

REPORT

Work package: WP07

Supply chains and market structures for biogas use (combined document)

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Deliverables:

- D22:** An overview of existing supply-chains and market structures arranged by their potential for increasing the biogas use for heating and cooling
- D23:** A list of recommendations for installing “Biogas feeding-in and feeding-out pools” on the basis of the detected supply chains with the highest biogas use potential
- D24:** A list of recommendations to policy makers for public funding of selected supply chains and market structures with the highest project relevant potential

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REDUBAR

WP07 D22 + D23 + D24

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1 Introduction

The Redubar project deals with the conversion of biogas into biomethane and distribute it by official natural gas grids to modern high efficient poly generation systems (heating, cooling, power generation). Main objective of the project is to determine and remove existing non-technological and administrative obstacles and barriers and to propose legislative regulations for the injection of biomethane into natural gas grids and its distribution.

In this work package, WP07, the supply chains and market structures for biogas use has been investigated. The deliverables presents:

- An overview of existing supply-chains and market structures arranged by their potential for increasing the biogas use for heating and cooling
- A list of recommendations for installing “Biogas feeding-in and feeding-out pools” on the basis of the detected supply chains with the highest biogas use potential.
- A list of recommendations to policy makers for the future development of selected supply chains and market structures with the highest project relevant potential.

The chains of technological processes, from biomass up to polygeneration, must satisfy requirements from various sides. They must be accepted as desirable by society, feasible in engineering, regulated in administrative terms and profitable in terms of economy. There are considerable differences in the development of the market structure for biomass in the member countries of the European Union. These differences exist at all stages in the utilisation chain of biomass but mainly in:

- Structure and potential of biogas production (agricultural and industrial biological wastes, biomass production for energy, competitors for biogas production from biomass)
- Demand structure of natural gas, infrastructure for natural gas distribution, demand for heating, cooling or combined power generation

This report describes the existing and potential market actors and/or chains for biogas production and utilization identified within the project. The chains of technological processes using biomass are presented as chains of actors in the market and their corresponding interests. The various actors are grouped according to:

- type of enterprise / type of business ownership (property)
- (business-) interests
- alternatives available to them
- stages at which they play a role in the overall process

Analyses of clusters and included interviews of the various actors shows:

- actors' motivation,
- competitive situation,
- degree by which they are influenced by market forces,
- how activities can be supported by legislative/regulatory measures

The structure of the market for each stage along the chain illustrates the necessary to initiate, stimulate and control the formation of such chains.

Recommendations for installing “Biogas feeding-in and feeding-out pools” for supply chains with the highest potential of biogas use results from analyses and evaluations of the evidence of economic and ecological effects under the situation of the member countries.

To support the biogas utilization and the introduction of biogas feeding-in and gas equivalent feeding-out in EU-member states, where the technology does not exist by the time this project ends this report suggests a list of Recommendations and actions.

2 D22 - An overview of existing supply-chains and market structures arranged by their potential for increasing the biogas use for heating and cooling.

Deliverable: D22

Full title:

An overview of existing supply-chains and market structures arranged by their potential for increasing the biogas use for heating and cooling. Relevant to target group 2, 3 (basis for achieving the best value for money concerning decisions on the installation of new "Biogas feeding-in and feeding-out pools", see D23) and target group 5 (basis for correct recommendations for the dissemination process)

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2.1 Work Conducted

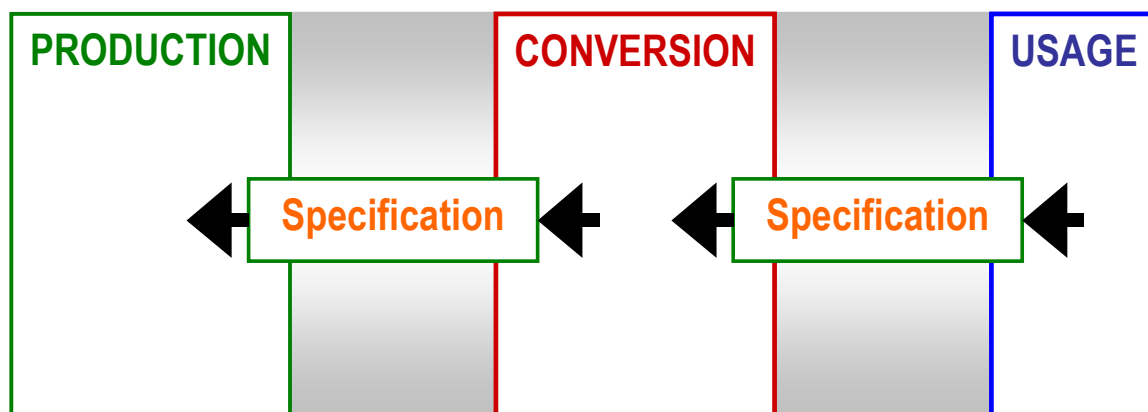
A questionnaire in the form of a matrix was prepared and distributed to the partners involved within the work package. Aim was to investigate all EU-27 countries but feedback was received from 16 countries only. From the response however, it became clear that there is quite some overlap in the collected information. Therefore, it can be tentatively concluded that additional contributions would most likely not change the overall conclusions.

Co-operating task partners: INIG, DBI, CRES, GIF, FEE, UNI MISKOLC, ETE, ICT, EAV, LEI, ECN. The EU-27 countries were divided amongst the task partners.

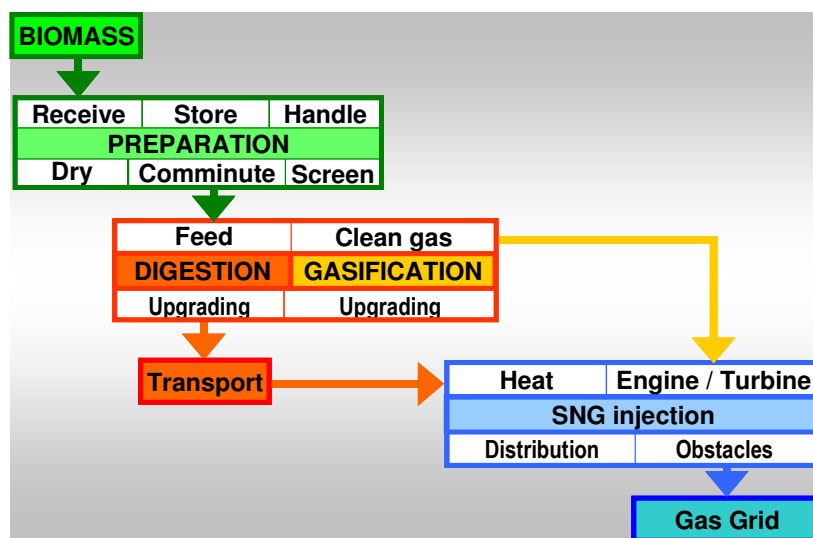
At the time of preparing this deliverable, not all expected information was available. As mentioned, response from only 16 countries could be collected and those deliverables supposed to provide input to this deliverable (D22) were either not completed or of poor quality.

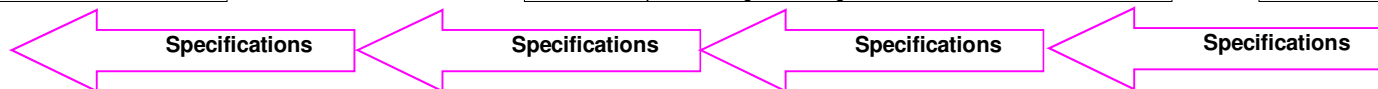
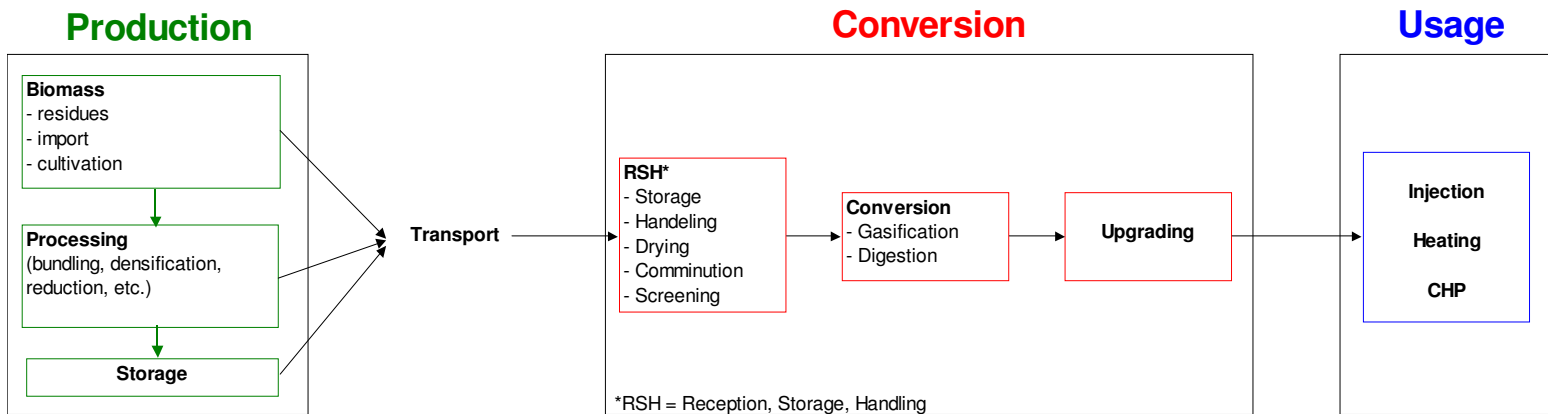
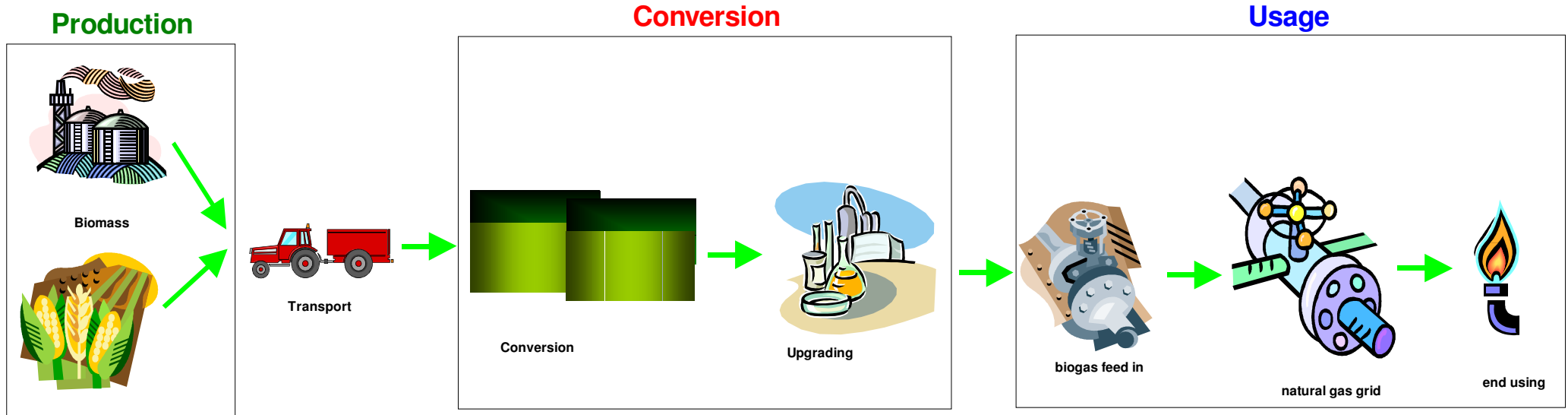
2.2 Process chain

Schematic, the process chain can be illustrated in a simple way as follows:



The production, conversion and usage are interlinked and determine the specification of each process. In more detail, the process chain can be illustrated as follows:





The technological process chain from biomass resources to gas injection and the market actors is analysed in the following matrix.

	Chain →	Biomass resource	Biogas production	Upgrading	Distribution/ transportation	Injection	Whole chain
		1	2	3	4	5	6
A	Process or aspects	Manure Agricultural residues Fats/oil Energy crops Green waste households Sewage sludge Waste water treatment Industrial residues (food, pulp & paper, slaughterhouses)	2.3 Digestion Gasification	Membranes Washing VPSA LP Coaab	Quality Quantity	Pressure	-
B	Actors	Households Municipalities Waste collectors Landfills Agricultural organisations Industry Traders Farmers Waste water treatment	Farmers Industry Vendors Equipment suppliers Contractors Investors Greenpeace (NGO's: FAO, WHO?)	Farmers Industry Equipment suppliers Investors R&D	Industry Plant suppliers Utilities Distributor Local authorities Contractors Public cooperations	Utilities Distributor Consumers Gas companies	Authorities Policy makers Investors Energy agencies Branches
C	Interest / motivation	Getting rid of the waste Making profit	High quantity and quality Beneficial to local communities	Quality Costs	Decoupling production and utilization	Substitute natural gas	Substitute natural gas
D	Alternatives Competitors	Dumping Animal feed Food Resource for industrial products Composting	Combustion Pyrolysis	Syngas Hydrogen Liquid fuel Chemicals (C-source)	Storage Direct usage Infrastructure of existing natural gas grid	CCHP Central heating District heating Automotive fuel Injection local grids	Solar Wind Bio-oil Thermal conversion biomass (co-combustion/direct)

	Chain →	Biomass resource	Biogas production	Upgrading	Distribution/ transportation	Injection	Whole chain
E	Obstacles	Small quantities Availability Cost price biomass Seasonality of biomass	Digestate disposal No legislation	No national quality requirements Costs Quality insurance	No obligation for the distributor to accept Green Gas Micro organism Safety	Investment costs for piping, special measures to be taken No consistent government policy Certification	Safety Lack of awareness of the possibilities
F	Current Market (Country specific)	Forest residues MSW Domestic (residential) firewood Peat Agricultural Solid Waste	sawmills pulp & paper industry power plants CHP plants			Injection is practiced in a limited number of EU-27 countries	Limited experience with injection
G	Support Legislative & Regulatory			Finance	See D17, D18	Production support (feed-in tariffs) Tax exemption Investment support Market introduction measures R&D subsidies EU Emission Trading Scheme (ETS)	Production support Tax exemption Investment support Market introduction measures R&D subsidies EU Emission Trading Scheme (ETS)
H	Input from	D5, D6, WP3, D9, D15			D13		

2.3 Availability of biomass resources

The availability of biomass as a fuel varies considerably according to the climatic conditions, the existing socio-economic situation, the available logistic networks, the applied agricultural policy (subsidies, rules of the Common Agricultural Policy, etc.) as well as the alternative uses (i.e. biomass for wood industries, paper industries, animal feeding and other non-food uses). Consequently, the provision of feedstock on a continuous basis and with strict standards (i.e. elementary analysis, calorific value, moisture content, ash content, etc.) is practically non-feasible.

The main sources of biomass used for biomethane production are:

- Industrial crops
- Manure and chicken litter
- Non-lignocellulosic biowaste (slaughterhouse residues because of assumed BSE-risks excluded)

There is a large difference in the availability figures or volumes between the EU-27 countries, so little can be said on this point. Nevertheless, some recent trends include:

- Locally and in first cases even regionally first signs of scarcity of arable land for industrial crop cultivation, that even led to abandoning projects and to higher rents for arable land.
- Demand of crediting banks to present long term delivery contracts for biomass to the plant operators and strict control of secure over the years supply logistics.
- Industrial crop bonus and strict regulations on for remuneration accepted biomass by legislative regulations caused undue preference for industrial crops and neglecting the use of biowaste.

Some specific biomass sources are influenced by water and/or seasonal effects but industrial crops (at the moment mostly maize and green rye plants can be stored in silo/bunkers to guarantee the supply of input substrate around the year.

The prices for agricultural commodities on the world market have risen up to 170 % in 2007/2008 thereby endangering the operation of biogas farmers. Therefore in the amended feed-in act the bonus for industrial crops (since 2004) had been risen and a bonus for the use of manure (from 01-01.2009) was implemented.

2.4 Existing and potential market actors

The most important actors are:

- farmers and agricultural enterprises with large areas of arable land,
- slaughterhouses,
- municipalities,
- pulp and paper industry,
- big power and gas companies,
- municipal and rural utilities and
- investors.

New actors are:

- large electricity companies starting biomethane projects, most of them created specialised subsidiaries,
- biogas and biomethane trading agents
- companies that up to now offer “green electricity” started with offering “green gas” to consumers
- regions aiming at becoming completely independent from fossil fuel, i.e. 100 % RES

It has to be noted that the actors analysed refer in some countries only to potential actors and not actual ones, because biogas in some countries is currently generated only in sanitary landfills and municipal wastewater treatment plants.

The most important influence is exercised by the actors European Union (EU) and Member States (MS) because of:

- energy security
- climate protection and
- change of agricultural policy.

There is a difference between biogas plants and their size and biomethane plants for injecting. For small scale farm size plants up to about 150 kW_{el} the most important actors are farmers and specialized constructing companies. These plants often are erected without specialized project engineers. This is one of the reasons these plants are often not state-of-the-art.

For plants of middle capacity of about 500 kW_{el} (which is the most applied size) large agrarian companies, specialized on both animal breeding or on plant cultivation.

From about this capacity upwards prevails the rule of success by close cooperation between the planning engineer, the plant building company, for engineering and erecting the plant at one hand and in operation the chain logistics of supply-operation - use of the fermentation residues.

For biomethane injection most suitable 1,500 to 4,000 kW_{el} the cooperating chain is to be prolonged by the operator of the natural gas grid or in first cases the distributor of the automotive biomethane and the operator of suitable filling stations. In the biomethane process chain all links are indispensable with a very strong and to a certain degree risky interdependence.

The bigger the plant the more important the investor, in larger plants (up to now up the 20 MW_{el} even investment companies.

Most important insecurities with all actors exist with regard to missing experiences concerned the new situation:

- in the course of implementing a bundle new legal regulations as Amendment of the Act on Granting Priority to Renewable Energy Sources, Act on RES Heat, Amendments of Combined Heat and Power Generation and several Ordinances related to access to the natural gas grid
- the finance and revenue situation.

The weak link in the chain is the permanent supply of biomethane plants with industrial crops. Farmers hesitate to conclude long-term supply contracts, which banks demand from any investor as a risk lowering pre-condition for crediting.

Farmers often prefer their freedom of action for selling their crops to buyers who pay highest prices. In recent years food and feed crops have become a very volatile commodity.

It is important to create a strong and local based organization to erect and operate the plants. A project turns out to be successful only on the condition that the farming community is deeply involved by planning, organizing and financing the undertakings and projects. During the operational phase of the project an exclusive agreement/fuel contract with the raw material suppliers for the steady and unhindered provision of wastes to the plant, has to be determined and established (e.g. supply contracts with the individual farmers, material owners, SMEs). The collection and transportation factors are also decisive components in the biogas chain.

The plant construction and operation require a series of key players who must participate and interact in various phases of project development, such as technology vendors, contractors, equipment manufacturers, industries/end users (SMEs) enterprises as well as financing providers. To run and operate the plant on EPC (Engineering – Procurement – Construction) partners has to be identified.

2.5 Motivation of market actors

Big energy and gas companies:

- seem to fear losing dominating the market
- do not want to repeat their failure they committed with the underestimation of RES utilisation in the electricity market, where they lost clients and portions of the market
- want to gather experiences in a market sector and technology that has been unknown to them up to now.

Utilities

- look for substituting fossil primary energy carriers because the sharply risen prices and CO₂ reduction,
- make use of their experiences with sewage gas production in water purification.

Farmers

- establish a new source of income,
- counteract to the small revenues they get for food and the changes in the European Agrarian Policy
- prolong the bios generation chain they are already acquainted to biomethane.

Investments Funds try to avoid the highly speculative real estate market.

All of them, including biogas and biomethane trading agents, engineering and manufacturing companies hope to open a new source of profit. In most countries favourable financial incentive schemes are introduced for green electricity and heat.

In difference to the direct use of biogas in energy converters (combustion engines, fuel cells, micro turbines) directly at the fermenter tanks there will be in future a new actor the biogas or biomethane trading agent. He might buy biogas or biomethane directly at the biogas plant or biomethane plant or at the injection point into the grid or at the filling station. Trading with biogas or biomethane demands special knowledge which at the moment operators of bio-digestion plant do not possess.

Additionally, the neighbourhood of planned biogas plants of any type as actors should be taken into consideration because of their sometimes very harsh resistance against the building of plants. Their NIMBY - not in my backyard - behaviour has prevented already several projects.

If the biogas chain only is taken into account (not the whole process with upgrading biogas to biomethane and injecting it into the grid or use it as automotive fuel)

than one of the most important general obstacles is the low exergetic utilisation of

the chemical bound energy by producing electricity only and the technical use of only about one third of heat produced for heating the fermenters and not being able to sell the heat at the isolated sites where biogas plants are normally being built because in most cases at that places there are no heat consumers at all. The consequence is poor economy, no profit, so no plant in the end.

As for their interests, the farms, slaughterhouses and agro-industries have large amounts of wastes that are very difficult to get rid off, so they are disposed on the land posing huge environmental burdens. In addition, livestock is mainly shepherd and thus the produced manure is spread on the grazing land. Consequently, these groups of actors seek for solutions to tackle the huge environmental pollution they cause in their area from this uncontrolled disposal of wastes.

At the same time they have a relative large demand on both electricity and heat. The heat demand (partly steam) gives the possibility to internally utilize the surplus heat from the engines even in the warm climates like South European countries. The electricity could be either utilized on the farm/slaughterhouse or exported to the grid.

Technical/financial consultants\Lawyers, technology vendors, contractors, equipment manufactures (i. e pumps, bankers, agitators, containers, compressors, digesters, etc), financial actors (banks, investors) and industries/end-users are the potential actors in this part of the biogas chain. Their interest is to make profit.

Raising income from many sources (energy, manure management, gate fees) is an asset of great importance and the main interest of the actors involved. This also means that it is difficult to compare the economical possibilities of setting up plants in different economical and environmental context, because sometimes energy is most important and some others agriculture and environment is the most important income factor.

Besides raising profits, the energy exploitation of biogas has positive environmental impacts, which is the main concern of public authorities and the public services mentioned before, as the pollution of surface and underground sources pollution, as far as the accumulation of organic nutrients and pathogens is concerned, is greatly reduced.

2.6 The influence of the actors on each individual process step of the chain

Biomass resources

The agriculture has to be a driving partner and this issue is a core business for the project. A project turns out to be successful only on the condition that the farming community is deeply involved by planning, organizing and financing the undertakings and projects. Dissemination measures and support is absolutely required to incorporate farmers groups, farmers organisations and farmers unions into the entire undertaking and understanding.

During the operational phase of the project an exclusive agreement/fuel contract with the raw material suppliers for the steady and unhindered provision of wastes to the plant, has to be determined and established (e.g. supply contracts with the individual farmers, material owners, SMEs). Through this agreement/contract the suppliers will assume all the responsibility for providing the fuel in sufficient quantities and in condition which is suitable for storage and fermentation on site.

In summary, animal farms, slaughterhouses, agro-industries, local authorities, agricultural unions, lawyers are the potential actors in the biomass resources part of the biogas chain. As for their interests, the farms, slaughterhouses and agro-industries have large amounts of wastes that are very difficult to get rid off, so they are disposed on the land posing huge environmental burdens. In addition, livestock is mainly shepherd and thus the produced manure is spread on the grazing land. Consequently, these groups of actors seek for solutions to tackle the huge environmental pollution they cause in their area from this uncontrolled disposal of wastes.

Intermediate stages

Industries, users / (SMEs), private individuals, dealers, owners of transportation means (tracks, lorries, tankers) and equipment sellers or manufacturers (i.e. pumps, bankers, containers, etc) are the potential actors for this part of the chain.

The collection and transportation factors are decisive components in the biogas chain. The transport means, costs and site collection could be proven crucial points for the determination of types of sources and the distance provisions. The screening of raw materials types would be based on capability for the steady provision of wastes and the related transport costs.

Thus, the aforementioned actors could open communication channels with each other and find out measures for the improvement of market mechanisms so as to lower costs and make profit. Clusters containing the aforementioned actors would assure constant and efficient linking between different policies – on energy, environment, etc – and marketing activities. The aim of such clusters would be to determine synergies, dependencies and interactions between the involved key players in each stage of the biogas technology chain and find out which productive systems can be derived.

Biogas production

The plant construction and operation require a series of key players who must participate and interact in various phases of project development, such as technology vendors, contractors, equipment manufacturers, industries/end users (SMEs) enterprises as well as financing providers. To run and operate the plant on EPC (Engineering – Procurement – Construction) partners has to be identified.

Additionally, an O & M contract is needed with a third party Contractor with extensive experience in similar plants. During the commissioning phase all the technical problems will be given with technical solutions by the properly identified players.

Technical/financial consultants\Lawyers, technology vendors, contractors, equipment manufactures (i. e pumps, bankers, agitators, containers, compressors, digesters, etc), financial actors (banks, investors) and industries/end-users are the potential actors in this part of the biogas chain. Their interest is to make profit.

Biogas technologies

The actors to be involved in this part of the biogas chain are the industry, equipment suppliers, investors, engineers, technical consultants, academia.

Distribution networks

These distribution networks include:

- networking for preparing, marketing and distributing compost to end users
- administration bodies to ensure liaison with Local Authorities
- training modules for farmers and plant operators
- support SMEs evolution for additional activities (transport contractors, heat pipe manufactures, etc.)

Local authorities, contractors, planners, firms for piping, networks construction, manufacturers, civil engineers are among the potential groups of actors in this part of the biogas chain, together with Public Power Corporations, the Gas Transmission System operators, the Public Gas Corporations and/or Gas Supply Companies.

Raising income from many sources (energy, manure management, gate fees) is an asset of great importance and the main interest of the actors involved. A common approach would include:

- improving the biogas market conditions (increases of demand and thus increases of the selling price of the energy products).
- increasing of the price of the biogas-produced electricity to the grid (75,82 Euro/MWh set at present to the 150 Euro/MWh).
- increasing of the percentage of the public funding on the investment capital costs from the 40 % that is now to 50 %, mainly for the advanced bioconversion technologies.
- organizing the market of digested slurries used as fertilizers.

2.7 Obstacles

Obstacles and barriers are to be investigated in WP 4 and WP5. Several obstacles exist in the complete technology chain. The main obstacles identified in this WP7 are:

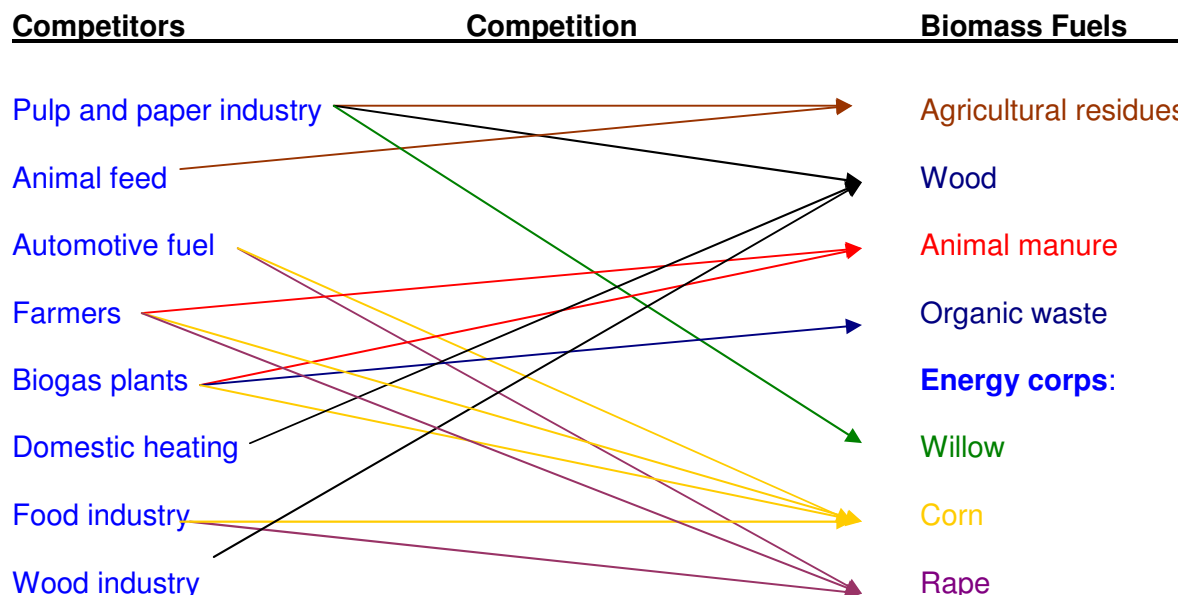
- Lack of awareness of the possibilities;
- Lobby activity of gas company;
- No upgrading plants and no methodology to calculate this biogas price;
- No national policy regulating purchasing and injection of biogas into gas grids;
- Incomprehension of the necessity of getting more energy from RES;
- Different support mechanisms and prices for Biomass in EU countries;
- Unclear borderlines to avoid double counting;
- Lack of quality standards or guarantees to reduce consumer risk when purchasing new efficient technologies;
- Past unsuccessful efforts can cause the lack of credibility;
- There is a need for a successful demonstration project in the agricultural and industry sector;
- Public opinion – problems with odour on several biogas plants. It is hard (sometimes nearly impossible) to change the opinion of local authorities or inhabitants in case of building a new biogas plant.

Some facts:

- Enormously risen investment and production costs (input, internal-used energy and fuel, steel, rent of real estate and arable land at the moment put in danger any new project if there are urgent and special measures taken)
- Extremely risen prices for food and feed commodities on the world market put in danger almost all plants operating on an industrial crop basis because the input material f.i. maize and other cereals used for silage achieve high prices on the food and feed market and are no longer affordable for biogas plant operators because of the fixed prices for the electricity fed into the grid.

2.8 Competitors

The competitors in the market for biomass sources and biogas usage is illustrated in the following figures



2.9 Support measures

The important support measure for the whole chain is creating investment security and making profit by:

- obligation to the grid operators to accept every kWh electricity and m³ biomethane offered by the operators of biogas and biomethane plants
- obligation to the grid operators to pay fixed prices for long periods that allow to amortization of investments and a small profit
- introducing a bonus for the use of wanted biomass, CHP, new technologies
- allowing the grid operators to distribute the higher costs to all consumers likewise (application of the polluter pays principle)
- decreasing remuneration for new investments from year to year (to accelerate application and faster decreasing plant prices and avoid windfall profits for the manufactures)

There are different legislative & regulatory support measures in place in various countries. This include a. o.:

- Act on Granting Priority to Renewable Energy - Renewable Energy Act, last amendment adopted 06-06-2008
- Act on Energy Economics
- Ordinance on Access to the Natural Gas Grid

- Ordinance on Remuneration for Supply to the Natural Gas Grid
- Ordinance on Regulating Incentives
- Ordinance on Biomass
- Rules of the Federal Grid Agency on Gas Balance Regime
- Act on Renewable Energy Heat
- Act on Combined Generation of Heat and Power.

2.10 SWOT analysis

A summary of the SWOT analysis for each country concerning this topic, divided per step in the chain is given in the following table.

SWOT	Biomass resource	Biogas production	Upgrading	Distribution transportation	Injection	Whole chain
<i>Strength</i>	We are using waste water treatment and butcheries residues only. There is other unused biomass resource (like: pigs, cattle and poultry manures).	Favourable purchasing tariff for electricity from RES. Only several waste water treatment and industrial companies are producing biogas.	Free market.	Near biggest towns are developed pipelines.	distribution	Region has unused potential of biogas producing.
<i>Weakness</i>	Farmers are not cultivating energy plants. People are conservative in habits.	There are not clear situation, national policy and regulation. Nimby effect	Lack of awareness of the possibilities;	In region are private lands, and people are conservative in habits. So, lack of awareness of the possibilities;	Lobby activity of gas company.	Lobby activity of gas company. No market for digestate
<i>Opportunity</i>	There are possibilities to cultivate green biomass resources (crops, maize, oats end etc.). There are a lot of possibilities to use: pigs, cattle and poultry manures.	Biogas production market is free. There are possibilities to use biogas instead natural gas in local boiler-houses (in little towns).	Upgrading can to give opportunity to use biogas in vehicles and etc.	There are small region areas without developed distribution pipelines. There are possibilities to use biogas in local boiler-houses instead natural gas.	Natural gas grids are enough developed. So there are opportunities biogas plants connected to natural gas grids.	We can develop this segment of market.
<i>Threat</i>	Farmers will cultivate mainly energy plants. Competition	Actors are afraid that investments to biogas plants will not payback. Strong local opposition		Lobby activity of gas companies Bureaucratic procedures Lack of quality standards A more diverse energy portfolio and greater energy security Reduce of the amount of biowaste		

2.11 Recommendations

The following recommendations can be formulated for each step in the process chain:

Biomass resource

- Create favourable conditions for farmers for long term supply contracts
- Involve farmers into the operating companies and participate them at revenue
- Organise projects for regional development
- Improve conditions for the use of biowaste.

Biogas production

- Build a biogas store at every plant to secure constant delivery
- Guarantee equal biogas quality, mainly high methane-content
- Improve the use of digestates, f.e. as fertilizer to close the matter circle or by combined generation of electricity and heat (for heating the digestion tank)
- Implement best available practise to capture methane-emissions from digestates.

Upgrading

- Select an upgrading technology with low methane slip and low operational costs.

Distribution/transportation

- Change the definition of "plant" in the legislation to allow optimised plant sizes orientated at the benchmark: regional supply of biomass
- Build integrated plants with no need for distant transport.

Injection

- R&DT to build, test and implement reliable, certificated and inexpensive measuring devices for biomethane quality.

Whole chain

- Implement certification of origin to exclude betrayal
- Look for integration of all stakeholders of the added-value chain (farmers, engineering or manufacturing company, grid operator, investors)
- Optimise the whole chain
- Guarantee operational stability of the whole chain
- Tax incentives should favour projects with technological innovation and low environmental impact; today, there are no such criteria for giving tax incentives
- The requirements and procedures for environmental impact assessment should be harmonised across the regions

- Premiums under the special system should be reallocated to favour less developed technologies
- Incentives should be developed to support investment in the development of new technologies
- Developers of projects for renewable energy sources should get discounts for their payments to mutual guarantee societies.

2.12 Questionnaire

In WP7, Supply chains and market structures for biogas use (Month 15-24, February-November 2008), BTG is responsible for D22: An overview of existing supply-chains and market structures by their potential for increasing the biogas use for heating and cooling.

In order to prepare D22, input is needed from Task 1, 2 and 3. The respective task leaders BTG, INIG and DBI agreed to develop one common questionnaire for data collection.

Information of the whole process chain and the market structure need to be analyzed for the EU27 countries. The different aspects are listed in Matrix 1. Task partners are requested to use the matrix as basis for the more detailed question. The answers to this questionnaire will be the basis for WP7 task 1, 2 and 3.

We divide the 27 countries among the co-operating task partners and ask you to collect the necessary information about the assigned countries. Please return the information before the end of August 2008 and contact us in case there are questions or problems regarding this deadline.

DBI	BE, LUX
BTG	NL, SE
GIF	IT
INIG	PL, Latvia
CRES	GR, PT, SP
FEE	D, AT, Ireland
UNI Miskolc	HU, Finland, SE
ETE	RO, Cyprus, BG
ICT	CZ, SK
EAV	SL, MT
LEI	LT, Estonia
ECN	DK
DVGW	F, UK

Schematic, the process chain can be illustrated in a simple way as shown in Figure 1.

Important general question: is the matrix complete for the country under consideration? Please make additions where appropriate.

Ad Row A: Process or aspects

1. What are the specific sources of biomass in examined country?
2. What volumes are available (in general)
3. Are the specific types of biomass heavily influenced by weather or season?

Ad Row B: Actors

4. Indicate which actors are relevant for each technology chain
5. Indicate in what way the actors are important for the technology chain
6. Indicate the influence of the actors on each individual process step of the chain
7. Indicate the influence of the actors on the whole process chain

Ad Row C: Motivation / Interest

8. Indicate what motivation each actor as defined above could have to participate in this technology chain. (Specify for the examined country).
9. What motivates market actors to use specified source of biomass?
10. The interests of the actors differ, while the biogas sector is seeking for a common interest/approach to increase the production and usage. How can this be achieved?

Ad Row D: Alternatives / Competitors

11. What is currently done with the biomass that is not used for digestion/gasification? What are the alternatives?
12. Is gasification competing with anaerobic digestion?
13. What is the driving force behind each alternative/competitor?

Ad Row E: Obstacles

14. What barriers and obstacles exists for further development of the technology chain?
15. What barriers and/or obstacles are foreseen in the future for this technology?
16. Are there any environmental laws that make implementations difficult?
17. Are the specific types of biomass heavily influenced by weather or season?

Ad Row F: Market

18. How many biomass suppliers are on the national market?
19. Is there any difference between biomass prices?
20. Does the country import or export biomass?
21. Give an indication of the number of plants in the country and the general size/capacity
22. What strategies are competitors pursuing and how successful are these strategies?
23. Identify who the most direct competitors are and on what basis they compete? (per column)
24. What are the strengths and weaknesses of competitors?
25. What other organizations exists in the market?

Ad Row G: Support Legislative & Regulatory

26. Are there any law regulations, which motivate market actors to use specified source of biomass?
27. Is there any financial support or funding for using biomass by actors?
28. Are there any norms to use biomass by specified group of actors?
29. Which legislative & regulatory support measures are in place for each process step of the chain?
30. What is the most important support measure for the whole chain?

Answering the above questions should lead to a clear view of the market and the possibilities for implementing the technology in each country. Please conclude with the development of a general SWOT analysis for the country concerning this topic, divided per step in the chain:

SWOT	Biomass resource	Biogas production	Upgrading	Distribution transportation	Injection	Whole chain
Strength						
Weakness						
Opportunity						
Threat						

Strengths: attributes of the sector that are helpful to achieving the objective.

Weaknesses: attributes of the sector that are harmful to achieving the objective.

Opportunities: **external** conditions that are helpful to achieving the objective.

Threats: **external** conditions which could harm the business's performance.

3 D23 - A list of recommendations for installing “Biogas feeding-in and feeding-out pools”

Deliverable: D23

Full title:

A list of recommendations for installing “Biogas feeding-in and feeding-out pools” on the basis of the detected supply chains with the highest biogas use potential. The pools will be installed on national level, be connected EU-wide and act as “Lighthouses”. They will be multipliers for the broad dissemination. D21 is the operational part of the complex D23/D24. Target groups: 1 and 2 (Gas industry and its branch organisations).

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3.1 Methodology

The market structure was analyzed by carrying out a SWOT analysis in every member country. As there were not partners from all member states, the co-operating task partners were assigned to collect information from the rest of the countries.

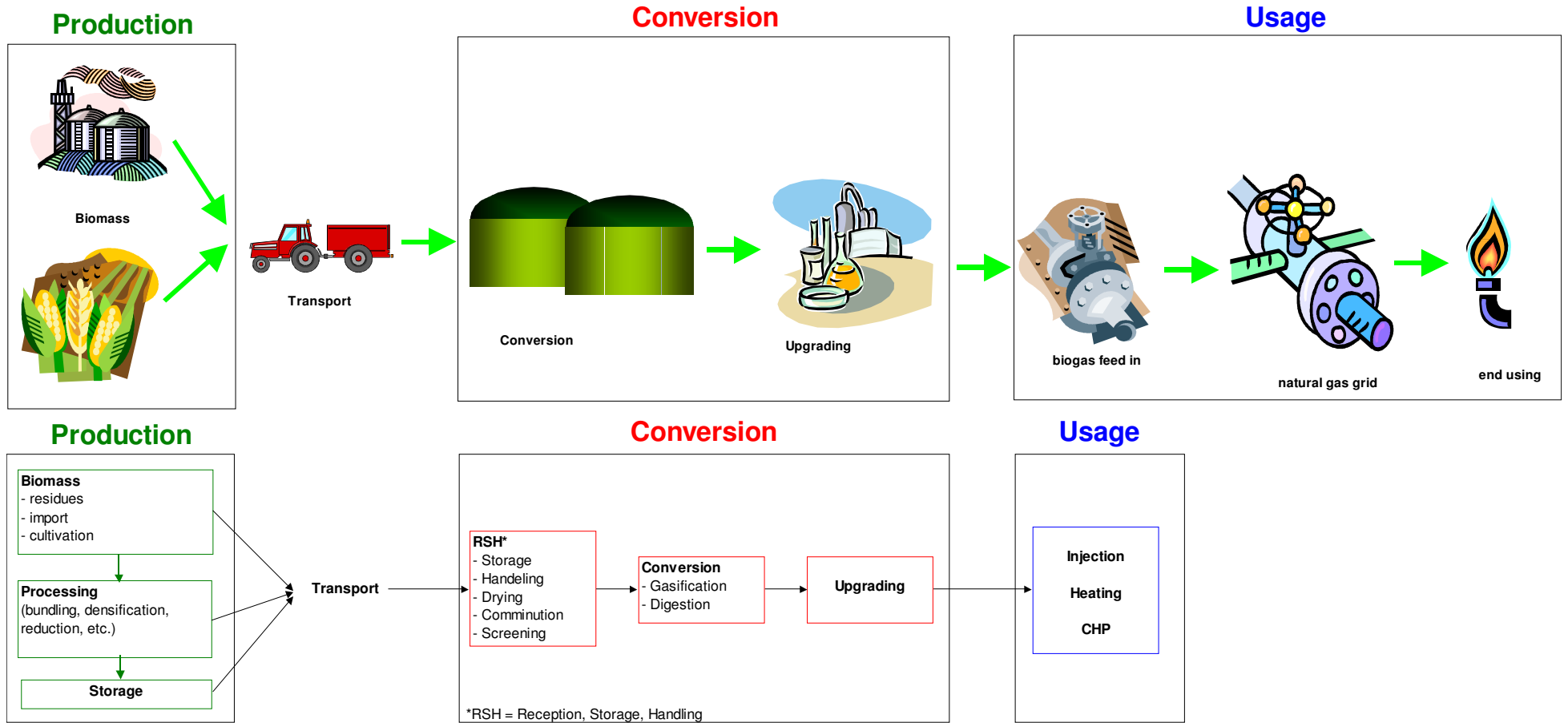
The input for Belgium and Luxemburg was provided by DBI, for Germany by FEE, for Italy by GIG, for Poland and Latvia by INIG, for Czech Republic by ICT, for Estonia and Lithouania from LEI and for Hungary by UNI Miskolc and ETE.

For the rest of the countries studied below, information was collected from personal contacts, existing literature, articles in journals and presentations available in the internet.

The biogas production data in the tables were taken from the Euroobserver, the Biogas barometer published in 2008.

The supply and process chains are illustrated in a simple way as shown below. Recommendations refer to the main three stages of the biogas supply chain:

- **biomass production,**
- **conversion,**
- **usage**



Source: BTG, D22

3.2 List of recommendations

Basic recommendations

Biomass production

For the liquid manure it is important to keep the dry matter content as high as possible by reducing water consumption in the stables and avoiding rain water to go in the manure system.

Solid manure from feed lots (cows) where it is removed with sand and soil is not suitable. Manure from poultry has a high energy content but also a high nitrogen content that can inhibit traditional biogas systems. If we can get a high amount of poultry manure it normally pays to build in equipment for handling biomass with high amount of nitrogen.

Figures on manure production given from the farm rather than calculated by models is important because it provides with an indication of the dry matter content of the manure. A drawing showing stables, manure outlets from the stables, manure storage facilities (possible pre-tanks and storage tanks), access roads and possible obstacles in getting access to the farm, etc are required in order to make credible assessments on how to pick up the manure and the costs of equipment, etc.

All industries manufacturing food will have residuals suitable for biogas production; the price however is an important factor, as it is difficult to get a clear answer from the industries in relation to the present cost of the handling. In certain countries/regions there are waste collection companies which could supply the wastes (mainly fat) to the biogas plant.

Multi biomass feedstock is recommended, with 80% manure and 20% agroindustrial wastes. The latter improve the biogas production, mainly the fats from slaughterhouses and the wastes from the olive-oil primary and secondary conversion.

Specific questionnaires are recommended interviewing the industries on the type of residues they produce, seasonality of the residues, sanitation procedures they follow, lab tests analyses they are able to carry out, present handling procedures, transportation facilities, supply to biogas plants, etc.

Long-term contracts between biomass producers and the biogas plants operators are required in order to guarantee the biomass supplies and reduce the project investment risks.

Conversion

The biogas process is a complex microbiological process with many decomposition steps. Research and development has to target in optimizing the process and increase the amount of methane that can be extracted, while quantifying and minimising the microbial risks from the usage of gas. Research topics should include studies of the nutritional and environmental requirements of the important microorganisms involved, new substrate mixtures (e.g. seaweed) and pre-treatment technologies (e.g. treatment with enzymes and ultra-sound), different digestion methods (e.g. two-step digestion, dry digestion etc.) and development of measurement and sensor techniques to monitor the status of the process.

RTD is also recommended on second generation biogas from gasification of lignocellulosic biomass as well as on CO₂ conversion to additional fuel by electrochemical process.

Support demonstration projects based on the existing biogas plants lay-out in order to build practical, hands-on experience on how a biogas industry can develop.

Usage

A harmonized definition of what is biomass for all Europe is still missing. This would greatly contribute towards a European collaboration in terms of policies and trade.

EU Directives in relation to energy and climate change have to be adopted by the National Laws of all Member States.

The National or European targets however, have to be supported by a number of economic incentives and measures. Among others, the most important are energy taxation which encompasses energy, carbon dioxide and sulphur taxes, electricity certificate system, the feed-in tariff system, and the emission trading system.

Additionally, public aid should be granted in the form of subsidies or incentives to investors to compensate for the high investment and operating costs of the biogas plants, at least at their initial phase.

Common technical standards for the upgraded biogas have to be applied in all EU Member States for nationally produced or imported biogas to facilitate biogas distribution and trade.

Politicians and other decision-makers should strengthen their support in order ensure the successful development of biogas in the future.

3.2.1 Austria

Main features of the biogas market

The primary energy production of biogas in Austria in 2006 amounted to 118 ktoe and is estimated to have reached 139 ktoe by 2007. It is mainly produced by agricultural codigestion units (350 units in 2007) and household units (15 units) [Euroobserver, 2008].

The growth rate was 18% from 2006 to 2007, and that was contributed to the even greater growth of biogas production from agricultural and household units (22.2%). 88 – 91% of the energy produced in 2006 and 2007 respectively originated from agricultural and household units, whereas 9.4% and 7.7% have been produced by landfill gas. Biogas is used in electricity generating plants.

Austria	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	11,2	10,7	-4,46%
Sewage sludge gas	3,5	2	-42,86%
Other biogasses	103,4	126,4	22,24%
Total	118,1	139,1	17,78%
Gross electricity production of biogas (GWh)			
Electricity plants only	424,1	469,8	10,78%
CHP plants	23	22,8	-0,87%
Total	447,1	492,6	10,18%
Gross heat production of biogas (ktoe)			
Heat plants only	4,7	4,3	-8,51%
CHP plants	4,2	4,2	0,00%
Total	8,9	8,5	-4,49%

Source: Euroobserver, 2008

According to the Biogas Road Map for Europe, published by AEBIOM, there are 240 decentralised biogas plants operating in Austria in 2008, with an average capacity of 260 kWe. The feedstock is grown in short distances from the plants, so transportation requirements and relevant costs are minimal.

Biogas is mainly used for electricity generation, with approximately 350 plants in operation; however the spare heat cannot be used efficiently. Biogas upgrading to biomethane and/of fuel is starting¹.

¹ R. Braun. Short Report – Status Austria 2009. IEA Task 37. Energy from Biogas and Landfil Gas. Available at: http://www.iea-biogas.net/Dokumente/countryreports/09/austria_report409.pdf

Recommendations

Biomass production

The manure that is available at sufficient quantities has to be used with all other industrial residues and energy crops all year around, so as to compensate for the fluctuation in the prices of cereals and other energy crops that are anticipated to directly influence the development of the biogas market.

Usage

The regulatory framework for electricity generation is considered sufficient. The buying price of 17 €/kWh is particularly favourable for small scale installations of less or equal to 100kWe capacity. Only plants that use the produced heat (excluding their process heat consumption) are permitted to feed-in electricity into the grid with favourable conditions, leading thus to a better overall efficiency (Biogas Road Map of Europe). However, incentives should be given for other uses of biogas, i. e as a transport biofuel or substitute to natural gas.

As far as the upgrading of biogas is considered in order to substitute natural gas, or as a transport fuel, financial support is necessary, because of the high investment and operating costs, which are even higher in comparison to other methods of utilization of biogas.

Creation of technical standards would help in stabilizing the supplies and guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas. Introducing new technical standards will improve the competition between upgraded biogas with natural gas

Reinforcement of the natural gas grid so as to support the biogas injection is required.

3.2.2 Belgium

Main features of the biogas market

The primary energy production of biogas in Belgium in 2006 amounted to 77.6 ktoe and is estimated at 78.6 ktoe by 2007 produced mainly from landfill gas. According to the table below, with data from the Biogas barometer [Euroobserver, 2008], it is depicted that the use of other than landfill gas and sewage sludge biogas sources is growing by 38% from 2006 to 2007. These sources involve decentralised agricultural plants, municipal solid waste methanisation plants and centralised co-digestion plants.

Belgium	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	51	48,1	-5,69%
Sewage sludge gas	17,6	18	2,27%
Other biogasses	9,1	12,5	37,36%
Total	77,7	78,6	1,16%
Gross electricity production of biogas (GWh)			
Electricity plants only	158,3	152	-3,98%
CHP plants	120,6	127,4	5,64%
Total	278,9	279,4	0,18%
Gross heat production of biogas (ktoe)			
Heat plants only	1	1,6	60,00%
CHP plants	12,9	12,6	-2,33%
Total	13,9	14,2	2,16%

Source: Euroobserver, 2008

The Belgian company OWS (Organic Waste Systems) is currently operating in the country with 16 methanisation units of industrial sizes, having a treatment capacity of 524,500 tons. Two more units will be operated in 2008, one in Tenneville/Belgium with a capacity of 39,000 tons and the second in Kempten/Germany, with a capacity of 18,000 tons [Euroobserver, 2008].

Recommendations

Biomass production

The manure that is available at sufficient quantities has to be used with all other industrial residues all year around.

In Wallonia region the wastes have to be separated.

Usage

Financial support and rules supporting bioenergy in Belgium are required to increase the production of biogas. There are two different compensation systems of Flanders and Wallonia which have to be combined. In the Flemish region, a 40% support is granted in companies for heating installations and material using renewable fuels (biofuels, biomass). A 30% support is granted in companies for installations and material required for the production of renewable energy sources (such as oil press installations). Environmental friendly investment in the region is eligible for an ecological premium (35% for SMEs and 25% for big companies). Several projects promoting biofuels are defined under the Climate Policy Plan of Flanders (2006 - 2012) (www.cres.gr/biodiesel, D7, D18). On the other hand, the Walloon region has appointed a facilitator to support project developers for production and use of biofuels but no direct financial subsidy for promoting biofuels has been made available so far.

Financial incentives to feed-in to the grid (also for heat), additional use of biogas for heating, financial aid to improve the competitiveness in relation to non-renewable energy (i.e. tax advantages) and linking of biogas application with urban development and environmental permissions are expected to provide incentives for a competitive biogas market.

Towards that direction, reducing bureaucratism (i.e. building license) as well as creating partnership clusters at local - regional - national level would facilitate the development of the biogas market.

Introducing a Research-and Development-department to increase the quality of biogas and organising courses to convey technical know-how and qualifications to farmers would also help towards improving biogas quality. Relevant information campaigns about the advantages of biogas would allow its public acceptance.

3.2.3 Bulgaria

Main features of the biogas market

There is no biogas market in Bulgaria yet (no interest for biogas use) although there is a substantial potential of 388 ktoe, deriving from animal wastes (320 ktoe) and landfill gas (68 ktoe)². The regulatory framework and supporting and incentive measures for biogas use are considered fair, whereas there is not any business or economic cooperation among relevant stakeholders³.

Most biomass is used in the residential sector (about 80%), in the form of firewood. Most of the remainder (17% of total) is used for energy production in industry⁴. Biomass applications for electricity generation are limited only to a couple of CHP installations using the wastes of the pulp and paper industry⁵.

In 2007, electricity is generated by thermal, nuclear and hydro power stations, almost all being state-owned. Coal represents a significant share of the fuel mix and is widely used for electricity, space heating and in industrial processes³.

Conventional thermal power plants seem to be the most interesting from the market point of view, as they generate nearly half of the electricity in the country; around 60% of them use lignite, 23% use coal and the rest 10% use natural gas³. The increased contribution of the private sector that is recently reported in the food industry, agriculture, civil services, etc.⁶, and the privatization of these plants will result in establishing new actors in the field of electricity production and thus contribute towards the increasing of the biomass use.

Recommendations

Biomass production

Although nuclear energy will be needed in the long run³, additional electricity could be produced from alternative local and renewable sources if proper incentives are to be established, in the form of:

- direct aids to farmers to grow energy crops; it is reported that 8% of the agricultural land in Bulgaria is not used⁷,
- as the land is split to many owners, awareness campaigns are also crucial to stimulate farmers' interest
- direct aid and incentives for cattle breeders to organise the logistics (collection, storage, distribution) of their animal wastes

² Angel Nikolaev, Development of a strategy and national policies for biomass energy in Bulgaria, Black Sea Regional Energy Centre, June 19, 2006. Available at: http://www.biomasa.sk/files/jrcbiomass_bulgaria.pdf

³ Personal communication with Denitsa Dimitrova, ENERGOPROEKT Jsc. Bulgaria

⁴ <http://www.bioenergy-in-motion.com/index.php?id=3&sld=15>

⁵ P. Ganev. Bulgarian electricity market restructuring. Utilities Policy 17 (2009) 65–75

⁶ http://www.joanneum.at/ief/erabioenergy/data/pass/presentation/2002/Presentation_Bulgaria.pdf

Usage

Legislation should strengthen the state support for biogas production and use, which could be in the form of:

- Subsidies. Current investment subsidies do not compensate for the high investment and running costs.
- feed-in tariffs, that allow adequate compensation
- tax alleviations for use of biogas for electricity and other energy forms
- incentives for investors to increase productivity
- reducing bureaucratism (i.e. building license) as well as creating partnership clusters at local - regional - national level would facilitate the development of the biogas market.

Public acceptance has to be assured by continuous information campaigns and training of the involved actors.

3.2.4 Cyprus

Main features of the biogas market

Cyprus ranks the last among the EU Member States as regards biogas production. The primary energy production of biogas in 2007 is estimated at only 0.2 ktoe produced by small methanisation units [Euroobserver, 2008].

Cyprus	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas			
Sewage sludge gas			
Other biogasses		0,2	
Total		0,2	
Gross electricity production of biogas (GWh)			
Electricity plants only			
CHP plants	0,2	1,4	600,00%
Total	0,2	1,4	600,00%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	0,02	0	-100,00%
Total	0,02	0	-100,00%

Source: Euroobserver, 2008

The general development level of the biogas market is low but promising. Only some plants exist, but awareness of target actors and potential is substantial.

Recommendations

Biomass production

There is a substantial potential in biomass resources which is still unused. The cooperating actors are cattle breeders who have designed and will now start operating cattle breeding wastes collection systems at two areas of Cyprus. The wastes that will be collected will be processed in central biogas production units. The goal of these incentives is the minimization of capital costs (common design and construction procedure) and operational costs of the biogas production (mainly transportation costs)⁸.

Support shall be thus granted to the feedstock supply chain. It could be in the form of direct aid/incentives to the cattle breeders/investors dealing with the logistics (collection,

⁸ Personal communication with Mr. Dimitris Glekas, AEOLOKI ltd

transportation, storage, etc) of the biodegradable wastes deriving from cattle manure or agro-food industries.

Usage

The regulatory framework is good, assuring an electricity price from biomass at 13.5 c/kWh and electricity price from biogas at 11.45c/kWh, but there is fair business and economic cooperation among actors. In addition, an incentive scheme is promoted by the Cyprus Government, providing subsidies for biogas production.

However, considerable support shall be granted to biogas plants in order to initiate investments on biogas as there is no previous experience.

As far as the upgrading of biogas is considered in order to substitute natural gas, financial support is necessary, because of the high investment and operating costs, which are even higher in comparison to other methods of utilization of biogas.

Creation of technical standards would help in stabilizing the supplies and guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas.

Although awareness of target actors and potential is reported as substantial, dissemination actions and forming clusters of local stakeholders and public biogas operators are considered crucial to boost the development of the biogas market.

3.2.5 Czech Republic

Main features of the biogas market

The primary energy production of biogas in the Czech Republic in 2006 amounted to 63.4 ktoe and is estimated at 78.5 ktoe by 2007 produced equally from landfill gas and sewage sludge [Euroobserver, 2008].

As in the case of Belgium, the primary energy production from decentralised agricultural plants, municipal solid waste methanisation plants and centralised co-digestion plants is expected to grow in the years to come.

Czech Republic	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	24,5	29,4	20,00%
Sewage sludge gas	31,1	32,1	3,22%
Other biogasses	7,8	17	117,95%
Total	63,4	78,5	23,82%
Gross electricity production of biogas (GWh)			
Electricity plants only	63,1	80,3	27,26%
CHP plants	112,8	142,6	26,42%
Total	175,9	222,9	26,72%
Gross heat production of biogas (ktoe)			
Heat plants only	10	9,6	-4,00%
CHP plants	13,9	14,3	2,88%
Total	23,9	23,9	0,00%

Source: Euroobserver, 2008

Recommendations

Biomass production

The strong points of biogas development in Czech Republic is the high potential in biomass resources and the available, still unused, agricultural land that could support energy crops cultivation for anaerobic digestion, although that should take into account the future needs of the food and feed market. There is also great potential of biodegradable waste.

Support shall be granted to the feedstock supply chain. It could be in the form of direct aid to farmers growing energy crops for biogas production and incentives for investors dealing with the logistics (collection, transportation, storage, etc) of the biodegradable wastes deriving from cattle manure or agro-food industries.

Usage

There is a strong and developed biogas market in the country with highly efficient technologies available in the market and strong RTD. A large coverage with gas grid exists in Czech Republic. However support shall be granted to biogas plants in order to initiate investments on biogas as there is no previous experience. As far as the upgrading of biogas is considered in order to substitute natural gas, financial support is necessary, because of the high investment and operating costs, which are even higher in comparison to other methods of utilization of biogas.

Towards that direction, defining of rights and duties of producers and gas companies, setting up of green bonuses for biomethane producers and other beneficial policies could efficiently contribute to the development of the biogas market in the country.

A definition of biomethane quality is needed and the creation of technical standards would help in stabilizing the supplies and guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas. Introducing new technical standards will improve the competition between upgraded biogas with natural gas

Dissemination actions and forming clusters of local stakeholders and public biogas operators are considered crucial also for Czech Republic. A willingness of gas grid operators to be involved in this process is being noticed, but the general public opinion is still negative.

3.2.6 Denmark

Main features of the biogas market

The primary energy production of biogas in 2006 amounted to 93 ktoe and is estimated at 98 ktoe by 2007 [Euroobserver, 2008]. With 20 centralised plants and over 35 farm-scale plants, the digestion of manure and organic waste is a well established technological practice in Denmark⁹. These units use mainly liquid manure mixed with municipal wastes and wastes from the food industry.

Biogas is mainly used in CHP plants and the produced heat is recovered by a large network of district heating plants.

Farmers were the main driving force in the development of the biogas market in Denmark, which is based on the centralised biogas plant concept. Farmers formed cooperatives that collect, store and digest the manure in centrally located biogas plants. In normal situations they do not get a profit from the biogas companies. Instead they gain a number of derived economic benefits as a result of the biogas plant operation¹⁰.

Denmark	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	14,3	14,3	0,00%
Sewage sludge gas	21	21	0,00%
Other biogasses	57,6	62,6	8,68%
Total	92,9	97,9	5,38%
Gross electricity production of biogas (GWh)			
Electricity plants only	1,6	1,6	0,00%
CHP plants	278,4	293,3	5,35%
Total	280,1	295	5,32%
Gross heat production of biogas (ktoe)			
Heat plants only	3,7	4,7	27,03%
CHP plants	17,1	18,8	9,94%
Total	20,9	23,6	12,92%

Source: Euroobserver, 2008

⁹ R.P.J.M. Raven, K.H. Gregersen. Biogas plants in Denmark: successes and setbacks. *Renewable and Sustainable Energy Reviews* 11 (2007) 116–132

¹⁰ Kurt Hjort-Gregersen. Development and implementation of the Danish centralised biogas concept – Financial aspects. In E.C. van Ierland and A. Oude Lansink (eds.), *Economics of Sustainable Energy in Agriculture*, 177–188. © 2002 Kluwer Academic Publishers. Printed in the Netherlands.

According to Raven and Gregersen¹, three factors have been important for the current status of biogas plants in Denmark:

- First, the Danish government applied a bottom-up strategy and stimulated interaction and learning between various social groups.
- Second, a dedicated social network and a long-term stimulation enabled a continuous development of biogas plants without interruptions until the late 1990s.
- Third, specific Danish circumstances have been beneficial, including policies for decentralised CHP, the existence of district heating systems, the implementation of energy taxes in the late 1980s and the preference of Danish farmers to cooperate in small communities. The current setback in biogas plants is mainly caused by a shift in energy and environmental policies and limited availability of organic waste.

Recommendations

Biomass production

Although the development of this centralised biogas plant has advanced the most in Denmark, there is now a long period without the construction of new plants or further research on new, technologically and economically improved, sustainable technologies. Therefore, clusters of representatives from industries, researchers, users and policy makers should be formed and work to improve the technical, economic, regulatory and social context of the biogas deployment in the country.

With anaerobic digestion having reached a sound maturity level and market penetration, further RTD should be developed towards the direction of further cost reductions, improved gas production and gas utilization.

Since biogas is mainly used for heat and power generation, alternative markets should also be developed in the country, such is biogas upgrading and injection in the natural gas grid. Biogas is also an excellent transport fuel widely used in Sweden in public fleets. The utilization of the biogas in fuel cell could also be an interesting perspective for new applications.

The continuity and stability of the existing preferential to biogas governmental policy is of utmost importance.

3.2.7 Finland

Main features of the biogas market

The primary energy production of biogas in 2006 amounted to 36.4 ktoe and remained stable in the following year [Euroobserver, 2008].

Finland	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	26,1	26,4	1,15%
Sewage sludge gas	10,4	10,3	-0,96%
Other biogasses			
Total	36,4	36,7	0,82%
Gross electricity production of biogas (GWh)			
Electricity plants only	0,9	0,9	0,00%
CHP plants	21,4	21,4	0,00%
Total	22,3	22,3	0,00%
Gross heat production of biogas (ktoe)			
Heat plants only	2,5	2,5	0,00%
CHP plants	19,7	19,7	0,00%
Total	22,1	22,1	0,00%

Source: Euroobserver, 2008

According to the Finnish Biogas Register XI - Year 2007 Summary, there were 15 biogas reactor plants in operation at different municipal wastewater treatment plants by the end of 2007. Industrial wastewaters were treated anaerobically at three different plants, one at a fluting mill and two in food-processing industry. Farm scale biogas plants were operating at 8 places. Municipal solid wastes were treated at three biogas plants: Stormossen and Laihia plants, both near the city of Vaasa, and Biovakka in the south-western Finland. There were altogether 33 landfill gas recovery plants operating at the end of 2007. The advance in landfill gas utilization is due to increase of utilization especially in Ämmässuo dump in Espoo.

In addition there are about 500 gas vehicles in the country and around 11 public natural gas fuelling stations in Southern Finland with more to come in the following year¹¹, whereas it is possible to inject biomethane into the natural gas grid. As a consequence, a farm-scale biogas fuelling station outside the natural gas grid near Jyvaskyla is expected. Moreover, about 15 biogas vehicles fuelling is possible with a potential of 200 cars fuelling with the farm's new biogas plant.

¹¹ Jukka Rintala. Country Report Finland. University of Jyvaskyla.

RecommendationsBiomass production

R&D is required on new feedstocks, like wastes from the pulp and paper industries, biorefinery industries, etc.

R&D is required on new energy crops, dealing with new crops, more productive and less demanding, cultivation methods, harvesting times and methods, storing, pre-treating, etc.

Usage

A higher diffusion of biogas technologies in all other sectors has to be implemented and that would be achieved with proper legislative measures. The main feedstock developed in Finland is landfill because of the preferential legislative framework.

3.2.8 France

Main features of the biogas market

France is the 5th in the list of the EU Member states in terms of energy production from biogas but the 14th in terms of the biogas produced per capita. The primary energy production of biogas in 2006 amounted to 300 ktoe and is estimated at 310 ktoe by 2007 almost equally produced from landfill gas and sewage sludge gas. The other biogases refer mainly to five household methanisation units [Euroobserver, 2008].

France	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	150,5	161,3	7,18%
Sewage sludge gas	144	144,2	0,14%
Other biogasses	3,6	3,7	2,78%
Total	298,1	309,2	3,72%
Gross electricity production of biogas (GWh)			
Electricity plants only	487,3	505,3	3,69%
CHP plants	35,4	35,7	0,85%
Total	522,7	541	3,50%
Gross heat production of biogas (ktoe)			
Heat plants only	44,4	47,4	6,76%
CHP plants	5,8	5,8	0,00%
Total	50,2	53,2	5,98%

Source: Euroobserver, 2008

Biogas production is increasing by almost 10% every year during the last decade and power production from biogas is increasing by 18% every year. The economic incentives that promoted biogas development in the country were the price for electricity from biogas and the feed-in-tariff, revised in July 2006¹².

Recommendations

Biomass production

Support shall be granted to the feedstock supply chain. It could be in the form of direct aid/incentives to the cattle breeders/investors dealing with the logistics (collection,

¹² Christian Couturier, SOLAGRO. Overview of centralized biogas plants projects in France

transportation, storage, etc) of the biodegradable wastes deriving from cattle manure or agro-food industries.

Promote the centralised biogas plant concept of Denmark as that could help farmers to fairly share the economic advantages and costs.

Usage

As biogas is mainly used in electricity producing plants incentives should be given for alternative markets.

The development of district heating systems that would absorb the excess heat produced by the biogas plants would give a very strong incentive for biogas investors, since that would improve the plant economics.

Setting targets and prices for heat production from biomass and applying long term financing support mechanisms would greatly enforce the biogas investments.

Promoting heat consumption in the domestic and tertiary sectors as well as in the industry would significantly boost the biogas market by increasing the demand.

Other alternatives for the use of biogas are its upgrading and injecting into the natural gas grid or as a biofuel for transport. For this reason, extensive technical measures have to be applied to deliver biogas in due quality, time and pressure.

Proper technical quality control mechanisms have to be applied. To that extent, a common certification system has to be applied for all EU countries and outside Europe.

Reinforcement of the grid so as to support the biogas injection is required.

Financial measurements supporting the high investment costs are necessary.

The quality and commercialization of solid digestate from biogas plants, hazards from the biogas plants as well as the specific biogas canalization have to be properly and clearly addressed by the relevant legislation framework.

Clusters of biogas producers, converters and users have to be organized so that the biogas market will be deployed and not be distorted by new investments.

Business plans including technical assessment, environmental studies, financial and risks assessment will greatly contribute towards the planning the development of the biogas market in the country.

3.2.9 Germany

Main features of the biogas market

Germany is the leading country in biogas production in Europe. The primary energy production of biogas in Germany in 2006 amounted to 1,665.3 ktoe and is estimated at 2,383.1 ktoe by 2007 produced mainly from small farm methanisation units [Euroobserver, 2008]. The largest biogas potential is in agriculture, which contributes about 70% of the primary energy production. At the end of 2007 there were around 3,700 agricultural biogas production units, using mostly energy crops (maize, wheat, sunflower, etc). Their electrical power totals 1,100 MW and thermal power 2,200 MW. Germany aims to increase the share of biogas in electricity and heat production so as to produce the 17% of the country's entire electricity production by 2020.

Germany	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	383,2	416,4	8,66%
Sewage sludge gas	270,2	270,2	0,00%
Other biogasses	1011,7	1696,5	67,69%
Total	1665,3	2383,1	43,10%
Gross electricity production of biogas (GWh)			
Electricity plants only			
CHP plants	7446	9520	27,85%
Total	7446	9520	27,85%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	8,7	8,7	0,00%
CHP plants	14,5	14,5	0,00%
Total	23,2	23,2	0,00%

Source: Euroobserver, 2008

Upgraded biogas (sewage gas) was injected in Germany very early, in 1982 in a sewage treatment plant in Viersen at the low calorific gas grid (L-Gas), followed by another plant built in the frame of an EU-demonstration project, in 1984 in a sewage treatment plant in Stuttgart, which fed into the high calorific gas grid (H-Gas). Both plants had a capacity of

about 400 m³ raw gas per hour. The plant in Viersen was shut down in 1998, the one in Stuttgart in 1999, after successful operation [BIOCOMM Project]¹³.

Recommendations

Biomass production

Due to the high investment costs and the economies of scale, large agricultural areas may be needed, since biogas is mainly produced from cereals.

Agriculture is most important source for biogas production in Germany. As the 80% of all farms are below 50 ha a minimum compensation scheme should be considered. It is anticipated that the aid for energy crops, in particular, will give a boost to the development of the biogas market.

Usage

Gas injecting companies have to take over all technical obligations of utilities. They are obliged to deliver gas secure, cost-effective, consumer-and environment-friendly. Therefore, extensive technical measures have to be applied to deliver contracted energy carriers in due quality, time and pressure (i.e. regulate the pressure in the gas pipeline, the distance between gas pipelines and biogas plant, the volume flow through the gas pipeline, the gas quality in the gas grid and condition of the prepared biogas, etc)

Reinforcement of the grid so as to support the biogas injection is required.

Clusters of biogas producers, converters and users have to be organized so that the biogas market will be deployed and not be distorted by new investments.

The legal framework ruling the biogas market in Germany should include all types of biogas (i.e. biogas produced from fermentation or gasification of biomass, landfill gas, etc) and specify the trace substances contained in the biogas produced.

To that extent, any certification system must be applied to all types of biomass; either it goes to the food market or for energy applications. Certification systems should be equally applied to the biomass produced locally, at EU level or is imported from other countries outside Europe.

Financial measurements supporting the high investment costs are necessary.

There has to be cost effective and efficient priority access to all levels, enabling:

- full integration of biogas into the energy supply system,
- development of the available potential,
- new ways of utilization of biogas (for private households, as biofuel, for electricity generation in modern CHP plants)
- independence from local heat producers

¹³ Fachverband Biogas eV (German Association) (GBA). Deliverable D1: Market Analysis Report Deliverable D2: Commercialisation Strategy Report. BIOCOMM Project: 4.1030/C/02-082/2002. Regulation Draft of Biogas Commercialisation in Gas Grid – BIOCOMM.

3.2.10 Greece

Main features of the biogas market

The primary energy production of biogas in Greece in 2006 amounted to 21.2 ktoe and is estimated to almost double (38 ktoe) in 2007 produced mainly from landfill gas [Euroobserver, 2008]. Most of it is used for electricity generation.

Greece	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	21,2	38	79,25%
Sewage sludge gas	8,6	9,8	13,95%
Other biogasses			
Total	29,8	47,8	60,40%
Gross electricity production of biogas (GWh)			
Electricity plants only	69,3	91,3	31,75%
CHP plants	38,5	84	118,18%
Total	107,9	175,3	62,47%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	2,9	3,5	20,69%
Total	2,9	3,5	20,69%

Source: Euroobserver, 2008

Recommendations

Biomass production

The number of animals/ manure production as well as the agro industrial wastes has to be mapped so that credible statistical data are publicly available. Along with cattle manure, low-input crops, agriculture and forest residues should be also used, because they have no requirements for fertile lands or impacts on food and fiber production. They have a good potential in Greece, which is so far not exploitable.

Multi feedstock is recommended, as Greece presents a variety of biomass types. In this case the logistics of the supply chains have to be carefully designed, taking into consideration the types of the feedstock and the seasonability, the mixing ratio, the feedstock properties and storage requirements.

Long-term (i. e 20 years) contracts with farmers and agroindustries are required in advance, in order to guarantee the security of supply, in terms of quantity and quality of the feedstock and minimise the investment risks.

Transportation of feedstock has to be properly designed in Greece, according to the different biomass types, their properties and seasonality. The feedstock before being transported to the main biogas unit has to be characterised as far as its origin and its chemical properties are concerned (i. e pH, dry matter, total solids, pathogenic substances).

To improve the economics of the plant, farms and industries have to be located in a radius up to 30 km.

Significant investment in RTD on lignocellulosic feedstocks aiming to improve crop yields, genetic modification of crops and crop growing techniques are required as well as improvements in efficiency of feedstock collection and logistics.

Finally, a gate fee has to be set up, as to start exploiting the animal wastes and other residual forms.

For Greece, the Centralised Co-digestion concept is recommended according to the Danish model, because of the high number of small-sized animal-breeding units (50,000 units approx) and the wide range of biomass types provided by different suppliers (in contrast to the German model, where there is only one autonomous biogas producer using his own biomass feedstock).

Besides the technical constraints, the legal framework in Greece is more in favour of the Danish model allowing the economic viability of the biogas plants.

Usage

The feed-in-tariff of the electricity produced from biomass (gases released from sanitary landfills and biological treatment plants and biogases) sold to the grid has to be increased from 80.14 €/MWh, that is at present, to at least 100 €/MWh. According to investors, the price should be doubled for profitable investments (without the need for subsidies). Besides the price, reinforcement of the grid so as to support the biogas injection is of outmost importance.

Thermal market does not exist so far in Greece and thus has to be developed, by setting up feed-in tariffs also for heat. A price for thermal energy should be at 60 €/MWh, according to the stakeholders, which will greatly improve the economics of the biogas plant by offering the possibility to sell thermal energy, apart from the electricity.

The market for the fertilisers produced from a biogas plant has to be also developed, by setting a price of 25 €/t, according to the stakeholders, and by creating a cluster of stakeholders which would distribute the material to the end users.

The liberalization of the Greek electricity market and the natural gas market has to be fully implemented in Greece. The market power of the partially state-owned organisations, the Public Gas Corporation S.A (DEPA), the Hellenic Gas Transmission System Operator S.A (DESFA) and the Public Power Corporation (PPC), constitutes a big impediment to effective competition.

Putting in place a one-stop shop for licensing renewables projects is a prerequisite for promoting investments. Clear guidelines for authorisation procedures with a clear attribution of responsibilities to all institutions involved have to be established.

The establishment of a Specific Spatial Planning Framework and Sustainable Development for RES that would indicate the areas with high biomass-to-biogas potential is of outmost importance to deploy the biogas market and minimise the investment risks.

Public acceptance has to be assured by continuous information campaigns and training of the involved actors, because Greece has a strong local resistance on RES investments in general.

Establishing pre-planning mechanisms that require regions and municipalities to assign locations for renewables is also going to help towards public acceptance of biogas plants. Towards that direction, partnerships between biogas and natural gas fuelling stations have to be formed and partnership clusters at local – regional – national level have to be created.

Motives (i.e. tax advantages) and subsidies for biomethane have to be set up so as to be competitive to natural gas.

Finally, a European as well as a national Technology Platform for Biogas to strengthen the biogas lobby should be established.

3.2.11 Hungary

Main features of the biogas market

The primary energy production of biogas in Hungary in 2006 amounted to 12.2 ktoe and is estimated to almost double (20.2 ktoe) in 2007 produced mainly from sewage sludge gas [Euroobserver, 2008].

Hungary	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	1,1	2,1	90,91%
Sewage sludge gas	8	12,4	55,00%
Other biogasses	3,1	5,7	83,87%
Total	12,2	20,2	65,57%
Gross electricity production of biogas (GWh)			
Electricity plants only	22,1	22,1	0,00%
CHP plants	22,1	22,1	0,00%
Total			
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	2,6	2,6	0,00%
Total	2,6	2,6	0,00%

Source: Euroobserver, 2008

Recommendations

Biomass production

In agriculture-based biogas production a further problem arises from the fact that the number of livestock in Hungary has been reduced to 1/3 of its previous figures. The majority of large, concentrated animal husbandry plants that could provide biogas raw materials in sufficient quantities have ceased to exist. On the other hand, in Hungary approximately 60% of the towns and villages have a sewage system where biogas is produced. The construction of new sewage systems is almost continuous, although it lags behind the preferable pace. However, there is not information on whether these systems are operated or not. In this case it is recommended to implement national statistical surveys on the technically available quantities of the biomass resources and the biogas production in the country.

Usage

An efficient system direct or indirect subsidy is needed to balance the difference between the high costs of the energy unit produced by biogas and the energy unit produced by any other source. Today there is no expedient system of subsidy promoting the proliferation of biogas in Hungary.

Such a system should also set direct or indirect subsidies for improving/upgrading the quality of biogas or feeding the upgraded gas into the natural gas system. Upgrading the quality of raw biogas involves considerable costs.

The mandatory acceptance of 'green electricity' produced from renewable sources of energy is stipulated by law in Hungary. The official unit price (set by the authorities) of green electricity is considerably higher than that of electricity available in the liberalized Hungarian energy market. For an increase in the production and use of biogas it is recommended to amend the Law, so as to provide for the mandatory acceptance of biogas as 'green gas' and for the official price to ensure predictable and guaranteed profits for investors.

The technical-safety requirements for feeding biogas into the natural gas system have to be regulated in Hungary. According to the (non-official) standpoint of the gas distribution companies there are no obstacles to feeding biogas into the system if the gas and combustion technological parameters of the biogas correspond to those of natural gas.

At present the annual amount of natural gas meeting the demand is available in Hungary. The natural gas saturation of the country is high at 42% and there is no substantial unsatisfied realistic demand for gas on the consumer side. There is real demand for less expensive energy and less expensive gas. If as a result of subsidies, upgraded biogas could be marketed at a lower price than that of natural gas, the emergence of a consumer demand for biogas could be envisaged.

In Hungary there is usually a great deal of bureaucracy and the official licensing procedure of investments is circuitous and frequently complicated. Putting in place a one-stop shop for licensing renewable projects is a prerequisite for promoting investments. Clear guidelines for authorisation procedures with a clear attribution of responsibilities to all institutions involved have to be established.

Public acceptance has to be assured by continuous information campaigns and training of the involved actors.

Biogas does not appear on its own in the long-term energy strategy; the document on the Hungarian energy strategy draws attention to the necessity of creating the legal and economic framework for the use of biomass. At the same time there are a relatively large number of civil organisations dealing with biogas, and biogas appears on the program of several events, mainly in a technical approach and with the intention of raising awareness. The events planned in the framework of REDUBAR will be a useful supplement to the action plans of awareness-raising among the profession and the general public in Hungary.

Clusters of biogas producers, converters and users have to be organized so that the biogas market will be deployed.

3.2.12 Ireland

Main features of the biogas market

The primary energy production of biogas in Ireland in 2006 amounted to 32.3 ktoe and is remained almost stable (33.5 ktoe) in 2007, produced mainly from landfill gas [Euroobserver, 2008].

Ireland	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	25,4	23,9	-5,91%
Sewage sludge gas	5,1	7,9	54,90%
Other biogasses	1,8	1,7	-5,56%
Total	32,3	33,5	3,72%
Gross electricity production of biogas (GWh)			
Electricity plants only	108,4	101,9	-6,00%
CHP plants	13,6	16,9	24,26%
Total	122	118,8	-2,62%
Gross heat production of biogas (ktoe)			
Heat plants only	1,5	1,5	0,00%
CHP plants	2,6	1,9	-26,92%
Total	4	3,4	-15,00%

Source: Euroobserver, 2008

Agriculture is the single largest source of waste in Ireland¹⁴. Wastes include all types of animal excreta in the form of slurries and manure from cattle (dominating source), sheep and poultry.

According to Sign at al, the potential for energy generation from these feedstocks in 2020 is 68.8 PJ energy, sufficient to fuel about 1.7 million private cars (93% of present private car fleet), to replace more than 33% of natural gas, 20% of transport fuel and 10% of final energy demand. The practical energy generation in Ireland by 2020 is 16.2 PJ, sufficient to fuel about 390,000 private cars (22% of present private fleet), to replace 7.5% of natural gas supply, 5.1% of transport fuel and 2.3% of final energy demand.

¹⁴ Singh A, Smyth B. M., and J.D. Murphy. A biofuel strategy for Ireland with an emphasis on production of biomethane and minimization of land-take. *Renew Sustain Energy Rev* (2009), doi: 10.1016/j.rser.2009.07.004

Recommendations

Biomass production

Support shall be granted to the feedstock supply chain. It could be in the form of direct aid/incentives to the cattle breeders/investors dealing with the logistics (collection, transportation, storage, etc.) of the biodegradable wastes deriving from cattle manure or agro-food industries.

Usage

As biogas is mainly used in electricity producing plants incentives should be given for alternative markets.

The development of district heating systems that would absorb the excess heat produced by the biogas plants would give a very strong incentive for biogas investors, since that would improve the plant economics.

Setting targets and prices for heat production from biomass and applying long term financing support mechanisms would greatly enforce the biogas investments.

Promoting heat consumption in the domestic and tertiary sectors as well as in the industry would significantly boost the biogas market by increasing the demand.

Other alternatives for the use of biogas are its upgrading and injecting into the natural gas grid or as a biofuel for transport. For this reason, extensive technical measures have to be applied to deliver biogas in due quality, time and pressure.

Proper technical quality control mechanisms have to be applied. To that extent, a common certification system has to be applied for all EU countries and outside Europe.

Reinforcement of the grid so as to support the biogas injection is required.

Financial measurements supporting the high investment costs are necessary.

Tax alleviations should be applied so as to compensate for the low prices of fuels that make biomass fuels appear non-competitive.

The quality and commercialization of solid digestate from biogas plants, hazards from the biogas plants as well as the specific biogas canalization have to be properly and clearly addressed by the relevant legislation framework.

Clusters of biogas producers, converters and users have to be organized so that the biogas market will be deployed and not be distorted by new investments.

Public acceptance has to be assured by continuous information campaigns and training of the involved actors.

3.2.13 Italy

Main features of the biogas market

Italy ranks the 3rd among the European Member States, as regards the primary energy production of biogas, which in 2006 amounted to 383,2 ktoe and is estimated at 406,2 ktoe in 2007. It is produced mainly from landfill gas and used mainly for electricity generation [Euroobserver, 2008].

Italy	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	337,4	357,7	6,02%
Sewage sludge gas	1	1	0,00%
Other biogasses	44,8	47,5	6,03%
Total	383,2	406,2	6,00%
Gross electricity production of biogas (GWh)			
Electricity plants only	1061,9	1125,6	6,00%
CHP plants	241,8	256,3	6,00%
Total	1303,7	1381,9	6,00%
Gross heat production of biogas (ktoe)			
Heat plants only	38,60	40,9	5,96%
CHP plants	38,6	40,9	5,96%
Total			

Source: Euroobserver, 2008

Recommendations

Biomass production

Multi feedstock is recommended, because of the variety of biomass types (agricultural and forest biomass and residues, animal sewage, sludge). It is also possible from a technical point of view to use forage beet, but there is a huge discussion and also not a positive attitude towards the utilisation of agriculture sites used for energetic use instead of food production.

In this case the logistics of the supply chains have to be carefully designed, taking into consideration the types of the feedstock and the seasonability, the mixing ratio, the feedstock properties and storage requirements.

In order to use residual agro-industrial wastes in plants within an agricultural framework, the Consolidation Act foreseen for plants for the agricultural sector has to be amended, since the residues are defined by law as waste, and therefore they do not meet the criteria foreseen (Decreto Legislativo 3 April 2006, n. 152 – "Norme in materia ambientale" Testo Unico Ambientale).

New limits for the spreading or discharge of livestock effluents and the excessive use of fertilizers have been established (adoption of the EU Directive), therefore the incentive tariffs have to be strengthened, else the biomass risks not to be seen as a positive incentive for farmers

Usage

The EU Directives have to be adopted by the National Laws.

The biogas properties and technical-safety requirements for feeding biogas into the natural gas system have to be regulated in Italy, since, for instance, the types of pipelines are different and the variety of end-users is much bigger.

The effect Green Certification system on the biogas market has to be strengthened and promoted. Apart from this, legal and financial incentives should be strengthened, as competitors (i.e. other renewable energy resources, photovoltaics) are much more privileged.

Public acceptance has to be assured by continuous information campaigns and training of the involved actors.

The decision making processes, the authorizations and licenses needed, etc have to be regulated and simplified, so as the investment risk is minimized.

3.2.14 Latvia

Recommendations

Biomass production

Creating long-term contracts between plant operators and feedstock suppliers

Determining biogas exploitation scheme to the widely varying site conditions (depending on the agricultural and farm structure)

Creating developing plans of biomass potential and site allocations for particular regions

Biogas production and the use of different waste (like agro-industrial waste with pig manure or dairy wastes) is necessary (Co-fermentation with other raw material must be examined)

Spatial Planning for taking biogas production projects into account

Establishing local biogas equipment producers and biogas experts gaining knowledge on biogas production under the country specific conditions

Usage

Implementing provision for third party access to natural gas transmission, distribution and storage infrastructure

A long-term policy framework on biogas use in transport (e.g. tax allowances for vehicles using biogas) is necessary

Determining technical criteria for biomethane injection

Establishing quality standards

Amend chapter 8 "Gas supply system" of the Latvian Energy Law ensuring that natural gas transmission operator gives permission for appropriate quality biomethane injection

Setting up the cooperation between industries or farms in a certain area or region as an obligatory act for the success implementation

Facilitating communication, sharing information and coordinating in and among governmental agencies, technology developers, end users and beneficiaries

It is necessary to establish some tighter legislative framework to facilitate municipal and household waste sorting practices

Liberalization of electricity market in Latvia not only in theory but also in practice, would give a positive impact regarding biogas development.

3.2.15 Lithuania

Main features of the biogas market

Lithuania ranks among the final couple of EU Member States when it comes to the primary energy production of biogas, which in 2006 amounted to only 2 ktoe and is expected to reach 2.4 ktoe by 2007 produced from sewage sludge, slaughterhouses residues and landfill (at this moment only project) [Euroobserver, 2008]. The annual production of biogas ranges from 0.6 until 6.4 mln. m³ in Lithuania.

Lithuania	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas		1,6	
Sewage sludge gas	1,5	0,8	-46,67%
Other biogasses	0,5		
Total	2	2,4	20,00%
Gross electricity production of biogas (GWh)			
Electricity plants only			
CHP plants	5,4	6,3	16,67%
Total	5,4	6,3	16,67%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	0,3	0,3	0,00%
Total	0,3	0,3	0,00%

Source: Euroobserver, 2008

Recommendations

Biomass production

Only waste water treatment and butcheries residues are used for biogas production. There are other unused biomass resources (pigs, cattle and poultry manures). When pigs, cattle and poultry manures are used for energy purposes environmental regulations, norms and regulations of crops fertilization should be tighten.

Farmers do not grow energy plants. There are possibilities to cultivate energy crops (maize, oats, etc.) but farmers are conservatives. In this case, there has to be a direct aid to farmers to grow energy crops (maize, oats end etc.).

In addition, there are a lot of possibilities to use pig, cattle and poultry manures. Therefore, support shall be granted in the form of incentives for investors dealing with the logistics

(collection, transportation, storage, etc.) of the biodegradable wastes deriving from cattle manure or agro-food industries.

Usage

Favourable purchasing tariff for electricity from RES is already applied in the country. On the other hand, biogas production market is free. There are possibilities to use biogas instead natural gas in local boiler-houses (in little towns). However, actors are afraid that investments to biomass resources and biogas plants will not be profitable. Only several waste water treatment and industrial companies are producing biogas. Therefore national policies and regulations should be revised and provide clear incentives for investors and privileged tax policies.

Natural gas grids are developed near big towns offering thus opportunities for biogas plants to be connected to natural gas grids. Simplified regulations, allowing tertiary persons to connect to natural gas networks and adapt ejection into NG network norms applied in West European countries (e.g. Sweden, Germany) are of outmost importance.

Educational campaigns, lobbying activities, information campaigns are necessary in order to get public acceptance, taking into account that people is conservative and sceptical.

New processes always need political will to support them.

3.2.16 Luxemburg

Main features of the biogas market

Luxemburg ranks among the last in the list of EU Member States regarding the primary energy production from biogas, which in 2006 amounted to only 9.2 ktoe and is estimated to have reached 10 ktoe by 2007. However, it is the 3rd in the rank EU Member state regarding the biogas production per capita (21toe/1000 inhabitants) [Euroobserver, 2008]. In contrast to the other countries, biogas is not produced from landfill gas or sewage sludge. The biogas market is growing in conflict with the food market.

Luxembourg	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas			
Sewage sludge gas			
Other biogasses	9,2	10	8,70%
Total	9,2	10	8,70%
Gross electricity production of biogas (GWh)			
Electricity plants only			
CHP plants	32,6	36,6	12,27%
Total	32,6	36,6	12,27%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	4,4	5	13,64%
Total	4,4	5	13,64%

Source: Euroobserver, 2008

Minett-Compost plant and Ros Roca (including a biogas preparation) plant in Kielen are two of the biggest plants in Europe. Using the highest available technology (i.e. Project Redange (MINETT COMPOST)) in Kielen different substrates can be treated independently from the water content. The plant capacity is 50,000 tons per year.

Recommendations

Biomass production

The biodegradable organic waste (75% Recycling) is very high in Luxemburg and involves municipal and industrial waste. Wood is the only natural biomass resource that is available in great quantities, whereas agriculture is not important in the country. Grain, corn, straw (small amounts) are available but not mainly used as biomass source in contrast to wood and wood wastes that are the most important biomass resource of the country.

Therefore, more sources should be identified, eventually imports so as not to depend totally on wood.

The use agricultural waste such as liquid manure and dung, various energy crops as well as biowaste and organic industrial waste for the production of biogas is advised to be done in Kielen.

Subsidies from the Government should also be granted to farmers to reinforce the poor biomass potential of the country.

Usage

There are a rising number of biogas plants in Luxemburg. However, the domestic market is very small, the demand is led by a few large energy intensive industries and the number of players is limited.

State supports renewable energy and subsidises projects, such as the planned feed-in of biogas to the public gas grid. Electricity generating capacity from renewable energy has expanded through buy-back tariffs and direct subsidies. However biogas production would not be profitable in absence of public aid in the form of:

- Subsidies. Current investment subsidies do not compensate for running costs. On the other hand, constant investment requires long-term constancy of the fed-in biogas
- Feed-in tariffs, that allow adequate compensation. Current feed-in tariff scheme does not have any time limit or degression element to lower the tariff over time. Moreover, there can be different prices for biogas-plants of the same size. Feed-in tariffs may be based on either the so-called 'avoided costs' of non-renewable power producers or the electricity price charged to the end-user, supplemented by a bonus or premium in order to account for the social or environmental benefits of renewable electricity
- Subventions for low energy consume (to motivate consumers to use renewable energy)
- Compensation agreements to increase the production and usage of biogas
- Higher taxes on the use of non-renewable natural resources
- Compensation for higher running production costs should be assured
- Increasing price of energy (biomass production is not profitable enough in moment) as well as setting up independent prices (price-stability) for renewable energy
- Introduce a compensation arrangement for biogas injection
- Decide a maximum level of tax exemption
- Introduce a law of deregulation for biogas injection
- Provide incentives for investors to increase productivity

Alternative markets for biogas, as the use of biogas for heating, the use of high quality compost for fertilisers, would give a boost to biogas development.

Biogas injection in the gas grid will increase independence from natural gas imports. The energy balance of Luxemburg depends almost totally (98%) on imports.

Regulators should keep in touch with its counterparts of neighbouring countries.

Linking two domestic electricity grids (CEGEDEL and SOTEL) should be explored with a view to expanding the market size and enabling greater choice for Luxembourg consumers.

Establish a Department for Investigation and Research on biogas production.

Shift the responsibilities for promoting renewable energy to the Ministry of Environment. Currently Luxembourg has the highest per capita greenhouse gas emission values.

Information campaigns, training and other dissemination activities are necessary to reinforce public awareness about the advantages of bioenergy.

3.2.17 Netherlands

Main features of the biogas market

Netherlands ranks the 6th in the list of EU Member States regarding the primary energy production from biogas, which in 2006 amounted to 141 ktoe and is estimated to have reached 174 ktoe by 2007. [Euroobserver, 2008]. In contrast to the other countries, in 2006 it was equally produced from landfill gas, sewage sludge gas and other biogases while the latter almost doubled in the following year. Biogas is mainly used for electricity generation.

Netherlands	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	46	43,2	-6,09%
Sewage sludge gas	48	48	0,00%
Other biogasses	47,1	82,8	75,80%
Total	141,1	174	23,32%
Gross electricity production of biogas (GWh)			
Electricity plants only	146,1	274,2	87,68%
CHP plants	215,2	223,2	3,72%
Total	361,3	497,4	37,67%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	1	1	0,00%
Total	1	1	0,00%

Source: Euroobserver, 2008

The Dutch ambitions for biogas as a replacement for natural gas¹⁵:

- Short term target: 1-3%
- Mid term target: 8-12% in 2020 including SNG production from biomass
- Long term target: up scaling to 50%

There are about 130 projects in operation with an installed capacity of 130MWe and in 2009 4-6 new Green Gas projects will start that will upgrade biogas for injection in the grid.

¹⁵ M. Dumont. Biogas in the Netherlands experiences and visions. SenterNovem, 2009 Jyvaskyla

Recommendations

Biomass production

There are 70,000 tons of manure slurry available plus residues from agricultural waste, which have a potential of 5% replacement (digestion) of natural gas. Subsidies from the Government should be granted to farmers to reinforce the logistics of the manure collection, storage and digestion.

Usage

The quality assurance has to be properly dealt by introducing technical standards for biogas. Creation of technical standards would help in stabilizing the supplies and guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas.

The grid has to be balanced so as to support the increased biogas injection quantities as projected in the mid- and long-term.

Certification system to provide incentives for investors is recommended

Interdependency between production and consumption of green gas has to be assured by creating a virtual market system.

Information campaigns, training and other dissemination activities are necessary to reinforce public awareness about the advantages of bioenergy.

3.2.18 Poland

Main features of the biogas market

The primary energy production from biogas in Poland in 2006 amounted to 62.4 ktoe and remained stable in 2007. It is mainly produced from sewage sludge and used in CHP plants [Euroobserver, 2008].

Poland	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	18,9	19,1	1,06%
Sewage sludge gas	43,1	43	-0,23%
Other biogasses	0,5	0,5	0,00%
Total	62,4	62,6	0,32%
Gross electricity production of biogas (GWh)			
Electricity plants only	0	0	
CHP plants	160,1	160,1	0,00%
Total	160,1	160,1	0,00%
Gross heat production of biogas (ktoe)			
Heat plants only	6	6	0,00%
CHP plants	28,1	28,1	0,00%
Total	34,2	34,2	0,00%

Source: Euroobserver, 2008

Recommendations

Biomass production

Increase the utilization of different kind of biomass: energy corps, animal wastes etc.

Accepting priorities of regional biomass development adequate to regional energy sources

Creating long term development plans for biomass utilization for all regions in Poland-
Identification the agricultural areas for growing biomass

Model of long term agreements considering the different condition of biogas production

Creating long term development plans for biogas for all regions

Conversion

Expanding the knowledge about technical aspects of developing and using biogas

Developing the market for biogas upgrading technologies and equipment

Introduction tax allowance for upgrading technologies

Developing the market for biogas technologies and equipment

Usage

To improve the serious lack of financial resources, funds have to be built and financial support mechanisms have to be developed in order to support and promote RES investments. In addition, financial institutions specializing in RES investment financing and improving their performance have to be set up.

As a step towards that direction is to improve „green certificates” and energy costs system as well as to prepare and set up innovative systems of biogas investment financing including investors, financial institutions and EU support mechanism for innovative technologies

Regarding the biogas injection in the natural gas grid, the following actions should be taken:

- Expanding the norms of NG supply to the biomethane injection of defined parameters
- Reforming the relevant laws for stimulating the biomethane production and utilization
- Model of long term agreements considering the injecting process
- Assuring priority in access to natural gas grids for the producer of biomethane
- Establishing qualitative and quantitative parameters according to the injection of biomethane to the grid
- Determining measuring methods so as to assure delivering of secure, cost-effective, consumer-and environment-friendly gas; therefore, extensive technical measures have to be applied to deliver contracted energy carriers in due quality, time and pressure.

There is lack of Renewable Energy Law Act in Poland. It is thus necessary to legislate Renewable Energy Law Act or to create an article regarding RES in Energy Law Act.

There is lack of development plans for RES in all regions in the country. Therefore long term development plans for RES for all regions have to be created and a model of long term agreements considering the different condition of raw gas production and the injecting process has to be developed. This can be made through reviewing of regional development strategies regarding RES and accepting priorities of regional RES development adequate to regional energy sources.

Setting up regional energy agencies and appointing civil servants to coordinate regional RES development would serve towards solving the lack of national organizational structure implementing country's policy regarding RES.

Clusters of biogas producers, converters and users have to be organized so that the biogas market will be deployed and not be distorted by new investments.

To increase the low public awareness of possibilities and benefits in using biogas, higher energy usage has to be used in the public sector, to demonstrate the technical and environmental benefits deriving from the use of biogas.

Expanding information about biogas, regulations and investment financing possibilities, creating biogas production projects for specific public infrastructure like: schools, hospitals,

civil service building and promoting biogas energy usage as ecological element of business practices and life style could also increase public acceptance.

The actions mentioned above together with creating educational system about needs and methods in using RES energy, implementing educational programs about RES resources and technologies in all levels of education, and disseminating scientific-research studies would help to train specialists into higher education system.

Increasing funds for scientific- research studies in biogas would help overcome the technical barriers related to biogas technologies and equipment on the market.

3.2.19 Portugal

Main features of the biogas market

The primary energy production from biogas in Portugal in 2006 amounted to 9.2 ktoe and increased to 15.4 ktoe in 2007. It is mainly produced from sewage sludge and used in CHP plants [Euroobserver, 2008].

Portugal	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas			
Sewage sludge gas			
Other biogasses	9,2	15,4	67,39%
Total	9,2	15,4	67,39%
Gross electricity production of biogas (GWh)			
Electricity plants only	25,2	58	130,16%
CHP plants	7,4	7,3	-1,35%
Total	32,6	65,4	100,61%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants			
Total			

Source: Euroobserver, 2008

In 2005, 10 ktoe (kilo tons oil equivalent) of biogas have been produced in Portugal, mainly based on agricultural and household wastes [European Renewable Energy Council, 2006]. For 2005, 100 agricultural biogas plants have been reported [AD-NETT, 2005]. Although hardly any information seems to be available, it is likely that about 80% of these plants are operated on animal manure, as this was true for the 1990's (Holm-Nielsen and Al Seadi, ~1998). Nevertheless, the current use of animal manure for biogas production has been described "as close to zero" [EUBIONET, 2002 b].

For Portuguese biogas plants, severe technical and operational problems have been reported. Poor economic efficiency has been made responsible for a low quality of constructions and equipment, a low level of maintenance and a deficient control of the plants (Holm-Nielsen and Al Seadi, ~1998). Thus, for Portugal a general lack of confidence in anaerobic digestion solutions have been stated [EUBIONET, 2003].

The current lack of information may be due to Portuguese renewable policy focusing mainly at forestry biomass and biodiesel/bioethanol production as well.

In Portugal there are regions with high concentration of pig farms in Santarem, Leiria, Montijo and Rio Maior. In these regions 4 centralised biogas plants are operating at Lourinhã, Rio Major and Leiria. About 60 farm scale plants are operating in the central and the southern part of the country.

The centralised biogas plants operate with not very satisfactory results, due to an inappropriate choice of treatment method. The most common used technologies are anaerobic digestion with biogas production (plug-flow, up-flow anaerobic sludge blanket, conventional digestion and anaerobic filter), activated sludge, composting treatment lines. Co-digestion of manure and other substrates do not take place in Portugal.

Recommendations

Biomass production

The manure that is available at sufficient quantities has to be used with other industrial residues and energy crops all year around, to secure reliable and cost effective biomass supplies which are a decisive parameter for the economic viability of the biogas plants.

Usage

The national programme "Energia" supports the biogas production activities as part of the renewable energy production. Further support projects are promoted by public or private entities. To stimulate the uptake of RES-E:

1. Fixed Feed-in tariffs per kWh exist for PV, wave energy, small hydro, wind power, forest biomass, urban waste and biogas.
2. Tendering procedures were used in 2005 and 2006 in connection to wind and biomass installations.
3. Investment subsidies up to 40% can be obtained.
4. Tax reductions are available.

The main problems are the insufficient incentives, high investment costs and low income. The lack of monetary incentives affects the possibilities of improving the technical knowledge and results in a low quality of constructions and equipment, a low level of maintenance of the existing plants and a deficient control and exploration of the systems.

Therefore, what has to be done in the country is to:

- Ensure that the promotion of renewable sources, including through a new Energy Programme, encourages a decrease in their costs, e.g. by introducing competition among them.
- Continue to seek the most cost-effective ways to promote renewable sources, including biomass and in the domestic sector.
- Impose higher taxes on the use of non-renewable natural resources
- Compensate for the high capital and operational cost of the plants should be assured
- Increase the price of energy to compensate for the high biogas production costs

Support shall be granted to the feedstock supply chain. It could be in the form of direct aid to farmers growing energy crops for biogas production and incentives for investors dealing with the logistics (collection, transportation, storage, etc.) of the wastes.

Environmental benefits as well as the possibility of the initial investments amortisation, in reduced periods of time (3 to 7 years), with the commercialisation and/or use of the produced energy, are underlined as the driving force to integrate biogas in the energy sector. The development of alternative markets for biogas utilisation (for heat, substituting natural gas) would also help towards that direction.

There is optimism in Portugal about the future of biogas, even though there is very little public awareness about it. The public is aware of the problems concerning water effluent pollution and everybody wish solutions to be found. That brings biogas in a favourable position. Workshops are a usual method to promote and stimulate biogas production. However, training and dissemination actions should be strengthen in order to promote the development of the biogas market.

3.2.20 Spain

Main features of the biogas market

The Spanish biogas sector has grown rapidly in the last years. The crude biogas production in 2001 was 134 ktoe and today Spain ranks the 4th among the EU Member States regarding its primary energy production from biogas, which in 2006 amounted to 320 ktoe and increased to 330 ktoe in 2007. It is mainly produced from landfill gas (78%) while sewage sludge gas and other biomass resourced gas (animal manure and agricultural or municipal organic wastes) had a significant contribution (15% and 7% respectively). Most of the biogas produced is used in power generation plants [Euroobserver, 2008]. In another source [INTERES-2007] it is assumed that Spain generates 46 million cubic metres of dung water from pork and milk cows per year.

Spain	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	251,3	259,6	3,30%
Sewage sludge gas	48,6	49,1	1,03%
Other biogasses	19,8	21,3	7,58%
Total	319,7	329,9	3,19%
Gross electricity production of biogas (GWh)			
Electricity plants only	610,3	631,1	3,41%
CHP plants	56	56	0,00%
Total	666,3	687,1	3,12%
Gross heat production of biogas (ktoe)			
Heat plants only	14,7	14,7	0,00%
CHP plants			
Total	14,7	14,7	0,00%

Source: Euroobserver, 2008

In January 2004, Spain and Portugal formally signed an agreement to create a pan-Iberian electricity market (Mibel). The new market will allow generators in the two countries to sell their electricity on both sides of the border. The country's two energy market regulators, Spain's OMEL and Portugal's OMIP, will merge to create a single operator for the integrated electricity market. Repeated delays have plagued the implementation of Mibel, though the official launch date is now slated for October 2007.

Recommendations

Biomass production

Based in the information published from the BIOPRO EIE project, in Spain, the biomass is the renewable energy source with the lowest level of development, according to its potential. It is a very heterogeneous sector with very fragmented contributions from many companies with their main activity focused also in other fields. Now the involvement of Spanish companies in biomass projects is very low. On the other hand the biomass logistic supply is not sufficiently developed.

Consequently, the manure that is available at sufficient quantities has to be used with other industrial residues and energy crops all year around, to secure constant feeding of the biogas plants.

The logistics of the supply chains have to be carefully designed, taking into consideration the types of the feedstock, the mixing ratio, the feedstock properties, storage requirements and transportation needs, so as to secure reliable and cost-effective biomass supplies.

Separation and use of organic waste – using the organic waste for biogas production is a great business opportunity in a country like Spain, where use of organic waste is still not as common as it is in other countries.

Usage

According to the national energy plan of the country, barriers include:

- Economical and financial constraints.
- Lack of information and social awareness.
- Lack of legislation.
- Poor collaboration among different administrations.
- Insufficient research and technological development in some areas.
- Insufficient tax incentives.
- Poor stability, quality and security for connecting to the grid

RES-E in Spain benefits from the following support mechanisms: feed-in tariffs or premium price is paid on top of the market price and low-interest loans that cover up to 80% of the reference costs. The fuel tax exemption currently in place is applied specifically to the volume of biofuel. However, they are considered very low.

A series of incentives and measures will be necessary to remove these barriers. The energy plan suggests various measures without going into much detail about their implementation, and makes these recommendations:

- Tax incentives should favour projects with technological innovation and low environmental impact; today, there are no such criteria for giving tax incentives.
- The requirements and procedures for environmental impact assessment should be harmonised across the regions.
- Premiums under the special system should be reallocated to favour less developed technologies.
- Incentives should be developed to support investment in the development of new technologies.

- Developers of projects for renewable energy sources should get discounts for their payments to mutual guarantee societies.

Some more that could be added are:

- Incentives to recover energy from slurry and organic wastes, and additionally use the heat and fertilizers. That could be achieved by increasing the price of electricity produced from biogas, set a convenient price for heat and improve the market for fertilizers, so as to increase the income sources of the plant and compensate for the high investment costs.
- Impose higher taxes on the use of non-renewable natural resources
- Compensate for the high capital and operational cost of the plants should be assured
- Increase the price of energy to compensate for the high biogas production costs
- Launch R&D cooperation projects on more efficient technology options and equipment supplies
- Improve social awareness through educational and informational activities

3.2.21 Sweden

Main features of the biogas market

In 2006 and 2007 27.2 ktoe were produced from biogas in Sweden in CHP plants. The produced heat is then absorbed by the well developed district heating systems, as in the case of Denmark. The 63% of the primary energy is produced by sewage sludge and another 34% by landfill gas. Only a 3% is produced from biogas deriving from agricultural waste processing units. According to Euroobserver, in 2007, there were in total 233 biogas units, including 139 waste treatment plants, 70 waste storage centers, 4 food processing industries and 7 agricultural biogas units.

Sweden	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	9,2	9,2	0,00%
Sewage sludge gas	17,1	17,1	0,00%
Other biogasses	0,8	0,8	0,00%
Total	27,2	27,2	0,00%
Gross electricity production of biogas (GWh)			
Electricity plants only			
CHP plants	46,3	46,3	0,00%
Total	46,3	46,3	0,00%
Gross heat production of biogas (ktoe)			
Heat plants only			
CHP plants	11,7	11,7	0,00%
Total	16,4	16,4	0,00%

Source: Euroobserver, 2008

Apart from heat, biogas is also used as a transport fuel, as a substitute to natural gas being injected in the natural gas grid and for electricity production. According to the Biogasforingen¹⁶, in 2006-2007, the biogas was used for heat (55%), as a vehicle fuel (24%), for flaring (13%) and a smaller amount for power generation (8%). The contribution of biogas in the transport sector is very pronounced in the country, where, according to the Euroobserver, 14,400 gasfuelled vehicles are running, 86 service stations distributing biogas and 27 service stations reserved for buses are operating since the end of 2007.

¹⁶ Stefan Dahlgren, Biogas State of the art – Sweden, Biogasforingen. Available at: <http://www.aebiom.org/IMG/pdf/Dahlgren.pdf>

Recommendations

Usage

Adjustment of the natural gas laws and tax laws to the Green Gas Principle, in order to promote injection of biogas in the natural gas grid. In 2007, almost 2 million cubic meters of natural gas were replaced by upgraded biogas, according to Euroobserver.

EU-standardization of biogas quality for injection on gas grid and usage as vehicle fuel. Creation of technical standards would help in guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas.

Higher CO₂-taxes on fossil vehicle fuels and tax exemption for renewable vehicle fuels have to be applied

Investment support for biogas plants and support for biogas production because of the high investment and operating costs especially for biogas upgrading, which are even higher in comparison to other methods of utilization of biogas.

3.2.22 UK

Main features of the biogas market

UK ranks the second, after Germany, among the EU Member States regarding the primary energy production from biogas, which in 2006 amounted to 1,500 ktoe and is estimated to have reached 1,624 ktoe by 2007. It is also the 2nd after Germany in the rank EU Member state regarding the biogas production per capita (26.7 toe/1000 inhabitants) [Euroobserver, 2008].

Biogas is mainly produced from landfill gas in contrast to Denmark, Sweden, Germany and Austria that used AD technologies to produce biogas from municipal solid wastes, food processing industries and other agricultural sources.

The reason for the extended use of biogas for electricity generation lies in the green certification system called Renewables Obligation Certificates (ROC) that provides benefits to the producer in addition to the electricity market price. Landfil gas has by far the lowest cost of production compared to the other RES, therefore the English system favors the most cost-effective systems, according to the Euroobserver.

UK	2006	2007	Growth rate
Primary energy production of biogas (ktoe)			
Landfil gas	1318,5	1433,1	8,69%
Sewage sludge gas	180	191,1	6,17%
Other biogasses			
Total	1498,5	1624,2	8,39%
Gross electricity production of biogas (GWh)			
Electricity plants only	4424	4795	8,39%
CHP plants	463	503,4	8,73%
Total	4887	5299	8,43%
Gross heat production of biogas (ktoe)			
Heat plants only	61,9	61,9	0,00%
CHP plants			
Total	61,9	61,9	0,00%

Source: Euroobserver, 2008

Recommendations

Biomass production

The biodegradable organic waste is very high in UK and involves municipal and industrial waste that currently are not exploited, causing serious environmental problems since the methane released is by 21 times more harmful than carbon dioxide.

The use of agricultural waste such as liquid manure and dung, as well as organic industrial waste from the food processing industries has to be sought. According to an article of Terry Slavin in The Guardian the 30th July 2008, it is reported that the Department for Environment, Food and Rural Affairs (Defra) is seeking for solutions, not only to generate energy from these wastes but also to address the issue of using the huge amounts of food Britain households waste. These, according to the Waste and Resources Action Programme (Wrap), amount to 6.7m tons of food waste.

Support shall be thus granted to the feedstock supply chain. It could be in the form of direct aid/incentives to the farmers to organise profitably the collection, transportation, storage, etc of the biodegradable wastes deriving from cattle manure or agro-food industries.

Incentives should also be granted to local authorities to consider AD for all their food waste. According to the article in The Gardian, there are only a few large-scale AD plants in the UK processing 80 tonnes of kitchen and garden waste a week from 20,000 local homes and businesses. However, according to the article, real key to success for AD in UK may lie with major food retailers rather than the government.

Usage

The regulatory framework for electricity generation is considered sufficient. However, incentives should be given for other uses of biogas, i.e. as a transport biofuel or substitute to natural gas.

Taking into account the current use of biogas in electricity generation plants, the spare heat, other than that used inside the plant, has to be locally distributed in district heating systems or in nearby communities. Promoting heat consumption in the domestic and tertiary sectors as well as in the industry would significantly boost the biogas market by increasing the demand.

Other alternatives for the use of biogas should be sought; such is its upgrading and injecting into the natural gas grid or as a biofuel for transport. For this reason, extensive technical measures have to be applied to deliver biogas in due quality, time and pressure.

As far as the upgrading of biogas is considered in order to substitute natural gas, financial support is necessary, because of the high investment and operating costs, which are even higher in comparison to other methods of utilization of biogas.

Creation of technical standards would help in stabilizing the supplies and guaranteeing the quality of the injected gas to the natural gas grid, as well as in distributing and transporting the biogas. Introducing new technical standards will improve the competition between upgraded biogas with natural gas

Proper technical quality control mechanisms have to be applied. To that extent, a common certification system has to be applied for all EU countries and outside Europe.

Reinforcement of the natural gas grid so as to support the biogas injection is required.

Business plans including technical assessment, environmental studies, financial and risks assessment will greatly contribute towards the planning the development of the biogas market through AD technologies in the country.

Information campaigns, training and other dissemination activities are necessary to reinforce public awareness about the advantages of bioenergy.

4 D24 - A list of recommendations to policy makers for the future development of selected supply chains and market structures with the highest project relevant potential

Deliverable: D24

Full title:

A list of recommendations to policy makers for the future development of selected supply chains and market structures with the highest project relevant potential. Like D23, but the strategic-structural part of the complex D23/D24.

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D:24 GIF

D24 “An overview of existing supply-chains and market structures by their potential for increasing the biogas use for heating and cooling”

This document is based on a questionnaire that has been developed and spread to the participants.

The aim of this questionnaire was to identify barriers and the perception of them in the analysed European countries.

4.1 Questionnaire Analysis

As for D22 , and D23 also for D24 the starting point of this work has been the distribution of a questionnaire to identify the most relevant elements for increasing the biogas use for heating and cooling in the European countries, providing data and information on elements which can first positively improve the market for biogas.

A series of instruments that are implemented to enhance the policies for biogas technology i.e. promotion, including design, planning and management, regulatory instruments, economic instruments, partnerships and technology.

The questionnaire target are the 27 countries of the EU, despite several reminders some countries information are still missing and this influences the project final results; besides the input received are in some cases very basic and they do not provide detailed information on countries market.

The second main critical element is due to the fact that the situation in Europe is heterogeneous regarding the transportation of biogas in the natural gas grids and this element dramatically change the perspective of development of the existing supply chains, since transportation in gas grids nets are not considered a priority in many countries.

The first point which has been analysed concerns the general development level of biogas market as precondition for the analysis of existing forms of business and economic cooperation.

Portugal, Romania, Bulgaria and Spain are still in a low but promising situation, which means few plants exists but the awareness of potential and existing target groups is relevant and plays a considerable role.

The situation is different in countries where there is no general awareness and biogas development is in initial phase; we identify as initial phase that few plants are active, but there is no awareness from the target groups. These countries are: Greece, Latvia, Cyprus, Spain, Poland and Hungary.

Elements which can make the market grow are incentives and regulations, as well as the cooperation of actors, where this exists and it is good developed the supply chains can better function and there is a developed market for biogas, therefore these countries are considered well developed and further growing (actors are organised, regulations and incentives already exist), these countries are Germany and Denmark. Regarding United Kingdom and Sweden. These countries identify as weak elements and missing links, regulations, incentives and cooperation of actors; in this perspective the countries have been classified as developed. In other countries like Italy, Finland, France and Czech Republic the market is young, but it is growing.

Italy is for example together with Sweden Netherlands, Belgium, Germany and Austria one of the most active country regarding the creation of biogas plants. (source Analisi di mercato by Frost & Sullivan, Biomass: un mercato in crescita in un'Europa affamata d'energia pulita", www.rinnovabili.it)

Regulatory framework plays a fundamental role, a certain and well functioning and accessible regulatory framework able to provide a certain regulation and normative structure represents the key point for the development of a stable biogas market in Europe; the regulatory framework can strongly support the market structures. According to this principle, the situation is good in Sweden, Czech Republic and UK; while is very good in Denmark and Germany, it is fair in Bulgaria, Romania, Spain, Finland, France, Cyprus and Greece (please explain why); it is unsatisfactory in Portugal, Hungary, Italy, Estonia, Lithuania, Latvia, Malta and Poland. According to Italy we can say that the regulatory framework is unsatisfactory due to the extreme high uncertainty of the regulation system; in fact the still not yet implementation of the decrees foreseen by the Financial Act Legislation 2008). As foreseen by the Financial Act 2008, in Italy 300 MW are potentially installable for the period 2009 – 2010 (2 years).

Good is for UK, although the weak link is Biomethane to grid. Both local electricity (ROC scheme) and local vehicles use (RTFO) is financially attractive due to support mechanisms; the regulatory framework is good also for Sweden and Czech Republic. The regulatory framework is very good in Denmark and Germany.

Public Policy measures to support biogas include also supporting and incentive measures which are different according to each country and which have been taken into account within our project.

The situation and the perception of their functioning in the different European countries are very heterogeneous; they have been identified as follow:

The regulatory framework is very good in Denmark and Germany; here a short overview if the main legislation acts which compose the regulatory framework:

- Act of supply of Electricity and Natural Gas (EnWG);
- Renewable Energy Sources Act (EEG)
- Renewable Energies Heat Act (EEWaermeG)
- Act for Preservation, Modernisation and Extension of Combined Heat and Power Generation (KWK-Gesetz)
- Ordinance on Remuneration for Access to the Natural Gas Supply Grid (GasNEV)
- Ordinance on Access to the Natural Gas Supply Grids (GasNZV).

The situation is missing or unsatisfactory in Poland, Malta, Latvia, Lithuania, Estonia, Italy, Hungary and Romania, Cyprus and Spain. For these reasons in countries where biogas plants and generally speaking opportunities are not known information campaigning and training activities should be developed to form relevant authorities, bodies responsible for authorisation and licenses as well as other local and regional interlocutors.

Concerning the example of Italy we can say that there are several supporting and incentive measures for biogas use. A new regulatory framework should come into force reforming the green certificate system for the electricity produced by biogas plants. Incentives are foreseen for electricity produced by plans inserted in the so called "short supply chain", within a limit of 70 km; as well as incentives are foreseen in case of supply chains agreement; compared to the other renewable energy sources green certificates, an

increase coefficient of 1.8 is foreseen for green certificate from the biogas sector. Besides, the new financial Act for 2008 foresees an extension up to 15 years for the green certificate. The mandatory year quote of renewable energy has been fixed in 0.75 points for the period 2007 – 2012. Another important contribution is foreseen from the nation law 222 for the production of electricity by biogas plants and biomass from agricultural products, forestry, cattle and pork breeding. The law gives a possibility to cumulate the green certificates with other funding, and co funding opportunities at regional, national level. Easier authorization procedure should also be allowed for the carrying out of biomass plants under 220 kW and biogas plants less than 250 kW.

Measures are considered fair in Portugal, where according to the actual incentive mechanism for renewable energy production, biogas converted in electric power, 1 kWh can be priced around 0.11 euros. In Greece too, existing supporting and incentive measures for biogas are Development Law, State and EC financial incentives.

Supporting and incentive measures for biogas is good in France with the following incentives:

incentives for the production of electricity Apply to biogas plants below 12 MWe, the price for electricity is the sum of 3 components: T+M+PM.

T : base price

power \leq 150 kW, T = 9 c€/kWh

power \geq 2 MW, T = 7.5 c€/kWh

M : efficiency bonus

if energy eff. \leq 40%, M = 0

if energy eff. \geq 75%, M = 3 c€/kWh

The situation is fair in Finland with the following tools: tax subsidies, discretionary investment subsidies and guaranteed access to the grid for all electricity-producing plants

The situation is fair also in Bulgaria and Romania, but we do not have more information.

4.2 Business and economic cooperation

Business and economic cooperation among actors has been analysed due to the essential role in promoting supply chains. This cooperation is missing or unsatisfactory in Poland, Malta, Latvia, Lithuania, Estonia, Italy, Hungary, Portugal, Greece, Romania, Cyprus; the situation is fair in France, Spain, Bulgaria, Romania, Cyprus, Greece, Portugal, Finland and it identifies the following subjects. Gas/energy companies, municipalities, waste and water treatment companies, upgrading companies.

The situation is very good in Germany and Denmark, while it is good in Czech Republic, Sweden and UK.

Generally we can say that business and economic cooperation has been recognised unsatisfactory in the majority of the analysed countries, but this is one of the basic elements necessary to reduce obstacles for the market. A better business and economic cooperation can be obtained by a stronger cooperation and cohesion among the target groups. The

biogas chain is the tool to work together in partnership, improving the market potential and reducing costs for the chain participants.

This part could be better developed and become an essential part of this work.

Target groups can play a fundamental role in the biogas market development, raising awareness on the existing opportunities.

4.3 Conclusions

Firstly we identified the necessity of coordinated actions at European level, this is also the recommendation given by all the European projects dealing with biogas.

Legal and political stability is the necessary precondition for the opening and widening of the market. This goal can be reached also by offering ad hoc initiatives to the civil servants, people working in public institutions.

The combination of investment subsidy should be linked to quality control, in order to establish product reliability which is basic for market penetration.

Transport costs are still extremely high and they have a different impact on the market, since where we have to differentiate between countries where biogas injection in the natural gas grids and countries where it is not possible, since grids are more efficient and cheaper.

Existences of investment schemes which are competitive are necessary since biogas plants need long term pay back investments. At the same time incentive are necessary also to stimulate innovation and promote adoption of new technologies.

Besides the harmonization of EU legislation and normative is highly recognized as we identified in other EU projects (for example in the BIOCOMM Project www.biocomm.eu).

4.4 List of recommendations

- A common overall strategy should be launched and implemented at European level; the biogas market suffers from a lack of uniform situation regarding biogas injection in the natural gas grids.
- A solid legislative and regulatory framework is necessary precondition for the development of biogas market as basic to guarantee access to the market for potential producers, as well as consumers and end users.
- A solid regulatory framework needs smooth and flexible administrative structures.
- Cooperation among the actors is also highly recommended
- Implementation of “ad hoc” tools for the promotion of electricity through feed-in-tariffs or through green certificates especially dedicated to biogas should be considered, especially for those countries where biogas plants are very common.
- Communication and Dissemination, vocational training for a better known and acceptance of biogas and its applications
- promotions, organization of professional further education
- Increasing funds for scientific- research studies in RES
- Expanding available arable land by putting set-aside land into production, regional planning, collecting and using biowaste.
- Searching of promising sites for establishing biomethane injecting plants (establish a plant register as comprehensive as possible) on the base of rather uniform assessment criteria

4.5 Questionnaire

Analysed country:

1. General development level of the biogas market:

- A) No biogas market yet (no interest for biogas use)
- B) Very low – very initial phase (only a few sporadic plants, no general awareness)
- C) Low but promising (only some plants exist, but awareness of target actors and potential is relevant)
- D) Young but growing market
- E) Developed but there are still some missing links (regulations, incentives, cooperation of actors, etc.)
- F) Well developed and further growing (actors are organised, regulations and incentives already exist)
- G) Other, particular situation:
.....

2. Development level of regulatory framework

A) missing or unsatisfactory B) fair C) good D) very good

3. Supporting and incentive measures for biogas use

A) missing or unsatisfactory B) fair C) good D) very good

If such measures exist (B-C-D) what type are they?

.....
.....
.....
.....

4. Business and economic cooperation among actors is

- A) missing or unsatisfactory B) fair C) good D) very good

If such cooperation among some actors at any level *exists* (B-C-D)

- who are the cooperating actors?
.....
.....
- how do they cooperate?
.....
.....
.....
.....

If cooperation among partners is *fair or good* (B-C)

- which are the missing links, weaknesses or obstacles which should be *eliminated* in order to develop the actual cooperation to a very good level?
.....
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- which kind of actors do not cooperate enough/at all?
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- what kind of actions/measures would be *needed* to achieve a *very good* cooperation among all actors?
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5 Summary

In this work package - WP07, the “*supply chains and market structures for biogas use*” has been investigated.

The chains of technological processes, from biomass up to polygeneration, must satisfy requirements from various sides. They must be accepted as desirable by society, feasible in engineering, regulated in administrative terms and profitable in terms of economy. This needs chains of actors who share common interests. There are considerable differences in the development of the market structure for biomass in the member countries of the European Union.

Three deliverables were to prepare.

- **D22:** An overview of existing supply-chains and market structures arranged by their potential for increasing the biogas use for heating and cooling
- **D23:** A list of recommendations for installing “Biogas feeding-in and feeding-out pools” on the basis of the detected supply chains with the highest biogas use potential.
- **D24:** A list of recommendations to policy makers for the future development of selected supply chains and market structures with the highest project relevant potential.

First the market structures and supply-chains were analyzed by carrying out SWOT analysis. Aim was to investigate all EU-27 countries but feedback was received not from all countries (only 60%). Questionnaires in the form of a matrix and multiple choice were prepared and distributed to the partners involved within the work package. As there were not partners from all member states, the co-operating task partners were assigned to collect information from the rest of the countries.

These chains were examined in terms of their maximum supply capacity. Within the WP recommendations will be given for the development of existing supply chains and closing of identified gaps in the utilisation chains. These recommendations will be elaborated specific to the situation in the member states or clusters of member states. Recommendations refer to the main three stages of the biogas supply chain:

- biomass production,
- conversion,
- usage

Also recommendations and actions were suggested to support the biogas utilization and the introduction of biogas feeding-in and gas equivalent feeding-out in EU-member states, where the technology does not exist by the time this project ends.

6 Legal Disclaimer

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