kitchen waste
- Commercial organic waste
- Sewage sludge

Biogas is currently produced at approximately thirty-five sites in Hungary, one part of which is based on agricultural by-products, while the other segment is represented by biogas plants connected to communal waste water treatment facilities. About thirty additional plants are currently under planning or construction. Hungary possesses excellent agro-ecological conditions for a competitive production of biomass. Hungarian agriculture is capable of sustainably producing biomass in excess of food and feed and at the same time, there is a significant biogas production potential.

i) Italy

In the case of wastes, the Legislative Decree 152/06 must be respected. The substrate will respect technical prescriptions in order to obtain maximum efficiency. The material will be evaluated by the regional administration during the authorization procedure. Those plants that produce energy and put in the net will obtain the Green Certificates (special incentives).

j) Slovenia

Biogas plants in Slovenia using a wide variety of substrates for biogas production. Slurry is still the basis of virtually all biogas plants; it is also used to stabilize the process of anaerobic decomposition. Levels of support for electricity produced from biogas impact on biogas producers to generally apply second substrate (primarily corn and grass silage) and the waste produced outside the farm. These wastes come from the food industry, public utilities, such as collecting food waste from households and municipal residues in the mowing area (sports grounds, parks, etc.). To achieve large quantities of biogas, energy crops are also used primarily corn silage but also sorghum, grass, etc.

Biomass for biogas production is divided into:

- B1: Energy crops or non woody plants grown solely for energy purposes
- B2: Biodegradable fraction of products, residues and waste
- C1, C2: Biodegradable municipal and industrial waste

For new biogas plants the quantity of corn silage is limited up to a 40 %. Some biogas plants also use substrates which origin is not from agriculture, so these plants can only conditionally be classified as agricultural. In some biogas plants also is in use glycerine (which is added to the principal substrate for better yield of biogas). The owners of biogas plants have a contract for glycerine (a by-product of biodiesel production) with the Slovenian producer of biodiesel fuel. In the future we see as an attractive alternative use of the plants from areas contaminated with heavy metals (soil ecoremediation crops for energy purposes), for treatment in biogas plants. The use of mentioned plant materials does not conflict with food production.

Where manure and slurry represent annually more than 30% of the volume of substrate for obtaining biogas, the RES generating plant shall be eligible to a supplement of 10% of the operating support for this RES generating plant. Where manure and slurry represent annually more than 70% of the volume of substrate for obtaining biogas, the RES generating plant with a nominal electrical capacity of up to 200 kW shall be eligible to a supplement of 20% of the operating support for this RES generating plant.

k) Sweden

1.4 TWh of biogas is produced annually in Sweden at approximately 230 facilities, half of the production is from wastewater treatment plants. New biogas plants are mainly co-digestion plants and farm plants. There is a large potential to increase the Swedish biogas production as biogas can be produced from various types of substrates that are currently treated as residues or waste. Agricultural residues represent the greatest potential resource. The theoretical potential biogas production in Sweden has been estimated to be more than 15 TWh/year, which is around ten times more than the current production.

The substrates that are used today for the production of biogas are:

- Sludge from wastewater treatment plants
- Industrial waste and residues
- Agricultural residues and manure
- Food wastes
- Wastes from parks and gardens

Biogas can also be produced from crops. This potential is difficult to estimate and depends entirely on which assumptions are made regarding the land use, crop and yield. If 10 % of the agricultural land in Sweden is used, approximately 7 TWh of biogas could be produced annually.

Studies are also made to find new substrates that can be used to produce biogas such as alga, fish gut and clams.

I) UK

Local authorities in England and Wales are in charge of the collection and disposal of municipal waste. In the Welsh part of the region the local authorities are unitary and therefore undertake both functions but in the English counties, the district councils collect the waste but the county councils are responsible for disposal.

All the local authorities in Wales are being encouraged by the Welsh Government to collect source-segregated food waste from the domestic stream and a series of consortium-based procurement processes are in place across Wales to secure a series of AD municipal food-waste processing plants. Many local authorities have already introduced food waste collections but none of the material currently is taken to a digester in Wales. In Wales, two AD plants digest commercial and industrial wastes and another three are dedicated to agricultural residues. There are also a number of sewage sludge digesters. Some local authorities in England are collecting food waste and sending it to AD plants but this is not yet the norm. There are not yet any food waste AD plants in Herefordshire or Gloucestershire but a new plant has recently been commissioned in Wiltshire.

The availability of segregated food waste from the domestic waste stream is growing steadily as more and more waste collection authorities implement segregated food waste collection. Most of the Councils in Wales now undertake such collections for at least part of their population and the number in England is steadily growing. Where Council's co-collect food waste with garden waste then the AD route is largely barred unless expensive separation technology is introduced. Food waste from restaurants, canteens, schools, hospitals, care homes etc is, however still potentially available and often collected outside of the municipal arrangements.

Waste disposal authorities must satisfactorily treat waste before it enters a landfill site. If this can be accelerated and undertaken within an AD plant then this requirement is met. There is only limited experience of such residual waste AD plants in the UK at present but the "dry" AD systems recently developed in Germany appear to be of considerable potential.

Category 1 and Category 2 (except Digestive Tract Content) material from abattoirs cannot be processed via an AD plant and must be sent for high temperature processing but some of the material (Low Risk Category 3) is available. Whilst there are currently abattoirs within and adjoining the project region that could be a source of suitable feedstock, the apparent uncertainty in the meat processing industry would be a cause for concern for any biogas developer.

The density of livestock across the project region varies quite significantly. The real opportunities for larger quantities of slurries arise in areas where dairy farming is common or where there are intensive pig or poultry units. Whilst these are largely concentrated in the English part of the region, there are also opportunities in Wales – particularly Carmarthenshire and Pembrokeshire.

AD plants utilising only animal slurries are perhaps less likely than those accepting mixed feedstocks but there still might be operations that revolve around the waste arising from within a single agricultural unit.

Whilst the growing of crops especially for digestion is reasonably commonplace in Germany at present, and there is some such production in the UK, it would appear not to be a favoured option from government in England and Wales. Most of the plants where energy crops are utilised do so as part of a mix with other feedstocks such as animal slurry. Grass and maize silage are perhaps the most likely energy crops and indeed, grass from roadside verges has been trialled at a small AD plant in Powys.

AD is now the preferred method of treating sewage sludge within the UK and there are digesters on waste water treatment plants throughout the country.

8. Gas Utilisation - Output

a) General information on options of use

There are different kinds of utilisation possible.

- Biogas for heat production only: The biogas can be burnt in a boiler which in most countries might not be as economic as electricity production due to feed-in tariffs for electricity from renewable resources.
- Biogas for electricity and heat production in CHP plants: The probably most common utilisation for biogas.
 - The CHP plant can be operated with focus on electricity production, that means it is working twenty-four seven. The heat is a "waste product" that can be used for example for district heating, but often is not used, which reduces the efficiency of the plant. This is more common than the other possibilities.
 - The CHP plant can be operated with focus on heat production, that means it is working only when there is heat demand. The electricity is a "waste product" that can be used by the CHP plant operator himself or fed into the public power grid.
 - The CHP plant can be operated with focus on peak electricity production, that means it is mainly working in times of high demand to gain high electricity prices. The heat is a "waste product" that can be used, but as the supply is irregular this might be a problem if there is no other heat supplier. The problem in this case is, that you might need a significantly larger gas storage which is expensive or you need to adjust the digestion process which is at the moment is hardly feasible.
- Biogas upgrading to biomethane and injection to the grid: There are several technologies available and it is more and more common. It offers the possibility to use the natural gas grid as gas storage. But not all countries allow this at the moment.
 - Biomethane for heat production only: see above
 - Biomethane for electricity and heat production in CHP plants: see above
 - Biomethane as vehicle fuel: This is done in Switzerland and Sweden since the 1990s and has been getting more and more attention in the other European countries for the last five years. The upgraded biomethane can be used in natural gas vehicles without any technical adaptations.

b) General information on the promotion

For the promotion of electricity from biogas there are different systems available. There are fixed feed-in tariffs and green certificates which sometimes don't have a fixed price. Furthermore there are large differences between the amounts that are paid and especially if there is no fixed price the biogas plant operator has only little planning certainty.

- feed-in tariff: Austria, Croatia, Denmark, France, Germany, Slovenia, UK
- green certificates: Belgium, UK

The time frame the remuneration is paid varies a lot:

- 20 years: Germany, Italy, UK
- 15 years: Austria, France, Hungary, Slovenia
- 14 years: Croatia
- 10 years: Belgium

An Europe-wide trade of electricity from renewable energy sources seems to be far away as not only the system, the duration and the amount of promotion differ but also the technical requirements. For example in some countries the power grid operators don't have an obligation to connect the biogas plants to the grid in others they are obliged to connect. And even much more complicated is it for biomethane as there is no common standard for the biomethane itself.

For the promotion of biomethane hardly no regulations exist. Germany and Austria gain a bonus for electricity from biomethane. UK has a feed-in tariff and France recently introduced a feed-in tariff. Several other countries allow the biogas upgrading and injection of biomethane but so far don't have feed-in tariffs..

c) Austria

The utilisation of biogas for electricity and heat production in CHP plants represents the state of the art.

The green electricity Act is the base of Austrians green energy governmental support system. Producers sell their green electricity to Clearing and Settlement Agency (OeMAG). Smaller plants generally are remunerated at a higher rate than larger ones. In a further step, the OeMAG sells the Green electricity to the individual traders who have to buy the power to transfer pricing. The system is financed by the transfer price paid by the retailer to the OeMAG and by the end user who has to pay a flat rate for the smart meter. In July 2012, the new Green Electricity Act comes into force. From 01.07.2012 the feed-in tariff should be prescribed accordingly. The details of this regulation are currently (23 April 2012) not known. Accordingly, the economic design of biogas plants is difficult to estimate. The initial strong growth has fallen due to falling feed in tariffs and rising raw material prices (corn). By the end of 2011 there are 360 biogas plants feeding as recognized green power plants with a total capacity of 102.59 MW in the Austrian electricity grid. Of these, 289 systems (79.2 MW), a contract with the OeMAG completed and received by the legally mandated green electricity tariff. 2010 were 539.47 GWh of green electricity from biogas is fed into power grid.

For feeding biogas into the national gas grid the required quality criteria of gas must be fulfilled. Thus, the variable quality of the biogas is a technical challenge. Continuous liberalization of the Austrian gas market and the resulting law for feed in specify the legal and economic conditions The feeding of biogas into the natural gas grid and a common combustion/utilization in large plants enables more efficient utilization of biogas in large CHP plants. High electrical efficiency (> 50%) is possible. In 2005 the first biogas treatment plant for public supply network feed was put into operation. In 2011 there are 10 plants that produce biomethane.

The Directive ÖVGW G31 contains combustion characteristics which are based on imported gas (in Austria the high quality natural gas from Russia) and must be fulfilled for feeding. Gas from regenerative processes must fulfill additional requirements, regulated in the Directive ÖVGW G33

d) Belgium

The heat supply from biogas plant to buildings around the farm is not submitted to specific regulations except of the urban permit concerning the distribution facilities. The tariff is decided by the seller.

A supply license is required to sell electricity according the decree of 12 April 2001 related to the electricity regional market organisation. For connecting to the grid, the authorization depends on the agreement of the local/regional electricity supply company based on a feasibility study concerning the local grid capacity, the voltage, the situation, and the facilities. The connection must follow the technical recommendations of Synergrid. The cost of the connection is very high and totally in charge of the owner of the plant (around 25 000 to 50 000 €, in medium voltage for a farm unit).

In Walloon Region, a green certificate system is in operation since the 1st October 2002. A green certificate is a transferable certificate issued to producers of green power for a number of kWh generated which is equal to MWh divided by the carbon dioxide saving rate. This saving rate is calculated by dividing the carbon dioxide gain achieved by the system under consideration by the carbon dioxide emissions of the traditional reference electric system (steam and gas turbine) defined and published annually by the Walloon Commission for Energy. The carbon dioxide emissions are those generated by the green power generation as a whole and include fuel production, emissions during combustion if applicable, and waste processing if applicable but also the transportation of external wastes or fuel consumption for energy crops. The price of Green Certificates is guaranteed at a minimum price of 65 €/GC.

Until now there is no biogas upgrading and injection implemented Belgium. However, the legislative framework in Wallonia for the natural gas network was expanded to the use of gas from renewable sources. In addition, technical specifications determining the technical characteristics of biogas can be injected into the natural gas grid were published by Synergrid in December 2010. Moreover, the Walloon government has legislated a model of support: GAZ transferable guarantees of origin. This system is similar to the mechanism of green certificates. Biomethane as fuel is not yet implemented in the Walloon region, no framework is established.

e) Croatia

The Law on Electricity Market provides legal base for five sub-laws describing RES-E&CHP (Tariff system for the production of electricity from renewable energy sources and cogeneration, Regulation on the fee for the promotion of the electricity production from renewable energy sources and cogeneration, Ordinance on the usage of renewable energy sources and cogeneration, Regulation on a minimum share of electricity produced from renewable energy sources and cogeneration in the electricity supply and Ordinance on the obtaining of the eligible electricity producer status), it's the only law that has implementation acts in force. Market Operator announces the amount of tariff item for a specific year. Feed-in tariff for biogas differs according to the size of the plant and by substrate. Actually is under revision the Regulation on Incentive Fees for Promoting Electricity Production from Renewable Energy Sources and Cogeneration.

The operating agricultural biogas plants eligible for FiT sell total electricity produced to the grid and gain FiT while electricity demand of the process and the plant is purchased from the grid. Currently, this practice is under discussion at the Croatian Regulatory Energy Agency (HERA) and will most likely end up in purchasing net electricity from biogas.

Technical regulations are determined by the Croatian electricity provider (HEP) that also determines access to the grid. The eligible producer status approves Croatian Regulatory Energy Agency. Power purchase agreement is signed with Croatian Energy Market Operator (HROTE). The investor is responsible for building the sub-station under the technical conditions determined by HEP. The substation becomes HEP's property.

The Law on Production, Distribution and Supply of Thermal Energy states that the construction of a cogeneration unit shall have priority in the selection of proposed energy projects and in deciding on the construction of energy units. There is no special stimulation to use heat from biogas either as a condition to be eligible for electricity subsidies or special conditions.

The Law on Natural Gas Market stipulates that rules of this law and related sub-laws apply on biogas, gas from biomass and other types of gases if those types of gases meet technical and safety standards for transportation via grid. Biogas is equally treated as natural gas if technical characteristics of natural gas are reached but so far there is no current biogas feeding into the grid.

The Law on Biofuels in Transport recognises biogas as a type of biofuels, but, to the difference of biodiesel and bioethanol, it does not have a defined subsidising (purchasing) price. There is no current use of biogas as biofuel.

f) Denmark

The Danish government has since 2008 market supported mechanism for larger renewable electricity production from AD plants. The support is 0.77 DKK per Kwh in 2009. The grant is index linked each year and in 2012 the price is 0.79 DKK per Kwh with an engine power of 35 %. The grant is paid to the AD plants.

Should a gas pipeline or heat main from the AD plant be considered, then it would clearly be necessary to come to an early agreement with the owners of any “third party” land to be crossed. Most of the gas pipelines in Denmark are owned by the Danish state/DONG Energy, Energinet.dk or private gas companies as Naturgas Fyn and HMN, which is a company owner by 27 municipalities.

Combined heat and power (CHP) is an attractive option in that it combines the production of renewable electricity, and thereby income from marked support from the Danish state, with the productive use of the heat that is an inevitable by-product of the power generation process. The key, however, is the identification of an appropriate heating/cooling load and therefore the ability to attract additional income from energy sales.

In the Danish case the natural gas that is supplied from the north has a very high quality and heating level, so propane might have to be added to biogas in order to maintain the same quality and heating level as in natural gas. This option has only been implemented in one case in Denmark, but might be a future option if subsidies are provided for this logistic and use of biogas. The Danish self-supply from natural gas resources has just ceased and the decline has started, but it is very difficult to predict the production for the coming years. The parliament has not yet decided to support upgrading and injection into the grid. It is not necessary to be within few kilometres from the gas main thus extension of the main with a biogas collection grid is an option. Early discussions with the gas network operator are recommended which is Energinet.dk as the national operator and HMN Naturgas, Naturgas Fyn and DONG Energy as regional gas operators are relevant in the central and north region of Denmark.

Denmark does not use methane as transport fuel. Utilising a cleaning process similar to that required for injection into the gas main, biogas can be converted to a transport fuel. In the 70s there were many cars in Denmark using methane gas as fuel but settled slowly and completely disappeared in the early 1980s. In 2012 a municipality in Fyn started using methane as fuel to 14 of their cars. By far the most likely scenario for this utilisation would be where there is a captive fleet of vehicles or possibly a public bus fleet e.g. in Sweden today. The big cars companies are producing cars using gas as fuel. In the future it would be important that the projected output of the AD plant matched reasonably well with the demand for fuel. Storage of the bio-methane is very expensive but it is equally important that there is always sufficient fuel available to the captive fleet. This would be a difficult balance to achieve unless the transport fuel option is run in parallel to a main gas operation.

g) France

In 2011, the feed-in tariff for electricity produced from biogas has been reassessed. This has permitted to reduce the size of the farm-scale plants projects with the need of less external substrates on the farm.

At the end of 2011, regulations finally allow the injection of bio-methane into the gas network; a feed-in tariff has been fixed as well as a guarantee of origin. The injection of gas produced from water treatment plant is still not permitted; the notice/recommendation of ANSES (French Agency for Food, Environmental and Occupational Health and Safety) is expected during 2012.

h) Germany

Biogas is most likely used for the production of combined heat and power due to the feed-in tariffs. For electrification usually a piston engine is used. Lately some plants are trying a turbine or fuel cell but it is not very common so far. The Engines are usually specified for maximal full-load hours. In the new renewable energy act 2012 the production flex-load energy is promoted by additional instruments.

Generally the utilisation of biogas is promoted by fixed feed in tariffs that are content of the Renewable Energy Act (EEG). In the past the EEG basically consisted of a basic feed in tariff and additional bonuses (e.g. for using energy crops, or utilisation of heat, etc.). In the EEG, that is valid from the beginning of 2012, most of the requirements that were rewarded with bonuses before are now compulsory (e.g. heat utilisation). There is only a basic tariff and an additional substrate bonus. With that the substrates can be mixed regardless whether they are waste or energy crops. Small scale installations up to 75kW electrical capacity and utilisation of minimum 80% of manure, will receive 25ct/kWhel. as an extra class of biogas plants. Also there is a special category for biowaste plants.

For the connection to electric grid renewable energy plants are treated preferential. The grid owner is obliged to purchase all electricity from the RE-plant (as long as it is technically feasible). The plant operator is obliged to install a remote - control to make the grid owner able to partly shut down the engine in times of grid-overload.

In the old legislation (before 2012) for the utilisation of heat a bonus was given. In the new law (EEG 2012) it is obligatory to utilise 60% of the heat of the CHP-Engine. 25% can be calculated as digester heating. So another 35% of the heat needs to be used, there are some requirements given in the Renewable Energy Act. It has to be mentioned that many existing plants especially around 200-300kW have no sufficient heat utilisation. Only the small scale installations up to 75kW electrical capacity with utilisation of minimum 80% of manure don't need heat utilisation.

The goal of the German federal government is to contribute around 10% of the natural gas supply by biomethane until 2030. Therefore the feed in of biogas into the natural gas grid needs to be considerably increased. At the moment there are about 80 biogas upgrading plants. The legislative support has been increased in the EEG 2012. To avoid misunderstandings it has to be made clear that not the feed in of biomethane into the gas grid is rewarded by a fixed feed in tariff, but the electricity derived from (virtual) biomethane taken of the grid, therefore the complete heat has to be utilised according to the Renewable Energy Act.

To feed the biomethane into the gas grid the same quality as in the local grid has to be achieved. Gas is generally categorized into H(igh) and L(ow) caloric gas. There are different configurations of gas into the German grid depending on the origin. The quality parameters are defined in the technical regulations of the DVGW (German Association of Gas and Water Works) and specified by the local grid operator. For the feed in quality the data-sheets G260 and G262 are relevant.

Analogue to the electricity grid owner the gas grid owner has to offer access for biomethane to the grid, but the gas grid operator doesn't have to buy the biomethane. According to the latest version of the gas grid access ordinance the grid owner has to pay 75% of the grid connection. This includes connection to the grid, devices for odourisation and adding of propane to raise the heating value as well as the running costs. It has to be mentioned that this fact very often leads to a lack of cooperation in biomethane projects by grid operators. It has therefore to be negotiated at an early stage of the project what the attitude of the local/regional gas grid operator towards biomethane is like.

In Germany there are currently around 90.000 natural gas vehicles and around 900 filling stations for natural gas. Around 200 stations offer biomethane in a mix between 10 and 50%, in mid 2012 nearly 80 filling stations offer 100 % biomethane, mostly sold from the bioethanol producer VERBIO. Unfortunately the advantages of natural gas/biomethane in traffic are hardly known to the general public. In the freight sector the use of dual-fuel-vehicles might make sense in the future to achieve lower emissions. By now there is no legislative framework for these engines implemented. Therefore no general type registration (only individual registration) is possible.

The sale of biomethane as fuel is either free of energy-tax or the biofuel-quota can be sold to mineral oil companies to gain extra income. For the biofuel quote it has to be proven that it has been produced sustainably.

i) Hungary

Waste produced and stored should be considered a valuable asset rather than an issue, and its treatment waste asset management, which can have a significant impact on job creation, on the revenues of the environmental industry and on employment. In the case of EOP (Environment and Energy Operational Programme), the impact of the aid scheme is measured using indicators (e.g. electricity generation from renewables in GWh/year; reduction in the emission of greenhouse gases in kt/year, etc.), the targets for which are set forth in the Operational Programme and the Action Plans. It is expected that, as a result of the NHRDP (New Hungary Rural Development Plan) schemes, the number of biogas plants attached to livestock holdings could increase significantly; numerous low capacity biofuel plants could appear; and the farming of ligneous or herbaceous energy crops could become more widespread. In many cases the purchase price of green electricity under the mandatory off-take scheme does not produce returns within reasonable time unless the "waste heat" generated during biogas production is utilised.

The measure is of a legislative nature, and is currently based on the following laws:

- Act XL of 2008 on Natural Gas Supply
- Government Decree No 19/2009 (I. 30.) on the

The Hungarian gas network infrastructure is extremely advanced and reaches almost all settlements; its coverage meets the consumers' demands. The system operators carry out a ten-year survey of demands every year, and decide on the development of capacities. Standard biogas equivalent in quality to natural gas can be fed into the system, and therefore it is not unreasonable to establish parallel systems. Taking this into account, the measures of the upcoming period must include a review of the feed-in conditions laid down in Act XL of 2008 on Natural Gas Supply (gas equivalent in quality to natural gas, network access, the detailed rules of a off-take support system to facilitate the use of gas equivalent in quality to natural gas).

There is only one plant in Hungary which produces biomethane. It is the The Zalavíz Waterworks Company, a wastewater plant. This is the first bio-methane filling station in Central and in Eastern Europe.

j) Italy

From 9 biogas plants in 2005 the number increased up to 176 biogas plants in 2010. The biogas produced can be used for the production of energy, with the acquisition of Green Certificates. There are also other kinds of incentives, the TEE are granted to certify energy consumption reduction and energy efficiency.

The biogas produced can also be used for heat production both for self production inside the companies and in district heating system. To be connected to the grid the owner has to present a request, according to the Electric Energy Authority normative n.281/05 to :

- Terna if the connection power is ≥ 10 MVA
- other local distributors such as ENEL if the power is < 10 MVA.

The procedure is ruled by normative DK5310 which establishes also timing and contract conditions.

The Lgs. D 164/2000 and L. 81/2006, respectively, provided that the rules on access to the gas market are also applicable to biogas and gas from biomass and from 1st January 2007 a minimum proportion of biofuels and other renewable fuels derived from biomass, must be placed in the conventional fuels used for transport. At the moment in Italy it is not possible to use biomethane for transport or for the injection in the grid as there are no specific technical and administrative rules so far, but the L. decree 28/11 foresees the future coming into force.

The new Decree DM 06/07/2012 foresees the incentives for electricity production from renewable sources plants that are new, rebuilt or reactivated with no less than a 1 kW and that will start operation after 31/12/2012.

Biogas plants up to 100 kWe access directly the incentives, while the plants up to 5 Mwe access the incentives after signing in a specific register. For the plants > 5 MWe, the person in charge of the plant must take part in public bids for tender.

k) Slovenia

Since 2009 there are new support schemes for electricity produced from renewable energy sources (valid from 1st November 2009).

Currently biogas is in most cases only used to produce electricity and heat in cogeneration. The amount of heat generated in cogeneration unit is greater than electrical power, but it is also used to a lesser extent (only a small number of biogas plants sells heat to third parties). There are some cases where the thermal energy is used for process purposes. In cogeneration process, the use of heat is very important for the economic viability of the project, especially because it is sometimes difficult to spend all the heat on the biogas plant and other facilities on the farm.

Sales of heat needed to make the project viable, and sometimes requires the construction of district heating, which means additional costs for owner of biogas plant. This investment should be supported by the municipality. Moreover, mobilization of local authorities is important for the general benefit of local communities, so that the developer is not the only one who is responsible for this service (heating).

Where the annual useful heat deployment exceeds 15% of the input biogas energy, the RES generating plant shall be eligible to a supplement of 10% of the operating support for this RES generating plant. Heat from biogas plants used for obtaining biogas shall not be deemed to be useful heat.

In Slovenia from January 2012 started use of methane for transport but at the moment there is no use of biomethane for gas in grid injection or vehicle powering. The use of biomethane for vehicles in near future will not have greater impact, except for public transport vehicles.

Greater opportunity is also for the use of biomethane-powered tractors and other agricultural machinery on farms. Law on Excise account biogas as a biofuel, which are exempt of taxes.

Biogas can be fed into the network of natural gas if the needs of the network will be satisfied. There are two options: connection to the national network operated by a company Geoplín or connection to the distribution network, which operates several distribution companies. These networks have different characteristics. In both cases it is necessary to obtain the company to connect and become a gas supplier.

l) Sweden

Typical applications in Sweden include:

Heat utilisation: The gas is combusted in a boiler. The heat generated warms up water which can be used to heat the digester and nearby buildings or be exchanged on a local district heating network.

Heat/Power: Biogas can be used as a fuel in stationary engines, typically Otto or diesel engines, or gas turbines.

Vehicle fuel: Water scrubbing, chemical scrubbing and PSA are the most widely used techniques for upgrading biogas to vehicle fuel quality. The gas must also be odourised and pressurised to around 200 bar before it can be used as vehicle fuel. Due to the dependency of fossil fuels in the Swedish transport sector, utilisation of biogas as vehicle fuel has gained large interest during the last few years. Today, it is a mixture of natural gas and biogas that is sold as vehicle fuel of which biogas comprised 62% by volume in 2011. Both the biogas volume used for vehicle fuel as well as the number of vehicles that are able to use biogas as a vehicle fuel has increased considerably during the last few years. Today there are about 40 upgrading plants in Sweden producing vehicle fuel.

Upgraded biogas can also be introduced into the national gas grid, which will stimulate the development of new markets and applications.

m) UK

Electricity produced from biogas (except for biogas produced from sewage sludge) is eligible for “double ROCs” or Feed-in Tariff and a producer is thereby receiving an income very significantly higher than the value of the power sold. ROCs (Renewable Obligation Certificates) represent the current UK government market support mechanism for larger renewable electricity production plants and their value depends upon the requirement of the electricity supply industry to include a minimum percentage of renewable energy in its sales, or effectively pay a fine for under-performance. ROCs are a market based mechanism with no guarantees as to their value over time. The more recently introduced Feed-in Tariff provide a guaranteed price for all of the generated electricity for 20 years and is index-linked.

A very significant consideration at the stage of planning of a biogas project is the capacity of the local network to accept the anticipated production and the cost of connection. The only really secure way of calculating this cost is via direct contact with the Distribution Network Operator (DNO) for the area concerned. For northern Wales this is SPMANweb and for southern Wales, Gloucestershire and Wiltshire, it is Western Power Distribution. The DNO covering Herefordshire and a very small part of mid Wales is Central Networks.

There is some requirement for heat in the digestion process itself and this is best supplied by utilising some of the biogas. Should a private gas pipeline or heat main options be considered then it would clearly be necessary to come to an early agreement with the owners of any “third party” land to be crossed. The Renewable Heat Incentive has recently been introduced and will provide revenue support for heat from biogas but only up to 200 kWth and the heat used to keep the digester at the correct temperature is specifically excluded from the payments.

Combined heat and power (CHP) is an attractive option in that it combines the production of renewable electricity, and thereby income from ROCs or FiT, with the productive use of the heat that is an inevitable by-product of the power generation process.

Biomethane can be injected into the gas grid and sold anywhere that is grid connected. This option has been implemented in a very small number of cases in the UK but it is heavily supported as a means of reducing the UK's increasing dependence on imported gas. The cost of the equipment required for the gas processing operation is still high, however the standards laid down for the quality/purity of the gas and the cost of the equipment required to monitor gas grid injection are the primary technical and economic barriers in the UK. The Renewable Heat Incentive pays a premium for each kWh of gas injected into the grid and thus has significantly improved the financial case for this option. It is clearly necessary to be within reasonable distance of the gas main and early discussions with the gas network operator are recommended. In the case of the region directly under consideration, the relevant operators are Wales and West Utilities and National Grid.

Methane is already in use as a transport fuel in the form of compressed natural gas and rather more usually liquefied natural gas. There is a mechanism for supporting the utilisation of biomethane as a transport fuel through the Renewable Transport Fuel Obligation (RTFO). This operates very similarly to the ROCs system with the relevant target for fuel suppliers being 10% by 2020.

Where biomethane is to be used as a vehicle fuel it is important that there is always sufficient gas storage available to meet the fuel demand. This can be a difficult balance to achieve unless the transport fuel option is run in parallel to a mains gas operation. Spare gas could be injected into the mains and any under-provision could be purchased from the mains. An alternative might be to deliberately under-size the AD output with the remainder of the gas purchased from alternative sources. The conflict between the RTFO and RHI financial support mechanisms would suggest that all biomethane is injected into the grid and any used for vehicle fuel is taken out again without the ability to claim RTFCs. There is bio-methane in use as transport fuel in the UK at present but most, if not all, is derived from landfill gas.

9. Utilisation of Digestate

a) General information

Both the liquid and solid digestate has potential value as a bio-fertiliser, displacing the use of mineral fertilisers. For every tonne of mineral nitrogen displaced there is a potential reduction in carbon dioxide emissions of 2.3 tonnes with the equivalent figure for phosphate fertilisers being 1.1 tonnes. The majority of the phosphate content is usually within the solid fraction of the digestate. The carbon reduction arguments are supplemented with cost savings to the agriculturalist – the cost of mineral fertiliser is soaring.

Great care will always need to be taken in the timing, methodology, practice and spreading rates when applying the fertiliser/digestate. There is usually likely to be the requirement for storage capacity for at least 6 months production of digestate but even if not required by license or legislation, digestate should only be applied when weather and soil conditions are appropriate. Spreading digestate when plants are not in a position to take up the applied nutrients immediately is wasteful and potentially polluting.

Digestate must not be agitated (eg by spraying) during application and thus it is best applied by either direct injection into the soil or by trickling it onto the surface. To do otherwise, would see the release of compounds of nitrogen, such as ammonia, into the atmosphere, seeing a loss of nutrient value to the soil, odour nuisance and atmospheric pollution. Within Nitrate Vulnerable Zones the limits for the spreading of organic manure (which would include digestate) are 250kg of nitrogen per hectare per year for grassland and 170kg of nitrogen per hectare for arable land.

The solid digestate from AD installations can also provide a soil conditioner benefits due to the residual organic carbon content. Where the feedstocks can be demonstrated to be free of contaminants this product can be utilised in circumstances where food-crops are involved. Lightly contaminated feedstocks will give rise to a solid digestate that would be suitable for use in the cultivation of non-food crops. Some feedstocks will only provide a digestate suitable for daily cover on a landfill site or combustion. In some circumstances it may well be necessary to provide a further period of aerobic composting in order to comply with “Landfill Directive” requirements for the treatment of bio-degradable waste.

b) Austria

All fermentation residues must be declared by law to be waste. The residue loses this property as soon as it has been subjected to its concrete and approved recovery. As part of a waste management concept, the recovery measures for authorizing are listed. The recycling is, according to the hierarchy of waste management, prior before thermal utilisation. In Austria the path of recycling is direct spreading or the production of compost in the form of biogas slurry. The direct spreading may only be applied, if as raw material only energy crops, manure and waste from the key number 92 are used, and is performed the yield according to the recovery operation R10 "Land treatment resulting in benefit to agriculture or ecology" Fermentation residues are fast-acting fertilizer, and comparable in their effect with pig and cow manure. Basically, in the agricultural utilization of the fermentation residues the provincial law of soil protection and the regulations of the Water Rights Act (e.g. Action Plan 2008 - nitrate) must be observed. Sewage sludge is also used as a substrate for fermentation, then, the soil conservation regulations for the application of sewage sludge for the fermented substrates apply correspondingly. For the production of compost may only be used fermentation residues resulting from the use of energy crops, manure and residuals listed in the fertilizer regulation. Another way to use it would be to bring it into circulation as biogas slurry according to fertilizer regulation.

c) Belgium

The use of digestate is allowed only if there is respect of the norms. If not, the digestate must be destroyed by incineration, co-compost or used as landfill or industrial wasteland cover. If the digestate characteristics are conform to the norm, the farmer receives a use certificate guarantying the quality of the output product and its utilisation in agriculture. The analysis must be carried out twice a year. The legislation about this certificate is in the AGW of 14 June 2001. The spreading on the agricultural land can be done only in respect with the Nitrogen Directive. Before the spreading of digestate, a comprehensive soil analysis must be carried out. The necessary data are the percentage of organic matter, of minerals and of heavy metals.

The AGW related to the sustainable management of nitrogen in agriculture does not allow the spreading of fertilisers if it is only to cover the physiological needs of nitrogen of plants, attending to limit the waste nutritive elements. Maximum amounts of spreading nitrogen are defined. The limits are fixed in step with the type of affection of lands profited by fertiliser contributions, with the geographical situation of lands and with the integration or not of farmers in a Quality Approach. In the same way, the maximum amounts of fertilisers vary in function of the situation in a vulnerable area, in a zone which is submitted to particular environmental constraints or elsewhere in Walloon. According to the type of manure and soil cover, there are periods when fertilization is prohibited.

d) Croatia

Special properties of biogas plants related to the substrate and digestate are determined in Croatia by Regulation on management of sludge from waste water treatment facilities when the sludge is used in agriculture; regulation on protection of agricultural land against pollution of various matters. Regulation on good agricultural practice on manure utilisation determines non-spreading periods for special types of crops and soils. In general, spreading of slurry is prohibited from 1/12 to 1/3 and, without inserting in the soil from 1/5 to 1/9. Manure spreading is prohibited 1/5- 1/9. Minimum storage requirement is 6 months.

e) Denmark

Both the liquid and solid digestate have potential value as a bio-fertilizer, displacing the use of mineral fertilizers. The majority of the phosphate content is usually within the solid fraction of the digestate. The carbon reduction arguments are supplemented with cost savings to the agriculturalist – the cost of mineral fertilizer is soaring.

In Denmark the digestate is regulated in connection with the total VVM screening (Impact on the Environment) that the municipality has to make to give the permission for each AD plant. Digestate always contains waste and is therefore to be treated and disposed as waste.

In Denmark you must have at least storage capacity for 6 months production of digestate, but even if not required by license or legislation, digestate should only be applied when weather and soil conditions are appropriate. Spreading digestate when plants are not in a position to take up the applied nutrients immediately is wasteful and potentially polluting.

Digestate from AD plant that is treating residual or contaminated wastes will not be allowed to be disposed of to agricultural land. Under some circumstances it may be possible to use it as a fertiliser to non-food crops.

f) Germany

The utilisation of slurry and manure and the spreading of digestate is defined in:

- the Fertilizer Act
- the Fertilizer Ordinance

Lately manure in biogas plants was defined as waste according to EU regulations. According to the type of manure and soil cover, there are periods when fertilization is prohibited.

g) Hungary

The utilisation of digestate is not precisely defined by law. The most important regulations regarding the utilisation of the digestate are:

- 90/2008. (VII. 18.) FVM; expert opinion on soil protection
- 23/2003. (XII. 29.) KvVM; decree on biowaste management and composting technical requirements
- 71/2003. (VI.27) FVM; decree on veterinary hygienic rules and regulations regarding the treatment of animal waste
- 16/2001 (VII. 18) KöM; decree on waste incineration

h) Italy

If the digestate comes from anaerobic digestion of manure, energy crops and agro-industrial waste it has to be followed the DM 07/04/2006 regarding the agronomic utilization of this product. It fixes the conditions of the spreading and the maximum amount of N per unity of surface. If a percentage of other waste is in the input substrate also the digestate is considered as waste and the agronomical spreading has to be authorized in line with art. 208 of legislative Decree n.152/06. Other regional measures:

- Delib.G.R. 7 settembre 2007, n. 899)“Art. 92 - D.Lgs. 3 aprile 2006, n. 152 - Approvazione definitiva del programma di azione per le zone vulnerabili da nitrati di origine agricola rielaborato a seguito delle osservazioni ministeriali”
- L.R. 17 luglio 2007, n. 22 (Pubblicata nel B.U. Abruzzo 25 luglio 2007, n. 42.) “Promozione dell'utilizzo dei rifiuti comportabili e degli ammendanti per la tutela della qualità dei suoli”

i) Slovenia

The substrate should preferably be immediately incorporated in the soil as fertilizer - recommended is the use of slurry tanks with special injectors for shallow or deeper incorporation of substrate directly into the soil. Quantitative restrictions relating to the Nitrates Directive. Substrate must meet the requirements for processing biodegradable waste. Slovenian legislation is very strict on the amount of heavy metals in organic fertilizers or compost (including processed substrates from biogas plants). The limits for these heavy metals are quite rigorous in comparison with neighbouring countries!. Biogas plant itself can lead to concentrations of heavy metals, so that in case of exceeding the limits set out in the Slovenian legislation, such digestate cannot be spread on agricultural land. Digestate from agricultural biogas plants should meet the requirements of the Order of the management of biodegradable (kitchen) waste. In this Order are set limits for copper and zinc in compost (which include processed output media - digestate from biogas plants).

j) Sweden

Depending on the substrate, the digestate has different properties. In Sweden, the main substrates are sludge from wastewater treatment plants and various food and industrial wastes such as food waste and slaughter house waste.

REVAQ is a certification system for digestate from wastewater treatment plants that are spread on arable land. The certification include an active upstream work and continued improvements on the wastewater treatment plant.

Furthermore, the producer of the digestate has to be open with all information and has a developed traceability for the produced digestate. In the beginning of 2012, 45% of digestate from wastewater treatment plants were certified according to REVAQ.

The certification system "Certifierad återvinning" was initiated in 1999. The certification is voluntary and is based on open communication between the producer and the consumer of the digestate through documentation and free insight on the quality of the product. The entire chain from substrate to end product is adapted to environmental and user needs. The certification of digestate from waste is described in SPCR120. Of the certified digestate according to SPCR120, 92% was spread on arable land in 2010.

k) UK

The current Regulatory Position Statement of the Environment Agency is that digestate produced from the treatment of non wastes (e.g. specifically grown energy crops, or site generated slurry) is not considered as waste and therefore fall outside of Waste Management Regulations. In the majority of cases where some component of the AD feedstock comprises a waste, all of the resultant digestate is classified as a waste and therefore is regulated as such. However, where digestate is produced from source segregated feedstocks that are of sufficiently high standards, and where the requirements of PAS110 and the Anaerobic Digestate Quality Standard (ADQP) can be met, the digestate is considered of sufficient quality to represent a 'product' and is therefore not subject to waste management regulations.

Digestate that is PAS110 and ADQP compliant can be applied to land without further regulation (subject to agricultural good practice). Digestate that fails to meet PAS110 and the ADQP may still be suitable for land application, but will require a waste management exemption for this to be the case. The ADQP and PAS110 are currently undergoing a revision. The European End of Waste Criteria being compiled by the EU Commission Joint Research Centre may override countries individual specifications in the future.

Digestate from AD plant that is treating residual or contaminated wastes will not be allowed to be disposed of to agricultural land. Under some circumstances it may be possible to use it as a fertiliser to non-food crops.

10. Avoidance of Hazards

a) General information

Some information can be found in the chapter on components of biogas plants. The requirements on the components are made to secure a safe operation of the biogas plant to minimise the risks for people and environment.

b) Belgium

The security regulation for the agricultural biogas plant concern the construction, the exploitation and the maintenance of the plant.

- *Construction*: leak-proof and biogas-resistant materials, gates, mechanisms against fire, firebreak, airing of the rooms and ventilations, an appropriate distance between the plant and the others constructions... These are part of the elements to be considered for the construction of a plant.
- *Electricity*: the wiring and the electrical equipment have to be in accordance with the rules of the general electric facilities regulation and with all the standards in application. A protection against lightning is required for the aerial constructions.

Safety boards have to be put near the dangerous areas (risk of explosion / burning, no smoking), monitoring of the plant (temperature, alarms,...).

Plant inspection by the responsible authorities, before the beginning of the activities.

c) Croatia

The main risk issues of the biogas plant to take into consideration are: fire risks, explosion risk, asphyxia risks, emission of pollutant, smell, phytotoxicity. A proper formation and information of operator is necessary in order to prevent any kind of risky situations and properly react in case it happens.

d) Denmark

The contractor constructing the plant will have to comply with these regulations, which fall under the Danish "Arbejdstilsynet – vejledning D.2.7." These regulations (DSEAR) require a formal risk assessment be carried out and a suitable strategy implemented to minimise the risk of explosion. They implement in Danish law the "Gasreglement" and the Directive of the EU. They are clearly relevant to biogas plant and require extensive planning and strategy implementation particularly in respect of potential sources of ignition in key areas.

e) France

There is no specific guideline or standard regarding the construction of a biogas plant. The construction of a biogas plant will have to be in line with the regulations: ATEX zone, fire fighting, animal waste storage... but also in line with the new orders/decrees concerning biogas (for installations subject to authorization or declaration) which impose technical and organizational requirements.

f) Germany

There are several applicable regulations mentioned in the chapter on the components of biogas plants to secure that there won't be hazards. Unfortunately there are more and more accidents on biogas plants. The problem is not a lack of regulations, quite the opposite there are so many regulations that the plant operators, mainly farmers, are overcharged.

Due to this fact, it is discussed to implement a kind of "drivers license" for biogas plant operators. Indeed most of the approving authorities claim a safety training, but this is one time only and regulations and requirements are steadily changing.

g) Hungary

Decree No 3/2009 (II. 4.) of the Minister for Local Governments on the technical requirements of the fire protection of facilities utilising renewable energy sources: biogas, bioethanol and biodiesel.

h) Italy

The main issues of the biogas plant to take into consideration are: smell, fire risks, explosion risks, asphyxia risks, emission of pollutant in air, examples of previous accidents occurred, phytotoxicity. The relative measure to avoid the relative hazards have already been included in previous chapters. Moreover a proper formation and information of operator is necessary in order to prevent any kind of accident and properly react in case it occurs.

i) Slovenia

The law on fire protection requires that in the construction of energetic plants requirements for fire safety and fire protection must be accounted. Appliances, fixtures, installations, products, components and assemblies structures of buildings must be built or constructed from such materials that fire safety is ensured in accordance with the provisions of the preceding paragraph. At the reconstruction and maintenance of facilities, the fire safety of buildings should not be reduced. Paths intended for intervention vehicles, must be identified in accordance with the regulations.

j) Sweden

Signs that show where the first aid material can be found, where reassembly of people takes place and where the emergency exit is, are necessary in every work place.

The main risk issues in a biogas plant to take into consideration are: fire risks, explosion risk, emission of pollutant and smell. Signs showing what is required in the premises e.g. clothing, protection equipment such as hearing protection, goggles, gloves etc. as well as what is prohibited (smoking etc.) should be placed in a visible place as well as the emergency stop sign. Also the contents of the pipes should be clearly marked.

k) UK

The contractor constructing the plant will have to comply with these regulations which fall under the Health and Safety at Work Act and administered by the Health and Safety Executive. The purpose of the regulations is to ensure the safety of those involved in constructing the plant.

The Dangerous Substances and Explosive Atmosphere Regulations (DSEAR) require a formal risk assessment be carried out and a suitable strategy implemented to minimise the risk of explosion. They implement in UK law the ATEX (Atmospheres Explosive) Directive of the EU. They are clearly relevant to biogas plant and require extensive planning and strategy implementation particularly in respect of potential sources of ignition in key areas. Equipment in the areas identified as being at risk of explosion must be ATEX compliant.

11. Barriers and Obstacles

a) General information

All countries still have barriers for the development of the biogas sector. There are no reasonable technical problems as all technology needed is available. The main problems are legislative and economic problems as well as the lack of knowledge in several countries. The development is very much depending on the political intent.

b) General information on the development of the sector

# of biogas plants	2006	2010	2011/12
Austria	334	360	
Belgium	n/a	n/a	70
- Wallonia	6	14	19
Croatia		(2 MWe)	(4,5 MWe)
Denmark			
France			137
Germany	3500	5900	7200 (end 2011)
Hungary	1	14	15
Italy	9	176	
Slovenia		12	19
Sweden		229	
UK		30 (in March)	68 (September 2011)

It is obvious that the highest increase in the number of biogas plants has been in Germany. Due to changed legal frameworks and recently given political statements the further development will be at a significant lower level. In most countries the development still is on a very low level, but is expected to grow within the next years.

Biomethane plants are not very widespread yet:

- Austria: 1 upgrading plant in 2006, 9 upgrading plants in 2011
- Germany: 2 upgrading plants in 2006, 79 upgrading plants in 2011
- Hungary: 1 upgrading plant in 2011 (sewage gas)
- Sweden: about 40 upgrading plants in 2011
- UK: 1 upgrading plant in 2010 and 2011

It seems to be the beginning of a development towards biogas upgrading and biomethane injection in several countries. Recently there have been legislative changes to enable the injection to the gas grid in several countries, now it's necessary to develop incentive programmes and to install demonstration plants in the respective countries.

# of	Sewage gas plants			Landfill gas plants		
	2006	2010	2011/12	2006	2010	2011/12
Austria	64*	68*		64*	68*	
Belgium - Wallonia	n/a n/a	n/a n/a	21 6	n/a n/a	n/a n/a	25 12
Croatia						
Denmark						
France			60			
Germany	~700 (data from 2004)	n/a	~1700	n/a	n/a	n/a
Hungary			8			14
Italy	5	47		161	228	
Slovenia			4			4
Sweden		140			57	
UK	Not quantified	Not quantified	146 (Sept.)	Not quantified	299 (March)	Not quantified

* Austria: one number for sewage gas and landfill gas, no separate data

There is a utilisation of sewage and landfill gas in all countries, but it's expected that there is still more potential in all countries.

c) Austria

In the 1980s only a small number of biogas plants exist. The exponential growth started in the 1990s and reached its highest growth between 2002 and 2005 due to a successful energy policy scheme introduced in 2003. There were around 50 plants in 1999 and this number almost tripled until 2003. The growth rate stagnates since 2005 because of numerous changes of the Green Electricity Act and linked insecurities. From the past experience the following subjects are classified as key hurdles.

- Long-term availability of raw materials
- Fermentation residues
- Legal framework
- Economic conditions

d) Belgium

In Belgium, a first difficulty is that all regions manage the biogas sector as they like. So, all commented explains below concerned the Walloon Region.

One of the most significant barriers in Wallonia is the high investment. Also, a complicated permit procedure and a high level of uncertainty regarding the green certificate market constituted a barrier to the biogas development. Currently, the Administration is working on the point to simplify the access of biogas especially to the farmer.

Other obstacles are that the support scheme is not adapted and an instability regarding the existing supports exists. Some constraints concerning permitting and operation (including the use of digestate) are also barriers in Wallonia.

e) Croatia

EIHP in the framework of a project BiogasIN has conducted during 2010/2011 a survey between stakeholders on the *Bottlenecks of Permitting Procedures for Biogas projects in Croatia*. The conclusions are:

- Lack of leadership of the MoELE to address the difficulties and advocate for RES sector among other authorities involved in permitting
- RES policy is more declarative than applicable
- once property rights and location permit are obtained, the permitting procedure is bearable
- when biogas plants are recognised by physical planning the procedure is much shorter
- connection to the grid and other grid related issues are strongly depending on the regional distribution system operator
- too many grey areas in the permitting procedure
- location permit that requires biogas plants pushes away biogas from rural areas (agricultural land) to industry zones (construction land)
- time between biogas start-up production and purchase agreement could extend vastly due to the issuing use permit while the electricity is delivered to the grid but not paid
- all barriers are clear but someone has to act
- each plant design has to be approved by a Croatian licensed civil engineer, which takes up to 8 months as civil engineers have little experience
- detailed engineering is necessary for Location permit and if something changes, it returns one back to the starting position
- inspectors that check the constructed plant for use permit are too detailed
- little knowledge about safety and fire protection measures related to biogas

General bottlenecks could be summarised as follows:

- complicated permitting procedure for RES-E projects in general and for biogas projects specifically
- weak communication between MoELE and MoEPPPC
- lack of knowledge among biogas project developers and biogas feedstock owners

f) Denmark

There are a number of barriers to the development of biogas plants in Denmark with the difficulty - one of the greatest, seemingly - VVM and country planning consent. On the other hand it does appear that the market conditions are changing and that good quality AD developments based on the processing of waste products from farmers and food industry production are now economically attractive if the settlement prices for electricity and biogas is about 1.15 DKK/kwh and 5.00 DKK m3 methane. The Danish parliament will spring 2012 present a new energy agreement. The agreement will also indicate how large the subsidy to the AD plants will be the next 8 years.

The barriers for biogas plants are the ownership and capital requirement (equity) which is very difficult to provide due to the current financial situation and debt crisis that also affect farm operations in Denmark. Only a very few plants have been established during the past 10 years. Also, the profitability is considered to be low and uncertain.

Lack of standardised biogas plants and extended operational services are other barriers, as only a very few existing plants are standardised rather than individually built and expanded.

Government revenues/charges are high from the national gas sale and this revenue is maybe the most significant barrier for biogas distribution throughout the country. It seems not to be an option politically to remove taxation of biogas.

g) France

This sector is in the process of maturity, it requires support and coordination and is therefore one of the main objectives of the European project “Bio-methane Regions” led by AILE for the regions of Brittany and Pays de la Loire, and by RAEE for the region of Rhône-Alpes. When a farmer has a project, he needs to be accompanied to be able to define precisely his project and to go through all the different steps.

The investment costs remain very important. Although the feed-in tariff for electricity produced from biogas via anaerobic digestion or the feed-in tariff for bio-methane do not consistently make the projects profitable, there are also investment and accompaniment aids. The implementation of biogas plant (with territorial approach) beyond 200 kWe remains complicated and definitely still needs appropriate accompaniment. For farm-scale biogas or territorial projects, the major issue concerns the possibility of financing the implementation.

The anaerobic digestion process is a growing sector, the know-how is available and specialised firms are developing more and more. The political and administrative level is fairly open, but there are still some regulations aspects to be clarified.

Considering the French context, it is very difficult to base a project only on energy dedicated crops.

h) Germany

In general the conditions for anaerobic digestion in Germany have been good in the past. Regarding the lately introduced Renewable Energy Act conditions will become worse for mid-size agricultural biogas plants. Plants using biowaste will receive a higher feed in tariff. Additionally to the incisions there is a on-going discussion about the benefit of the promotion and if the promotion should be further reduced. This leads to uncertainty for potential investors.

Several biogas plants at the moment face the problem of high substrate costs as they don't have enough substrate on their own and have to buy corn silage. Therefore a big point in the planning of new biogas projects is the long-term availability of substrates at a constant price.

One problem at the moment is the insufficient capacity of the electricity grid especially in areas with lots of wind power plants and the grid expansion is too slow due to the variety of protests. Planning and building new power grids now takes about 10 years. With a new law this shall be reduced to five years, but there are hundreds of protests against the new power grid development plan. One possibility could also be the production of wind gas in times of high energy production and low energy consumption.

Due to some accidents at biogas plants and sometimes very negative and even incorrect reporting the attitude of citizens towards renewable energy and especially towards biogas plants turns more and more negative. It seems that the four big energy companies still have a lot of influence on the government and the reporting.

The problems with biomethane are that some grid operators are not cooperative due to the high costs and that the plant operator has to find costumers at the free market and natural gas is too cheap compared to biomethane. Furthermore there is a lack of public awareness for natural gas and biomethane as fuel and compared to the high feed-in tariff for electricity it is not economic.

i) Hungary

One of the most significant barriers, which hindered the widespread utilisation of biogas is the approval procedure. Investors faced a complicated permit procedure and a high level of uncertainty regarding the conditions of the electricity grid connection. The National Action Plan for Renewables (approved by the Hungarian Parliament) aims to reduce the time to maximum 6 months.

Another significant issue is, that the feed-in tariff system doesn't provide a transparent, clear answer for the duration of application and the feed-in tariffs are flat.

j) Italy

The development of biogas production is very often hindered by obstacles and barriers. The barriers that Regione Abruzzo/ARAEN analyzed in the development of the biogas chain in Abruzzo have been detected in the production stage (raw material, producers) as well as in the consumption stages and also in the regulation (this point especially for biomethane). Regione Abruzzo at the moment has no experience in such kind of plants so there is the general difficulty to take on with a new technology.

The main are:

- low awareness in the agricultural and agro-food sector
- difficult economical framework
- lack of awareness of the product biogas among farmers, breeders and citizens
- potential producers demand complete but simple and understandable information
- biogas management is easier than biomethane
- specific rules for biomethane should be set by the national government
- no standardized procedure for system design and prediction of the quantity of gas
- difficulties in raw materials collection at a local level
- almost no district heating network to be fed with the heat
- no refuelling station using biomethane
- no specific technical rules that set the upgrading requirements
- companies that sell and install biogas plants are located in the north of Italy or in foreign countries
- lack of information about the possible use of the digestate as fertilizer
- no production of energy crops in the region and some research has to be done to study the cultivations to be started in the region
- biogas for cogeneration is more easier to be managed than biomethane
- subsidies and funds received by the farmers per cultivated hectare are insufficient
- investment cost to build a biogas AD plant are really expensive and the payback time is usually more than 5-10 years. Moreover, banks and financial bodies are not willing to take long term risks if the turnover of the plant is not guaranteed.

k) Slovenia

Biogas is currently used in most cases only to produce electricity and heat in CHP units. Only a small number of biogas plants give off heat to the customers (due to socio economic and technical barriers, for example an inappropriate location of biogas installations that require thermal energy, distance of biogas plants from distant heating networks, lack of information of potential users, a lack of funding, various licenses, etc.).

With the injection of biomethane in existing gas grid into the future it will be possible to use existing network of natural gas and the gas will be transported over large distances, where it will be accessible to users who would not have been achievable due to its improper location.

Lack of knowledge and information on the available technical potential for the use of biogas and biomethane, especially the agricultural biogas is typical for agriculture. In general, knowledge of the biogas technology is relatively well for large investors and less on the individual level or for individual farmers.

Currently the biggest obstacles are to the introduction of the upgraded biogas in the form of biomethane into the natural gas network. There is no possibility of selling biomethane (no purchase price for bio-methane, there are no conditions for the injection of biomethane into the natural gas network).

Financing investments in renewable energy power systems remains big problem. This problem will be improved by reducing costs and improving the competitiveness of technologies that exploit renewable energy sources, as many investors would like to enter as soon as possible in the energy sector. New financial instruments used by private banks for green investment funds with a low interest rate and economically viable technologies helps to investors. At this moment in Slovenia miss clear and stable financial conditions. Especially problematic is the funding of joint projects for collective biogas plants.

Until now there is no project to achieve an agreement between two or more farmers for building the biogas plant. Agreement with a public entity (e.g. municipality) is more difficult. Some farmers are interesting in financing with third parties and are looking for investors, because they are not able to invest themselves. Commercial banks do not offer specific financial services for environmental investments. One possibility is favourable credit support Eco Fund.

Viability of agricultural biogas plants at current prices is a little above zero due to rising prices of corn silage and corn silage input restriction on the maximum 40%. In addition, the farmers expect that they will have payment in the case of the collection of manure on nearby farms. Viability of CHP installations in landfill or biogas from wastewater treatment plants is very good (the time of investment recovery is from 6 to 9 years).

The whole process of preparation before construction takes a long time. The entire procedure usually lasts from one year to a year and a half. Local communities often do not support the use of innovative technologies, because they do not want to take the risks associated with the testing and use of these systems in their vicinity. Social acceptance is relatively poor. Environmental awareness, which takes account of global change and reduction of land degradation and water pollution, is still very low.

The district network in Slovenia is very poorly developed (there are only in major cities) it is even more sense to aim the introduction of purified biogas to biomethane into the natural gas network.

I) Sweden

Unlike in many other countries, gas is traditionally not a big part of the energy supply in Sweden. Approximately only 17,6 TWh of the total energy supply of 616,5 TWh in Sweden consist of gas.

Out of the 117 TWh oil (without conversion losses) that is used annually in Sweden, almost 80 % is used in the transport sector, which makes this sector the most fossil fuel depending sector. Electricity and heat production is mainly produced from non-fossil energy carriers. This makes the utilisation of biogas as a vehicle fuel the best way to decrease the fossil fuel dependency in Sweden.

Today there is no investment support for investments in distribution such as filling stations and pipelines. This is a huge cost for a municipality or a gas station that wants to offer bio-methane as an option to gasoline or diesel. Therefore the biggest barrier is the necessity of a new infrastructure for bio-methane.

Another important obstacle is the lack of goals and long term rules that are necessary for every company that wishes to make investments in biogas/bio-methane plants. For people considering the purchase of a gas vehicle, the biggest obstacle is the uncertainty about tax reliefs. Those that are valid today will not be valid after 2013.

m) UK

There are a number of barriers to the development of biogas plants in the UK with one of the greatest, seemingly, the difficulty of gaining town and country planning consent. On the other hand it does appear that the market conditions are changing and that good quality AD developments based on the processing of waste products are now economically attractive.

Securing sufficient feedstock to maintain an economically viable plant over a medium / long term is also a challenge when developing a plant in the UK. As the industry is moving through a phase of rapid growth, the market is experiencing some uncertainty as to the availability of feedstocks, particularly at local levels, where a number of potentially competing plants are under development.

Also waste treatment related gate fees have started to reduce and in some cases very significantly and for some plants the biogas related incentive is now the largest part of the income and this is impacting on further significant expansions of the sector.

Linked with this, the securing of sufficient capital funding to build an AD / biogas upgrading plant can also be a limiting factor. Funders are still fearful of any kind of uncertainty, and therefore AD developers must have a very robust business case in order to secure financial backing for plants.

The general shortage of people wishing to work in practical trades is possibly as much of a significant obstacle to progress as is the specific current shortage of those with specific AD skills and experience.