REDUBAR

Investigations targeted to the creation of legislative instruments and the reduction of administrative barriers for the use of gaseous fuels produced from renewable energy sources for heating and cooling

Final Report

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1 Introduction and Summary

1.1 The Objectives

One of the most important ways for using renewable energy sources (RES, mainly biomass) is the conversion into combustible gases by digestion plants and the generation of electricity by gas engines or combined heat and power plants (CHP). The production of biogas mostly takes place in small agricultural companies far away from energy consuming urban areas. A transportation of produced electrical energy to these areas is solved but the utilization of the generated heat is limited to local heat sinks. So the overall energetic efficiency of the biomass is limited to 30 – 40%.

However, to increase the utilisation of biomass it is highly suggested to convert the biogases into an energy carrier of higher quality – into biomethane with natural gas quality – and to distribute this energy carrier by official natural gas grids for the decentralised energy supply in power generation, heating, cooling and climatisation. By that way biomethane can:

- be used in modern high efficient polygeneration systems (CHP, CHCP) away from the production place with an increase of overall efficiency up to 70 – 90%;
- substitute the fossil energy carrier natural gas and other;

The main objective of the project is to help to remove or decrease obstacles and barriers which can be found in the unstable or weak cooperation along the utilisation chain of biomass resulting from

- a poor knowledge and insufficient experience with the technologies within the utilisation chain;
- a deficiency in legislative rules on the level of the European member countries and operational legal instructions and technical regulations to handle the biomethane injection into gas grids, its distribution and usage;
- hesitating investors and a leak of investment funds for promoting energy farmers and energy distributors.

This project was focused to encourage the share of heating and cooling by utilising biogas. The Project should:

- indicate major obstacles and barriers along the vertical added-value chain from biogas to the application of heat and cold in residential and industrial areas as well as the horizontal dimension of digestion, sewage and landfill gases and its conversion into biomethane of natural gas quality.
- define the demand of legislative and technical regulations in the member states of the European Union;
- determine the deficiencies in the market structure;
- give an overview and evaluation about successful applications in the utilization chain of biomethane;
- elaborate materials for information and education the market partners as well as developing activities for establishing and disseminating successful projects;
- elaborate measures and a road map for target groups to overcome the identified obstacles and barriers.

1.2 Achieved Results

The status of biogas production and biogas utilization in most of the European member countries at the beginning of project could be identified. The differences between the countries are very large in legislative and technical regulations but also in awareness of possibilities. The scale of
application differed from country to country extremely, from almost zero in several Member States (MS) to more than 3,500 biogas plants at that time in Germany. Application of biomethane was almost unknown, even among important stakeholders. The first bio-SNG demonstration worldwide had been in the engineering stage.

The main obstacles and barriers are identified. They differ between the countries. In most of the countries with emerging markets technical regulations and guidelines are missing. A supporting structure for biogas producers and biogas users is not available. In principle there was a lack of public awareness in most of the countries. The target group members were mostly not aware of technologies along the supply chain from biomass to energy as well as to use the biogas chain as possibilities to reduce green house gas emissions or as an option for profitable business. The analysis helps to understand the situation and to prepare the right information to different regions and target groups.

During the work information and experience on biogas production and upgrading technology were collected. A large number of information materials were produced for public information. The experience from countries with developed structures in the biogas business was integrated in these materials. Working tools were developed to evaluate business cases and to calculate economic behaviour for starting supporting measures.

The project has been a great challenge, but it had a positive impact in terms of raising awareness on biogas and biomethane among not only the identified target groups, but also among entrepreneurs or public bodies interested in developing biogas plants. The established advisory committees contributed to understand the situation within the partner countries but also help to spread information and solutions.

During the action dissemination activities and workshops permanent discussion and cooperation between professionals from diverse branches were established. Barriers for biomethane usage and injection especially in view of gas companies were eliminated in nearly all partner countries.

A network of consultancy centres for biogas production and usage has been established by the project partners.

An analysis of supporting measures were elaborate, which includes implementing of technical and legislative regulations, guidelines as well as supporting financial measures and structures for small and medium enterprises in biogas production, trading and usage.

Finally the partners elaborate a road map for installing measures for increasing the biogas business.
2 The Project Partners and Their Collaboration

2.1 The Partners

REDUBAR is a collaboration of partner from 8 European countries evenly distributed between agricultural and highly industrialized countries. The partners come from different branches of the energy sector. There are consultancy companies, energy agencies, technical-scientific associations, universities and research institutes. This consortium seems to meet the objectives of the action. The following partners collaborate:

Germany:
- DBI DBI Gas- und Umwelttechnik GmbH (research and engineering company)
- FEE FEE Fördergesellschaft Erneuerbare Energien e.V. (technical association)
- DVGW DVGW Deutscher Verein des Gas- und Wasserfaches e.V. (techn.-scient. ass.)

Netherlands:
- ECN Energy research Centre of the Netherlands (research centre)
- BTG BTG biomass technology group B.V. (energy consultancy company)
- EEI Energy Experts International B.V. (energy consultancy company)

Poland:
- INIG Instytut Nafty i Gazu (research institute)
- MAES Małopolska Agencja Energii i Środowiska sp. z o. o. (energy agency)

Hungary:
- Uni Miskolc University of Miskolc (university)
- ETE Hungarian Scientific Society of Energy Economics (technical-scientific ass.)

Czech Republic:
- ICT Institute of chemical technology, Prague (university)
- EAV Energeticka agentura Vysociny. Z.s.p.o. (energy agency)

Lithuania:
- LEI Lithuanian Energy Institute (energy agency)

Italy:
- GIF GRUPPO IMPRESA FINANCE s.r.l. (financial consultancy company)

Greece:
- CRES Centre for Renewable Energy Sources (research centre)

2.2 The target groups

The objectives of this action are directed to target groups. The project targets all groups and persons “around” the use of gaseous fuels produced from energy plants and agricultural residues for power generation, heating and cooling. These are producers, distributors/sellers and users of these energy sources on one hand and all groups having any influence on the processes, supply-chains and market structures on the other hand. The most important target groups are:

1. Gas companies, like natural gas grid owners, operators and gas suppliers
2. National organized and trans-national acting branch decision makers, representing a lot of entities in their country
3. Policy decision-makers in the participating countries and EU-wide
4. Environmental organisations, biogas producers, agricultural companies
5. Professional disseminators and multipliers such as energy agencies
6. Users from diverse branches (agriculture, gas industry, energy industry)

Last but not least, the project participants themselves are an essential target group of the project and its results. Using the project results, they will be able to act more effective than before for the realization of the project main target – increasing the utilisation of biogas from RES for heating and cooling EU-wide.

Recognizing the importance to involve the highest possible number of target group representatives into the project, the consortiums composition was planned at first and realized in the stage of preparing the proposal. The most important target groups are represented by the project partners as follows:

- **Target group 1**: DVGW, INIG
- **Target group 2**: DVGW
- **Target group 4**: FEE, BTG, CRES, DBI
- **Target group 5**: FEE, MAES, ETE, EAV, CRES
- **Target group 6**: DBI

The Partner DVGW is the German natural gas association with more than 700 gas companies as members. The DVGW has excellent connections to other European gas associations. The DVGW is also active member in the biogas steering group of MARCOGAZ (Technical Association of the European Natural Gas Industry).

### 2.3 The Project Management

The project management REDUBAR was handled following the hierarchy:

1. EACI
2. Co-ordinator (DBI)
3. Steering committee (co-ordinator and work package leader)
4. other co-beneficiaries
5. LOI-connected organisations in the partner countries, partially organized in national advisory committees
6. Target groups and key actors

The management groups 1 to 4 represent the internal management, groups 5 and 6 the external management. DBI as coordinator is the intermediary between the EACI and the beneficiaries. In Figure 1 the management structure of the project is shown.

The management approach of DBI based on a broad involvement of all partners into the management respecting the above described hierarchy. This was realized via an intensive communication and dissemination and clear fixed responsibilities: The co-ordinator is responsible for the complete communication to EACI, all financial issues and to support the WP leader. The WP leaders are responsible for organising tasks and deliverables within the WP. They were free to involve the co-ordinator for getting these targets. The task leader organised the execution of task in small groups in strong collaboration with the leaders of deliverables. The responsible partners are authorized to give instructions to the other partners targeted on achieving deadlines and quality of the task or WP. The control process of resulting documents (mostly deliverables) followed backwards the hierarchy. The deliverable leader prepared the deliverables. First check was done by WP leader and final check before publishing by co-ordinator.
Figure 1: Management structure of the REDUBAR project

The responsibility of each project partner follows the described hierarchy. The main outcomes are based on the work packages and also the chapters in this report. The responsibility for preparing the chapters is listed in the Table below. Nevertheless parts of the content based on deliverables prepared by additional partners. The reference to these deliverables are outlined in the specific chapters as well as the responsible partner.

Table 1: Responsibility of Partners

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<td>DBI</td>
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<td>6 Biogas injection into the natural gas pipeline grid: framework, conditions, methods, barriers and demand for regulation</td>
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During the action a project website (www.redubar.eu) has been installed. This website represents the communication interface between the project consortium and the general public. All information materials, information about workshops, events and related to REDUBAR interesting other projects, deliverables of the project, software tools and last but not least contact data of project national consultancy centres are available on the website. This website will also used after the end of action for further dissemination purposes. For further and more actual information to this report and particularly to access the deliverables please refer to the project website.

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3 Technological and non-technological evaluation of heating, cooling and power generation from biogas

3.1 Overview

The problem of combining heat and power generation with cooling has been solved in technical and engineering terms. However, applications of this principle in connection with biogas usage are still rare. The reasons for this situation are often non-technological ones, but the roots of this situation are technological ones (e.g. the dominating energy carriers are oil and natural gas up to now).

This chapter will focus on identification of technical obstacles and barriers at the various stages of the process which are the possible cause of non-technological obstacles Example: the heat generated by a CHP plant cannot use because a too low local heat demand (technological barrier). The administrative and technical authorities don't approve the installation of the plant (administrative barrier). The mentioned various stages are biomass and biomethane generation, the on-site usage of none or partly upgraded biogas, the supply of micro heat grids or injecting into micro gas grids.

The evaluation of diverse biogas technologies is not the focus of the project, but the basis for understanding non-technological barriers and missing regulations. So the approach must take into account the separate generation of heat and cooling, but the main focus is on paths towards a wider use of biogas for the combined generation of heat and cooling for practical applications. The most efficient way for utilizing biogas seems to be the transportation from decentralised production at biogas generation sites to places with a high demand for power, heating and cooling.

This way is compared with the state of technique the using of biogas on-site of biogas production for power generation or heat usage in agricultural facilities. On-site using considers also new ways of usage as none or partly upgraded biogas:

- in micro gas grids or
- for heat production in micro heat grids or
- for fuel for transportation

in the direct surrounding of the biogas producer. The comparison and evaluation of supply chains includes the analysis of costs in different stages and the contribution to CO₂-reduction.

3.2 Economical, Energetically and Ecological Efficiency of CHP Techniques from Biogas in On-Site Supply Chains

Responsible Partner: EAV
Referred Deliverable: D02 (Report)

Cogeneration is one of today’s most environmental and at the same time economically feasible ways of generating electricity and heat. Efficiency of the cogeneration units is between 80 – 90%. In addition, in case of smaller decentralized sources the electricity and heat are produced and consumed in the same place, which eliminates the distribution expenses and losses caused by the distribution. The electricity produced in the decentralized cogeneration source is used to cover the power consumption of the building it is situated in and the excess can be sold to network.

Problems have to be solved when burning biogas off-site, in the place of consumption:

- Supplying the biogas plant with heat and electricity for self-consumption.
- Treatment and transport of gas
- Building the engine room for the cogeneration units off-site
- Securing consumption of electricity and heat during the whole year
In the following table the advantages and disadvantages of on-site (in the place of production) and off-site (in the place of consumption) biogas utilization will be compared.

On site:
- Lower investment
- Lower revenues (no revenues for heat)
- Simple accounting
- Lower operation costs

Off-site:
- Higher investment
- Higher complexity of inner relations
- Gas treatment costs
- Costs of self-consumption heat and electricity source
- Costs of decreasing self-consumption of heat

Economical efficiency off-site will be much higher, mainly due to greater revenues for selling heat and cooling.

Operating cogeneration sources on the place of consumption brings:
- Significant reduction of emissions, mainly of CO₂
- Better economic parameters, project is realizable
- More than twice as high energy efficiency

It can be assumed, that even better results could be achieved, but only in some of the categories. E.g. by using ORC the environmental and energy efficiency can be increased, but make worse the economic parameters significantly. Using of each technology had been evaluated carefully regarding the conditions of each particular project. A detailed feasibility study including a calculation model had been created and a comparison of several examples for on-side and off-site usage of biogas have been calculated. The results are explained in detail in the deliverables D02. In the following the results are summarized.

Operating cogeneration sources on the place of consumption brings:
- Significant reduction of emissions, mainly of CO₂;
- Better economic parameters, project is realizable;
- More than twice as high energy efficiency.

The cogeneration (CHP) is the main way for efficient energy using. The part of power generation in power plants have to be reduced in favour of CHP and CHPR units. For using CHP an electrical and heat (or cold) energy demand have to exist simultaneous during a long time in a year.

With climatic conditions like in Germany a heating system needs approx. 1600 h/a – 1800 h/a hours of operation at full power equivalent only. Normally the heating demand is to less to operate a CHP unit cost-effective. Therefore CHP units have to be as small as possible for long operating time to work as a basic supplier. Often the realization of ecological reasonable CHP units fails because of the competition with the power authorities. Therefore to establish distributed systems of power supply still needs support from the public authorities.

In order to improve the economy of CHP systems the energy efficiency of power generation and fuel cells has to be advanced. A further decentralization of power supply with CHP systems requires development capable and reasonable units in a small performance range (1…10 kW). Fuel cells, combustion engine, Stirling motor, Pulse-Tube-Stirling-Motor and gas turbine are suitable in this range of performance potentially. The procedural and technical development of CHP units for small performance ranges have to be supported by public authorities. The aim of
R&D promotion should be decreasing costs of small CHP systems. (Compare the support of using of photovoltaic)

Especially for using waste heat in a temperature level between 600°C to 1000°C it is necessary to develop multistage refrigeration absorption systems. The state of art of special CHP systems (Fuel Cell, combustion engine, Stirling Motor, gas turbine) demands a continual adjustment of refrigerating systems. The optimizing of every component has to be done for reach the highest CHP(R) system efficiency (It means lowest CO2- Emission also). An important precondition for economic mass production is more R&D in the field of small performance range single- and multi-effect absorption refrigerating systems.

Further R&D demand exists to create heat driven refrigeration systems for using temperatures below 0°C in a performance range between 1 kW and 50 kW also.

3.3 Simulation model for the Estimation of the economy of CHP from biogas and natural gas

Responsible Partner: ICT
Referred Deliverable: D03 (Tool)

The model has to consider especially the economy of upgrading biogas to different qualities and the cost structure in micro grids (biogas or heat). The result of D03 was to prepare a quick, simple and easy-to-use tool. For the estimation, the tool needs only one input value, the hourly biogas production of the biogas plant. From this value the tool estimates investment and total costs for different upgrading technologies and for different gas quality (H-, L-gas etc.). Three main upgrading technologies were taken into account, Pressure Swing Adsorption (PSA), Pressure Water Absorption (PWA) and processes of Chemical Absorption (ChemA). Nearly all the prices and costs in this tool are related to the German market due to a lack of information from other countries. Users from different countries have to consider the differences to their market in order to avoid deviations in the calculation. In deliverable was also added calculation on natural gas and a price comparison Bio-methane- Natural Gas.

The aim of the computer-supported model is to estimate of the economy of combined power, heat and cooling generation from biogas in comparison with technologies based on natural gas including the transportation and distribution process. The model considers especially the economy of upgrading biogas to different qualities and the cost structure in micro grids (biogas or heat).

This excel-based tool enables the user to compare basic costs for the utilization of Natural Gas versus Biomethane in combined power, heat and cooling generation. The main part is focused on the upgrading costs of Biogas to Biomethane and also on Biomethane injection to Natural Gas grid and transportation. The "Comparison" sheet compares the most important cost when confronting the utilization either Biomethane or Natural Gas. This sheet requires two kinds of information which should be added by the user:

- the place/market relevant data according to the local economic conditions;
- the data related to the upgrading and injection process of biomethane, which can be preestimate using the internal "Biogas upgrading" sheet. This sheet is useful for basic comparison for three different upgrading technologies (PSA, PWA a chemical absorption), with additional treatment to L-gas or H-gas quality or just processing to add-gas quality. Basic costs for Biomethane odorisation, injection and local grid construction are also included in this sheet.

In this tool no financial subsidies or green bonuses are included due to different legislative regulations in participating countries or different forms of support for the utilization of RES.
3.4 Register of Existing Technical Regulations concerning Biogas Production, Injection into Grids and Biogas Usage

Responsible Partner: INIG
Referred Deliverable: D04 (Tool)

Several methods exist for creation of registers of documents. Reports and legal acts are created including collecting data in a form of “paper mode” or “electronic database systems”. Nowadays collection of documents in “paper mode” form are archival mainly, because the access is limited (they may be stored in distant places). For the time being the information science and computer technology enable creation of easily edited registers which allow for quick and easy access to data.

Oil and Gas Institute (INIG) was made responsible for creation of a tool which would be used for recording Acts of Law related to REDUBAR Project. Different possibilities for creation and simple access were evaluated. The best way to offer a quick access by a maximum in actuality is a register in a form of database available via internet. Such register seems to be the best solution because it is readily available via internet. Advantages of the database:

- unlimited access to data (for participants only) from any place; internet is required
- possibility of searching for data in Database
- possibility of continuous updating of Database content – number of entries is unlimited
- change of Database construction is possible – must be justified
- entries are introduced in unified form
- construction of Database is intelligible

The developed database is available via the project website or direct at http://d04.redubar.eu. The detailed description is also available via the project website (D04). With the data base each user has quick access to effective legal documents related to the project. At the end of the action 69 Regulations of 10 countries and EU were listed, mainly in the countries of the project. Further extensions – regulations from other European countries – are planned.

3.5 Analysis of Existing Technical Barriers by Standards and Instructions

Responsible Partner: INIG
Referred Deliverable: D05 (Report)

The decentralization of energy market is not an easy process; several barriers and obstacles exist including:

- legislation problems,
- administration and financial barriers,
- organizational problems and obstacles related to human mentality – people are rather reluctant to accept the new solutions if the old system works.

The limitations specified above are observed in all EU countries. They are related to legal systems, which is effective in each of member countries. Information about barriers and obstacles (BaOs) have been collected from all EU countries, but at lest up to the end of the action in 10 member states technical and legislative regulations have been found. The specified data were gathered directly from Partners via internet. The data unification and transmission to data base was possible using a simple questionnaire. Source materials provided by project participants are grouped by categories. The identified technical barriers and obstacles are related to:

- European law (lack of regulations or incomplete regulations)
- Ordinances and recommendations
• Standards (guidelines) which regulate feeding of bio-methane into distribution network as well as standards devoted to distribution and utilization of biogases.

Hindrances should be divided into “barriers” and “obstacles” (abbreviated: BaO or in plural BaOs). They bear different features, importance for the outcome to reach a set or intended target and consequently define the required efforts to surmount them. Both should not been mixed up. In this project REDUBAR consortium agreed on definitions as follows:

“Barrier means a crucial, very serious problem, difficult to surmount, but if it is not removed or might not be bypassed it endangers or even blocks the technical development or the introduction into the market for a medium (5 … 10 years) or long term (more than 10 years) or even for ever.”

“Obstacle means a difficult problem or complex situation that slows down the speed of technical development and / or market penetration and causes a high amount of efforts to be solved.”

Both definitions characterise the consortium’s approach relating to tools and instruments to tackle the challenges. In this context a barrier should be usually approached by strategic decisions, by change in the rules, by targeted and stringent measures to permanently solve the problem, to set up a new framework allowing different interventions and at the same time, trying to positively implement the desired situation. BaOs might occur on different levels. This project focused mainly on national and European level, less on regional aims or down to a single technology, plant or project. An obstacle requires often different tools to intervene on the situation. It could be tackled with less structured interventions, with measures which do not present a permanent character or normally do not dispose of uniform value to any single case.

The analysis of barriers and obstacles was carried out for various stages of process in biomass supply, biomethane generation, the on-site usage of none or partly upgraded biogas and the supply of micro heat grids or injecting into micro gas grids. The found BaO are grouped also to the kind of regulation: legislative, administrative, economical, operational, and infrastructural.

INIG prepared a feedback-questionnaire about deliverable 05 for workshops and the results of the completed feedback-questionnaires was collected and submitted as an Annex to D05. As a result of the analysis the share of BaO regarding to different production stages and kind of regulation is defines and shown in the following figures.

![Figure 2: Number of BaOs in the biogas production stage](image-url)
A vast majority – 36 out of 61 (59%) BaOs identified in biogas production stage is related to pumping biogas into the natural gas distribution network, out of which over 50% (19) are BaOs qualified as operational.

The next figure shows the level of difficulty in defeating BaOs for biomass production and biogas usage methods. 57 % of the BaOs (35 out of 61) have been qualified to the HE category. 13 have been qualified to the VHE category (VHE – very hard to eliminate, HE – hard to eliminate, EE – easy to eliminate, VEE – very easy to eliminate). This shows the difficult situation within the area of fighting BaOs limiting the availability of biogas as a power source for heat and electricity generation.

![Figure 3: Difficulty of eliminating BaO in the biogas production stage](image)

Figure 3: Difficulty of eliminating BaO in the biogas production stage

There are no technical barriers or problems in the field on biogas production and use. The facilities and technologies are well known and available on the market. Thus the proliferation of biogas faces not technical, but primarily economic and, to a smaller extent, regulatory barriers.
4 Biogas Production Potentials, Market Chances, Competitors and Regulations

4.1 Overview

Progress of work in the Project, keeping to scheduled deadlines, evaluation on what is going on in this awaking industrial branch, reliable results and recommendations were extremely dependent on the good will of stakeholders, their real data input and provisions of hard core information, from the cooperative behaviour of members of the TGs, most of them big gas and energy companies, of owners of the natural gas grid, of biogas producers, project planers, engineers, of manufacturers of upgrading plants, of investors and first operators of biomethane plants, last but not least, of users of biomethane. These severe difficulties became obvious right from the beginning and had to be solved anyway as a key for the success of the Project. The main changes during the whole course since concluding the Project are:

- The situation on the global, EU and national energy markets changed in an unprecedented manner (oil and gas prices, gas quarrel between Russia and Ukraine resulting in temporary interruption of natural gas supply to MS of the EU etc.) all of them with strong repercussions to the main subjects of the project.
- Alternations in EU energy and climate mitigation policy accelerated. The European Council adopted for the first time binding objectives on energy efficiency, application of RES, use of bio fuels, consequently, the legislative situation on European and national levels changed essentially. The EU-Biomass Action Plan was published and obliged the MS to elaborate their national programs to fulfil it.
- Dramatic turbulences around bio fuels and their effects on food, feed and material supply occurred and caused tremendous influences on several countries.
- The state-of-the-art of biomethanation, the use of biomethane, gasification for bio-SNG, even of simple biogas generation and the knowledge about it within the EU, between all MS and within the participating in the project partner countries were extremely different and developed with unbalanced velocities.
- Since mid of the year 2008, just at the historical top of the oil and gas prices, the global financial and afterwards economic crisis hit the emerging markets of biogas, biomethane and automotive transport fuel, specially severe in East-European MS.

The situation around biogas, its onsite use for CHP or CHPR, injection of biomethane, its utilisation as automotive fuel and the future production of bio-SNG were strongly influenced by an outcome of a study of extraordinary value of a group of German research institutes (at that time: Institut für Energetik und Umwelt, now Deutsches BiomasseForschung-Zentrum, Öko-Institut), published in summer 2007. In an in depth investigation on the potential of biomass for injected biomethane produced by digestion and thermo-chemical gasification in corridors along the complete pipeline structure from Russia to Western Europe they came to the conclusion of enormous strategic value for the EU. They summarized that given well-defined conditions theoretically and under ideal assumptions all natural gas imported by the EU might be substituted by biomethane in a long-term period. Although, this would be in reality impossible this conclusion made clear, biomethanation might become for the EU and their MS a high-ranking strategic issue.

These changes led in Germany to an accelerated development in the biomethane sector at one hand and to growing contradictions with unsolved general problems and insufficient regulations hindering all interested parties at the other. Until May 2008 the first eight plants went into operation (by July 31, 2009: 17 plants), but the pioneer companies became ever more reluctant delivering data in fear to give up unique know-how and benefits in an emerging competitive market section. Even the fulfilment of tasks of REDUBAR were put in danger. Obviously, organising the target groups for collaboration and finding common points of view with became ever more necessary, also with regard to joint activities in public and for concerted actions to achieve a favourable
attitude of governmental and elected legislative bodies to strategic issues of implementing biomethane in the market.

As major conclusions of the situation the project partner FEE initiated, the following measures:

- elaborate a first German overview on biomethane plants in operation, under construction, in planning and engineering stage and given-up projects, exchange data with the German representative to IEA task 47 “Biogas and Landfilling” and the “Biogaspartnerschaft” [biogas partnership] of mainly governmental-owned dena Deutsche Energie-Agentur GmbH, and keep it regularly up to date,
- propose to the REDUBAR group to tread at every project meeting the state-of-the art in at least one country,
- establish contacts to all identified EU- and German national projects related to biomethane and
- most important and sustainable for the future found as a lesson learnt from REDUBAR and to facilitate the achievement of its targets jointly with BBK the BioMethane-Board (BMK) a national platform for stakeholders.

The main objective of REDUBAR was to remove or decrease BaOs for the implementation of biomethane. They were found in the instable or weak cooperation along the utilisation chain at all levels of stakeholders (poor knowledge with the actors, deficiencies in legislative, technical rules and administrative structures, hesitating investors and further concerned parties). Therefore, FEE, as a national innovation network among others for dissemination of innovations and its socio BBK Bundesverband Biogene und Regenerative Kraft- und Treibstoffe e.V., as a national lobby organisation, were integrated into the project group. Both integrate members from all links along the biomethane added-value chain.

One of the first conclusions in the first months of the project was: neither one single workshop nor several dispersed activities will be sufficient to fulfil both tasks: analyse BaO’s and contribute to remove them. But a permanent body integrating stakeholders of all, or at least, most of the TG’s, at the best, at management level, including lawyers professionally dedicated to the matters of biogas, biomethane, biofuels and natural gas, combined with regular meetings or workshops, links further projects might be able to do so. This led to the idea to call for a workshop as inaugurating meeting, inviting stakeholders, present the first results of REDUBAR analysis and ask them for their opinions. BMK was founded on May 21, 2008. The inauguration assembly accepted rules for its activities among them the EU-project REDUBAR might serve as its basis as long it’s exists and will stay active after its termination as a national biomethane branch network.

Furthermore:

1 Dissemination activities should be directed to all TG’s, which turned out to be a very difficult aim to be achieved with conventional means Partners from all TG’s and other entities related to the subject (from farmers, managers, manufacturers, bankers to scientists, lawyers and governmental officers as well as NGOs) take part in BMK, some of them even with contradicting interests

2 Legal deficiencies and lack of legislation to facilitate the access of biomethane into the market were defined by REDUBAR analysis as one of the gravest and most difficult to solve obstacles BMK serves as a regular meeting point between juridical and technological experts for mutual consultancy and understanding to elaborate jointly effective proposals (A resolution was adopted already at the first meeting. Letters were directed to the Federal Chancellor, related with biomethane issues Federal Ministers, Prime Ministers of Federal States, deputies of Federal Parliament. Two of the results are the contribution to the acceptance of biomethane in the calculation for the national biofuel quota and to the decision of tax exemption of biomethane as automotive fuel until 2015.)

3 In the first year, the participation of FEE in separate conferences and workshops to inform on REDUBAR proved to be insufficient to join forces and execute influence
Immediately after founding BMK the situation changed completely. The acceptance has risen sharply, not only by the gas industry but also by governmental authorities. (Already at the 3rd BMK meeting representatives of federal authorities took part, partially even as speakers (Federal Environmental Agency, Federal Grid Agency, Clearing Authority for Feed-in-Act, Deutsche Energie-Agentur GmbH)

3rd BMK-Meeting accepted draft of annual plan for 2008/2009 and the 6th BMK-Meeting for 2010. A national meeting inviting all ongoing EU- und national projects on the subjects of biomethane and bio-SNG is planned as important event promoting not only mutual information but possibly future joint actions.

One task of the Commission to REDUBAR project is to contribute to sustainability of biomethane proliferation even after the project will be finished

BMK is the effective instrument to do so. It bears even the potential for international cooperation, say as a platform or network (the logical line of consequence from the REDUBAR project and its first conclusions which led to BMK were presented in posters to the 16th European Conference on Biomass (2 – 6 June 2008 in Valencia, Spain) and 17th (June 29, to July 03, 2009 in Hamburg, Germany

BMK might serve as an example for other MS to join and organise stakeholders and is ready to take part in international activities

As aimed by FEE, the BMK turned out to be a valuable and - most important – sustainable result of REDUBAR. The direct contacts to stakeholders of the TG’s improved immediately. FEE got direct access to their experiences in planning and realizing biomethane and injection projects as well as operating the first plants in Germany. The now regular meetings every four months led to improve the personal relations and confidence. At the 3rd (24.10.2008) and especially at the 4th meeting (09.02.2009) the speakers for the first time responded to our request to inform not only on the projects itself but analyse obstacles, give proposals for national and EU regulations how to surmount them and mention driving forces and first favourable results and still prevailing deficiencies of the new legislative regulations and the operational practise of the year 2008 in Germany. The information, describing progress, deficiencies and proposals of the speakers were evaluated, discussed individually with them and become part of several deliverables as D6, D 9, D 11, D 13, D 26, at least what Germany is concerned.

Without BMK receiving data for the software (D 11) and testing it would hardly be possible, comparing it to the insurmountable objections our partners from other participating countries met. We were not only being able to collect BaOs but especially jointly with the stakeholders find recommendations how the existing situation to bring biomethane into the market might be really improved and to solve problems encountered persistently in reality. Furthermore, BMK is in the meantime accepted by the young upcoming industrial branch of manufacturers, investors and operators. We are now preparing sustainability of REDUBAR even after the project end by having established a national network.

The overview on biomethane plants for May 2008 and end of the prolonged REDUBAR-project July 2009 is annexed (see Annex III). All data were cross-checked in consultations with the plant operators. At every meeting of BMK and the REDUBAR project the participants were informed about the at that time actual state-of-the-art.

What above mentioned European and national projects are concerned, FEE established contacts and in some cases initiated first steps of coordination to EU- and national projects on biogas / biomethane with

On EU-level:

- „AER-Gas II“ (Technische Universität Wien, ZSW Zentrum für Sonnenenergie- und Wasserstoff-Forschung)
- „BiG-East“ (WIP München GmbH)
- „Biogasmax“ (ISET Institut für Solarenergietechnik)
- „Bio-SNG“ (TU Wien, PSI Paul Scherer-Institut)
On national levels

Austria:
• Technische Universität Graz (socio of FEE)

Germany:
• “Biogaspartnerschaft” [“biogas partnership”] (dena Deutsche Energie-Agentur GmbH)
• „Biogaseinspeisung“ [“biogas injection”] (Fraunhofer-Institut für Umwelt-, Sicherheits-, Energietechnik (UMSICHT, socio of FEE).

As results of REDUBAR, BMK and further related activities, FEE and BBK were invited by the Federal Ministry of Environment, Nature Protection and Nuclear Safety (BMU) to participate in the preparation led by dena of the “Federal Biomethane Register” that should become operational at the beginning of 2010 as a national body for certification of biomethane as one of its major tasks.

In July 2009, FEE was asked by BMU to contribute to a list of future research topics in the framework of the national activity “Research for sustainable energetic use of biomass”. We were able to propose from our evaluations gathered in REDUBAR with regard to biogas and biomethane as topics
• elaborate a dissemination strategy
• use of biomethane, bio SNG and other gaseous bioenergy carriers in industrial processes
• utilisation of residues in bio energy conversion (f.i. digestates from biogas generation)
• analysis and research of unused soil resources for biomass production
• in international cooperation: adapting technologies approved under German conditions to the social, technical, legislative and normative environment of other countries and financial research for dissemination to divers markets
• combination of bio energy with measures of energy efficiency to create a system of full supply of energy by RES
• total balancing (energy, natural resources, water, humus, ecological, regional and macroeconomic) as easy to handle tools for decision makers

Only by combining all these additional but indispensable measures with the originally planned activities FEE and WP partners were able to reach the main targets of the contracted deliverables.

4.2 Estimation of the Existing Biomass Potential for the Conversion into Biomethane

Responsible Partner: Uni Miskolc
Referred Deliverable: D07 (Report, Data Base)

The distinguished role dedicated to biomass and bio energy raises the question to its sustainable availability and potential. But data in literature and internet sources differ yet substantially. The authors relied mainly on recent publications of EUROSTAT [EUROSTA 2008], WBGU Scientific Council of Federal Government Global Environmental Changes of Germany [WBGU 2008] and the earlier EEA report Nr. 7/2006 [EEA 2006]. UNI Miskolc as author of D07 could also count on data delivered by involved REDUBAR partners.

WBGU estimates the global sustainable potential of bio energy as about 104 EJ per year. This represents about 20 % of the global primary energy need of about 510 EJ per year. In 2006 about 51 EJ of bio energy were generated mainly by traditional bio energy production. To keep a global view in mind it seems to be important, as already now 26 EU–MS are net importers of energy. The only exception is Denmark. From an European point of view the environmentally compatible
primary energy potential will increase from 69 million tonnes of oil equivalent (MtOE) in 2003 to 195 MtOE in 2010 to estimated 295 MtOE in 2030.

EEA evaluates that already fixed European targets require 150 MtOE for 2010 and about 17 % for EU-25 in 2030.

What biomass production for bio energy is concerned, the strongest limiting factors are arable land and water. Although for example in Germany where industrial crops (a main source for substrates of the more than 4,000 biogas plants and for various bio fuels) on arable land had in 2008 already reached as much as 2 million hectares of in total about 12 million hectares arable land this amount is estimated to be increased up to about 4 million hectares. [FNR 2008, SRU 2007] Coincidentally, bio waste, including agricultural waste, like manure and dung, biodegradable household and municipal waste, is regarded by almost all sources as major biomass for bio energy production. The amounts sum up to 700 Mt agricultural wastes in EU-27 [EUROSTA 2008] or 100 MtOE total bio waste [EUROSTA 2008].

With regard to future bio-SNG production at the first glimpse wooden biomass seems to be abundantly available. One of the main sources of biomass is a total of 177 million hectares of forest and other woodland in EU-27 that in average is far from being exploited. Nevertheless, at least as far a Germany is concerned there are in some regions first signs of scarcity of unused waste wood, residues from industrial wood production and even forest energy wood, showing locally even an increasing pressure to violate the principle of sustainable felling for short term profits. As yet in about 2015 first bio-SNG and Biomass-to-liquid plants will be marketable it is estimated for Germany that all the wooden biomass might be used and these plants might be supplied only by redistribution in harsh competition for feedstock. [MANTAU 2008, MURACH 2008]

But short rotation coppices and agrarian wood systems are just at the beginning of their use, mid 2009 with about 1,300 hectares cultivated. In a recent study the German Bioenergy Research Centre (DBFZ) calculates with an increase of overall technical potential of energy carriers for bio-SNG from 1,074 PJ (2006) to 1,524 PJ (2020), given the actual framework conditions. [DBFZ 2009]

Estimating a conversion ratio of 95 % for biogas on base of the biogas potential and 65 % for bio-SNG on base of lignocellulosic fuels DBFZ came to the conclusion that from 2006 with 24.1 billion m³ i.n. biomethane in natural gas quality the potential might be expanded up to 34.4 billion m³ i.n. biomethane. That means industrial crops offer the lions share of potential and should be expanded by strategic targeted measures.

In the countries of the consortium the theoretical biogas potential is minimum 959 PJ and maximum 2,912 PJ, the average of these 1,936 PJ. In 2008. Expressed in biogas with a specific energy content of 25 MJ/m³, the extreme values are minimum 38.361·109m³ and maximum 116,490·109 m³, i.e. the amount of biogas raw material available in the countries in 2008 could have been used to produce theoretically that much raw biogas. The estimated amount of energy could have been actually extracted if all basic materials suitable for the production of biogas had been used to produce biogas. The potential actually used is much smaller than that, and a different methodology should be used to estimate its amount.

In the EU 27 countries the theoretical biogas potential is minimum 3,425 PJ and maximum 10,121 PJ, the average of these 6,773 PJ. Expressed in biogas with a specific energy content of 25 MJ/m³, the extreme values are minimum 136,992·109 m³ and maximum 404,827·109 m³, i.e. the amount of biogas raw material available in the EU 27 countries in 2008 could have been used to produce theoretically that much raw biogas. The REDUBAR countries might have a share of it 28,6 % in all.

The production of biogas is feasible from a high percentage from plant cultivation by-products. Without counting industrial crops cultivated for the production of biogas - biomethane 73.3 % of the average biogas potential is accounted for by plant cultivation by-products, 13.0 % by communal solid wastes, 6.6 % by communal waste water and 7.0 % is accounted for secondary products of livestock production.

If the sizes of the average biogas that can be produced are examined in a comparison of the eight countries, it can be established Germany has the largest share with 38.7 % in the summarised
potential of the eight countries. The average value for Poland is the second highest value at 19.1 %, Italy has the third highest value at 16.6 %, and the shares of the other four countries each are below 10 %: Hungary with 9.5 %, the Netherlands with 4.9 %, the Czech Republic with 5.5 %, Greece with 3.5 % and Lithuania with 2.2 %. The ratios reflect the geographical sizes, locations, topographies, agriculture and economic features of the countries as well.

4.3 Description of the Competitors Concerning the use of Biomass for Biomethane

Responsible Partner: FEE
Referred Deliverable: D06 (Report)

Major conclusions from biomass potential
There is all over the EU and in almost every MS sufficient “wet” and “dry” biomass available for elaborating a EU and national strategies for biogas, its upgrading to biomethane and thermo-chemical conversion to bio-SNG for the exergetic best practice in onsite polygeneration to power, heat and refrigeration, for injection and distant application for CHPR, industrial processes and material use as well as for utilisation as vehicle fuel.

Further studies in all MS are needed to create more reliable databases on technical potentials and related factors as arable land, water, fertilizers, finances and comprehensive balances.

The potential of bio residues of all kind (as a semantically better term should be introduced: secondary biomass), grassland, plant mass from landscape preservation is by far not used sufficiently. Conditions for it should be improved, also for the use of biomethane in urban areas.

Possibilities for biomass imports should be investigated very carefully and critically, as there are already clear signals that a lot of biomass rich countries might use their biomass by themselves. Some of them have already started with elaborating their own bioenergy and biofuel strategies. In export relations there should be given attention not only on certification but on biodiversity, too, for broaden the base for non-edible biofuel species.

Market chances
The use of biogas as gas from anaerobic digestion, its upgrading to biomethane to a quality of natural gas L (89 % CH4) or H (96 % CH4) or of bio-SNG (synthetic natural gas) produced via thermo-chemical gasification distinguishes not only by its high technical potential, broad biomass base, partially of biomass that otherwise might even not being utilised, and its availability as EU-indigenous renewable energy resource. Its most outstanding properties are the real possibility of high energetic and exergetic use, of being stored, its versatility of application either on site as raw biogas or transported in micro gas-grids to a nearby user, or after injection into the existing natural gas grid for off-site utilisation in polygeneration, in burners for industrial application, in cars, lorries, busses and trains as vehicle transport fuel or as base material in a biorefinery for material production and last but most important its low climate mitigation foot print.

The technology for the basic biochemical process to biogas is state-of-the-art, for the thermo-chemical conversion not yet. But the first results of a 1-MW fuel-pilot and demonstration plant as a joint EU-project with major Swiss participation (Paul Scherer Institut) at Güssing, Austria, are promising. The plant was commissioned in December 2008. The planning and engineering process for building a production plant and additionally a research and development platform based on a second technology (AER Absorption Enhanced Reforming) is ongoing in Germany. Industrial operation might be expected by about 2015.

Energetic use of biogas on site of the location of the digesting plants is to be preferred in the case of local need of the heat. As for obvious reasons the plants are located far away from heat or cold consumers combustion of biogas in engines only for power generation means anergetic losses and waste of valuable biomass, money and even damages climate. As the electrical efficiency of the conversion process in gas engines is about 34 – 40 % [FNR 2005] in relation to the energetic
content of the biogas (mainly 50 to 70 % CH4) and for heating the digesting tanks only about one third of the remaining energetic content is used with every biogas plant of that deficiency 40 to 45 % of the energy of the produced biogas will get lost by the unused exhaust gases. This substantial waste of energy is shown by the situation in Austria, where about 350 plants in operation have a degree of thermal efficiency of > 40 % only 5 %. The overwhelming majority of 34 % use 0% to 10 % of their heat, 27 % from 11% to 20 %, 19 % from 21% to 30 % and 9 % from 31% to 40 %. [Braun 2009] Given, for example, the high amount of > 4,000 biogas plants in Germany this means a substantial waste of energy.

In remarkable difference, injection of upgraded biogas into the grid could result to an utilisation of the energy content of even higher than 90 %. According to [Albring 2007] in his study for REDUBAR only 10 % of the supply of electricity and 7.5 % of heat is generated by CHP. On the other hand, more than 14 % of the electrical energy (5.8 % of the primary energy demand) is required for refrigeration with increasing tendency. The appliance of waste heat fired refrigeration facilitated by injection and direct use at the consumer’s site might rise hours of operation, the economical efficiency of CHP and lower emissions. Valuable from an energetic point of view heat driven cooling applications might be production purposes (4°C - 20°C), cold storage (0°C – 10°C) and even freezing storage (-20°C – 0°C).

Also further boundary conditions for biomethane and bio-SGN offer excellent market chances as f.i. the density of the natural gas grid in most MS of the EU, the growing number of vehicles driven by natural gas (Europe 1,127,165 vehicles of all kind, with Italy in a top position of 588,077, followed by Germany with 83,783 and Sweden 18,579) and 3,138 filling stations (Germany 835, followed by Italy 700) by the end of 2008. [Boisen 2009]

But objective market chances depend very much on the creation of favourable conditions. In the case of vehicle fuel the biofuel directive is a certain stimulus, but a strategy dedicated directly to biomethane still is missing in the EU. Only Germany has set indicative targets so far. In order to decrease import dependence and impulse climate protection natural gas for CHP and as vehicle fuel the Federal Government stipulated in its Integrated Program for Climate Protection and Energy that by 2020 6 % (= 6 Mrd. m³ i.N.) and by 2030 10 % (= 10 Mrd. m³ i.N.) of the natural gas should be substituted by biomethane. Biomethane may be counted for the biofuel quota and will be exempted from mineral oil taxes until 2015. Yet the velocity of putting plants into operation at the moment is by far to low to hit the target. Since 2007, in total 17 plants have been commissioned by July 2009, the end of REDUBAR project, but about 120 plants of about 500 m³ i.n. per hour biomethane upgrading plants ought to be built every year until 2010. Also the results within Europe are still meagre, about 80 plants are in operation, 76 of which within the EU, led by Sweden with 34 fuel plants. Besides the above mentioned units in Germany, there have been commissioned so far biomethane plants in the Netherlands (15, sewage gas), 4 in Austria (2 for injection, 2 for fuel), 3 in Belgium and one each in Iceland, Luxemburg and the UK, rounded up by 4 plants in Switzerland (fuel). [IEA 2009]

In 2009 in Germany for the first time one of the most important advantages of biogas was proved in a hybrid RES power plant, consisting of several wind energy parks, photovoltaic plant project and a biogas plant for 100 % regional supply of electricity for a rural region relying completely on renewable energy sources.

Although biogas and biomethane have got numerous advantages it has been so far underestimated. Biomethane offers all features needed as a base for an own strategy within the EU and every MS.

**Competitors**

Both conversion technologies to biomethane invade as competitors in different manner, level and scale into existing and emerging competing systems. The most important competing factors and situations are

- the currently dominating factors in the energy and transport fuel markets of established use of natural gas and fossil transport fuels with its special features like
• shrinking EU-internal resources, need for imports, consequently followed by dependency,
• long-term delivery contracts with suppliers or transport intermediaries mainly situated in conflicitive global areas, related to major economical competitors and following own, not in any case EU-friendly political lines at one end and consumers at the other,
• very favourable existence of a dense and well-established infrastructure of supply (pipeline grid, compressor stations, gas stores, filling-stations etc.) and final utilisation (vehicles, stationary engines, burners etc.),
• the often problematic challenge that these markets are monopolized, unbundling had not led to free competition but rather to hidden dominance over the complete logistics and value chains, from contract of sale over generation of end energy and its delivery to the consumers,
• in detail well-regulated and smoothly functioning norms, standards, behaviour and players all adopted to the needs and best of fossil fuel energy and automotive industry, exclusively
  • primary or balanced use of biomass for four f:
    • food,
    • feed,
    • fibres, as synonym for material for multiple industrial products and the emerging biorefinery concepts,
    • fuel, as synonym for energy,
  • availability of limited resources, as biomass, arable land, water, nutrients, to a certain extent finances, too,
  • primary or balanced bio-energetic application
  • conversion technologies.

This competition might have favourable or negative effects. Some of them might be grave with social, economic and energetic strategic repercussions on regional, national, European or even global level and might exercise additionally environmental influence.

As biogas and sewage gas are the basic gases for the conversion to biomethane, even their now still overwhelmingly practiced on-site combustion in engines might be a competitor to biomethane. Landfill gas is frequently loaded with gaseous impurities it suits for the economic reason of prohibitive higher efforts for purification less than the both other gases for biomethane. At the same time anaerobic digestion is the pathfinder for upgrading to biomethane. The decisive benchmark for preference energy efficiency will increasingly prevail by economical success. Biomethane itself might be used in different applications. Even they might compete in future one with the other. Currently, upgrading biogas to the quality of natural gas and injecting it into the natural gas grid as biomethane (or in other terms “bio-natural gas”, or “biogas L / biogas H” or “green gas”) is not yet a wide spread common technology, although many technically and commercially successful projects are already operational.

Biomethane it is also distributed as automotive fuel for natural gas vehicles by filling stations. Even the very first small near-distance special biomethane grids had been built recently.

Additionally, biomethane might be used in high-temperature industrial processes, an area where conventional primary energy carriers are to be hardly substituted by other RES.

With regard to the multiple competitive situations the project group decided to investigate in detail the competitive and interrelated positions of biogas-biomethane-bio-SNG putting main emphasis on biomethane along the complete added-Value chain from untreated biomass to final energy applications. Beginning with their role to reach strategic objectives of the EU and the MS, their
achieved state-of-the-art and main applications, the competitive situation was investigated in following chapters of D 6,

- in the system of utilisation of biomass,
- in the bioenergy market,
- with regard to Biomass-to-Liquid fuel (BtL),
- in relation to directly used synthetic natural gas,
- in distant polygeneration of power and heat and its its conversion to cold,
- in new applications.

Coinciding with the 16th European Biomass Conference (2 –6 June 2008, Valencia, Spain) REDUBAR came to the conclusion, biomass becomes a scarce commodity. All sustainable sources should be mobilized. They have to be used with clear priority criteria, in cascades and without exergetic losses with the highest possible energetic efficiency. [SCHMID 2008] In this regard biomethane and in future bio-SNG are commodities with outstanding properties. They have the making to contribute to solve major aims of the EU not only in energy security and climate mitigation but also in self-reliance on its indigenous availability, regional economic development and reshaping the agricultural sector. Many factors show that biomethane and bio-SNG deserve to be endowed with an own strategic role. To mention only one illustrative reason: A study for the German Fachagentur Nachwachsende Rohstoffe [Agency for Renewable Resources] came to the conclusion that the best performing fuel is biomethane, given equal conditions the car-driving distance with the energetic plant yield from one hectare is 67,800 km, in comparison to BtL (64,000 km), pure plant oil and biodiesel (both 23,300 km), bioethanol (22,400 km). [Schütte 2008]

**Regulations**

The consortium encountered already in the kick-off period of the project, that BaOs often are related to legal, administrative and normative regulations, concerning

- the lack of internalisation of the external costs in energy prices,
- prices and costs,
- access to financing,
- access to fuels,
- grid system properties
- access to the grid,
- administrative procedures,
- legislation,
- taxation and incentives
- norms and standards.

Up to now these factors play only in the countries with biomethane plants an influential role, in others only a marginal or even none. Therefore, only Project partners from countries with first practical expertise in running at least biogas plants could contribute their experiences (Germany, Hungary, Poland and the Netherlands). As it is expected by the authors that biogas and biomethane might be implemented in a larger scale in further MS and the European Community these data collected in D 9 might be useful for those countries to take early measures for easier implementation. Hence, the EXCEL sheet is structured as follows:

- Country,
- Items, like components of biogas utilization, market actors, market behaviour and point of supply chain,
• Range of influence,
• Barrier or obstacle,
• Term,
• Description,
• Kind of influence,
• Effect,
• Remarks.

The collection of regulations has shown, that the differences between the countries what legislation, administrative rules, norms and partially even standards are concerned are grave. In the EU and in nearly all MS existing regulations do not suit to the implementation of biomethane, not to speak about bio-SNG, in some cases they even block it as a barrier. It became obvious that even in countries like Germany with a rather advanced legislation there are still uncertainties (like measuring the biomethane quality at the injection point, the related costs for it and the justification of automatic cutting-off the injection in case one or several parameters vacillate around fixed points).

Because of the very high amount of regulations, which need special juridical and technical knowledge it was not possible in this project to compare in debt all related legal and other norms. On the other hand, they are often crucial for the success of strategic implementation. Hence the project group recommends, to

• call for a project for comparative evaluation of the different regulations in the MS,
• study the results of the existing regulations on the implementation of biogas and biomethane in the most advanced countries, in order to find out best solutions for copying them,
• try to harmonise at the best at EU-level the juridical rules for both technologies and
• look for regulations which are killing two birds with one stone: Regulate what in fact is inevitable but find out modalities to do it with less bureaucratic intervention as possible, that is often also the less expensive and the best way to promote dissemination.

4.4 Fixed Recommendations for Biogas and Biomethane Use

Responsible Partner: FEE

Right from beginning and with every deliverable, workshop, interview and questionnaire the consortium strived to put emphasis not only on finding out BaOs hindering application of biogas and biomethane but to find solutions for the challenges. All findings were cross-checked with the experts from the TG’s. The main recommendations to favour biogas, biomethane and in future bio-SNG, too, that have been elaborated in WP 3 and 4 that could be confirmed in the course of REDUBAR-Project are

• draft and implement a comprehensive strategy at both levels, EU and MS, supported by a programme of actions and financing, considering the strategic outstanding priority and energetic efficiency of biomethane in all further considerations and deliverables,
• grant priority to biomethane for injection into the grid,
• guarantee equal financial conditions at least in the same amount and duration as for natural gas. That might be done by different means, such as remuneration on base of kilowatt hours electricity produced finally, or cubic meter sold, or tax exemption harmonise European and national legislations, or payment for green certificates or a combination of several tools with or without targeted bonuses to promote strategic objectives, but in any case reliable and long-lasting to allow planning of refunding,
• avoid long-lasting subsidies, because they might change for new political circumstances and do not provide investment security inevitable for the success,

• elevate efficiency of energy conversion, f.i. by granting a bonus for CHP or even better CHPR,

• create conditions to make profit,

• mobilise biowaste as an important and so far often neglected source,

• check the possibilities for establishing a separate biomethane and bio-SNG platform like the REDUBAR stimulated BioMethane-Board on EU and / or national MS levels as a platform for organising the branch, lobbying in favour of biomethanation, pushing research, development and innovation and boosting an information campaign,

• keep in mind the advantages of the these technologies for regional development in times of globalisation,

• organise an EU-wide information campaign on biomethane,

• promote research, among others on the topics of realistic potentials, relation of climate protection and biomass, of bio-SNG, best strategic solutions in multiple interrelated, often contradictory matters with deep and immense repercussions,

• prepare early measures to avoid failures,

• take immediate actions for mobilizing financial investment, among them providing reliable securities for private investments, co-financing them and redistribute f.i. regional, technology and social funds,

• further profound investigations into objective, easy to handle decision tools to “compare the difficult to compare technologies” in a substitution effect analysis, f.i. by balances, scopes, nutrients, minerals, rare materials, consumption of soil and water and so on, of course together with usual benchmarks as energetic, economical, social factors and the ecological footprint,

• make use of REDUBAR conclusions and recommendations for just started biogas and biomethane strategies (biomass action plans. Poland, UK)

• use information tools of the EU to inform main target groups and decision-makers, especially federal and state governments, utilities, natural gas distribution systems owners and operators of biogas plants, as well as international partners in EU-projects on the results of REDUBAR

How urgent and important appropriate measures are was proved in an unprecedented appeal to the recent G8-Meeting of Energy Ministers by the Executive Director of the IEA (24 – 25 May 2009, Rome, Italy). He called for immediate action to counterbalance the effects of the global financial crisis by investing among others substantially into renewable energy, energy efficiency and decarbonisation of energy. Otherwise already as early as 2012 to 2013 a long-lasting energy crisis might begin with far-reaching effects on energy security and climate change. They may even lead to energy poverty. [IEA 2009]
5 Administrative Barriers for Biogas Usage

5.1 Overview

The chapter is directed to the detection of administrative (non-technological) barriers for the use of biogas. For the detection is taken into consideration, that there are two groups of non-technological barriers:

a) non-technological barriers caused by technological barriers (objective WP 02, see overview WP 02)

b) non-technological barriers for no apparent technological background.

The aims are to find out what hinders an increase in efficient power generation, heating and cooling from biogas, in scenarios where biogas is used on site of the biogas production directly or off site (e.g. in small heat or gas grids). This is the case in most of the EU member states where legislation favours power generation from renewable sources. The results are collected on regional and national level of the partner's countries. Afterwards will be evaluated, whether the single barriers are valid for only the national or for the EU level. For EU level, the proposals for reduction or liquidation are valid for all partners in the same way. National barriers will be removed, if removing them contributes to getting the project targets. From the results general conclusions have been drawn. The recent trend towards using combined heating and power plants for power generating and feeding local heating systems in highly developed residential and industrial areas will also be considered.

The barriers for upgrading biogas are one of the main subjects of the problem. For the on-site use, crude biogas or only partly upgraded biogas can be used. There are looking on the state of the art no technological barriers for partly upgrading, which might cause considerable non-technological barriers. The possible barriers are detected in the former chapter. For the off-site use and the injection and transportation before,

- only small crude biogas volumina can be transported because the requirement for a natural gas similar quality of the natural gas/biogas mix
- the biogas must be upgraded to or near to natural gas quality for making possible the transportation of big volumina.

The administrative BaOs are closely related to legislative and normative as well as financial regulations and the calculations of erecting and operating a plant. In the EU and in most MS in the project involved they did not exist for biomethane, neither bio-SNG, but for natural gas only, frequently not suitable to further the implementation of these new technologies. In Germany, as a kind of forerunner, the first ever adoption of rather comprehensive legal, administrative and financial regulations on injection of biomethane into the natural gas grid were adopted by the Federal Government and Parliament at March 12, 2008, as Gasnetzzugangsverordnung (GasNZV) [Ordinance on Access to the Natural Gas Grid] and Gasnetzentgeltverordnung (Gas NEV) [Ordinance on Remuneration for Injection into the Natural Gas Grid]. Further new regulations went into force at last at January 1, 2009, with the most recent amendment of the Gesetz für den Vorrang Erneuerbarer Energien (Erneuerbare-Energien-Gesetz, EEG) [Act on Granting Priority to Renewable Energy] and the first ever legally binding Erneuerbare-Energien-Wärme-Gesetz (EEWärmeG) [Act on the Promotion of Renewable Energy in the heat Sector], the latter one was published at August 18, 2008.

Growing costs for upgrading biogas to biomethane and its injection in the existing natural gas grid depend in most markets on accessibility to credits, financial support or administrative rules. Therefore deliverables D 9, D11 and D12 are interlinked.

The extremely different situations in the application of biomethane (2007/2008), even in the state-of-the-art biogas use in the participating countries exercised a negative effect. Most owners of plants were reluctant or rejected cooperation and delivering facts and data. Supposedly, they were afraid to give up commercial advantages in market competition. Therefore, partners were obliged
to concentrate on countries with existing plants and rely on establishing close links to operators. The key for the progress achieved was, as above mentioned, the BioMethane-Board.

5.2 Overview on Administrative Barriers and Obstacles

Responsible Partner: FEE, Uni Miskolc
Referred Deliverable: D09, D10 (Reports)

Barriers

From chapter 3 onwards, continued in chapter 4 and 5 and confirmed in the rest of the project, especially in the questionnaires with stakeholders and in several workshops the REDUBAR group found out and classified the following barriers:

- The both most decisive and interconnected barriers are the absence of profitability and investment security. If this double barrier is not removed, notwithstanding the level, there will be no biogas production, biomethane injection or use of biomethane or bio-SNG as transportation fuel worthwhile mentioning at all.

- This double barrier is often related to a missing special strategy for the use of biomethane and in future bio-SNG also at all levels, from the EU down to the MS and the regions and cities. This applies to aims, action plans, means and sanctions. With regard to biomethane, so far, only Germany has adopted the above mentioned clear cut strategic targets, but a comprehensive strategy combined with an action program has not been adopted so far. Sweden became the first EU-MS announcing the target to substitute fossil transportation fuel completely until the year 2030, but this objective still is not a binding legal target, although especially in some regions and cities far-reaching programs and measures have been taken, as Goteborg with preparations to build a bio-SNG plant.

According to reports of some national representatives to IEA task 37 “Energy from Biogas and Landfill Gas” to the meeting at April 17, 2009 in Jyväskylä, Finland, Denmark will triple the biogas production before 2025 [Holm-Nielson 2009], in France astonishing 1,000 biogas plants until 2013 are expected to be built [Theobald 2009], in the Netherlands a discussion is going on to replace in short-term 1 – 3 % of natural gas by biomethane, midterm (until 2020) 8 – 12 % biomethane and bio-SNG, that equals about 4 billion m³i.N. natural gas substitute per year and in long-term even up to 50 %, in 2009 4 – 6 upgrading plants will be commissioned [Dumont 2009] and in Sweden a recent study concluded that it should be possible to use 20 TWh biogas per year (2008: 1.5 TWH). [Petersson 2009]

All these aims or intentions underline the REDUBAR conclusion that provided demanding aims are set already midterm a strategic breakthrough in biomethanation might be achieved.

Precondition for this progressive move is however to clear every blockade for getting biomethane into the grids and the tanks of the vehicles. Priority of access to the grid and massive support for establishing the logistics of filling stations and suitable cars, busses and lorries are inevitable.

Every tendency of present owners of the grid to dictate unsupportable conditions, block injection or distribution has to be stopped, if necessary with harsh intervention of the European Commission or Court and national authorities responsible for free market conditions, combating unfair competition and building cartels.

These are the four most important barriers encountered. There is one more of serious blocking influence consisting in the poor, sometimes completely missing knowledge and belief in the feasibility and broad application of biomethane technology to substitute a considerable amount of imported natural gas but this is a relatively easy to solve problem that hence may be classified rather as an obstacle, likewise adverse legislation and regulations.
Obstacles

As in almost any case of implementation of an innovative technology, moreover if it bears the feature of revolutionary change obstacles to be encountered that have to be removed or bypassed. The WP 4 group found a lot of them with very different weight, grade of seriousness and area of effectiveness (see D 9). Some obstacles exercise their negative influence at almost all levels and within most of the MS and there are others to be met in some countries only.

An example of relatively general importance what biomethane or bio-SNG are concerned, much less already biogas, sewage gas or landfill gas, is the prevailing low level of knowledge and own experience leading to insecurity for taking decisions, being for strategic planning, investment, project development, permitting, supply of plants with input, treatment of output and so on. In recent months the growing resistance of bankers for crediting plants, projects or biogas- or biomethane-related enterprises at reasonable conditions for fear of granting a foul credit or investment turned out to become an ever more severe obstacle.

At the other end of the scale there are minor obstacles that prevail in a few countries or even a single country, only, as in Germany the one-sided implementation of a relatively high bonus of 6 €cent per kWhel for using industrial crops in anaerobic digestion and no bonus for “wet” municipal biowaste that lead to distortion of input material and neglecting residues.

Here should be mentioned only some examples of obstacles tackled within the WP to demonstrate their diversity:

- reluctance of farmers to conclude long-lasting contracts for delivering industrial crops
- most German grid owners accept for measuring of biomethane quality at the injection point expensive gas-chromatographs only, that are able to measure every 15 minutes,
- too bureaucratic permission rules applied by the authorities in almost all countries,
- in the Netherlands biogas is subsidised but biomethane not, leading to distortion,
- the still rather low amount of types of cars with permission to use natural gas or biomethane,
- in Poland several legal rules are contradictive with regard to biomethane,
- in Germany the Federal Government adopted a very narrow definition of the term “plant”, jeopardizing investors who had already built their plants,
- in most countries a regulatory agency with arbitrary rights for regulating disputes without involving courts of justice does not exist,
- some countries have a limited overview on what is really going on in this virgin market segment, the very first biomethane registers are being established just now needed for planning, reporting and taking the right measures.

Conclusions and recommendations to surmount BaOs

The following recommendations should not be regarded separately but in unit with the multiple conclusions drawn and proposals made above to promote biomethanation:

- recognise that biomass turned out to be a valuable and competitive global commodity and its strategically intelligent and efficient energetic use is an imperative must,
- avoid the hen and egg problem of interlinked amount of filling stations - for natural gas suitable vehicle engines – available biomethane by jointly developing the complete system at the best in congruent velocity and using the advantage of doing it in the first phase with and for natural gas,
- let farmers fairly make their needed profit in the added-value chain, the method to involve them as socio or shareholder with vote and power for decision in the enterprises operating the biomethane plants had turned out to be favourable,
• copy first positive solutions as proactively prepare a joint platform as BMK is for exchange of experiences and coordination among stakeholders, put main emphasis on innovative SMEs, but integrating all stakeholders,
• use such a platform and other means for exchange of information, opinions, conclusions with related and interested project groups and oncoming networks,
• keep technical and non-technical BaOs and progress under further observation as major and rapid changes are to be expected,
• discuss new findings gained during implementation and novel BaOs with representatives of the national governments, governmental authorities and involved utilities, biomethane suppliers and gas net operators,
• translate Deliverables with use for several MS into the concerned languages. For successful information and communication it is indispensable to prepare information, training material, guidelines and checklists in the native idioms of the national target groups. English might turn out to be useless under these circumstances,
• participate in important bodies like in Germany “biomethane register”,
• elaborate software, information material, checklists or guidelines or much easier ask for the permission to translate, use and distribute already existing like the manuals “Biogasgewinnung und –nutzung” [Production and Utilisation of Biogas] (2005) and “Einspeisung von Biogas in das Erdgasnetz” [Injection of Biogas into the Natural Gas Grid] (2006) of Fachagentur Nachwachsende Rohstoffe [Agency of Renewable Resources] acting on behalf of the Federal Ministry of Food, Agriculture and Consumer Protection or the matrix “Selection of optimum measures for increasing the use of biogas” (D 8), software tool for “Calculating a biogas, biomethane and bio-SNG project as well as quantifying the influence of existing financial regulations on the feasibility” all elaborated and test during REDUBAR.

To summarise, in both chapter 4 and 5 the conclusion was elaborated and confirmed in the following chapters, especially all public relations that biomethanation is an important, but unfortunately with many stakeholders yet underestimated subject. It might exercise substantial influence on energy security. Biomethanation as a very effective method and means for effective conversion in form of polygeneration of heat power and refrigeration and for mobility have not been introduced so far in almost all countries. Biomethane and bio-SNG deserve high strategic attention.

5.3 Calculation Tool for Feasibility Studies of Biogas Projects

Responsible Partner: FEE,
Referred Deliverable: D11, D27, D08 (Tool)

The software (D 11) is usable for all input variants and process media needed in the technological process, be it for a biogas plant, a biomethane facility or a bio-SNG plant. Existing national and EU-wide financial regulations might be considered. The output illustrates, how “near” or “far” a planned project is to the practice relevant implementation (from the financial point of view). The results might serve as the basis for proposals targeted on new or revised financial regulations.

The solution selected uses a modular structured address data base consisting of basic modules being used for all applications and additionally of basic modules corresponding to professional special modules. The versions used for REDUBAR are based on an already implemented module elaborated for and owned by FEE for collecting data of thermo-chemical gasification plants. This offers the additional advantage that also plants for the production of bio-SNG might be integrated quite easily. This module called “Process engineering” consists of a database of plants with the free property of choice of detailed description of plants in two additional levels “Systems” and “Components”, moreover, a database for all technologies to be realized with them (“Processes”) and materials applied (“Media”).
Due to the task for D11 of REDUBAR the version was expanded by a module “Finance". This module can be used independently or in correspondence with the module "Process engineering". The address database has been completed by an additional part „Finance services provider" aimed to hold the different programs and conditions for financing relevant projects. Links to the respective web sites of the programs may be added to the addresses. The user language can be switched between English and further languages, now exemplary shown for German. The extension to further languages had been prepared. It is easy to be done for every partner using a different language simply by translating the English terms in the masks into its national language and thus prepare the free utilisation by native speakers.

The module “Finance" provides a detailed consideration of the different positions for expenses and revenues. Each position (except “interests") can be provided with an individual rate of an annual increase. The positions of investment sources can be assigned to up to three groups. In case of subsidies, the sign of a group can be changed.

The use of input data for plants and financing as elements of a database allows a clearly arranged access to all kinds of data. The evaluation table will be generated on user’s request and can be exported to an Excel workbook.

The availability of updates will be checked via Internet after each start of the program. The download of the update will be executed if the user agrees.

Because of the commercial character of the basic program the access to the different specific modules is controlled by special files for each user. This procedure of initialisation cannot be avoided. But, the access to the modules „Finance“ and „Process engineering“ is guaranteed for all project partners.

Two more deliverables (D 8 Matrix) and (D 27) for proxy calculation of costs for implementing non-technical measures for resolving or removing BaOs could draw benefit from the software (D 11). Doing this the involved REDUBAR-partners could create tools with higher efficiency and value as originally planned.

The software (D 11) is tested with real plants (D 12), but unfortunately not yet under very different conditions in various countries. The authors consider that further applications might deliver further details that should be used for improvements. Additionally and outside the tasks of the project but in the interest of REDUBAR, FEE will elaborate a flyer and organise a special presentation related to BMK.
6 Biogas Injection into the Natural Gas Pipeline Grid: Framework, Conditions, Methods, Barriers and Demand for Regulation

6.1 Overview

Most biogas plants for power generation make no use of the waste heat from off gas; only a small amount is used for internal heating purposes. An utilisation for cooling is very rare. So it can be expected that combined energy generation will increase the efficiency considerably, if the potential of biogas energy can be used at sites with a high demand for heating and cooling. These sites are mostly not situated in the surrounding of the biogas production sites.

There are already concepts and technologies that allow to process biogas, feed it into the public natural gas pipeline-grid and to take out gas of an equivalent energy level at sites with a high or permanent energy demand for power generation, heating and/or cooling. The forerunners of such applications are technologies that allow using processed biogas or gas equivalents in vehicles.

Advanced biogas upgrading technologies are in existence and the advantages are clear. However, the question arises why efficient application schemes take such a long time to be put into practice, or why they (seem to) meet resistance. So, which obstacles are there other than in engineering, and how they can be overcome?

In this project the process / technological chain is considered at all stages starting from the biogas upgrading to natural gas quality, the compression, the injection into public natural gas grids, the gas transportation, the supply of gas up to the demand for cooling and heating including a combination with power generation. The main market actors in this utilization chain are gas supplying companies. During the preparation phase of this project a number of market actors (international acting gas distribution companies, GdF, RWE, E.on Ruhrgas) were contacted. The goals of the project were published to gas companies by the project partners. As described in chapter 4 gas companies (target group 1) will be involved in this WP directly or by their national and international associations. This measure should result in a higher practice relevance of the project. Experiences and actors (e.g. via Advisory Committee, dissemination workshops, LOI-connection) from running biogas injection projects will be evaluated.

The most important target group are gas utilities and gas supplying companies (TG1). The reduction/removal of their mental barriers concerning transportation of biogas in their pipeline systems is essential for the success of the project. Under this aspect, deliverable D15 (catalogue of mental barriers) is the most important outcome.

6.2 Quantification (a list) of the Potential for Increasing the Use of Biogas for Heating and Cooling by Liquidation the Bottleneck

Responsible Partner: FEE,
Referred Deliverable: D13 (Report)

The actuality originates from the obligation to reach 20 % share of renewable energy sources in energy consumption in all Member States of the European Union. The role of biogases becomes increasingly significant. The bottleneck of its utilization as rough biogas on the site – originated from the lack of harmony between the production and consumption of heat (cold) - is expected to be surmounted by upgrading the methane content of biogas to natural gas quality. It can be injected into the natural gas grid, mixed with natural gas and supplied the mixture to the end-consumers for highly efficient combustion in polygeneration plants or usage in industrial processes.

The up to now generally unsolved problem is the penetration of this technology into the existing system which is for security of application, economic and ecological reasons highly regulated and
in most cases dominated by big companies. The market and the grids are sometimes privately monopolized, sometimes state-owned. It has been so far an extremely inflexible market sector with almost no interference from outside.

The outcome of the deliverable is directed to almost all REDUBAR target groups (TG), but mainly to TG 1 gas grid owners, operators and gas suppliers. The members of nationally organized and trans-nationally acting decision makers (TG2), biogas producers (TG 3), professional disseminators (TG 4) and gas users (TG 5) are strongly concerned too.

D13 enumerates the main barriers and obstacles (BaO) hindering the injection of biomethane, its transport in the natural gas grid, and the possible repercussions for all partners involved, as farmers, operators of biogas and upgrading plants, owners of the grids, gas suppliers and consumers. The collection of the BaO-s and their first evaluation should facilitate the search for solutions to liquidate still existing bottlenecks.

The situation within the EU is extremely divers. It ranges from the first countries with established experiences, as Sweden and the Netherlands, via countries with a pressing need for solutions, like Austria and Germany, and the overwhelming majority of Member States where at the moment the very first biogas plants are going to be built. The hindrances are strongly influenced by surrounding conditions, like social, financial, further economic, environmental, legislative aspects, ownership, permitting rules for operations, training, knowledge of all involved parties as well as public acceptance.

BaOs might were structured into the following groups

- neglected strategic, social and political aspects at regional, national and international level
- economic and financial insecurities
- missing practice with contractual agreements, mostly combined with inconsistent ownership
- existing adverse or missing legislation, technical rules and standards
- low level or frequently even absence of knowledge and information about the huge potential, overall importance and the already achieved high state-of-the technical art
- competitive uncertainties concerning priorities in application as injection and transport in natural gas grid versus local micro-biogas grids or versus use of biogas as automotive fuel
- objections of end-users
- unsolved or insufficiently solved technical problems

Within the groups were defined more than 80 points of views (practically questions for answering before installation of upgraded biogas plant).

The report states, that a new added-value chain has to be established, which is different to the usual relation of across-frontier gas export-import, transport, distribution and supply to the end-consumer. It has to integrate farmers as new players as well as biological processes into a highly industrialized sector. The different parties involved need completely new thinking and activities. It should be the main task of policy-makers to create a most favourable atmosphere for it and conditions to minimise clashes and crashes.

Considering these basic principles there were listed most the important factors influencing the strategic decisions.

- the, so far missing criteria as general base for setting priorities for the use of limited resources,
- a comprehensive balancing with regard to energy, material circular flow, ecological, climate, nature, humus, water, economical, financial resources,
- closed material circuits, concerning minerals from the soil – fermented residues fertilizer, or water from harvested crops, passing the digesters and being rained back on the soil,
• a realistic estimation of the existing potential for biogas generation and upgrading it to biomethane or wooden biomass to bio-SNG,

• looking for the best-suited business models. One of the most promising business models is a co-operation between gas industry and farmers.

The report emphasizes the importance to elaborate biogas strategies in all Member States where no biogas plants or a low level of biogas knowledge exist. It analyzed detailed the economic benefit of biogas transportation led back to the excess of the produced heat developing at the on the site utilization of biogas and evaluated the optimal level of grid pressure as well.

Through analyses of BaO-s, the report D13 compiled some conclusions and recommendations. Consequently the most important tasks:

• Organizing the stakeholders in a technological platform but keep care to integrate innovative small and medium sized enterprises

• Finding out needs for research, development and demonstration needs on EU, national and regional levels and elaborating congruent programs for filling the gaps

• Implementing biomethane utilisation into the suitable EU subsidy programs as ESF, EFRE, Interreg and Leader

• Designing and offering capacity building courses for investors, bankers and farmers

• Elaborating of a special manuals for bankers, investors and farmers in their national languages

• Granting priority to methanisation and injection into the grid instead of unlimited imports of natural gas

• Supporting intra-European technology transfer from the in biomethane application higher developed Member States, as Austria, Germany, the Netherlands, Sweden to countries with nil applications and limited technical experience in this field so far primordially in national languages

• Stimulating a demonstration program by the European Commission for constructing in every Member State several biogas, upgrading and injection plants of different types at least one plant each for organic residues and one for energetic crops

• Drafting model contracts

• Providing checklists for example for developing and controlling projects in national languages

• 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

• Checking to establish biomethane trading platforms either as a kind of virtual or real exchange place that might contribute rapidly to create economic criteria

• Accompanying pioneer plants by research projects

• Organizing study tours, workshops, awareness campaigns for waste management companies, utilities, gas grid operators and gas suppliers, municipalities and not to forget related non-governmental and lobby organisations

All these measures of interference should be elaborated with care, in any case with prior studies, taking into account prevailing regional conditions to give freedom of choice for the selection of the most favourable application be it injection and distant use in highly efficient conversion to power, heat and cold polygeneration, be it in local biogas or biomethane micro grids or be it for direct supply to industrial consumers or as automotive fuel.
6.3 Evaluation of Effects by Optimized Regulations, Norms and Legislative Instruments and Removed Barriers

Responsible Partner: ETE,
Referred Deliverable: D14 (Report)

Based on the BaO list completed at D13, this report prepared an efficiency calculation for all possible conditions of the supply chain (impact on diverse point of chain). It made possible to estimate the impact of the different measurement numerically. It results a priority list. The direct aim of the work is to help the decision makers and the other actor of the supply chain for setting up an actual activity plan considering the priority list and the numerical data of the expected effects.

The report has been based on an excel sheet including the data coming from the participating countries namely Czech Republic, Germany, Greece, Hungary, Italy, Lithuania and Poland.

As first step there were listed the most significant barriers and obstacles. Similarly, a list was created including the possible (optimal) measurements for their reducing (eliminating). An excel sheet was prepared, in which the cells indicated the estimated effects of the selected measurement(s) on the different BaO-s as small, middle or high level. They showed the estimated increasing rate of the biogas production. These data can be summarized at each country separately at each measurement.

The reality of carrying out the selected measurements is different. Hence, there was applied a “chance factor” $K_1$ to consider the probability of their coming into force (given in table). The data of the excel sheets of the countries and the evaluation have to be based on the present raw biogas production. The estimation of increasing of the biomethane volume for injection into the grids was based on a defined rate – indicated as $K_2$ – of the present biogas production at each country (its value was chosen 0.5 as constant). The same action could have an effect on more BaO-s, hence instead of multiplication the effect of these actions has to be considered by the factor $K_3$ (its value could defined by equation).

Considering the present biogas production of the countries, the increasing of biogas volume could be estimated at each country. Additionally, it could be established an approximate rate of effect of different measurements on the increasing of biogas production of net quality. The results could be extrapolated on EU level as approximate estimation. The cells of the excel sheet are divided on eight parts according to the participants of the supply chain of biomethane production. Through analyzing of the indicated effects, became it possible to define the effect of the measurements on the single phases of the supply chain as well.

The list of the BaO-s was completed on the base of deliverables D13 and D05. There are six groups hindering the proliferation of biogas injecting processes.

- obstacles of strategically character.
- barriers of financial character.
- problems of contracting and of the ownership.
- lack of norms.
- lack of general and specific information for the relevant actors.
- refusing impression of the consumers directing against the establishment and operation of biogas plants.

There were selected ten kinds of possible measurements for reducing or eliminating the BaO-s. Namely

- establishment (addition) the relevant laws for stimulating the biomethane producing and utilization
- expanding the legislative instruments of NG supply to the biomethane as well
- expanding the norms of NG supply to the biomethane injection of defined parameters
• applying of a price structure considering the specialities of biomethane (biogas) production
• elaboration of supporting system stimulating the harmonious operation of the supplying chain
• working out of documents of high professional quality for the actors of supplying chain.
• lobby activities including popularizing publications and reference visits for the members of the target groups
• development of purposeful legal service system
• foundation of professional society unifying the participants of the supply chain
• standardizing the measurements – carried out separately at different countries – on EU level

There were analyzed seven participants of the supply chain. The biogas producer, the operator of biomethane producing process, the operator of biogas injecting process, the transporters, the distributor, the consumer, and the investor. A significant part of the measurements are regarding to all of the members. The eighth cells indicated these cases.

For making the effects numerical, the applied indicators were chosen as follows (estimated average values):

1  small effect  the expected growing rate is 5%
2  middle effect.  The expected growing rate is 30%
3  high effect  the expected growing rate is 75%

Starting from the theoretical effects characterized by indicators above, on behalf of the corrections factors, there were defined the real effects estimated of each measurements at each analyzed countries for each participants of supply chain.

The calculated growing rate is referring to the biomethane production. The basic volume has to be chosen as 50% of the present biogas production. The effects of single actions contributing to the total growth of biomethane production are summarized at tables. The lobby activities and the establishment (addition) of stimulating laws are having the greatest effect among the discussed measurements. The expanding of the relevant norms, the standardization and the elaboration of documents of high quality as also important actions represent the same range.

The numerical estimation of the increasing of the biomethane production on European level was based on ratio of the present biogas production of the investigated countries to the one of European level in 2007 (5 billion m$^3$/year to 12,4 billion m$^3$/year). The estimated effects of the measurements analyzed could result a growing range of the biomethane production of about 6,15 billion m$^3$/year, equivalent of approximately the same volume of natural gas of good quality. The structure of biogas production and utilization is very different not only at EU level, but among the analyzed countries too. For further calculations according to the relevant technical-economical characteristic can be modified by the following factors

• the kinds of the BaO-s (changing or addition)
• the types of the measurement (changing or addition)
• the effects of the measurements
• the chance of carrying out the measurements (K1 factor)
• the starting (and future) rate of raw biogas-biomethane production

The report introduces the Effect of measurements on the actors of the supply chain too. About 20% of the measurements have an effect on every partners of the supply chain. The analyses to the members shows that the operators of biomethane producing and the operators of the injecting technologies require the most of actions, promoting the complete injecting process. The indicated measurements promise the best effect at these categories. The actions stimulate the biogas
producers, the investors and the distributors too, but by somewhat less intensive. The consumers and the transporters are influenced in the least by the measurements.

6.4 Important mental barriers of natural gas grid operators and gas companies related to the biogas injection

Responsible Partner: DBI,
Referred Deliverable: D15 (Report)

Deliverable D15 of the REDUBAR project comprises a catalogue of the most important mental barriers based on a questionnaire according to the task 5. The results of the prepared questionnaire “Input of biogas into the natural gas grid” have been the input for this catalogue. The questionnaire has been sent via e-mail to target groups of the countries, which are involved in this project. These include Germany, Poland, Greece, Hungary, Netherlands, Czech Republic, Italy and Lithuania. The main results of the anonymous questionnaire have been collected in this catalogue. Most of the participants are gas companies.

The questionnaire included five questions. The report evaluated the answers and demonstrated them in different diagrams. Because of the high number of gas supplier was it more efficient to concentrate the actions to a small representative group of gas companies.

The project partners contacted altogether with 38 companies. There were obtained 17 responses, less than 50 percent. This fact shows one important mental barrier - It is a reservation to publish information outside the company. Other reasons include lack of stability and the anxiety of economical disadvantages. Every company or organisation is interested in receiving more information from outside but only a smaller portion of them publish their own information outside.

For this deliverable, participants from all target groups are asked. The main focus was fixed on target group 1 (gas companies and gas grid operators), i.e. 11 of 17 questionnaires are filled out by gas transport companies. In the following are shortly introduced the questions and the substance of the answers.

1. How have you informed yourself about the input of biogas into the natural gas grid?

According to the answers all participants are informed. That’s a positive fact. A basis of information exists allowing for discussion and an understanding of the importance of measures for increasing the biogas use, especially for biogas injection into public natural gas grids. One third of the participants are informed by self-education via literature and Internet (about 41750 clicks to the REDUBAR homepage). More than 40 percent use Seminars (such as workshops designed and planned by DVGW) and Symposia (such as BMK –BioMethan Kuratorium initiated by FEE) to inform them.

2. How do you estimate your level of knowledge in regard to the topic?

The questions concentrated on seven items. Generally it could be established, that the participants, about 44 %, have a “Good” knowledge about the general and the separate steps of the supply chain for biogas injection into the natural gas grid. Less than 10 per cent did not know any information about the steps in the supply chain of biogas use.

Referring to the structure of biogas supply chain, most of the participants have good or very good knowledge about the “General Biogas System” and about “Biogas Generation”. Similarly, the interviewed participants were well informed about the “Biogas Conditioning” and “Biogas injection”. The level of knowledge at the „Legal Aspects” and „Investment and Operating Costs” was lower. The report analyses its reasons. The participants of asked gas companies fixed their good knowledge about their responsibilities.
3. What is your position on the input of biogas into the natural gas grid?

Over 60 percent of the asked participants have an open attitude to the biogas use. About 28 percent of the asked participants are sceptical. More, than 10% of asked companies see problem with economics, with plant sizes, open technical questions. There is fear about too much small biogas suppliers.

4. Where do you see general problems arising with the injection of biogas? Why do many gas grid operators oppose the input of biogas in your opinion?

Many countries are concerned about the localized nature of biogas production and the associated costs of establishing a distribution grid for relatively small-scale operation. Additionally, there is a lack of regulation and standards for gas properties such as methane content and gas quality. There is also uncertainty with respect to the economics and the costs associated with conditioning, injection, metering and compression. Developed countries such as Germany have problems with the clear distinction of responsibilities between grid operators and those being supplied. Furthermore, there is still debate on which processing technologies are the most effective. An overall lack of technical expertise and knowledge is another reason for many countries being apprehensive towards biogas injection. The Czech Republic is concerned about corrosion of pipelines as well as unstable calorific value and quality of treated biogas. Finally, some people believe that there may be repercussions to their healthy as they believe biogas is produced from waste.

5. Which reservations are applicable to you and describe shortly why?

There were listed eleven possible barriers, practically equivalent to the ones of report D14. According to the answers, the biggest problems are the unfavourable ratio of costs and benefits and the lack of financial support at the using of renewable energies. The unavailability of trained staff isn’t any significant reason of the non-committal attitude.

Summarized the answers, the report establishes, that more, than half of the questioned companies indicated an open position on the input of biogas into the natural gas grid.

The financial barrier seems to be the biggest problem. Most of the participants have suggested that the financial background of the government is not given. In the current financial and economic crisis it will be hard to achieve the injection of natural gas in Europe. So it will be not be possible without financial subsides from the national governments as well as EU funds. Unavailability of trained staff is not seen as an important barrier.

Furthermore, the insecure quantities and quality of the natural gas will be a big point too. The unstable calorific values of biogas, unstable quality as well as unknown contaminations are an issue for the lack of acceptance and interest.

Some of the participants stated, that the lack of sufficient knowledge about the technology and law regulations of biogas is a problem, which has to be resolved as well.

The security of supply and regulatory issues were denoted as further barriers. Additionally, the overall costs are difficult to estimate, the economic efficiency is unfavourable and it is difficult to visualise the regulatory framework. Some participants see the expensive process and the long-term development as a problem.

6.5 Bio-Gas-Entry-Exit-Model and Quantification of the Possible Economic Effects Resulting from using Pipeline Systems for Biogas

Responsible Partner: DBI, Referred Deliverable: D15 (Report)
In the European Union, the actual potential for biogas production is about 4,896 PJ per year (approx. 270 billion Nm³ per year). The transportation of biogas also works trans-European, so that member states with high potential of biogas production possibilities and low energy demand could supply Member States with a high demand of energy. This would also decrease the dependency from natural gas imports and cause the creation of value in the European Union.

To simplify the feed-in, feed-out and trade of biogas, an entry-exit-model was developed in D16. This could base on the entry-exit-model for natural gas, which was adopted with the national implementation of the European guidelines, regarding the liberalisation of the gas market, in 2003/2004. The study was based on the German circumstances, where the entry-exit-model as a prototype is operating. There are introduced also the present Czech, the Hungarian and the Lithuanian feed in systems too.

The exit-entry model displaced the “point to point”-model, where the gas transportation capacities have to be booked bound to a concrete transportation path through the gas grid. The costs for the gas transportation depend on the length of the transportation path and thus on the theoretically way of the gas flow.

In an entry-exit-model, the operators of natural gas grids have to offer feed-in and feed out capacities, which enable the access to the gas grid without defining a transportation path depending on the transaction. Feed-in and feed-out capacities can be usable and tradable independent from each other. The booking of entry and exit capacities may occur in different amounts, to different times and for different periods. Entry-points can be fed e.g. directly from natural gas production, from proceeding gas grids or from transmission pipelines, exit-points can feed-out to e.g. subsequent gas grids or major customers.

Operators of gas grids are committed to cooperate in a way, that customers need only one feed-in and one feed-out contract, even if the transportation of the gas goes about multiple, via interconnection points connected, gas grids. Precondition is, that the cooperation is technical possible and economical reasonable.

To enable the gas trade between balancing groups within a market area and also between several market areas, a tool called virtual trading point was created. A virtual trading point is not allocated to a physical entry- or exit-point. It allows transmission customers to purchase and sell gas without booking transportation capacity in the gas grid. The balancing groups can be formed from physical entry- and exit-points as well as from virtual and physical entry /exit-points or solely virtual points.

In 2003 and 2004, the European guidelines, according common rules for the natural gas market and the security of natural gas supply, have been passed. As European guidelines require a national implementation, all members of the European union will have to pass adequate national laws. In Germany, an entry-exit-model has been implemented with the passage of the Gasnetzzugangsverordnung24 (GasNZV) in 2005. Since then, natural gas grid operators have to replace their “point to point”-model with a two-contract-model, the “entry-exit model”. In the co-partners states Hungary and Czech, the European guidelines were implemented in 2007.

To transport biogas into the natural gas grid, the question of the required gas quality has to be considered. The biogas includes unwanted gas escort substances like hydrogen sulphide, carbon dioxide and siloxanes. On the other hand even lightly conditioned biogas (desulphurized, dried) won’t meet the requirements of the regulations as the main parameters like heating value and Wobbe index differ highly from the parameters of natural gas. To feed-in as exchange gas, a conditioning - consisting of CO₂-removal, desulphurisation and drying - is necessary. Therefore, the gas can be handled like natural gas.

To support the feed-in of biogas in the European Union regulations and conditions for access to the gas grid must be adapted to the needs of biogas. This occurred in Germany with the modification of the GasNZV in April 2008 with the intention, to increase the biogas feed-in in Germany from 6 million m³ per year in 2007 up to 10 billion m³ per year until 2030.

The costs for the connection have to be shared one each half between the gas grid operator and the operator of the biogas plant (connection taker). If the connection pipeline is longer than 10 km, the connection taker has to bear the additional charge.
The grid connection consists of the following components: the connection pipeline between the gas conditioning plant and the gas grid, the access to the connection point of the gas grid, the pressure regulation station, the facilities for pressure increase and the measurement which has to be appropriate for verification.

The grid operator owns the grid connection. He also is responsible for operation and maintenance and has to bear the whole costs. The natural gas grid operators are obliged to close feed-in and feed-out contracts preferential with biogas transportation customers and to prior transport biogas, if these gases are compatible to the gas grid.

Balancing group network operators within a market area have to offer an advanced balancing service for the feed-in and feed-out of biogas, additionally to the basic balancing service. The balancing group manager of a special biogas-balancing group has to pay to the balancing group network operator a fee of 0.001 EUR per kWh for the advanced balancing service for the effectively engaged part of the flexibility frame.

The supplier of biogas has to ensure, that the gas at the entry-point and during the feed-in meets the requirements of the accordant German DVGW guidelines. The costs have to be beard by the biogas supplier.

In Germany, the economic effects be substituting 6 billion m³ of natural gas with the same quantity of biogas like it is planed in 2020, with the current costs for natural gas and biogas additional costs of 1.44 billion EUR would be created. A doubling of the natural gas price until 2020 would cause an equilibrium between the natural gas price and the price for biogas.

D16 includes a dynamic forecast calculation model as well. It enables the user to compare the costs for natural gas and biogas having regard to different transportation costs, as the entry-points for biogas (nearby the biogas production) will be others than for natural gas, even if the exit-points are the same. The next steps, to adopt an European biogas entry-exit-model, must be the implementation of an entry-exit-model for natural gas in the member states of the European Union with immediately or subsequent integration of biogas. A simplification of the access to the natural gas grid and an increase of the long term safety for operators of biogas plants will be able to boost the feed-in of biogas to the natural gas grid in the European Union.

D16 establishes, that for applying an European biogas entry-exit-model, the first task is its implementation for natural gas in the Member States of the European Union, according to the European guidelines. Therefore, the first steps lay in the hands of the national legislature, which is also responsible for the timing of the implementation. Another factor, important for the initiation of an entry-exit-model, is the structure of gas supply and gas grid operation in the member states and also the satellisation from other states. The experiences of Germany and other states, which have already implemented an entry-exit-model, could be well usable. The simplification of the access to the natural gas grid and an increase of the long term safety for operators of biogas plants will be able to boost the feed-in of biogas to the natural gas grid in the European Union.

In the frame of the WP05 there was compiled a list of the BaO-s, hindering the more wide-ranging application of biogas (biomethane) and obstructing the feed-in process into the NG grids. On behalf an excel sheet could be estimated the numerical effect of the different measurements for their reducing or eliminating. Two of the significant effects influencing the biogas injection process – namely the mental factor of the members of supply chain and the condition for access to the grids (entry-exit model) were elaborated detailed. Each of the deliverables summarized the results of the surveying and the proposals. The accomplishment of the work package met the contractual expectations.
7 Benchmarking for Increasing Biogas Injection

7.1 Overview

The aim of project is to find out the barriers and create legislative and administrational instruments for wider use of biogas/bio-methane. In this chapter a analysis of standards and rules, regulating biogas/bio-methane quality, security requirements, reviews best practice of transportation via natural gas pipelines is performed. Also a simple mathematical model for assessment viability of the use of biogas/bio-methane has been created.

The main focus of this chapter is benchmarking for increasing biogas injection. Convincing material and arguments need to be delivered for reducing and removing the non-technological barriers regarding biogas in natural gas grids. Main foci are quality, safety and best practice solutions.

7.2 Best practice examples

Responsible Partner: ETE
Refereed Deliverable: D19 (Report)

Project partners have collected best available information on the use of biogas/bio-methane, for own use as well as for sale as cars fuel or supply to local or natural gas pipelines. Provided information includes best practice of Sweden, Denmark, Austria, France, Germany, Netherlands and Switzerland.

Not developed national natural gas supply pipelines in Sweden defined more favourable conditions for the use of biogas. First biogas was used as cars fuel in locations without natural gas grids, later development of local biogas pipelines enabled the use of biogas in local boiler-houses and supply to local residents living in the vicinity of biogas plants. Currently biogas is supplied to consumers of four towns via distribution pipelines. Biogas is produced using food and industrial residues in Helsinborg. Biogas is cleaned and injected into 4 bar pressure network. Biogas produced in Henriksdal is used by cars and some residential houses in the vicinity of the plant. The quality of produced biogas in Gothenburg is upgraded and this gas is supplied into municipal natural gas distribution network.

Austria is among the first European countries which attempted to inject biogas into natural gas network. First pilot project started in 2005 on cleaning and upgrading the biogas quality to meet natural gas quality standards. Unfortunately estimated transportation tariff made biogas non-competitive.

There are a number of biogas plants in France producing biogas from industrial residues, water treatment sludge and this gas is mainly used as cars fuel.

During the 90`ies German landfill gases were injected into distribution pipelines, however such injection was forbidden because of the presence of harmful chemical compounds and such plants were closed. New biogas plants, constructed during recent decade produce biogas from biomass and biodegradable waste, and their upgraded production is injected into natural gas pipelines.

It is forbidden to supply landfill gases into natural gas pipelines in Switzerland as well as in Germany. Biogas produced using biodegradable municipal and industrial waste is used for energy generation locally or supplied to natural gas pipelines. Currently such biogas is injected into the network in seven locations. Most biogas plants install CHP units and use part of biogas to cover their own needs, and power generated in some other plants is sold. Power plant near Jona town has no energy generators and storage installations – cleaned and upgraded combustible gas is directly injected into natural gas network.

All biogas is produced using biodegradable waste and landfills in Netherlands. Such biogas is cleaned and upgraded (to reach better calorific value). Biogas achieved during waste water treatment process in Beverwijk location, after improvement of its quality, is injected into natural gas distribution network since 2006.
In Denmark all produced biogas is used for heat and power generation on the site.

### 7.3 The amounts of biodegradable waste

**Responsible Partner:** EAV,  
**Referred Deliverable:** D20 (Report)

Biogas is produced via biological decomposition of biomass and various biodegradable residues. According to Eurostat data, which was provided in the report of Deliverable D20 by project partners from Czech Republic (Energy agency „Vysociny“ (EAV)), the potential of biodegradable waste reaches 2105 PJ/year in all EU-27. The distribution of sources appropriate for production of biogas shows that highest potential comes with biomass grown purposely, eject of livestock and municipal waste. Available proportions of appropriate resources show that municipal waste (including water treatment and similar) and industrial waste is not fully used. The tendency of purposely grown resource (e.g. maize) for production of biogas/bio-methane in agriculture land is not very good. Efforts to use biodegradable waste formed during technological processes and human activity should be welcome.

In case the use of biodegradable waste from industry, stockbreeding and municipal waste does not cause bigger discussions, the use of purposely grown biomass raise some discussions. The use of big areas of agriculture land for energy plants is considered as reducing food stock supply and increasing of food prices. In average 45% of total resources are grown purposely for production of biogas/bio-methane. Some countries, such as Spain, France, Italy, Romania and UK grow up to 50% of total resources for production of biogas/bio-methane. Recently prevailing opinion shows that one should look for new resources and land should be used for food plants.

The opinion of EAV experts and data in D20 shows that just 40 % of energy is generated using biogas/bio-methane in CHP units. Here exceptions are Luxemburg and Cyprus, using much less that average energy generation potential from biogas/bio-methane; and in our opinion Malta has not provided data for this analysis. Analysis of statistical data shows that so we could reduce CO$_2$ emissions into atmosphere by 25 %.

### 7.4 Technical aspects

**Quality indicators**

**Responsible Partner:** Un Miskolc,  
**Referred Deliverable:** D17 (Report)

Sweden, Netherlands, Germany and other countries use biogas for several decades already. Biogas is produced from the following main sources: sewerage and water treatment sludge, landfills, compost, animals manure and slaughter residues decay gases. Combustible gas achieved from various sources differs in chemical composition and energy value. Combustible gas from landfills has hazardous chemical compounds – fluorine and chlorohydrocarbons, which can form dioxins during combustion process. For this reason countries refused from injection of landfill gases into natural gas pipelines before removing hazardous chemicals.

With regard to define and regulate the characteristics of combustible gases to use it independently as production source, countries have established standards for combustible gas. These standards rather comprehensively define obligatory characteristics of combustible gas: Wobbe index, calorific value and range, water dew point, permitted content of sulphur compounds, ammonia content, chlorine and fluorine content, dust content, temperature of injected gas, etc. Here we can distinguish Swedish standard, which, comparing to the standards of other countries, allows higher content of ammonia, sulphur sulphate, however defines lower allowed dust content. Netherlands, different from other countries, do not limit fluorine and chlorine content in combustible gas. Similar combustible gas standards are used in other countries – Germany, Austria, France and Switzerland.
With regard to wider use of combustible gas through supply into distribution network or as fuel for cars, biogas/bio-methane quality requirements and quality standards have been improved. Sweden regulated the quality of improved gas via national standard with regard to use this gas for transport. The standard defines characteristics of combustible gas: methane content, Wobbe index, dew point, oxygen, sulphur and ammonia content. Different from standards of other countries, it defines minimal octane number.

Switzerland has created its’ own standard – SVGW regulation G13. Swiss standard is different as it does not differentiate gas into groups, but simply limits injection volumes. Switzerland enables unlimited or limited gas injection: in case methane content in bio-methane reaches 96%, injection may be unlimited; if this index is lower and reach 85% limit, only up to 10% of natural gas flow debit can be injected.

On the basis of natural gas standard D260 Germany created standard G262 for combustible gas injection into natural gas pipelines. Germans distinguished two groups of gas – H and L groups. Combustible gas of H group may be injected without restrictions; however methane content in this gas should not be lower than 97.5%, and in gas of L group fluctuations of methane content in gas could be between 87 and 98%.

French national standard for biogas/bio-methane injected into network distinguished H and L groups of combustible gas as well as German standard. This standard is more restricting for oxygen content and regulates permitted content of solid metals and halogens.

Standards of mentioned countries regulate main values of obligatory indicators. Standards of investigated countries define obligatory values of Wobbe index and methane content, and French standard does not define methane content. Total sulphur content in the standards of most countries is defined by maximal value, and French standard defines maximal momentum and average annual total sulphur content.

Swiss and German examples show that flexibility of quality standards for injected gas give better opportunities for promotion of bio-methane development. Final gas consumer may not even feel that he uses natural gas supplemented with bio-methane in case combustible gas meets the demands for natural gas provided to final consumer.

Standards for injected combustible gas (bio-methane) in Germany and Netherlands were elaborated by state institutions with support from research institutes. The process of elaborating and adopting standards, regulation and other necessary legislation took up to three years. EU countries, which have no combustible gas standards and other regulatory documents for this activity, could adapt existing legislation thus saving time, means and fostering regulation process for injecting of combustible gas into natural gas pipelines.

Safety requirements

Responsible Partner: DVGW,
Referred Deliverable: D18 (Report)

Safety regulations for gas transportation via natural gas pipelines as well as requirements are stated in the report of Deliverable D18, which was elaborated by project partner German Technical and Scientific Association for Gas and Water (DVGW). On the basis of this report one can notify that there are EU regulations and standards applied for pipes of gas supply systems, integrity operating systems as well as safety managing systems for transmission (main) pipelines. There are also national standards and regulations for installation of gas transportation systems. Three main documents are adopted on EU scale for gas transportation through natural gas pipelines. European regulation on functional requirements for natural gas pipelines for maximum operating pressure over 16 bars; frame of reference regarding pipeline integrity management systems and guideline for safety systems management systems for natural gas transmission pipelines:

- EN 1594 (2000-03) Gas supply systems – Pipelines for maximum operating pressure over 16 bar – Functional requirements
Most countries have adopted their own rules regulating operation and maintenance of pipelines of various pressures and materials, pressure testing, gas supply for providers of communal services\(^1\), gas quality for final consumers; also actions in emergency cases\(^2\).

With regard to develop the opportunities to use bio-methane one should have rules regulating transportation via local and natural gas pipelines. On the basis of above mentioned report one should notify that just few EU member states have rules regulating third part access possibility to natural gas pipelines. Germany is most advanced country here as it has adopted order enabling supply of combustible gas, including biogas, into natural gas pipelines in 2008\(^3\). Hungary and Italy has just adopted gas pipelines codes, which regulate above mentioned order. Unfortunately there are no such regulations and natural gas codes in Lithuania, Poland or other post-soviet Baltic states.

Lack of regulations enabling third part access to natural gas pipelines is considered as one of the main legal and administrational barriers for development of biogas and its' injection into natural gas pipelines.

**Connection to natural gas pipelines and transportation practice**

Injection of biogas into natural gas pipelines is currently performed in Germany and Netherlands. These two countries have practical experience which could be used in other EU member states.

**Connection to natural gas pipelines.** Netherlands still implement pilot projects, so bio-plant connection costs to natural gas pipelines are covered by the state. Experts of REDUBAR project are not able to suggest who will pay connection fees after finishing pilot projects. Expected case is that Netherlands will intercept German experience in connecting bio-plants to natural gas pipelines. In Germany these costs are covered by natural gas pipelines operator and owners of the plant in equal shares.

Currently connection of bio-plants to natural gas pipelines according to the volume of injected bio-methane is not limited. Fast development of bio-methane production and injection into natural gas grids may cause problems related to balance of natural gas pipelines, which would define existence of new conditions and limitations of connection to the pipelines depending on the volume of injected nominal volume of bio-methane and technical parameters of natural gas network.

It is difficult to provide single conditions for connection to natural gas pipelines as this depends on specific collection place and classification level of natural gas pipelines. Natural gas pipelines in some EU countries are divided into two categories, in other - into four. As an example, German natural gas pipelines are divided into four categories: for international long-distance transportation, main, regional and local distribution pipelines. Bio-methane must meet the requirements of national standard on injected combustible gas, and pressure and other conditions for injection are applied for specific case.

**Transportation.** Operators of natural gas pipelines purchase, transport and sell bio-methane to final consumers. Above mentioned order exists in Germany only. In Netherlands market is divided into pipelines owners, gas sellers and service providers (quality control, metering, etc.). Transportation costs in these countries are defined in different ways: Germany has the same transportation costs, in Netherlands these costs depend on the volume of sold bio-methane, as there is also capacity fee. In other countries governments have adopted third party possibility for

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1. Hungary – MSZ 1648:200
2. Italy - Law 46/1999
3. Verordnung über den Zugang zu Gasversorgungsnetzen (Gasnetzzugangsverordnung - GasNZV)
transportation of combustible gas via natural gas pipelines; however this is not the matter of existing practice.

**Tariff aspects**

**Tariff.** Currently negotiations on tariffs take place in both countries (Germany and Netherlands) between biogas/bio-methane producers and specific final consumers (power plant, etc.). One should notify that discussions are ongoing concerning single tariff for bio-methane in Germany. Certain share of market players wish to adopt single tariff for sold bio-methane for all producers, other are ready to use existing order.

With regard to promote and develop the use of biogas/bio-methane in the market, state must form pricing system for “green” energy. National legislation of most EU member-states regulates obligatory purchasing of electricity produced using renewable energy sources. This order is needed for systematic and gradual development not only of electricity produced of RES, but also for bio-methane or other combustible gases and heat, when it can be used efficiently, e.g. are close to DH systems or other final consumers. In Lithuania thermal energy generated using renewable energy and geothermal sources has priority in purchasing for the use in district heating system. The decree of the Government of Lithuanian Republic no 982 from July 25, 2003 has adopted the priority order for purchasing electricity generated using RES and meeting public interest and also power tariffs. The tariff for electricity generated in hydro plants is 7.53 €cents/kWh, electricity generated in wind and biomass plants – 8.69 €cents/kWh. Applying of similar order in gas sector could bring more opportunities for development of biogas/bio-methane. In this case producers could be sure in payback for their investment and future profits, which would be one of crucial impulses for initiating business. Thus, necessary regulatory document on EU level is one that ensures priority order for purchasing combustible gas from RES and defines formulae for tariff, which could be applied by regulatory body in each country for national needs.

REDUBAR project partner from Miskolc University (UNI MICKOLC) in D10 report defines the need to establish obligatory purchasing order and pricing. Currently the price of II family natural gas of H group is approximately 40 €cents/m3 in EU member states. Hungarian experts participating in the project suggest even 40% higher tariff for „green gas”. They evaluate the following: investment, capital costs, depreciation, etc. In their opinion the tariff for “green gas” should be about 80 €cents/m3 at current fossil fuel prices. Hungarian experts justify their opinion on the basis of actual commercial projects, implemented in their country, however, they can’t publish the data of actual bio-plants because of copyright protection. It is evident from the report delivered by Hungarian experts that promotion of biogas/bio-methane development in the market needs part of the tariff compensation or part of costs compensation in bio-methane production chain, or increase the price of natural gas artificially. In first case all tax payers would take financial burden, in the second – just the final consumers of natural gas.

Education and research. Change of legislation, creation and applying of favourable pricing – no the only obligatory measures for promotion of the use of biogas/bio-methane. As every type of fuel in the initial stage of development biogas will require financial investment into technologies and research, popularisation and time. Countries must invest into popularisation of “green” energy, formation of public mentality and invest into research and improvement of technologies together with businessmen.

### 7.5 Peculiarities of legislation

**Responsible Partner:** EAV, LEI,
**Referred Deliverable:** D21 (Report)

European Union with regard to reduce Carbon dioxide emissions raised the goal by 2020 to produce 20% of energy from renewable energy sources. EU member states define index in Annex A of RES Directive which will be transferred to national legislation. The Directive does not define the way how this target will be achieved in each separate country.
Every country EU member state while implementing RES Directive will elaborate National Action Plan for promotion measures of renewable energy sources including also biogas. Countries will have to ensure permission, certification and licensing procedures and define national rules for regulation of these procedures. With regard to climate conditions and RES potential states will expectedly chose the most optimal options for implementation of Directive targets and will promote mastering of respective RES – use of solar, wind, biomass or geothermal energy. This selecting of promotional measures and regulatory process could be divided into the following main stages:

- Factors forcing promotion of the use of RES;
- Preliminary assessment of economic potential, priory RES while defining the need for promotion measures and volumes;
- Assessment, change and supplementing of legislation, removing of barriers if necessary;
- Assessment of rules and change if necessary;
- Adopting the decision on REA and measures for possible use and promotion, including also the definition of the volumes of biogas/bio-methane and including it into National Action plan.

Decision makers with regard to accepted state obligations must select the most optimal way to use RES. For this purpose they must know disposition of the most easily available RES potential, costs for mastering this potential, barriers in legislation and mentality problems which make obstacle for the use of above potential.

First step should be Feasibility study enabling Government of lower level authorities to decide which types of RES should be supported and promoted with regard to obligations of the country. Economic assessment would give opportunity to find out whether biogas/bio-methane production and use should be developed in specific country.

In case biogas/bio-methane is defined as one of priority RES, the next stage is analysis of national laws, standards, regulations and other regulatory acts, which have some impact on the use of biogas/bio-methane. Bio-methane ejection can be restricted in national rules and standards defining the use of natural gas pipelines, biogas/bio-methane standards and quality requirements for combustible gas supplied to final consumers.

While performing analysis of national legislation one should pay attention to existing good practice in the countries, where bio-methane is injected into natural gas or local combustible gas pipelines (Sweden, Germany, Switzerland, etc.). The principle of analysis is rather simple – first find out if the country has:

- Natural gas code, which enables third part access to natural gas pipelines with the aim of bio-methane transportation, including:
  - Obligations, responsibilities and rights of operators of natural gas pipelines;
  - Conditions and order for connection to natural gas pipelines;
  - Requirements for safety of natural gas pipelines and the whole system;
  - Necessary measures for change of pipelines configuration;
  - Implementation of metering, measuring and data exchange;
  - Requirements for safety of bio-methane production sources;
  - Disconnection of bio-methane production sources from natural gas pipelines in case of emergency;
  - Monitoring of meeting technical conditions for connecting to natural gas pipelines;
  - Formation of balance report;
  - Technological gas transmission losses;
  - General regulations for providing of system services;
System renovation after accident;
Principles for providing system control services;
General principles of operative planning;
Forecasting of demand;
Inter-system safety measures;
General principles for control of natural gas pipelines;
Control of normal operation of natural gas pipelines;
Control of natural gas pipelines in case of breakdowns;
Principles for assessment of system stability criterion in planning the development of the system.

- Operation rules for natural gas pipelines regulating the composition and quality of bio-methane for transportation;
- Bio-methane standards for injection into natural gas pipelines;
- Quality requirements for combustible gas supplied to final consumer:
  - In case final consumer is connected to developed natural gas network and he needs bio-methane meeting minimal natural gas quality requirements;
  - In case future final consumers live in location without natural gas network and local gas pipelines are possible in case of available biogas/bio-methane potential.

The results of legislation analysis should define necessary changes and supplementing in national legislation, which will promote the development of the use of biogas/bio-methane.

The results of biogas/bio-methane economic assessment and legislation will provide decision makers with the background for making decision on promoting type and range for the use of biogas/bio-methane according to the circumstances of separate regions:

- In case region has developed natural gas pipelines, it is possible to promote via costs compensation for ensuring bio-methane quality for injection into natural gas pipelines;
- In case there are no natural gas pipelines in the region, however region has biogas/bio-methane production and use potential, it is possible to promote production and use of biogas/bio-methane as much as to make it competitive to other alternative fuels in the region.

7.6 Conclusions

1 Analysis performed by Project partners shows that municipal waste and biodegradable industrial waste is not used sufficiently, and purposed grown biomass is used instead.

2 Swedish example shows that in locations without developed natural gas pipelines provides possibility for development of biogas via distribution gas networks.

3 Swiss example would promote injection of bio-methane with regard to gas quality.

4 Not all EU member states project partners have rules regulating third part access possibilities to use natural gas pipelines.

5 Sales volumes of biogas/bio-methane would be promoted by tax allowances and support for infrastructure in the regions without developed natural gas pipelines.

6 Development of bio-methane would be promoted by removal of legal and administrational barriers, obligatory purchasing of „green electricity and gas“, and “green heat” in case there is DH system in the vicinity as well as special pricing with compensation of the part of electricity tariff for final consumers or part of costs for market shareholders.
8 Supply Chains and Market Structures for Biogas Use

8.1 Overview

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. These differences exist at all stages in the utilization chain of biomass but mainly in Structure and potential of biogas production and demand structure of natural gas, infrastructure for natural gas distribution, demand for heating, cooling or combined power generation.

The objective was to analyze by their potentials and their missing links depending on the situation of every member country. Existing and potential market actors and/or chains for biogas production and utilization had to be identified. Our work followed analyses of clusters and includes interviews of the various actors. The formation of such chains is highly desirable for society. If they cannot be formed by market forces alone, it is necessary to find out how they can be initiated, stimulated and controlled. This was the starting point of the work as highlighted in the project.

8.2 Methodology

In this chapter the consortium analysed biogas market in 27 EU countries from the following points of view:

1. Market structures and their development;
2. The previous preferred technological supply chains identified in WP2 and WP5, were analysed from the economic and ecological point of view (impact) – considering the maximum supply capacity;
3. Last part of the work focused on market- and country-specific recommendations for measures/actions to stimulate the development of market structures, to close the existing gaps, to facilitate, stimulate and to control the formation of biogas supply chains according to different funding schemes, which need to be developed, too.

GIF as WP leader has developed a suggested collaboration method and a schedule for the activities. After a short time of discussion and integrations the WP partners accepted, and the activities began.

In the first phase a list of relevant questions about each task has been prepared (3 different aspects of market analysis), which were combined in a common questionnaire and this has been sent to all co-operating task partners. Since the EU countries are more than the partners, several partners will make research and will fill in the questionnaire about more countries in order to cover the EU27. The main encountered bottle necks and difficulties are mainly due to delay in receiving requested materials, therefore, to meet deadlines was very difficult.

Difficulties to elaborate the data collected in the questionnaires, due to the basic information and data collected through the questionnaires.

Concerning the questionnaires and the swot analysis, aim was to investigate all EU-27 countries but feedback was received from 16 countries only. Despite several reminders, the remaining countries did not deliver information. At the time of preparing this deliverable, not all expected information was available. As mentioned, response from only 16 countries could be collected, but although the level of answer is very low and basic.
8.3 Outcomes

Responsible Partner: BTG, CRES, GIF
Referred Deliverable: D22, D23, D24 (Report)

**D22: “An overview of existing supply-chains and market structures by their potential for increasing the biogas use for heating and cooling”**

D22 selected and identified the preferred chains and evidences of economic and ecological effects under the situation of the member countries, which have been analyzed and some conclusions have been drawn. These chains are examined in terms of their maximum supply capacity.

The questionnaires in the form of matrix was prepared and distributed to the partners; the aim of the questionnaire was also to represent and collecting data from countries trying to present the real situation in the European countries. 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.

The deliverable focused on the following elements:

- The process chain the production, conversion and usage had been illustrated, as well as the availability of biomass resources, existing and potential market actors and motivation of
- The main stakeholders have been identified:
  - Big energy and gas companies;
  - Utilities
  - Farmers
  - Biogas and biomethane trading agents, engineering and manufacturing companies.
- The influence of the actors on each individual process step of the chain had been taken into account, together with obstacles, support measures and competitors.

Also in this case final recommendations had been prepared.

**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“**

CRES developed a list of recommendations for installing “biogas feeding-in and feeding-out pools on the basis of detected supply chains with the highest biogas use potential. CRES focused on the

Differences exist at all stages in the utilization 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

Regarding the used 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 GIF, for Poland and Latvia by INIG, for Czech Republic by ICT, for Estonia and Lithuania 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 were implemented:
• biomass production,
• conversion,
• usage

Final recommendations had been developed for the following countries:
Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Spain, Sweden and UK.

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”

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.

8.4 Conclusion

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.

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 changes the perspective of development of the existing supply chains, since transportation in gas grids nets are not considered a priority in many countries.

The questionnaire raised the main issues contributing to the development of biogas market and barriers and obstacles reduction, as the general development level of biogas market as precondition for the analysis of existing forms of business and economic cooperation. The document focused also on elements which can make the market grow as incentives and regulations, as well as the cooperation of actors; the regulatory framework had been also taken into account.

These recommendations needed to be further elaborated and adapted to specific situations in the member states or clusters of member states. At the end of the project differences still play a significant role and the global situation is changing very fast and new problems totally unexpected two years ago are growing.
9 Proposals for the Reduction of Barriers and the Creation of Legislative Instruments and Regulations

9.1 Description of the work

The description in the grant agreement of the work for work package 8 referred on guideline 2003/55/EG. Injection of biogas in the national grid was priority one. There are legislations in Germany to make this possible. Nevertheless there can be concluded that the overall energy efficiency for the use of biogas can be higher. Rather than insisting on a priority for biogas feed-in, it is more reasonable to take measures for removing and/or reducing the barriers concerning the production and use of biogas. This will result in “equal rights” for natural gas and biogas and initiate a competition for the market. The probably disadvantages of biogas in this competition should be eliminated by a second step of non-technological regulations. This creates the desired priority for biogas feed-in.

Removing barriers can be achieved by providing appropriate information for the market.

First task in this work package WP08 is to set up an examination of all identified barriers for all points of the supply chain defined in WP07. Drawing up of practice relevant proposals for reduction/removing the barriers. The practice relevance will be guaranteed by intensive consultations with diverse target group actors. The highest priority has the biogas injection into the pipeline grid: if this bottleneck is not removed, other measures are useless. (Step 1).

For fulfilling this task a model is used, the biomethane-matrix. The biomethane-matrix has been adapted to the defined supply chain of WP07. The existing regulations and barriers were fixed in WP03 and WP04 and the main bottleneck for increasing the use of biogas, the biogas injection into the natural gas pipeline grid, was analyzed in WP5 and WP6.

During a brainstorm session with all partners it was concluded that the difference in the aspects of knowledge, approach, background, barriers and obstacles should be identified and should be made visible for every country individual. Therefore the biomethane-matrix has been set up for each partner country. The country level of the proposals for the reduction of barriers is hereby also given by each country’s biomethane-matrix.

For gathering practical proposals for the reduction of barriers in the field of technological, legislative and financial, we have chosen for interviews per country with key figures of several parts of the supply chain of Biomethane. The results of these interviews are described in the deliverables 25, 26 and 28. These deliverables content tables with proposals for the reduction of barriers (D25), proposals for the creation of legislative instruments (D26) and recommendations for the reduction of financial barriers (D28). The interviews where also used for gathering financial information and information about the roadmap for fixing barriers and obstacles.

The deliverables 25, 26 and 28 give a structured overview of all barriers, obstacles besides proposals and recommendations. Deliverable 29 contains a roadmap, in which is signed up the way and the priority for industry and government. Most barriers and obstacles require administrative changes or an financial injection. Some of the barriers require new legislation. The main conclusion is that the legislative barriers and obstacles are the most important and should have the highest priority. The interview results were not enough to set up a specific cost-benefit calculation program in excel for evaluation of the feasibility of barriers removing actions (D27). Most interviewed had no idea of the costs of removing actions or time needed for removing an obstacle or barrier.
9.2 Outcomes of this work package

Responsible Partner: DBI, EEI, GIF
Referred Deliverable: D24, D26, D28 (Report)

The expected outcome of this work package conform the grant agreement was a bundle of arguments, suggestions and ideas for removing the detected barriers and a substantial input for the dissemination.

The real outcomes of these work package is more than the deliverables, mentioned in the grant agreement:

1. **Biomethane matrix per participating country.**

   This matrix shows the relation between the biomethane chain and the important issues as economics, administrative, environmental and legislation. Every participating country filled this matrix and made obstacles and barriers visible.

2. **Results of interviews with stakeholders in every participating country.**

   The biomethane matrix and a questionnaire are used for interviews with stakeholders, with the main target to get recommendations and proposals for removing the barriers. Secondly the content of the biomethane matrix was checked by the interviewed person.

3. **Deliverable 25: A list of proposals for the reduction of barriers to increase the use of biogas for heating, cooling and power generation on different regional levels.**

   The proposals for the reduction of barriers are categorized 5 categories, the number of proposals that are made in each category is written between the breaks:

   - Educational (22), Financial (24), Legislative (14), Mental (12) and Technical/Technological (8).

   D25 is presenting **80 proposals** in total for the reduction of barriers to increase the use of biogas for heating, cooling and power generation on different regional levels, the national level of the partner countries and the EU-25 level.

4. **Deliverable 26: A list of proposals for the creation of legislative instruments to increase the use of biogas for heating, cooling and power generation on the national level of the partner countries and the EU 25 level.**

   This deliverable identifies nine obstacles/barriers and gives **16 proposals** for the creation of legislative instruments. Eleven of these proposals are on EU level; one for Hungarian, one for Czech Republic and three for Poland.

5. **Deliverable 27: A cost-benefit calculation program for evaluation of the feasibility of barriers removing actions**

   The interview results were not enough to set up a specific cost-benefit calculation program in excel for evaluation of the feasibility of barriers removing actions (D27). Most interviewed had no idea of the costs of removing actions or time needed for removing a obstacle or barrier.

6. **Deliverable 28: A list of recommendations for reduction of financial barriers. Proposals for effective public and/or combined public/private financial support for measures directed to the increase of using RES for heating and cooling.**

   This deliverable identifies most important barriers and obstacles and makes **8 recommendations** that aim at biogas market improvement and it makes **14 developing support measures** for the whole chain, to create investment security and making profit.

7. **Deliverable 29: Design of a roadmap for the step by step implementation of the proposed measures, connected to the dissemination plan.**
The final results of the project and especially from this work package 8, is deliverable D29. A road map for implementing recommendations for different barrier removing measures according to the situation in the member countries of EU.

### 9.3 Recommendations for overcome barriers and obstacles

**Responsible Partner:** INIG  
**Referred Deliverable:** D29 (Report)

In the next table the elaborated list of proposals for the reduction of barriers to increase the use of biogas for heating, cooling and power generation on different regional levels, the national level of the partner countries and the EU-25 level, is presented.

<table>
<thead>
<tr>
<th>type of B/O</th>
<th>Mechanism of breaking the barriers (B) / obstacles (O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational</td>
<td>To win in times of globalization do the best to promote regional economic development, accumulate indigenous knowhow and put it into global relations, according to the slogans “From research to industry and market”, “Capacity is the cheapest investment” start a EU-wide information and dissemination campaign to spread the knowledge and export technology gained in scientific institutions and by the practical experiences of bio-methane injection and best practice use of bio-methane as automotive fuel in the most advanced countries Austria, Sweden, The Netherlands and in the last three years soaring Germany to all Member states.</td>
</tr>
<tr>
<td>E</td>
<td>Adopt biomethanation as a focus to the EU funded programs as Intelligent Energy Europe, Life, Leader etc. putting special emphasis to modern media to reach the youth, professional associations to reach target groups like farmers or drivers, to governmental, municipal and communal bodies to reach the authorities</td>
</tr>
<tr>
<td>E</td>
<td>Developing the market for RES technologies and equipment Initiating activities to enable the transfer and production in EU countries of the best RES technologies.</td>
</tr>
<tr>
<td>E</td>
<td>Implement and co-finance the necessary educational restructuring, capacitating programs about RES resources and technologies in all levels not only of education, but of policy making and professional life in industry and agriculture</td>
</tr>
</tbody>
</table>
| E           | Founding a non-governmental European network for biomethane like the German BioMethane Board established as an additional initiative based on the needs analyzed within the REDUBAR-project with four main targets:  
- lobbying in favor of the technology and best conditions  
- join all stakeholders  
- further new technological solutions  
- disseminate knowledge |
<p>| E           | Supporting intra-European technology transfer from the in biomethane application higher developed Member States, as Austria, Germany, the Netherlands, Sweden to countries with nil applications and limited technical experience in this field so far primordially in national languages |
| E           | Stimulating a demonstration program by the European Commission for constructing in every member state several biogas, upgrading and injection plants of different types at least one plant each for organic residues and one for energetic crops |
| E           | Accompanying pioneer plants by research projects |
| E           | 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 |
| E           | Check the possibility to establish an exchange program for related stakeholders taking the programs for exchange of young scientists as an effective example |
| E           | Increasing funds for scientific research studies in RES. |
| E           | Creating new research and development (R&amp;D) programs. - Increasing funds for scientific research studies in RES (incl. biogas) |</p>
<table>
<thead>
<tr>
<th>type of B/O</th>
<th>Mechanism of breaking the barriers (B)/ obstacles (O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Creating educational system about needs and methods in using RES energy.</td>
</tr>
<tr>
<td></td>
<td>- Introducing RES trainings into higher education and further education</td>
</tr>
<tr>
<td></td>
<td>- Implementing educational programs about RES resources and technologies in all levels of education</td>
</tr>
<tr>
<td>E</td>
<td>Establish a program to “Train the Trainers” at all levels of stakeholders. This seems to be important not only for biomethanation but for almost all RUE and RES</td>
</tr>
<tr>
<td>E</td>
<td>Provide support for translating manuals and reports on biogas use, best practices into ALL languages of the member states.</td>
</tr>
<tr>
<td>E</td>
<td>Qualification of the personal of biogas plants for more efficiency</td>
</tr>
<tr>
<td>E</td>
<td>Intensively lift the RES technologies into technical education and into specific further education (for experts in gas industry and energetic).</td>
</tr>
<tr>
<td>E</td>
<td>promotions, organization of professional further education</td>
</tr>
<tr>
<td>E</td>
<td>Expanding available arable land by putting set-aside land into production, regional planning, collecting and using biowaste.</td>
</tr>
<tr>
<td>E</td>
<td>Designing and offering capacity building courses for investors, bankers and farmers</td>
</tr>
<tr>
<td>E</td>
<td>It needs to be studied properly especially if large quantity of bio-methane is going to get transported or distributed. - Prolongation of study BONGO and/or REDUBAR in specific areas.</td>
</tr>
<tr>
<td>E</td>
<td>Carry out researches and create adequate norms</td>
</tr>
<tr>
<td></td>
<td><strong>Financial</strong></td>
</tr>
<tr>
<td>F</td>
<td>Establish a “New Deal for Climate Protection and of Energy Supply Change” in favor of efficiency and RES</td>
</tr>
<tr>
<td>F</td>
<td>Create a special fund and a specialized financial institution to boost RUE and RES, including bio-methane, either as a separate body or within the EIB but with special rights</td>
</tr>
<tr>
<td>F</td>
<td>Check all established financial measures and institutions within the EU and obligate them to contribute to the anti-crisis, pro climate protection and energy change deal, including EFRE, GAP, LEADER, INTERREG at one hand and European banks, like ECB and EIB at the other</td>
</tr>
<tr>
<td>F</td>
<td>Set up innovative systems of RES investment financing including investors, financial institutions and EU support mechanism for innovative technologies</td>
</tr>
<tr>
<td>F</td>
<td>Establish a European investment fund for the purposes with favorable conditions for drawing rights</td>
</tr>
<tr>
<td>F</td>
<td>Build-up a guarantee fund to support liabilities of investors and small and medium-sized companies</td>
</tr>
<tr>
<td>F</td>
<td>Push a European Union-wide tariff for every cubic meter bio-methane produced either for injection or use as automotive fuel or for direct industrial consumption and take the very successful German budget-neutral feed-in tariffs for electricity from RES as a model</td>
</tr>
<tr>
<td>F</td>
<td>Provide favorable low-interests credits with from European banks and grants from European funds either directly to applying enterprises or investors or via business banks or groups of them but to the latter only under the condition that they pass all preferences immediately and directly to the applicants</td>
</tr>
<tr>
<td>F</td>
<td>Impede completely for all member states the practice of exemption from carbon dioxide taxes by 2012 at the latest</td>
</tr>
<tr>
<td>F</td>
<td>Allow tax exemptions for natural gas usage in member state only under the condition that they are provided without any discrimination to bio-methane likewise</td>
</tr>
<tr>
<td>F</td>
<td>Prepare a code of conduct, including sanctions against business banks which do not provide credits under defined reasonable conditions to enterprises and for projects in line with the above mentioned strategic aims of the EU Improving “green certificates” and energy costs system</td>
</tr>
<tr>
<td>F</td>
<td>With regard to bio-methane, give it the task to concentrate on financially weak member state, first of all East-European countries, and less developed regions with large potential for production of biomass</td>
</tr>
<tr>
<td>F</td>
<td>Do not allow the discrimination of biowaste within the member states</td>
</tr>
<tr>
<td>F</td>
<td>Creating and building funds in order to support RES investment programs. Promoting RES investments financial support mechanisms. Setting up financial institutions specializing in RES investment financing and improving their performance</td>
</tr>
<tr>
<td>F</td>
<td>Improving “green certificates” and energy costs system or setting up the biodiesel system for bio-methane (mix it). Preparation and setting up innovative systems of RES investment financing including investors, financial institutions and EU support mechanism for innovative technologies.</td>
</tr>
<tr>
<td>F</td>
<td>Decrease or repeal the VAT of energy comes from RES (incl. biogas)</td>
</tr>
<tr>
<td>F</td>
<td>Reviewing the Energy Law so as to set a price for heat, as there is already for electricity produced by biomass. - Preparing and setting up financial incentive mechanisms for those using biomass for heat</td>
</tr>
<tr>
<td>type of B/O</td>
<td>Mechanism of breaking the barriers (B)/ obstacles (O)</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>F</td>
<td>Set up an investigation plan (perhaps European wide for each country) and making decisions for the whole EU.</td>
</tr>
<tr>
<td>F</td>
<td>Market stimulation in the case of agricultural and industrial wastes for example with a decree about the acceptance prices of the agricultural and industrial waste types or with tax allowances.</td>
</tr>
<tr>
<td>F</td>
<td>Make available subsidies for increase biogas project –production and establish on the market.</td>
</tr>
<tr>
<td>F</td>
<td>Creating favorable financial conditions for the farmers, involving them into the operating enterprises and let them take part at the ownership of the upgrading or injection plants.</td>
</tr>
<tr>
<td>F</td>
<td>Checking to establish Biomethane trading platforms either as a kind of virtual or real exchange place that might contribute rapidly to create economic criteria.</td>
</tr>
<tr>
<td>F</td>
<td>In order to make the market price of renewable energy (and thus biogas) competitive, financial subsidies of various types and extent are needed in the complete vertical set-up of energetic from production to utilization.</td>
</tr>
<tr>
<td>F</td>
<td>Introduce the principles “polluter pays” and “perpetrator of the financial and economical crisis pays” within the EU and the member states.</td>
</tr>
</tbody>
</table>

**Legislative**

| L | Expanding the norms of natural gas supply to the bio-methane injection of defined parameters. |
| L | Specification of the quality requirements of the different types of biogases for different applications (CHP, injection, vehicle fuel) in the form of national standards. |
| L | Put into force a comprehensive Guideline / Act for Biomethane Injection, at the best, regulating all important issues, but at least, giving priority to injection. |
| L | Introduce biomethanation (both digestion and BioSNG paths and utilization) in all related strategic documents (Programs, Guidelines, White and Green Papers etc.)  
  - Prioritize bio-methane injection and use of automotive fuel equally at the levels of the EU and the member states  
  - Create conditions for real unbundling and prevent taking. In case of resistance allow expropiation for the sake of preservation of fundamentals of living and the interests of the community  
  - Give permission to the member states for free supporting measures to allow profit-making by use biomethane technology  
  - Establish conditions for cross-border delivery  
  - Start a G-20 initiative. |
| L | Introduce balanced aims for bio-methane into the binding objectives set by the Council for RES and biofuels:  
  - Elaborate criteria for the priority of use of arable land, forestry and biomass  
  - Call for fundamental research on potentials, technologies and accompanying investigative actions in the 7th framework program and in the preparation to the 8th FP  
  - Set minimal targets in amount and time to be reached by every MS  
  - Establish a control mechanism. |
| L | Creating long term development plans for RES for all regions.  
  Model of long term agreements considering the different condition of raw gas production and the injecting process.  
  Accepting priorities of regional RES development adequate to regional energy sources. |
| L | Establish (addition) the relevant laws for stimulating the bio-methane producing and utilization. |
| L | Establishing regional energy agencies and cooperation between them. Setting up regional energy agencies network program. |
| L | Organizing the stakeholders in a technological platform but keep care to integrate innovative small and medium sized enterprises. |
| L | For determination of the specific values of biogas parameters establish a system for measuring biogas parameters and legislatively define the biogas parameters needed for injection.  
  Use of existing experience and opportunities to supply biogas to the distribution network. (like Austria, Sweden or Germany). |
| L | Review of regional development strategies regarding RES.  
  Review of regional working plans regarding RES funds. |
<table>
<thead>
<tr>
<th>type of B/O</th>
<th>Mechanism of breaking the barriers (B)/ obstacles (O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Prepare simple administrative structures for the approval process of biogas plants (fix tasks and responsibilities)</td>
</tr>
<tr>
<td>L</td>
<td>Research and development, monitoring of the biogas injection plants to collect practical experience and later than for modification of standards for gas quality in the public natural gas grid</td>
</tr>
<tr>
<td>M</td>
<td>Lobby activities including popularizing publications and reference visits for the members of target groups</td>
</tr>
<tr>
<td>M</td>
<td>Promoting RES energy usage as ecological element of business practices and life style.</td>
</tr>
<tr>
<td>M</td>
<td>Good communication and promotion to the public. - Setting up a good definition about renewable energy (no food for fuel).</td>
</tr>
<tr>
<td>M</td>
<td>Setting up regional energy agencies network to promote and wide spreading usage of RES</td>
</tr>
<tr>
<td>M</td>
<td>Setting up financial incentives for developers to promote and wide spreading usage of RES</td>
</tr>
<tr>
<td>M</td>
<td>Creating RES projects for specific public infrastructure like: schools, hospitals, civil service building</td>
</tr>
<tr>
<td>M</td>
<td>Work out a ‘green gas’ certification system</td>
</tr>
<tr>
<td>M</td>
<td>Define clear sponsorship mechanism.</td>
</tr>
<tr>
<td>M</td>
<td>Preparation of rules and regulations for injection into natural gas grid (technical and non-technical)</td>
</tr>
<tr>
<td>M</td>
<td>Working out a quality and technical regulation / standard for biogas injection</td>
</tr>
<tr>
<td>M</td>
<td>Elaborating of a special manuals for bankers, investors and farmers in their national languages</td>
</tr>
<tr>
<td>M</td>
<td>Drafting model contracts</td>
</tr>
<tr>
<td>M</td>
<td>Providing checklists for example for developing and controlling projects in national languages</td>
</tr>
<tr>
<td>T</td>
<td>Optimizing the plant size to the territorial conditions – optimizing the collecting and transportation systems for raw materials</td>
</tr>
<tr>
<td>T</td>
<td>Working out a wide-ranging accepted injection model on the basis of operating West-European experiences.</td>
</tr>
<tr>
<td>T</td>
<td>Make enough buffer capacity in the natural gas grid available.</td>
</tr>
<tr>
<td>T</td>
<td>Collect experiences from injection projects (country and EU – level -&gt; revision of the actual regulations)</td>
</tr>
<tr>
<td>T</td>
<td>Create a basic uniform norm and introduce it all over the EU for bio-methane injection and use as automotive fuel</td>
</tr>
<tr>
<td>T</td>
<td>Creating a handbooks and RES equipment technical standards for using different RES technologies like in Germany:</td>
</tr>
<tr>
<td>T</td>
<td>- “Biogas – an introduction” by FNR</td>
</tr>
<tr>
<td>T</td>
<td>- DVGW-standard VP 265</td>
</tr>
<tr>
<td>T</td>
<td>Define the chemical composition of biogas and its combustion performance properties compared to natural gas.</td>
</tr>
<tr>
<td>T</td>
<td>Minimize methane leakages (f.i. covering stores, introduce emission limits for the upgrading plant) along the technological chain until injection by technical means partially to be demanded or ordered by authorities</td>
</tr>
</tbody>
</table>

### 9.4 Road Map

Responsible Partner: INIG  
Referred Deliverable: D29 (Report)

The roadmap is used for helping generate and implement a plan to develop appropriate proposals to reduce the barriers and obstacles (BaO) which limiting the development of biogas sector to produce heat, cool and power.

It was written to:

- support the vision direction,
- identify the major barriers and obstacles in the utilization of biogas for power generation, heating and cooling purposes,
• create a list of proposals of breaking the barriers and obstacles.

The roadmap offers guidance and direction to biogas producers, policy makers, gas suppliers, regulators, investors, researchers, grid owners, operators, and the public on the methods for removing and/or reducing the barriers and obstacles to increase biogas use for heating, cooling and power generation. As these stakeholders become more involved, the benefits to everyone involved increase.

The roadmap aims to focus on the most relevant plans, actions and recommendations at both the national and EU level. The roadmap is also designed to build upon the groundwork laid in the “Roadmap for implementation of the proposed measures” and the “Roadmap for increase the biogas use for heating, cooling and power generation”.

The Road Map is described in detail in deliverable D29.

9.5 Conclusion:

The roadmap provides direction for government and industry action. Document present state existing activities, main direction vision undertaken in the partner countries, as well as to establish of framework for coordination of activities and the promotion of the information flow in this paper.

The stakeholders will need to set priorities for activities to be taken over the near-, mid- and long-term and identify responsibilities for implementing the proposed measures for reducing the BaO’s. Some activities will require new legislation; others may be handled by executive or administrative order. Some will require budgetary actions while still others must be accomplished by industry, local government, and/or universities.

Realizing the vision for sustainable biogas development and achieving the state’s bio-energy goals requires a continuing process focused on identifying and assigning responsibilities for implementing the roadmap recommendations.

The legislative BaO’s are situated in the first place with the biggest number of barriers/obstacles and the number of other types (financial, educational, technological, mental) of BaO’s are almost equal.
10 Dissemination Activities during the Project

The main message to disseminate is: The project results offer huge potential for reducing non-technological barriers, creating new regulations and carrying out dissemination toward a significant increase of heat, cooling and electricity generation from RES, mainly biogas. But not only the dissemination of the project results outside the project is important, but also the same inside the project team.

Knowledge created from a project is only effective if it is transferred into practice. The best project results are useless without transfer into practice. Only by transfer and the following practical use added value (REDUBAR: European added value) can be generated, and the best value for money can be realized. It means the success of the REDUBAR project depends on a successful transfer of the results. The way for transferring the REDUBAR results into practice is the dissemination. The essential basis for effective dissemination is the communication. Communication with and dissemination to other actors (target groups, key actors) are essential to obtain input into the project works as well as to enable the target groups members and key actors to benefit from the project results and thereby ensuring impact at a wider scale und creating European added value. The dissemination begins at the start of the project and ends a long time after finishing the project.

It was very important to define the project related target groups and key actors already during the proposal preparation and the permanent specification of target groups and key actors during the project time (s. chapter 2.2). Recognizing this, the key actors and target groups cannot be separated. Key actors will be persons, bodies, organisation having the above mentioned position and experience. In this manner, key actors will be in the most cases representatives from the target groups, for example also project partners.

The basis for the successful communication and dissemination was the communication and dissemination plan. It was constructed in a manner that makes possible for all partners - also inexperienced - an effective dissemination. Main topics of the plan were the short description of target groups and key actors (already précised in comparison with the project proposal), a clear fixation of responsibilities and a precise description of all planned dissemination activities. The REDUBAR specific communication and dissemination plan was created after solving the following strategic problems:

A: What is to disseminate?
- Results from the project, which are useful for increasing the generation of heat, cooling and electricity from RES (main focus: biogas)
- Recommendations for the legislative framework
- Recommendations for other non technological regulations and for standards and specifications
- Concepts for training and education of target groups members and first experience from such measures
- Concepts for public and branch-specific campaigns
- Other measures towards specific branches

B: To/with whom is to disseminate?
- All participants and all practical relevant groups having any influence and having influence on the generation the above products from RES
- Multipliers - organisations which are interested and willing to promoting the dissemination activities on their national level
- Project specific dissemination structures
  - project Steering committee
LOI between partners and target group members on national level

advisory committees on national level

C: How, when and on which level is to disseminate?

- At local, regional, national and EU-level
- The communication/dissemination activities will begin at project start and will be carried on for at least two years after finishing the project
- Deliverables were integrated into the dissemination process as soon as they were completed
- Active dissemination for two years after finishing the project will guarantee, that too “late” deliverables will become full effective for the project goals
- Use all modern media for communication and dissemination

One of the most helpful communication and dissemination tool was, is and will be the project website: www.redubar.eu. All deliverables have been referred in this report are available on this website.

Another way to disseminate the results of the project is to held workshops For realisation these workshops a “Guideline for effective project-specific dissemination workshops” (D34) was prepared and used by project partners this guideline could be used by interested companies to prepare own workshops on the base of information from this project.

But dissemination (information transfer) without feedback from members of target groups (workshop participants) is lost money. Feedback from outside was and is a very reliable indicator for interest – the main condition for dissemination success. This information (what is good, what is bad, where see the member of target groups problems and so on) was collected by all project partners and combined in a combined document. This document includes at the one hand general information like workshop title, participants and target groups from D36 “Hold dissemination workshops” and at the other hand specific information like minutes and feedback of workshop. This specific information is collected to give an overview about “Results and experiences on dissemination workshops” - D37.

National and regional energy agencies are professional distributors of the project results → multipliers. Some project partners themselves are energy agencies. The consultation centres are partner of all target groups actors. They got excellent information from the project partners. Installation of project relevant consultation centres at energy agencies in all participating countries was the last but not the last to do deliverable D38. Here presentations, posters, flyers and other documents like brochures (D35 - “Biogas utilization chains”) prepared and published. A complete list of publications and dissemination activities is shown in annex II.
# 11 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BaO</td>
<td>Barriers and Obstacles</td>
</tr>
<tr>
<td>BMK</td>
<td>Bio Methane Kuratorium</td>
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<tr>
<td>CHP</td>
<td>Combined heat and power plant</td>
</tr>
<tr>
<td>CHPR</td>
<td>CHP plus refrigerating</td>
</tr>
<tr>
<td>D##</td>
<td>Deliverable No. ##, the deliverables are available on the project website <a href="http://www.redubar.de">www.redubar.de</a></td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EACI</td>
<td>Executive Agency for Competitiveness and Innovation</td>
</tr>
<tr>
<td>MS</td>
<td>Member states of the European Union</td>
</tr>
<tr>
<td>RES</td>
<td>Renewable energy sources</td>
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<tr>
<td>SNG</td>
<td>Synthetic natural gas</td>
</tr>
<tr>
<td>WP</td>
<td>Work package</td>
</tr>
<tr>
<td>TG</td>
<td>Target groups</td>
</tr>
</tbody>
</table>
12 Literature

[Albring 2007] Albring, P.: Economic, energetic and ecological efficiency of the combined power, heat and cold generation (CHPR). Short study of ILK Institut für Luft- und Kältetechnik gGmbH [Institute of Air Handling and Refrigeration non-profit company] for FEE Fördergesellschaft Erneuerbare Energien e.V. in the EU-Project REDUBAR


[GasNZV Verordnung über den Zugang zu Gasversorgungsnetzen (Gasnetzzugangs-

[GasNEV Verordnung über die Entgelte für den Zugang zu Gasversorgungsnetzen
2008] (Gasnetzentgeltverordnung – GasNEV) [Ordinance on Remunerations for the Access to the Natural Gas Supply Grids], amended 08-04-2008, BGBl. I. p. 693

[EEWärmeG Gesetz zur Förderung Erneuerbarer Energien im Wärmebereich (Erneuerbare

[Holm-Nielsen Biogas Plants in Denmark 2009 and Forward – New Tendencies and Projects

[Theobald Theobald, O.: French Situation of AD (Anaerobic Digestion) an biogas

2009] IEA Task 37 „Energy from Biogas and Landfill Gas“. Meeting April 27, 2009, Jyväskylä, Finland

[Petersson Petersson, A.: Country Report Sweden to IEA Task 37 „Energy from Biogas
2009] and Landfill Gas“. Meeting April 27, 2009, Jyväskylä, Finland

[FNR 2006] Einspeisung von Biogas in das Erdgasnetz [Injection of Biogas into the Natural Gas Grid], Study of Institut für Energetik und Umwelt gGmbH [Institute for Energetics and Environment non-profit company], Prof. Dr. Stefan Klinski an DBI Gas- und Umwelttechnik GmbH for FNR Fachagentur Nachwachsende Rohstoffe [Agency for Renewable Ressources], 2006, Leipzig
13 Appendices

Annex I: Project Fact Sheet

Investigations targeted to the creation of legislative instruments and the reduction of administrative barriers for the use of biogas for heating, cooling and power generation (REDUBAR)

Programme area: ALTENER, VKA7
Coordinator:
Dr. Hartmut Krause, DBI Gas- und Umwelttechnik GmbH, Germany
E-mail: hartmut.krause@dbi-gut.de, Tel +49 (3731) 4195 300
Website: www.redubar.eu
Partners:
DBI Gas- und Umwelttechnik GmbH (DBI); Germany
Fördergesellschaft Erneuerbare Energien e.V. (FEE); Germany
INSTYTUT NAFTY I GAZU (INIG); Poland
Małopolska Agencja Energii i Środowiska sp. z o. o. (MAES); Poland
University of Miskolc (Uni Miskolc); Hungary
Hungarian Scientific Society of Energy Economics (ETE); Hungary
Energy research Centre of the Netherlands (ECN); Netherlands
BTG biomass technology group BV (BTG); Netherlands
Energy Experts International B.V. (EEI); Netherlands
Institute of chemical technology, Prague (ICT Prague); Czech Republic
Energeticka agentura Vysociny, Z.s.p.o. (EAV); Czech Republic
Lithuanian Energy Institute (LEI); Lithuania
GRUPPO IMPRESA FINANCE s.r.l. (GIF); Italy
Deutscher Verein des Gas- und Wasserfaches (DVGW); Germany
Centre for Renewable Energy Sources (CRES); Greece
Budget: 1.265.911€ (EU contribution: 48,12%)
Contract number: EIE/06/221/SI2.442663
Benefits: better chances and competitiveness for biogas in heat, cooling and power market
Keywords: energy; biogas; renewables
Summary
In 2006 a project team with 15 partners from 8 European countries (D, PL, CZ, HU, LT, GR, I and NL) initiate this project which runs until 07/2009. The main objective of the project is to help to remove or decrease non-technical obstacles and barriers and to increase the use of biogas for heating, cooling and power generation. Main target groups are members of the energy and agriculture sector.

The project partners delivered a complete analysis of regulations in the EU member countries concerning the utilization chain of biomethane. A road map was elaborated, which will include recommendations for implementation and adaptation of legislative and technical regulations, an information and education program related to the different state of knowledge Europe-wide and a dissemination plan of successful projects of biomethane distribution and utilisation. Software tools are developed to estimate the economy of plants and cost models for several scenarios of biogas production, upgrading, injection into natural gas grids and utilization. A commercial Biogas-Entry-Exit-Model for biogas trading via natural gas grids has been proposed.

Expected and/or achieved results
1. Analysis of existing technical and non-technical barriers and obstacles
2. Development of several calculation tools for estimation of costs and economy of the elements in the biogas utilization chain
3. Analysis of existing supply chains and market structures for biogas use and recommendations for future developments on biogas supply chain and biogas distribution
4. Proposals and recommendations for reduction of barriers in biogas utilization, for reduction of financial barriers and for the creation of legislative instruments
5. Roadmap for implementation the proposed measures
**Annex II: Public Dissemination Activities and Information Workshops**

<table>
<thead>
<tr>
<th>Partner</th>
<th>Dissemination Activities</th>
</tr>
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<tbody>
<tr>
<td><strong>Dissemination workshops and other workshops, seminars</strong></td>
<td></td>
</tr>
<tr>
<td>ICT, EAV</td>
<td>“The REDUBAR project – using of biogas in natural gas quality”; February 14, 2008, Prague – Czech Republic</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>„Dissemination workshop of Biomethane Injection into Natural Gas Grids in connection with REDUBAR Project”. March 13, 2008, Miskolc – Hungary (1st Workshop in Hungary)</td>
</tr>
<tr>
<td>ECN</td>
<td>“Biogas injection into the natural gas grid”, April 16, 2008; Amsterdam – Netherlands</td>
</tr>
<tr>
<td>LEI</td>
<td>Conference “Will biogas become an alternative energy source in Lithuania?”, June 25, 2008; Seimas – Lithuania</td>
</tr>
<tr>
<td>GIF</td>
<td>The renewable energy sources , biogas for agriculture; April 18, 2008; Fiesse – Italy</td>
</tr>
<tr>
<td>GIF</td>
<td>A seminar has been organised with the local industrial association of Brescia for companies of the food sector, Brescia 30 January 2008.</td>
</tr>
<tr>
<td>GIF</td>
<td>A seminar has been organised with the local industrial association of Brescia for companies of the food sector, Mantova 13 February 2008.</td>
</tr>
<tr>
<td>GIF</td>
<td>A seminar has been organised with the local industrial association of Brescia for companies of the food sector, Mantova 04 December 2008. Agro food sector is one of the most interested sector in biogas plants.</td>
</tr>
<tr>
<td>FEE</td>
<td>BioMethan – Kuratorium (BMK); May 21, 2008, Berlin – Germany. Founding of a national network as conclusion from REDUBAR to surmount barriers and obstacles</td>
</tr>
<tr>
<td>DBI</td>
<td>59. BHT 2008 - gas technological colloquium; June 12-13, 2008, Freiberg – Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Joint meeting of national FEE-task group “Biogases – Fuel Cells” and REDUBAR FEE-BBK- Biomethane Board “Combined Heat, Power, Cold Generation with Fuel Cells and Motor Engines” in Rohr / Kloster (Germany), September 22, 2008 with presentations of FEE-subcontractor ILK Institut für Luft- und Kältetechnik gGmbH on “Technologies of Thermal Cooling” and FEE-Partner BBK on “Engineering of Biomethane Plants with Combined Heat, Power, Cold Generation” with visits to two plants of EAW Energieanlagen Westenfeld GmbH in operation</td>
</tr>
<tr>
<td>ICT</td>
<td>Second Workshop of the REDUBAR project, November 13th – 14th, 2008, (Könnern and Leipzig, Germany).</td>
</tr>
<tr>
<td>INIG</td>
<td>REDUBAR Education Event for students – Presentation about REDUBAR project; 15 January 2009, Krakow- Poland</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>“Biogas and biomethane - the barriers of growing of biogas production, utilization and injection into natural gas networks”, February 24, 2009, Miskolc – Hungary (3rd Workshop in Hungary)</td>
</tr>
<tr>
<td>LEI</td>
<td>Conference “Thermal energy and technology”, Kaunas University of Technology, 2nd-5th February, 2009, Kaunas.</td>
</tr>
<tr>
<td>Partner</td>
<td>Dissemination Activities</td>
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<tr>
<td>DBI</td>
<td>60. BHT 2009 - gas technological colloquium; June 18-19, 2009, Freiberg – Germany</td>
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<tr>
<td>INIG</td>
<td>REDUBAR 2nd Workshop “Production possibility and utilisation of biogas”; June 24, 2009, Krakow- Poland</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>“Biogas and biomethane - the barriers of growing of biogas production, utilization and injection into natural gas networks” (This was the repetition of the Workshop of February 24, 2009, take into consideration the high number of interested people), June 30, 2009, Miskolc – Hungary (4th Workshop in Hungary)</td>
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<tr>
<td>INIG</td>
<td>REDUBAR 2nd Workshop “Legal barriers and obstacles in development of biogas sector in Poland”; July 23, 2009, Krakow- Poland</td>
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<tr>
<td>FEE</td>
<td>4th meeting of REDUBAR FEE-BBK BioMethane Board on “Chemical Washing” with visit to a manufacturing site of MT-Biomethan GmbH of biomethane upgrading plants at Zeven; February 9th 2009 - Germany</td>
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<tr>
<td>FEE</td>
<td>5th meeting of REDUBAR FEE-BBK BioMethane Board on “Injecting Biomethane and its Utilisation as Transport Fuel – Live” September 9th, 2009 in Rathenow (Germany) and visit to the GreenGas production plant the day after being officially put into operation</td>
</tr>
<tr>
<td>Oral presentations on workshops / conferences</td>
<td></td>
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<tr>
<td>DBI</td>
<td>Erler, R., Franke, St.: “presentation of biogas upgrading methods on a workshop for a regional biomass association”; Biogas-Workshop 2007; May 10th 2007, Oranienbaum – Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Bräkow, D., Oettel, E., Rickert, I., Rinas F.: “Zur Beseitigung nichttechnischer Hemmnisse bei der Einspeisung von Biomethan in Erdgasnetze – aus der Sicht des EU-Projekts REDUBAR“ (Surmounting non-technical obstacles injecting biomethane into the natural gas grid – From the point of View of the EU-Project REDUBAR); conference of ETI Energie Technologie Initiative Brandenburg, September 26, 2007, Potsdam – Germany</td>
</tr>
<tr>
<td>ETE / UNI MISKOLC</td>
<td>Csete, J.; Kapros, T.; Csikyné, P. Zs.; Szunyog, I.: “REDUBAR or in other words: give way to biogas into the European natural gas system.”; Energoexpo; September 25-27, 2007, Debrecen – Hungary</td>
</tr>
<tr>
<td>INIG</td>
<td>Piotr Klimek: “Project information to conference participants”; Scientific-Technical Conference – “Municipal Landfill Site as a source of gas.; October 18, 2007, Czarna – Poland</td>
</tr>
<tr>
<td>BTG, ECN, EEI</td>
<td>Lensik, S.; et a.: “The REDUBAR-Project”; meeting of the platform “Green Gas”; October 4, 2007 Amsterdam – Netherlands</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>Csete, J. – Szunyog, I.: Földgáz-e a biogáz? (Is biogas natural gas?); 39th International Gas Conference &amp; Trade Exhibition; Siófok, Hungary 10.10.2007. 15:00 (section II.) (Conference presentation and abstract in Hungarian and English: page 54-55; with short summary of REDUBAR project)</td>
</tr>
<tr>
<td>Partner</td>
<td>Dissemination Activities</td>
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<tr>
<td>BTG</td>
<td>Knoef, H.: “The REDUBAR-Project”; Meeting from the project group: “Biomass and CHP”; October 25, 2007; Gronau-Epe – Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “Project information – REDUBAR” 3rd Green-Gas Congress of BBK Bundesverband Biogene und Regenerative Kraft- und Treibstoffe e.V.; November 6, 2007; Berlin – Germany</td>
</tr>
<tr>
<td>DBI</td>
<td>Krause, Dr. H., Werschy, Dr. M., Brödner, F., Fröbel, J.: “Forschung und Entwicklung im Spannungsfeld zwischen erneuerbaren Energien und Energieeffizienz”; Gas Discussion Forum; GAT2007; November 12 - 14, 2007; Karlsruhe – Germany</td>
</tr>
<tr>
<td>CRES</td>
<td>Zafiris, Ch.: “REDUBAR – Barriers and Obstacles for biogas use”; Three-days National Workshop, organised by the Technical Chamber of Central and West Thessaly; December 01, 2007; Larisa - Greece</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “REDUBAR – project information”; 3rd Forum bioenergy; December 6-7, 2007; Berlin – Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “REDUBAR-project - a new technology of isothermic and simultaneous cleaning and compressing biogas to the quality of natural gas”; Colloquium at the 15 anniversary of FEE; January 24, 2008; Berlin – Germany</td>
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<tr>
<td>DBI</td>
<td>Grunig, St.: “Biogas in the regional agriculture”; Biogas project meeting, January 30, 2008, Henningsleben - Germany</td>
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<tr>
<td>CRES</td>
<td>Zafiris, Ch.: ‘Energy exploitation of biogas: Trends and perspectives’; Workshop EUREM. NET; February 03, 2008; Athens – Greece</td>
</tr>
<tr>
<td>ECN</td>
<td>Lensink, S.: “REDUBAR – barriers and obstacles for green gas use in natural gas grids”; Meeting “Injection Green Gas”; April 8, 2008; Driebergen - Netherlands</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>Szunyog, I.: “The effects of flue gases derived from different upgrading level biogases to flue gas equipments”; National Chimney Conference; April 28, 2008, Kecskemét – Hungary</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “Elimination non-technical obstacles for injecting biomethane/bio-SNG into the natural gas grid. The EU-Project REDUBAR”; kick-off meeting of BioMethan-Kuratorium; May 21, 2008, Berlin - Germany</td>
</tr>
<tr>
<td>CRES</td>
<td>Zafiris, Ch.: ‘Biogas applications’; National Workshop; May 31, 2008; Patras – Greece</td>
</tr>
<tr>
<td>GIF</td>
<td>Participation at the “Research to Business, Research meet Enterprises”, 4th Industrial Research Exhibition”, Bologna 6 June 208. A conference has been organised .</td>
</tr>
<tr>
<td>Partner</td>
<td>Dissemination Activities</td>
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<tr>
<td>FEE</td>
<td>Oettel, E.: Conclusions of REDUBAR on biomethane and Bio-SNG were integrated into a paper “Chances for the Middle Class and the Regions by Renewable Energy and Fuel Cells” read to the 8th Regional Lusatian Exhibition “Energy and Environment” August 16, 2008, in Proschin – Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E: “Strategic Aspects, Scientific and Technological Development of Biofuels” paper read to the joint German-South African Public-Private-Partnership Workshop, August 21, 2008, at Zschortau – Germany</td>
</tr>
<tr>
<td>INIG</td>
<td>Joanna Niemczewska “Technical and legal obstacles in development of biogas sector” international conference Oils and Fuels for Sustainable Development Auzo; September 11, 2008; Gdansk- Poland</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “Upgrading of Biogas to Biomethane and its Injection into the Grid. From the EU-Project REDUBAR to the BioMethane-Board as a Network”, paper read to the 2nd International Conference for Sustainable Regional Development by Using RES, October 6, 2008, at SolarCenter Wietow – Germany</td>
</tr>
<tr>
<td>CRES</td>
<td>Zafiris, Ch.; “Biomass and applications”; Two-days National Workshop, organised by the Ministry of Defence; November 05-06, 2008; Athens - Greece</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: Project REDUBAR was integrated into the invited paper read to the annual symposium “To a Sustainable Development of the Electricity Sector” of the Colombian Power Industry and the Colombian Scientific Council, titled “First Experiences to Create a Renewable Energy Industry – Strategic Aspects of the Change and Chances for Entrepreneurial and Scientific Cooperation”, 27 – 28 November 2008, Bogotá, Colombia</td>
</tr>
<tr>
<td>LEI</td>
<td>Aurimas Lisauskas “Biodujų tiekimo teisiniai ypatumai” (Legal peculiarities of biogas supply), conference “Thermal energy and technology”, Kaunas University of Technology, 2009-02, Kaunas.</td>
</tr>
<tr>
<td>Partner</td>
<td>Dissemination Activities</td>
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<tr>
<td>CRES</td>
<td>Zafiris, Ch.: ‘Energy exploitation of biomass’, organised by the Ministry of Internal Affairs; February 06, 2009 in Athens-Greece</td>
</tr>
<tr>
<td>UNI MISKOLC</td>
<td>Csete, J. – Szunyog, I.: Biogázok a földgáza rendszereben, kereskedelmi kapcsolatok (Biogases in natural gas networks, trade connections) GasCon Konferencia; Budapest, Hungary 11.03.2009. (Conference presentation in Hungarian with short summary of REDUBAR project)</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: Project REDUBAR were integrated into the invited paper read to young people in the Voluntary Ecological Year Constructing the East “What are Common Issues of Opportunities in your Life, the Energy Change, Renewable Energy and FEE?” at March 25, 2009 in Berlin - Germany</td>
</tr>
<tr>
<td>FEE</td>
<td>Integration of FEE as participant to the expert group of Federal Ministry of Environment, Nature Protection and Nuclear Safety dealing with establishing the official German Biomethane Register, as of the kick-off meeting at June 18, 2009</td>
</tr>
<tr>
<td>CRES</td>
<td>Zafiris, Ch.: ‘Energy exploitation of biomass: Trends and perspectives’; Workshop EUREM organised by the Hellenic-German Technical Chamber; June 26, 2009; Athens – Greece</td>
</tr>
<tr>
<td>FEE</td>
<td>Oettel, E.: “Obstacles and Proposals for Realising Biomethane and Bio-SNG Injection Projects – Results of the EU-Project REDUBAR” presented to the 5th REDUBAR FEE-BBK BioMethane Board September 09, 2009 in Rathenow - Germany</td>
</tr>
<tr>
<td>Articles / written publications</td>
<td></td>
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<tr>
<td>DBI</td>
<td>Krause, Dr. H., Franke, St.: “REDUBAR: Investigations targeted to the creation of legislative instruments and the reduction of administrative barriers for the use of biogas for heating, cooling and power generation”; In: IEEA-News; January 4th 2007</td>
</tr>
<tr>
<td>DBI</td>
<td>Krause, Dr. H., Franke, St.: Project Fact Sheet; project fact sheet; IEEA-News; January 4th 2007</td>
</tr>
<tr>
<td>ETE, UNI MISKOLC</td>
<td>Szunyog, I: A megújuló gázok hasznosításának helyzete Magyarországban (Utilization of renewable gases in Hungary); Energiaigazdálkodás, 48. évf. 2007/4. (page 22-28); Hungarian</td>
</tr>
<tr>
<td>INIG</td>
<td>Piotr Klimek; Grzegorz Kołodziejak: “Możliwości wykorzystania potencjału gazowego składowisk odpadów komunalnych” (Possibilities to utilization of renewable gases); In: Wszechświat. Pismo przyrodnicze; No 4-6 April- June/2007 (page 106- 108), Krakow – Poland</td>
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<tr>
<td>Partner</td>
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<td><strong>ETE, UNI MISKOLC</strong></td>
<td>Csete, J. – Kapros, T. – Csikné, P. Zs. – Szunyog, I.: “REDUBAR, avagy biogázt az európai földgázrendszerbe!” (REDUBAR, or in other words: give way to biogas into the European natural gas system!); Energoexpo; September 25-27, 2007, Debrecen – Hungary Abstract in conference book: page 117-123 in Hungarian and English</td>
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<tr>
<td><strong>FEE</strong></td>
<td>Oettel, E. et al.: “Eliminating barriers for the use of biogenous gases – the REDUBAR-project” In: “Renewable energies in Central and South-East Europe, forum - new power” Magazine for renewable resources and energy, special edition; February 2008</td>
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<td>Jerzy Dudek, Helena Palkowska: “REDUBAR 1st Workshop description”, In: “Nafta-Gaz”; No 4/2008; Poland</td>
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<tr>
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<td><strong>UNI MISKOLC</strong></td>
<td>Szunyog I.: “A biogázok és földgázok eltérő összetételéből adódó hatások elemzése” (Analysis of the influences issued from the differences of biogas and natural gas compositions); Professional vetting by Dr. Barótfi, I. (University of Szent István, Gödöllő); Magyar Épületgépészet, LVII. évfolyam, 2008/4. szám (page 37-42) April, 2008. (reference to Redubar project in scientific journal);</td>
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<td><strong>ICT</strong></td>
<td>Prokes O., 2nd REDUBAR project workshop and Biomethane plant in Königern, Plyn (2009), 17, ISSN 0032-17617.</td>
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<td><strong>INIG</strong></td>
<td>Jerzy Dudek “REDUBAR information about Project meeting in Prague” In: Nafta- Gaz; No 1/2009; Poland</td>
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<td>Kapros, T. – Csete, J. – Szunyog, I.: A biogáznak földgáz vezetékbe történő betáplálását befolyásoló műszaki, jogi és pénzügyi szempontok az Európai Unióban (Technical, legal and financial consideration in the European Union regarding to biogas injection into natural gas pipelines), Bio Energia, 2009/2. (page12-16) (refer to Redubar project in technical journal); in Hungarian</td>
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<tr>
<td>UNI MISKOLC</td>
<td>Csete, J.: REDUBAR – egy EU project “félidőben” (REDUBAR – an EU project in “half time”) Biogáz-előállítás és -felhasználás 2009, (Biogas production and utilization) Info-Prod Kiadó és Kereskedő Kft., (page 62-64) (article about Redubar project in technical journal); in Hungarian with English abstract; published in 3000 copies</td>
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<tr>
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<td>INIG</td>
<td>Joanna Zaleska-Bartosz, Jerzy Dudek, Joanna Niemczewska “Technical and legal barriers in development of biogas sector” In: Nafta-Gaz; No 9/2009; Poland</td>
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</table>

**Presentations: poster / flyer**

| FEE | “The REDUBAR project”; flyer; presented at: 1st meeting of German biogas partners; November 27, 2007                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| EEI | “Green gas and liberalisation”; poster; presented at: Seminar: Presentation about REDUBAR-project with the title “Biogas injection into the natural gas grid”; April 16, 2008                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| GIF | “REDUBAR-project”; poster and Flyer; presented at:  
  - “The renewable energy sources , biogas for agriculture”; April 18, 2008  
  - “Research to business, research meet enterprises, 4th Industrial Research Exhibition”,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| FEE | “Call for participation in the REDUBAR activities”; flyer; April 2008                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| INIG | REDUBAR Project information to conference participants; flyer, Presented at: Scientific-Technical Conference – Municipal Waste Management; May 2008; Koszalin – Poland, 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| FEE | “EU-project REDUBAR: Upgrading of Biogas to Biomethane and its Injection into the Grid. Experiences and Proposals to Surmount Non-technical Obstacles”; Poster; Presented at: 16th European Biomass Conference, June 2 - 6, 2008, Valencia – Spain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| DBI | “REDUBAR-project”; Poster; Presented at: 16th European Biomass Conference, June 2 - 6, 2008, Valencia – Spain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| FEE | “EU-project REDUBAR: Upgrading of Biogas to Biomethane and its Injection into the Grid Experiences and Proposals to Surmount Non-technical Obstacles” presented as poster and/or flyer at the following conferences:  
  - 11th International Solar Conference of Mecklenburg Western Pommerania Aug. 4, 2008,  
  - 2nd International Conference for Sustainable Regional Development by Using RES, Oct. 6, 2008, at SolarCenter Wietow,  
  - 10th and 11th Energy Day of Brandenburg at Sep. 10, 2008 and 2009 at BTU Brandenburg Technical University, |
### Dissemination Activities

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<th>Partner</th>
<th>REDUBAR Project information to conference participants; flyer, Presented at: international conference Oils and Fuels for Sustainable Development Auzo; September, 2008; Gdansk-Poland</th>
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<td>INIG</td>
<td>REDUBAR Project information to conference participants; flyer, Presented at: Landfill Methane to Markets Workshop; November 2008; Krakow-Poland</td>
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<td>FEE</td>
<td>“From EU-Project REDUBAR to regional, national and (European) BioMethane and BioSNG Networks”; Poster and flyer; Presented at 17th European Biomass Conference “From Research to Industry and Markets”, 29 June – 3 July 2009, Hamburg, Germany</td>
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<td>UNI MISKOLC</td>
<td><a href="http://www.zoldtech.hu/cikkek/20070925-redubar-projekt">http://www.zoldtech.hu/cikkek/20070925-redubar-projekt</a>; Csete, J.; Kapros, T.; Csikyné, P. Zs.; Szunyog, I.: “REDUBAR or in other words: give way to biogas into the European natural gas system.”; September 25, 2007; Hungarian</td>
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<td>GIF</td>
<td>B. Goldoni gave a presentation of the REDUBAR project as case history in the framework of the course on European Union and European funds in the framework of the regional call “Ingenio” at the “Università degli Studi”, Brescia, 20 July 2007.</td>
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<td>Zafiris, Ch.: “REDUBAR project information”; biogas seminar; organised by the Ministry of Internal affairs; November 7, 2007; Tripoli - Greece</td>
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<td>DBI</td>
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<td>Erler, R.; “Introduction in the production, upgrading and feed in of biogas”; biogas seminar; November 13, 2007; Freiberg – Germany</td>
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<td>BTG, ECN</td>
<td>Meeting organized by SenterNovem, titled “Green Gas and heat utilization” November 15, 2007; Eindhoven - Netherlands</td>
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<td>Erler, R.; “Introduction in the production, upgrading and feed in of biogas”; biogas seminar; December 12, 2007; Freiberg – Germany</td>
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<td>FEE</td>
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<td>Erler, R.: “Introduction in the production, upgrading and feed in of biogas”; biogas seminar; April 10, 2008; Magdeburg – Germany</td>
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<td>Franke, St.: “Introduction in the production, upgrading and feed in of biogas”; biogas seminar; April 24, 2008; Berlin – Germany</td>
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<td>Zafiris, Ch.: ‘Biogas for energy’; biogas seminar, organised by the Ministry of Internal affairs; May 18th 2007 in Thessaloniki-Greece</td>
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<td>CRES</td>
<td>Zafiris, Ch.: ‘Biogas for energy’; biogas seminar in CRES premises, organised by CRES, in the frame of the EU ‘SU:GRE’ project; May 22nd 2008 in Athens-Greece</td>
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<td>Erler, R.; “Introduction in the production, upgrading and feed in of biogas”; biogas seminar; June 06, 2008; Bad Oeynhausen – Germany</td>
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<td>CRES</td>
<td>Zafiris, Ch.: Training course on RES technologies in the Technological Educational Institute of Athens in MSc level. September 29 – December 31 2008, Athens - Greece</td>
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Annex III: Summary Slides of Project REDUBAR

Investigations targeted to the creation of legislative instruments and the reduction of administrative barriers for the use of biogas for heating, cooling and power generation

REDUBAR
EIE/06/221/SI2.442663

from
December 2006
to
July 2009

15 partners
Main objectives:

- Determination and analysis of existing technological, non-technical and administrative obstacles and barriers in the European member countries for the usage of biogas for heating, cooling and power generation;
- Recommendation of legislative and technical regulations for the injection of biomethane into natural gas grids and its distribution;
- Elaboration of a road map for implementation and adaptation of legislative and technical regulations in the European member countries;
- Starting an information and education program to disseminate technologies for biogas production, upgrading and distribution in natural gas grids and to disseminate best practise projects;
Main target groups:
- Gas companies, natural gas grid owners, operators and gas suppliers
- National organized and transnational acting branch decision makers
- Policy decision-makers in the participating countries and EU-wide;
- Environmental organisations, biogas producers, agriculture companies
- Professional disseminators and multipliers such as energy agencies
- Users from diverse branches (agriculture, gas industry, energy industry)

Why the project was born?
- Poor knowledge and insufficient experience with the technologies of biogas use
- Deficiency in legislative rules and operational legal instructions and technical regulations
- Hesitating investors and a leak of investment funds
- Insufficient of no sponsor scenario in the European countries
Why is the project interesting and relevant?

- Substitute the fossil energy carrier natural gas and others by renewable sources;
- Increase the utilisation of biomass;
- Use biogas (biomethan) in high efficient polygeneration systems (CHP of CHCP);
- Identification of existing technical and non-technical barriers and obstacles;
- Show best practises for biogas use for heating, cooling and power generation;
- Show relevant regulations and legal documents in the partner countries of this project and the EU;
- Preparation of software tools for checking feasibility of biogas projects and more;
- Elaborating proposals and recommendations for:
  - Reducing the sown non-technical obstacles and barriers (financial, mental, . . .)
  - Creation legislative and financial instruments for increasing biogas use
  - Future development and biogas injection into the natural gas grid
- Elaborating a roadmap for implementation the proposed measures;
Tasks of the action:

- Identification of non-technological administrative obstacles and barriers in the utilization of biogas for heating, cooling and power generation.
  Obstacles and barriers results from:
  - technical standards and instruction
  - legislative rules and legal instructions
  - insufficient experience or knowledge
  - insufficient financial funding
- Analysing this hindrances by their priority and influence on the market partners
Tasks of the action:

- Recommendations to legislative acting or rule establishing bodies in the EU and their member states
  - concern technical regulations
  - concern legislative rules
  - concern market control measures
- Communication and dissemination plan for information and education the target groups
- Calculation models for the evaluation of technology chains from biomass over biomethane production and transportation to distribution and to the polygeneration of power, heating and cooling
Obstacles and barriers which were found:

- A analysis of existing supply chains and market structures for biogas use is prepared; the deficiencies in the market structure are determined; the main obstacles and barriers are:
  - in countries with emerging markets technical regulations and political guide lines are missing;
  - a lack in public awareness of technologies along the supply chain from biomass to energy as well as to use the biogas chain as possibilities to reduce green house gas emissions or as an option for profitable business;
  - missing supporting structure for biogas producers and users;
- Materials for information and education of the market partners, target groups and key actors are elaborated; Workshops and seminars have been started;
- An overview and evaluation about successful applications in the utilization chain of biomethane is given; Activities for establishing and disseminating successful projects are developed;
Solutions have been recommended:

- The demand of legislative and technical regulations in the member states of the EU is defined;
- Different calculation tools (spreadsheet application) have been prepared:
  - Estimations of economy of plants, biomass potentials and cost models
  - A software toll for detecting the feasibility of biogas project
  - Creation of a Biogas-Entry-Exit-Model
- Preparation Communication and dissemination activities for most effective transfer of results into practice
- Elaborating proposals for utilization chains with methods of financing;
- A list of proposals and recommendations for reduction barriers of biogas uses, reduction financial barriers and for the creation of legislative instruments is elaborated; Recommendations for future developments on biogas supply chain and biogas distribution have been given;
- A roadmap for implementation the proposed measures has been elaborated;
Activities after the end of the action:

- Continuing workshops and seminars to the most important target groups (gas utilities and farmers) to promote the idea of biogas production and usage in efficient CHP-generation systems
- Participation in other European and national projects to transfer the outcomes of REDUBAR
- Keep active the work in advisory committees or their following platforms to promote biogas as a renewable energy source which may substitute the fossil fuel natural gas
- Use these platforms to implement technical regulations in working standards or force to implement biogas usage in the national biomass action plan
<table>
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<tr>
<th>Organisation</th>
<th>Partner</th>
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<tr>
<td>DBI Gas- und Umwelttechnik GmbH [D]</td>
<td>DBI</td>
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<td>Energeticka Agentura Vysociny. Z.s.p.o. [CZ]</td>
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<td>Lithuanian Energy Institute [LI]</td>
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<td>Deutsche Vereinigung des Gas- und Wasserfaches [D]</td>
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<td>Centre for Renewable Energy Sources [GR]</td>
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Presentation of a Software for Calculation of Biomethane Projects as Result of EU-REDUBAR

Bundesverband Biogene und Regenerative Kraft- und
Treibstoffe e.V.
Fördergesellschaft Erneuerbare Energien e.V.

Extracts and Translation from a Presentation on
„State-of-the-art, Barriers and Obstacles for Realising
Biomethane- and Bio-SNG-Projects –
Presentation of a Software for Calculation of Biomethane
Projects as Result of EU-REDUBAR“

5th Meeting of BioMethan-Board
09.09.09 in Rathenow

Eberhard Oettel, Moritz Rickert
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09.09.2009
BBK-FEE-5.BMK-Treffen, Rathenow
Extract from the Content,  
Part 1

- Project

- Aims of generation of biomethane and need for action (in Germany)

- State-of-the-art in Europe and dynamics of development in Germany

- Most important identified barriers and obstacles

(Note. Part 2 was dedicated to the software and presented by Mr. Moritz Rickert)
EU-Project REDUBAR

“Investigations targeted to the creation of legislative instruments and the reduction of administrative barriers for the use of biogas for heating, cooling and power generation”

“Untersuchungen zur Schaffung gesetzgeberischer Mittel und zur Verringerung administrativer Hemmnisse für die Nutzung von Biogas für Heizung, Kühlung und Erzeugung von elektrischer Energie”

FKZ: EIE/06/1221/SI2.442663
(12/2006 – 07/2009)

Coordinated by DBI Gas- und Umwelttechnik GmbH, Freiberg
15 beneficiaries from 8 countries

09.09.2009 BBK-FEE-5.BMK-Treffen, Rathenow
Aims of generation of biomethane and need for action
(in Germany)

Federal Government
“To decrease import dependence and impulse climate protection natural gas for
CHP and as vehicle fuel should be substituted by biomethane
2020 6 % (= 6 Mrd. m³ i.N.)
2030 10 % (= 10 Mrd. m³ i.N.)

That means (using the Rathenow GreenGas plant as example with 4,7 Mio. m³ i.N biomethane / yr and a capital investment of about 10 Mio. €)

To build until 2020 about 1,275 plants of that capacity, that means 116 plants/yr
Until 2030 2,127 plants, that means 105 plants/yr
Real Dynamics of Development

December 2006 2 plants commissioned

May 2008 (BMK founded)

Biomethane injection
7 plants in operation
11 plants engineered or under construction
8 plants in planning

Biomethane vehicle fuel
1 plant in operation

BioSNG
1 plant in pre-planning

09.09.2009 BBK-FEE-5.BMK-Treffen, Rathenow
Real Dynamics of Development

December 2006 2 plants commissioned

July 2009 (End of REDUBAR)

Biomethane injection
17 plants in operation (+10)
15 plants engineered or under construction (+4)
28 plants in planning (+20)
about 6 projects given up

Biomethane vehicle fuel
1 plant in operation (some double used)

BioSNG
1 plant in planning

09.09.2009 BBK-FEE-5.BMK-Treffen, Rathenow
State-of the-art biomethane plants in operation (Europe)

34  Sweden (fuel)
17  Germany
15  Netherlands (sewage gas)
 4  Switzerland (fuel)
 4  Austria (2 for injection, 2 for fuel)
 3  Belgium

3 1 each in Island, Luxemburg, UK
80  Europe, 76 EU

(sources: Reports of country representatives to the meeting of IEA task 37 „Energy from Biogas and Landfill Gas“ 27-04.2009, Jyväskylä, Finland, and FEE)
Identified Main Barriers and Obstacles

(Extract)

- Biomethane strategy missing at all levels and in almost all countries
- No priority of access to grid, nor as vehicle fuel
- Far-reaching insecurity for investments and profits
- Adverse legislation, regulations, norms and standards
- Deficits in know-how and knowledge until complete ignorance within target groups and stakeholders
- Resistance of owners (monopolized grids, pretended unbundling)
- Faible readiness of farmers for concluding long-term contracts
- Reluctance, even rejection of business banks for crediting
- Insecurities in regard to reliability of (political) decisions and rules for injection and permitted use as vehicle fuel
We ask for and offer collaboration

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