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A priority list for removing or reducing the detected barriers. For each barrier a concrete proposal is added. For each proposal, existing relevant financial regulations are analyzed for the evaluation of the feasibility of the proposal from the financial point of view
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REDUBAR
WP04 D10

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

Agreement N^{o}: EIE/06/221/SI2.442663

Co-ordinator: DBI Gas- und Umwelttechnik GmbH

WP04 D10
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Contents

Preliminaries

Deliverable D10 is part of work package WP04 of the REDUBAR project. The title of work package WP04 is *„Administrative biogas use barriers"*. The work package included two tasks as followings:

„Task 1:

Identification and classification of all kinds of administrative obstacles and barriers. These are grouped as deficits in

- *competence or responsibility of executive authorities,*
- *legislative rules and legal operational instructions*
- *technical standards*
- *financial aspects especially funding schemes in competing biomass conversion technologies*

Estimation of the effect and the priority of identified hindrances in relation to:

- *a reduction in CO_2 emissions*
- *the substitution of imported fossil fuels,*
- *employment*
- *economical growth*

Task 2:

Creation of proposals for reduction or liquidation of the fixed administrative barriers. Evaluation of the barriers concerning their influence on the biogas use. Quantification of this influence („if the barrier is removed, the biogas production can be increased by…%,…m^3"). Creation of a priority list for trying to remove or reduce barriers.

Creation of a computer software for the influence of existing financial regulations and/or barriers on the feasibility of a biogas project. 5 model calculations for different biogas use projects."

The elaboration of the two tasks resulted in 4 deliverables, which are formulated in the REDUBAR grant agreement as follows:

„D9: A detailed list including the precise description of existing administrative barriers and their actual and possibly future influence on the use of biogas, the market actors, the market behaviour and the single points of the supply chain. The list is co-ordinated with key actors of the target groups 3, 4 and 6. The list is basic input for the partners for task 2 of this WP.

D10: A priority list for removing or reducing the detected barriers. For each barrier a concrete proposal is added. For each proposal, existing relevant financial regulations are analyzed for the evaluation of the feasibility of the proposal from the financial point of view (basis for D11).

D11: A software tool for quantifying the influence of existing financial regulations and/or barriers on the feasibility of a biogas project. The software is usable for all inputs variants. Existing national and EU-wide financial regulations are considered. The results will illustrate, how „near" or „far" is a planned biogas project to the practice relevant implementation (from the financial point of view). The results will be the basis for proposals targeted on new/revised financial regulations.
D12: Demonstration of D11 for 5 concrete biogas projects (1DE, 1 NL, 1 PL, 1 CZ, 1 HU). The results will be used for the dissemination process (e.g. presented during dissemination workshops)."

The report WP04 D10 includes first of all the priority list, which gives a guideline for removing the obstacles and barriers to the proliferation of biogas – bio-methane. The reports prepared in the course of the elaboration of the REDUBAR project provided an appropriate basis and a sufficient amount of information for the priority list. What presented a difficulty in writing the report D10 was first of all the fact that the market players involved in the biogas – bio-methane chain have not made their business figures public or have done so only to a limited extent.

In the frame of D10 the University of Miskolc did extensive research in the literature, conducted many-sided consultations with Hungarian experts, particularly with members of the Hungarian Consulting Board of REDUBAR. Subsequently, the University of Miskolc compiled a questionnaire of 25 items on the barriers to the proliferation of biogas and the effects to be expected of they are eliminated or reduced. It first invited its Hungarian cooperation partners to answer the questionnaire, and then sent it to all the members of the REDUBAR consortium with the request that the partners in the same countries should reconcile their answers to the questionnaire. According to the expectations of the University of Miskolc, the contents of the responses to be received from the 8 member countries of the REDUBAR project would have provided an appropriate basis for determining the weights of the individual obstacles and barriers and the significance of their elimination or reduction.

In addition to the above, the Hungarian responses to the questionnaire were also at our disposal for the solution of D10 with the remark that the Hungarian version includes the opinions not only of the two Hungarian REDUBAR partners, the University of Miskolc and ETE, but also the viewpoints of experts cooperating with them and representing various target groups.

Following the priority list in the report D10 the following are presented in three chapters …

… the interpretations related to the concepts included in the list proposed for the removal and/or reduction of the barriers, and an analysis of the financial and regulation issues related to the elements in the biogas – bio-methane chain and to its individual elements,

… the financial aspects of the barriers to the proliferation of biogas,

… the processing of the responses to the questionnaire on the obstacles and barriers to the proliferation of biogas and the conclusions drawn.

After the priority list in the first part the University of Miskolc attempted to explore thoroughly the relations within the complete biogas vertical set-up, the financial and regulation aspects of the 'biogas chain' from production to utilisation, and to determine the characteristics of the various biogas sources, to definitively separate the problem of biogas from that of bio-methane regarding D10, and finally the University of Miskolc formulated theses on the obstacles and barriers to the proliferation of biogas.

In Part II the University of Miskolc processed the publicly available Hungarian and international financial information and data on the biogas chain. The data processed have shown clearly that the enterprises involved and interested in the biogas – bio-methane chain make only very few business–economic data publicly available, and treat the financial issues in general as confidential to the business. In possession of the data for Hungary, the University of Miskolc was collecting the available relevant data from the countries of the consortium members for the final version of D10 so that the barriers for the proliferation of biogas – bio-methane could be examined from the financial side as well.

In Part III the University of Miskolc presents the findings of processing the questionnaire of 25 items relating to the obstacles and barriers as well as the effects of their elimination or reduction in terms of both Hungary and the other REDUBAR countries.

The priority list for removing or reducing the detected obstacles and barriers to the proliferation of biogas

1. The awareness of the members of the EU Parliament delegated by the partner countries should be raised concerning the fact that the production and use of biogas is a complex issue of energetics and environmental protection carrying a great number of advantages and deserving special attention within the category of biomass.
2. The members of the EU Parliament should be made to be active as lobbyists for biogas and bio-methane in the preparation and drafting of the EU legal regulation.
3. The expectations concerning biogas – bio-methane should appear as separate issues from biomass in the next publication of the EU directives on renewable energy.
4. In the new directive the many-faceted environmental and energetics advantages of biogas and bio-methane should be presented in a mutually connected form and should be given substantial emphasis.
5. The new EU directive rendering priority to biogas – biomethane will represent a turning point in the new energy strategies of the member countries, and thus via the new EU directive, the biogas – biomethane chain will be given increased weight in the national legislation of the member countries as well.
6. The awareness of the members of the national Parliaments of member countries as decision makers as well as that of the energetics and environmental experts involved in the decision preparation process should also be increasingly focused on the synergic significance of biogas – biomethane.
7. Decision makers should be made aware of the fact that the amounts and usability of biogases that can be produced from different raw materials also show great differences.
8. The elements of the biogas – biomethane chain should also be included in the agricultural policies as well as rural development strategies of the member countries.
9. The establishment of biogas – bio-methane production units should be set as a condition for EU support for establishing sewage purification plants and waste deposits in the member countries.
10. In sewage purification plants the purification of sewage is continuous, therefore changes in the intensity of biogas production have small amplitudes, the biogas output is

relatively constant, thus legal regulations and financial support should be used as encouragement for the production of biogas in sewage plants.

11. Regulation and financial support should be used as a means of achieving that the bio-methane produced in sewage plants should be injected into lower pressure natural gas distribution networks.
12. Legal regulation and financial support should encourage the local CHP utilisation of biogases produced in waste deposits.
13. If bio-methane is produced in waste deposits, the utilisation of the bio-methane as vehicular fuel in the community and transport networks of the villages in the region should be encouraged and supported.
14. In biogas plants based on agrarian raw materials, the local utilisation of the biogas and the production of bio-methane should be supported in differentiated ways depending on the capacity and the geographical location of the plants.
15. The system of mandatory acceptance of electrical energy generated from renewable energy sources is operating successfully in the EU member states, therefore it should be achieved that its long-term stability is guaranteed by all political powers.
16. The mandatory delivery price of electrical energy produced from biogas (or other renewable energy source) should be kept above the average price in the energy market.
17. Although several EU member states have regulations concerning the injection of bio-methane into the natural gas networks, the organisation supporting the harmonisation of the European natural gas market (EASEE-gas) should include the elaboration of a CBP (Common Business Practice) for the injection of bio-methane in its work programme.
18. The mandatory acceptance of bio-methane as “green gas” (similar to that of “green electricity”) should be achieved in every member state.
19. The rights and obligations of companies producing bio-methane and wishing to inject it into the national gas network should be stipulated as identical with those of natural gas producing companies in every member state.
20. Marketing bio-methane belongs in the licence portfolio of those trading in natural gas, in addition, a favourable regulation and financial environment should be developed in order that the distribution licence-holder should accept bio-methane for replacing network and measurement losses (uncounted for gas).
21. The investment costs of the facilities of the biogas – bio-methane chain should be carried in 10-50 % by the governments of the member states, and financed by the budget.

22. The achievements of biogas – bio-methane R+D projects supported by the EU should be disseminated to experts in workshops, conferences and professional journals, as well as the results should be made directly available to the general public, and particularly to those involved in decision preparation and decision making.
23. In the member countries it should be achieved that the media should give accurate and easily understandable presentation of the many-faceted advantages of the production and utilisation of biogas – bio-methane.
24. Steps should be taken in order that the teaching materials in the public education systems of the member countries should present the usefulness of biogas – bio-methane in its complexity in terms of environmental protection and energetics.

Part I

Analysis of the obstacles and barriers to the proliferation of biogas

1. Clarifying the concepts for the purpose of determining the obstacles and barriers to the proliferation of biogas

For experts involved in biogas, the differences are obvious between produced and purified biogases and biogases 'upgraded' to varies extents for energetics purposes, however, we often find that the ambiguity of the concepts or their inconsiderate and inaccurate use (particularly in oral communication) leads to a great number of misunderstandings and situations encouraging controversies and contradictions. In order to reduce their occurrence, we are formulating a few fundamental theses in the following.

The term 'biogas' is used for all combustible gases produced from organic matter by means of various processes.

According to the raw material of the biogas, or in other words, its origin, and in accordance with the classification used in WP03 D07, (at least) the following main and subgroups are to be distinguished:

- biogas connected to agricultural activities, or in other words, 'agrarian-based' biogas,
  - biogas from the waste of agricultural core products,
  - biogas from the waste of forestry core products,
  - biogas from stock breeding
- biogas from communal waste,
  - biogas from communal sewage,
  - biogas from industrial sewage and organic waste of the food industry,
  - biogas from communal solid waste.

The under-differentiation of the concepts is indicated by the fact that in addition to the term 'biogas' extensively used in the English language, only the terms '*sewage gas'* (biogas produced in a sewage plant) and the term '*landfill gas'* (biogas produced in a waste deposit/landfill) serve the purpose of differentiation, with '*biogas'* meaning renewable gases

of agrarian origin as well and being at the same time the umbrella term for all kinds of renewable gases.

In addition to and beyond the classification of biogas according to raw material, there are significant differences between the objectives of the processes in which biogas is formed or produced.

Covering the above classification backwards, first biogases originating in communal waste will be treated.

Communal waste as a source of biogas is only a possibility, the main objective of the activity is to purify and safely dispose of communal sewage, and to recycle it into the natural environment in some form. Thus the activity is a fundamental activity with an environmental objective, and increasing the biogas output produced from the raw material, the sewage, and utilising it for energetics purposes can only be a secondary objective of the technology. In the same way, dry sludge with its favourable properties, as a marketable product, is only secondary proceeds of sewage purification. It is also characteristic that the supply of the raw material of the biogas produced in sewage plants, the sewage gas is continuous, and the quantity of the sewage of a settlement varies in a relatively small range with time. It is not possible to increase the amount of raw material and thus to increase the biogas output under normal operation conditions. A considerable increase in the amount of biogas that can be produced is only possible if the capacity of the sewage plant is increased. It is also obvious that increasing the sewage plant capacity ‘for energetics purposes’, that is in order to increase the biogas output, does not make sense. It should be also noted that the ‘quality’ of the raw material can be described as relatively constant as regards the biogas output. Therefore the size of the plant and the technological parameters determine the maximum value of the biogas output for the individual sewage plants. The main issue concerning the wider proliferation of biogases is: is there a biogas collecting (eventually utilising) facility installed at all in the sewage purifying plant?

Concerning industrial sewage, the situation is the same and the destruction or safe disposal of organic waste from the food industry is again a stipulated obligation of the food industry companies in the interest of maintaining a sustainable environment, i.e. the objective is again the protection of the environment. The amount of industrial sewage – as the raw material of biogas – depends on the volume of industrial production, and the quality of industrial sewage in individual purification and waste processing plants connected to the technology applied is relatively stable. The question concerning the obstacles and barriers to the proliferation of

biogas here can also arise in the following form: is there or not a biogas facility in the purification or waste-disposal plant?

The amount of solid communal waste – according to both literature data and experience – shows a tendency to increase with time. The 'energy content' of the waste produced naturally depends, in addition to the quantity, on the quality of the solid waste as well. It is difficult or impossible to estimate a tendency of the composition of the waste changing with time in the area of waste collection (including the organic matter content of the solid waste). It is also well known that the amount of biogas that can be extracted from solid waste deposited against time decreases approximately along an exponential curve. Therefore the amount of biogas that can be produced from solid waste with a slowly increasing quantity and varying quality is determined between certain limit values, new technologies can be developed and applied at most for increasing the gas output. The true issue here concerning the proliferation of biogases is again whether there is at all a biogas collection system installed in the waste deposit, and if there is none, then with what expenditure and efficiency a biogas system can be installed in a particular deposit site.

The situation in respect of 'agrarian' biogases is fundamentally different.

In this area naturally the main economic objective is the agricultural and forestry production activity. In the course of the activity various kinds of waste are produced, the amount being proportional with the volume and intensity of the production activities. The waste of the agricultural core products and that of the forestry core products produces biomass. Biomass in general does not qualify as a pollutant, it is not compulsory to destroy biomass for environmental purposes. The biomass arising from waste is organic matter, and it decomposes with time through a natural decomposition process, and is naturally recycled. Intervention in the natural process, the treatment of biomass as an auxiliary activity connected to the agricultural and forestry core activities can be described by the term 'waste management'. One possible objective of waste management is the energetics utilisation of waste (biomass in our case). In the case of the energetics utilisation of biomass the question can be formulated in the following way: in what process is the energy content of the biomass to be released and utilised? For the purpose of the proliferation of biogas, as high a proportion of the biomass from agricultural and forestry waste as possible is to be utilised as raw material for biogas. So that it could increase as compared to the utilisation today, obstacles have to be removed indeed and barriers reduced or eliminated in the field of biomass utilisation.

The potential biogas raw material from stock breeding activities – under natural conditions – also decomposes and its energy content does not get utilised. The animal waste droppings produced concentrated in a site is a material representing a significant burden on the environment in the site of its production and its relatively rapid safe disposal is desirable. One synergic way of its safe disposal is biogas production. The raw material required for biogas production is a quantity determined by the size of the stock breeding facility, the species and number of the animals. Increasing the amount of the raw material is possible by increasing the capacity of the stock breeding facility. The question is: what minimum size facility is required for the individual species of animals for it to be worth preparing at least the feasibility study of a biogas facility installed?

The characteristic difference of 'agrarian' biogases against biogases based on communal waste is that here the amount of the raw material can be – almost to an extent at will – increased by plants serving as a basis for biogas raw material for energetics purposes outside of the categories of 'waste and by-products' discussed so far. The issue in this case is to analyse the policies and development concepts with an agrarian objective and those with an energetics objective, to harmonise them, to elaborate and implement alternatives close to the optimum scenarios.

In our opinion, a consideration of the obstacles and barriers hindering the proliferation of biogas requires the detailed discussion of biogas above as well as a differentiation of the problems according to the biogas raw materials.

We consider it a further essential issue to make a distinction also at conceptual level between 'raw' biogas, 'upgraded' biogas (within that also according to the extent of upgrading) and bio-methane.

'Raw biogas' is biogas that has formed or been produced from any raw material discussed so far. In its original state, raw biogas cannot practically be utilised; even for the simplest utilisation technology raw biogas is to be purified at least of certain impurities and harmful components. The energy content of a unit volume of the purified biogas remains the same as the energy content of a unit volume of the raw biogas.

Gas preparation, 'upgrading' of the purified biogas is a process with an energetics objective: by removing the inert components of the purified biogas, the energy content of a unit volume of the biogas will increase. Upgraded biogas is generally utilised locally for heat and/or electricity generation. Theoretically it is possible to feed the biogas of upgraded quality under

precisely determined conditions into a natural gas system, but it is exactly this point where the operators of natural gas systems show the greatest (and understandable) resistance to biogas injection.

The highest level of upgrading the biogas formed or produced is the production of bio-methane. Bio-methane is identical in all its parameters with some kind of natural gas in public supply, i.e. it is a gaseous energy source equivalent with natural gas. The operators of natural gas systems have and may have reservations against injecting bio-methane into the natural gas system. However, these reservations and concerns can be eliminated by means of R&D achievements, pilot experiments with favourable outcomes and last but not least by means of the accurate and fair regulation of biogas injection.

In our view the concretisation of the obstacles and barriers to the proliferation of biogas requires that we state the following: it is expedient to utilise purified and upgraded biogas first of all locally, and it is natural-gas-quality bio-methane the injection of which into the natural gas network deserves attention.

Summing up: in order to determine the obstacles and barriers to the proliferation of biogas it is essential that biogas is discussed separately according to raw materials, its quality and level of preparation.

2. Theses and hypotheses for determining the obstacles and barriers to the proliferation of biogas

Beyond the differentiation of biogases according to raw materials and quality, the following two theses are formulated concerning all kinds of biogas:

- the price of unit energy generated from biogas is currently higher than that of unit energy generated from fossil energy resources,
- under competitive market conditions, due to the higher specific costs, no profit-oriented player in the economy would be involved in biogas.

The conclusion that can be drawn from the two statements: the proliferation of biogas requires external intervention into the competitive market mechanisms in terms of financial, regulation and other aspects. Concerning the problems studied under the REDUBAR project, the intervention in the processes of the competitive market may be of EU level or national – state level.

The objective of financial intervention into market mechanisms is to level the unit prices of renewable and fossil energies (in our case those of upgraded biogas, bio-methane, and natural gas) in favour of the competitiveness of biogas and bio-methane. There are two possible ways of balancing the unit prices of energy:

- increasing the market price of fossil energy by means of taxes and/or tax-type burdens,
- decreasing the market price of renewable energy by means of financial subsidies.

It is a global phenomenon that energy prices show a tendency to increase. However, the individual countries present considerable differences in the extent of tax burdens and contributions of various types they add to the world market price of unit energy, i.e. what the price of energy from fossil resources for the end user is in the energy markets. The picture is further differentiated by the fact that the extent of tax and contributions added to the cost-price of unit energy may and does change with political regimes, in connection with the energy and tax policies of the governments in power from one election to the next.

We can also state that the end user price of energy from fossil resources even with the tax and other burdens is lower than the specific price of energy from renewable sources. It is only a theoretical possibility that in order to strengthen the market position of renewable energies the price of energy should be increased by further burdens in any country.

For the wider proliferation of biogas (and other renewable energies) thus only the other route is viable today: 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 energetics from production to utilisation. The development of various financial subsidy systems requires the thorough and fair regulation of the complete process.

We make a digression at this point. Increasing the use of biogas and other renewable energy can also be achieved by means of regulation at the end user. It is for every state a theoretical possibility that can be transferred into practice to stipulate quotas for energy users. Here we highlight two modes of regulation regarding our topic:

- certain end user groups have to cover a minimally stipulated ratio of their energy consumption from renewable energy sources,
- progressive fines for emissions related to energy use at the end user.

It is evident that the introduction of a quota system for the end users is also an intervention into competitive market mechanisms, the internal policy and financial projection of which may present serious problems.

Coming back to intervention into market mechanisms, let us now examine the concrete possibilities for intervention concerning biogas.

Two well-defined areas of financial intervention are the installation of biogas facilities and their operation.

There is demand for financial support for investment into and construction of new biogas facilities, irrespective of the kind of the biogas raw material. In the field determined by the umbrella term ‘communal waste’ today it is common that in the construction of a new sewage purification plant, in increasing the capacity or in the reconstruction of an existing plant a biogas facility is also installed. The investment representing the main activity is environmental protection-oriented, and central funds are required for the investment in the first place. The question arises whether the generally scarce central funds will be sufficient to grant funds for the full-scale development of a biogas system that is only connected to the main activity although will earn direct profits later. In that case biogas is not an energy market issue, and the fate of the biogas facility depends on the decision makers disposing of the central funds. In communal solid waste deposits there exists a minimum capacity, under which it is not worth dealing with collecting or utilising biogas. The issue of waste deposits (including the additional biogas system) is not a market issue either, the proliferation of biogas in this field also depends on the amount of central funds (and naturally on the interests and standpoints of the decision makers).

It is clear that the construction of biogas systems based on agrarian raw materials cannot do without financial support either, - irrespective of the biogas raw material being agricultural waste, originating in stock breeding activities or being plants produced for this purpose.

Another important problem of biogas investments is what quality-improving gas preparation technologies are applied in addition to the production, purification and collection (possible local utilisation) installations. The investment cost demand of the various biogas preparation technologies varies in a wide range.

The investment cost elements of a biogas project are as follows:

- costs of the feasibility study,
- costs of making the business plan and the cash-flow plan,
- costs of the proposals for subsidies,
- costs of bank loan applications,

- costs of preparing the implementation plan,
- costs of the authority licensing processes,
- costs of the construction – implementation (including technical inspection),
- insurance costs connected to the planning and construction,
- costs of forward contracting the biogas raw material,
- advertising and communication costs.

The continuous operation of the biogas system developed also requires financial support. Differentiation must also be made here according to the biogas raw materials and the upgrading level of biogas, for in almost every case the obstacles and barriers to the proliferation of biogas are different.

We consider it a common a feature that the return on the investment may and is to be made secure by means of financial intervention, together with continuous operation of the facility, its depreciation, and the guaranteed delivery price earning the expected profits is to be provided for the total return period of the facility.

In biogas facilities based on communal waste no separate subsidy is needed for production, biogas is inherent in the continuously occurring main activity in the case of both fluid and solid waste.

The situation is again different in biogas plants connected to agricultural activities. The biogas raw material is not continuously available or not in nearly uniform quality, therefore provision must be made for the storage of certain raw materials (or even preparation) as well. The costs of the storage of the raw material are part of the operation costs of the system.

In 2008 in Hungary there are no plants cultivated for biogas raw material. It can be assumed that the cultivation of biogas plants again cannot be solved without financial subsidies.

There are no factual data available either, but it is certain that there may be considerable differences in operation costs between upgrading the quality of biogas, the levels and methods of gas preparation. It is also certain that the extent of upgrading biogas is in close correlation with the operation costs in all preparation technologies. The production of bio-methane is the most expensive gas-preparation method.

The elements of the operation costs of a biogas facility are as follows:

- labour costs and contributions,
- management costs,
- the costs of continuous biogas raw material supply,
- energy and material costs of biogas production, purification, treatment and storage,
- maintenance costs of the facilities,
- depreciation of the facilities,
- bank loan repayment and interest costs,
- taxes and tax-type costs,
- advertisement and communication costs.

It is to be especially emphasised that further operation costs are incurred if bio-methane is fed into the natural gas network. Natural gas networks consist of networks with different pressures and, in order to be injected into the system, the pressure of bio-methane is to be raised to the level of the operation pressure of the natural gas system. Bio-methane is generally available at near atmospheric pressure (or at a pressure of a few bars, depending on the gas-preparation technology), thus the compression costs will be proportional with the pressure gradient and the compressed amount of gas. In the case bio-methane being fed into a natural gas system, additional costs are incurred by the continuous measurement, registration and documentation of the quality and quantity of bio-methane. It is difficult to concretise, but the requirement that daily nominations and daily demand forecasts are to be performed for the input and output points of the Hungarian natural gas system will also incur costs.

The profit and loss statement used by companies with regard to a biogas enterprise gives the annual economic balance of the activity with the following items:

- results (profits and losses) of the activities of the biogas plant;
- results of the connected financial (banking) activities;
- operational and financial results together, pre-tax results;
- corporate tax;
- profits of the enterprise.

The problem is more complex if the operation and profitability of the biogas plant is treated not separately but as part of the main activity (sewage purification, stock breeding, etc.). The separate treatment of the costs and revenues connected to biogas stands a chance only by means of a well-operating, transparent accounting system.

Finally we repeat that in our opinion a biogas enterprise can be profitable only with the assistance of financial intervention (investment support, obligatory biogas acceptance, tax benefits, etc.). Separating the financial-economic barriers to the proliferation of biogas from each other is not expedient (e.g. supporting biogas production financially or financial support for feeding biogas into the natural gas system), the elements of the biogas chain are closely linked to each other, therefore increasing the share of biogas requires the elaboration and long-term operation of a complex, many-sided financial support system.

Parallel with the financial intervention into the market mechanisms, the regulation of the economic and financial processes is also required. Regulation is also an intervention into the market mechanisms in the interest of the proliferation of biogas.

A biogas project involves (at east) the following regulation areas and issues:

a) Energy policy, energy strategy:

- EU guidelines,
  - energetics guidelines,
  - environment protection guidelines,
- national level legislation,
  - energy policy,
  - protection of the natural and man-made environment,
- government decree on the biogas support system and financial funds,
- ministerial decree on the biogas-supply chain, technical framework regulation,
- technical specifications, normative standards for elements of the biogas supply chain.

b) Further regulation areas:

- the place of producing biogas raw materials in the agricultural policy,
- the place of renewable energies including biogas in rural development,
- relations between employment policy and biogas supply,
- the role of renewable energies including biogas in reducing the burden on the environment,
- simple and fast authority licensing procedures for biogas project.

It is important that the regulations should be long-term and authentic and should cover the complete lifetime of biogas projects (e.g. the obligatory acceptance of biogas should be ensured in the complete return period of the biogas investment).

The conceptions and efforts related to the proliferation of biogas can be realised efficiently if the financial subsidies and regulation aspects create an integral, coherent system. In other words: increasing the utilisation of biogases with different raw materials and different qualities requires a coordinated and appropriately differentiated financial and regulation intervention in the market mechanisms.

Issues with a smaller weight as compared to the financial and regulation issues that cannot, however, be neglected are collected in the Section 'Further aspects'.

Other, primarily non-economic aspects of the proliferation of biogas are as follows:

- environmentally conscious education in schools and outside schools,
- propagation of 'green thinking and outlook" at the level of society,
- determining the role and responsibility of the media concerning sustainability.

The three spheres of issues are closely related with each other. Today the media have a decisive weight in providing information or disinformation for the society and the experience in Hungary shows that concerning the issue of biogas and the other renewable energies there are frequently superficial, perhaps well-intended, but unprepared amateur presentations in the media carrying half-truths. It can, however, be perceived that in the past years various layers of the society show a strengthening demand, though in different degrees, for discernment concerning the global issues of the future. At the same time the 'scissors' of knowledge are opening wider: the number of people taking care of their environment and assuming responsibility for it is increasing, while the negative impact of the deprived layers of the society is also becoming stronger in common issues concerning all of us.

At the end of our analysis of the issues of the proliferation of biogas the following summarising statements are formulated:

a) The proliferation of biogas is a complex problem with many sides.
b) The constituent elements of the problem are closely related to each other.
c) Examining the individual elements is not sufficient in itself.
d) The barriers to the proliferation of biogas also constitute an organic system.
e) Individual barriers can be hardly separated from the other barriers.
f) The possibility for removing individual barriers separately is rather small.
g) The impact of removing one barrier on biogas supply cannot be quantified.
h) The development of biogas supply requires complex, government-financed financial-regulation programs.

i) The proliferation of biogas essentially requires the mandatory acceptance of biogas guaranteed by statutes.
j) The effect of the statutory guarantees must be at least of equal length with the lifetime of the biogas facility calculated with depreciation.
k) The delivery price of biogas is to be equal with or lower than the limit of the liberalised market for the complete period.
l) Beyond the financial-regulation aspects of the proliferation of biogas, the issue of accurate and authentic information on the problem at the level of society connected with environmentally conscious education for the purpose of sustainability is of great importance.

Part II

Financial aspects of the barriers for the proliferation of biogas

The production and use of biogas, upgraded biogas, and bio-methane are examined in a great number of literature, studies, papers, publications and conference presentations. The majority of publications discuss general issues of biogas: the role of biogas among renewable forms of energy, plans and wishes for increasing the use of biogas, biological problems in the process of biogas production, environmental advantages of biogas (primarily emission), etc. The publications contain a great deal of generalities and repetition, and lay opinions and views of good intentions but far away from reality are frequently published.

Professional publications discuss first of all the theoretical problems of biogas production and utilisation, present various facilities that have been implemented and frequently discuss the technical parameters of the biogas chain. They also offer ground for discussing the environmental and social issues related to biogas.

There is little information and few data published on the economic aspects and financial background of biogas production and utilisation or the economy of the installation and operation of the facilities. The financial support systems existing in the EU member states are also mostly covered by general publications not always free of political slants or innuendoes or the publications discuss the regulation problems connected with the topic.

Concrete or specific financial data on biogas facilities, investment or operation costs were hardly available. If some facts and figures are nevertheless published, it is frequently not possible to find out what they actually cover. For example in connection with a biogas investment are capital costs, interest or exchange rate risks presented? Or do the biogas operation costs include the additional costs of the wages?

Keeping in mind the objectives of the REDUBAR project including those of part report D10, we performed the financial analyses for biogas in 3 areas:

- In terms of the biogas raw materials,
- In terms of the investment and operation costs of biogas facilities,
- In terms of the mandatory acceptance of electricity produced from biogas and bio-methane.

1. Financial analysis related to the raw materials of biogas

As it was discussed in Part I, biogases have to be discussed separately according to their raw materials.

In Hungary the treatment of solid and liquid communal waste is the task and responsibility of the local authorities, which has to be solved by 2015 by every local authority. As a result of the large number of local authorities with small areas, up-to-date sewage purification and/or complex waste management can only be achieved through cooperation, on a regional level.

The traditional technology used for the purification of communal sewage did not include biogas facilities. The anaerobic treatment of sewage sludge is an efficient environmental technology and biogas appears as synergy primarily for meeting the local demand for energy.

Average costs of the treatment of sewage in the partner countries are as follows:

Unit: €/m^3

Cost of sewage		
Czech Republic	1,3	1,6
Germany	1,0	1,5
Greece	0,2	0,5
Hungary	0,7	1,8
Italy	no data	no data
Lithuania	0,99	1,03
The Netherland	no data	no data
Poland	0,04	0,4
Average	**0,59**	**1,14**

These sewage costs are incurred under any conditions, but if the purification technology includes biogas production, the expenditure is partially returned.

The efficiency and economy of biogas production are also improved if the dry sewage sludge is utilised in agriculture. We were unable to find any concrete data for the prime costs or market price of dry sewage sludge.

Like the purification costs of sewage, the costs of depositing solid communal waste are also unavoidable.

Average costs of depositing solid communal waste in the partner countries are as follows:

Unit: €/ton

Depositing cost of communal waste		
Czech Republic	40	50
Germany	30	40
Greece	22	30
Hungary	27	32
Italy	no data	no data
Lithuania	33	39
The Netherland	no data	no data
Poland	50	100
Average	**35**	**53**

In Hungary there is a specific regulation in force on 'green waste'. The costs of 'green waste' in 2008 were:

Depositing cost of 'green waste' for citizens 3… 4 €/m^3

Depositing cost of 'green waste' for enterprises 17…20 €/m^3

It should be noted that here we do not cover 'hazardous waste'.

The similar cost in Poland: 6.75…17.75 €/m^3 for both citizens and enterprises. In Lithuania 4.8 €/m^3 for citizens and 5.6 €/m^3 for enterprisers.

The raw material of the 'agrarian' biogas plants in Hungary is the waste of plant main products, plant by-products, animal breeding waste and slaughterhouse waste.

Average costs of the disposal of organic waste in the partner countries are as follows:

Unit: €/ton

Cost of elimination of organic (animal) waste		
Czech Republic	85	150
Germany	3	45
Greece	10	15
Hungary	90	220
Italy	no data	no data
Lithuania	145	145
The Netherland	no data	no data
Poland	50	100
Average	**95**	**155**

The purification, depositing or disposals of materials suitable for the production of biogas incur costs. If a complex financial – regulation – system is elaborated for the development of

the biogas – bio-methane chain, the above (unavoidable) costs will come under a different form of estimation.

The significance of the costs related to biogas raw materials is shown by the fact that, between 2004 and 2007, 43…61 % (!) of the income of the largest agrarian biogas plant in Hungary (located in Nyírbátor) originated in agrarian waste accepted for disposal and used for biogas production.

2. Investment and operation costs of biogas facilities

The European and the global markets offer equipment for biogas – bio-methane technology of various standards. The installation costs of the same equipment may differ from country to country in the EU as well, e.g. due to the differences in wages and their contributions.

As has already been mentioned, the actual costs of biogas investments are hardly available. We have used several feasibility studies, which cannot be used for reference, for 'constructing' a model biogas plant and have determined the average investment costs. Again we have used studies not publicly available for calculating the average operation costs of the model biogas plant.

The investment and operation costs of a typical biogas facility in Hungary in 2008 were as follows:

Biogas plant, 3,2 MW el., HUNGARY, 2008.		
Investments	**€**	
Building costs	310 667	*3%*
Technical installation for production	6 334 388	*54%*
Gas engine and supplemental equipments	2 658 750	*23%*
Measurement and control	778 000	*7%*
Engineering costs, licences, plans	1 556 098	*13%*
Total investments	**11 637 903**	*100%*
Operating costs	**€**	
Substrates costs	1 548 000	*63%*
Energy costs	150 000	*6%*
Management and engineering costs	45 600	*2%*
Supervision and control	224 400	*9%*
Maintenance	324 000	*13%*
Insurance	111 600	*5%*
Taxes	69 600	*3%*
Total operating costs	**2 473 200**	*100%*

Note: without cost of capital and amortization

And the other partner countries (costs without cost of capital and amortization):

Biogas plant, 537 kW el., CZECH REPUBLIC, 2008.		
Investments	**€**	
Building costs	1 300 000	*48%*
Technical installation for production	1 000 000	*37%*
Gas engine and supplemental equipments – 537 k	268 000	*10%*
Measurement and control	113 000	*4%*
Engineering costs, licences, plans	24 000	*1%*
Total investments	**2 705 000**	*100%*
Operating costs	**€**	
Substrates costs	165 000	*41%*
Energy costs	26 500	*7%*
Management and engineering costs	65 000	*16%*
Supervision and control	8 000	*2%*
Maintenance	65 000	*16%*
Insurance	15 000	*4%*
Taxes	55 000	*14%*
Total operating costs	**399 500**	*100%*

Biogas plant, 3153 kW el.,GERMANY, 2008.		
Investments	**€**	
Building costs	1 080 000	*54%*
Technical installation for production	324 000	*16%*
Gas engine and supplemental equipments	252 000	*13%*
Measurement and control	144 000	*7%*
Engineering costs, licences, plans	185 000	*9%*
Total investments	**1 985 000**	*100%*
Operating costs	**€**	
Substrates costs	398 200	*56%*
Energy costs	217 100	*30%*
Management and engineering costs	No information	
Supervision and control	63 900	*9%*
Maintenance	27 800	*4%*
Insurance	74 000	*10%*
Taxes	No information	
Total operating costs	**714 400**	*100%*

Biogas plant, 2MWe, GREECE, 2008.		
Investments	**€**	
Building costs	1 067 000	*13%*
Technical installation for production	4 004 571	*50%*
Gas engine and supplemental equipments	1 566 000	*19%*
Measurement and control	300 000	*4%*
Engineering costs, licences, plans	1 123 031	*14%*
Total investments	**8 060 602**	*100%*
Operating costs	**€**	
Substrates costs	220 000	*24%*
Energy costs	180 000	*19%*
Management and engineering costs	28 000	*3%*
Supervision and control	205 000	*22%*
Maintenance	233 000	*25%*
Insurance	30 000	*3%*
Taxes	40 000	*4%*
Total operating costs	**936 000**	*100%*

Biogas plant, 573 kW el., POLAND, 2005.		
Investments	**€**	
Total investments	**1 075 000**	*100%*
Operating costs	**€**	
Maintance and exploitation	16 500	*32%*
Service personnel	7 500	*15%*
Measurement and control	4 500	*9%*
Administration	3 000	*6%*
Insurance	8 250	*16%*
Others	11 250	*22%*
Total operating costs	**51 000**	*100%*

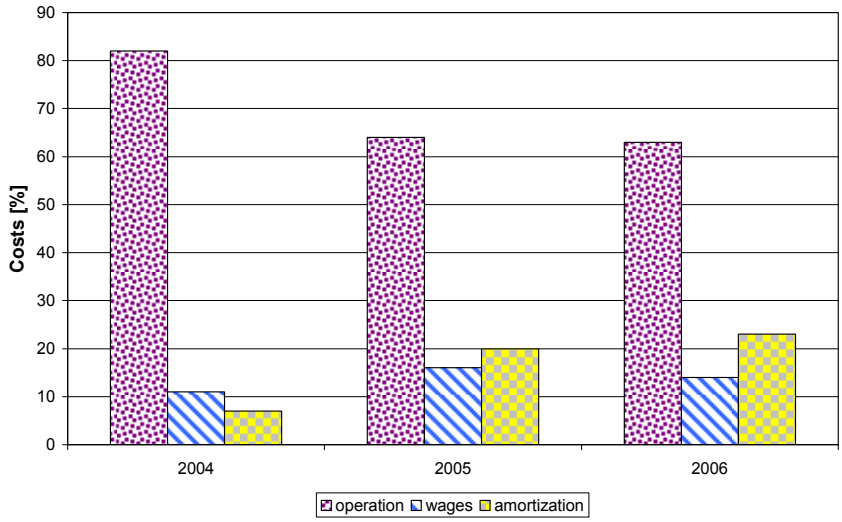
The specific investment costs and the specific operation costs of the biogas facilities built in the different partner countries at different times and having different outputs show considerable differences in some cases. It is particularly conspicuous that in Germany the specific investment cost for 1 kW is one order of magnitude smaller than in the other countries (!).

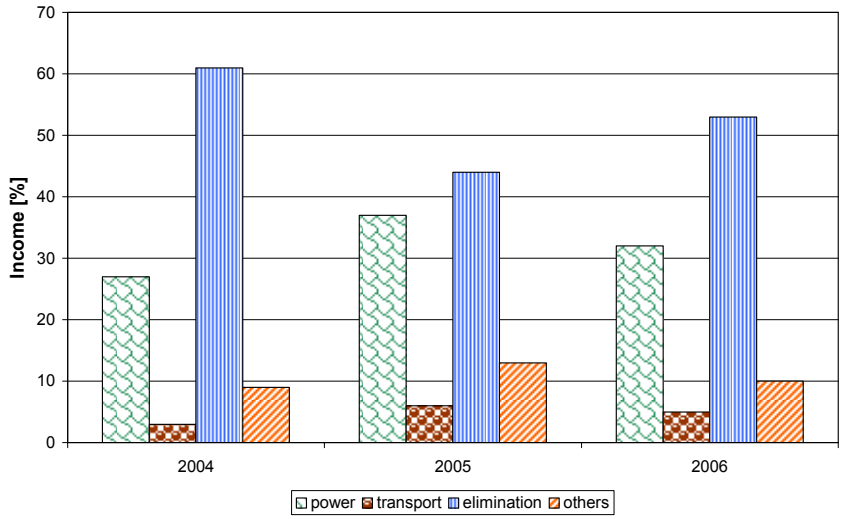
	Specific [euro/kW]	
	investments	**operating costs**
Czech Republic	5037	744
Hungary	3637	773
Germany	571	227
Greece	4030	468
Poland	1878	89

Note: without cost of capital and amortization

As for the payback period of the investment in bio-methane facilities, different figures from 10 years to 20 years are given in the professional literature. The amortisation of the facility and the payback of the capital invested, and in case of funding from loans, the amount of the capital costs represents significant further cost items added to the prime cost of bio-methane.

The biogas plant in Nyírbátor, Hungary, mentioned above (which is the largest in the country and uses agrarian by-products and waste as its raw material) published the following cost and income structure in a paper.





The second Figure places special emphasis on the fact that the costs of the disposal of waste constitute a significant element in the cost structure of the biogas – bio-methane chain.

3. Mandatory acceptance of electricity produced from biogas and of bio-methane

The prime costs of a unit quantity of renewable energy suitable for use are higher than those of a unit quantity of energy produced from fossil energy carriers. If the system of regulations did not make the acceptance of renewable energy mandatory (at a fixed price), renewable energy (and thus biogas – bio-methane as well) would not be a marketable product.

In order to perform the financial examination of biogas and bio-methane production, a simple model was set up. The following statements were made regarding its energy flow on the basis of our previous investigations:

- If the energy content of the input of a biogas production plant (Point 1 of sales and investigation) is 100 %, then the output (Point 2 of sales and investigation) is 50…70 % of the input energy content due to the plant's own use of energy;
- If the energy content of the input of a bio-methane production plant (Point 2 of sales and investigation) is 100 %, then the output (Point 3 of sales and investigation) is 70…80 % of the input energy content due to the energy consumption of upgrading the gas quality.

Prior to our economic investigations we wish to state a few more findings:

- the biogas appearing in Point 2 of sales is generally used locally, in the form of heat or combined heat and electricity generation;
- the bio-methane appearing in Point 3 of sales is generally not used locally, but is marketed either as replacement gas equivalent to natural gas in the natural gas network, or, comprised to above a pressure of 200 bars, is sold as vehicular fuel.

Thus mandatory acceptance can be achieved in Point 2 of sales in the form of 'green electricity' and in Point 3 of sales in the form of 'green gas'.

Let us now examine what guaranteed delivery price ensures a return of a biogas – bio-methane investment under the average European conditions.

For example: the annual amortisation costs of a bio-methane facility with investment costs of $6{,}7.10^6$ € for a payback period of 15 years and a linear method of depreciation are 446.10^3 €, and the capital costs at a rate of 8 % are 530.10^3 €.

If the plant produces annually e.g. 7.10^6 m^3 of bio-methane, then a 6 €cent/m^3 specific depreciation cost and 8 €cent/m^3 specific capital costs will be added to the specific prime cost of the bio-methane. The total additional costs amount to 14 €cent/m^3.

At a session of the Hungarian Advisory Body it was mentioned that in the European Union the average prime costs of bio-methane were 4-6 €cent/kWh. This is confirmed by a conference presentation (*Kopetz, H.: Energy from Biomass – Achievements targets strategies. Strasbourg, 18-05-2006*), in which the costs of bio-methane were given as 5-6 €cent. Similarly to natural gas, supposing a bio-methane with a calorific value of 36 MJ/m^3 (10 kWh/m^3), the prime costs are 35-52 €cent/m^3. Adding amortisation and capital costs to the prime costs makes the price of bio-methane 49-66 €cent/m^3. Taking the mean value of the range, thus the mandatory delivery price of green gas should be at least 57 €cent/m^3 for the biogas – bio-methane investments to be repaid.

In Hungary the average delivery price of green electricity can be only estimated due to zone times and the different prices used in the zone times without the actual operation time being known. On the basis of operation times that are highly probable, the average mandatory delivery price of the electricity is 8 €cent/kWh.

If the calorific value of bio-methane is 10 kWh/m^3 (36 MJ/m^3), then, on the basis of the energy content, the average mandatory delivery price of green gas should be 80 €cent/m^3.

By performing approximate calculations due to having deficient data at our disposal, we have come to the conclusion that if bio-methane could be produced in Hungary (as in the EU) at a prime price of 4-6 €cent/kWh, and if amortisation and capital costs developed according to the above calculations, that is the total costs of bio-methane production were 49-66 €cent/m^3, then a mandatory delivery price of green gas of 80 €cent/m^3 identical with the average mandatory delivery price of green electricity (8 €cent/kWh) – in terms of energy content – would make the bio-methane business profitable in Hungary as well, or would rather start it off.

It should be added to the above calculation that the guaranteed delivery price should be ensured for the total period of payback of the investment.

And a reference value: in Hungary the average consumer price of H quality natural gas was 43 €cent/m^3 at the end of 2008.

Finally, the investment and operation costs, made available to us of the biogas plants in the partner countries presented in the previous chapter, were used for net present value calculations in terms of the minimum mandatory acceptance/delivery price necessary for a return on the investment. The repayment period of the investment was taken uniformly to be 15 years, and the expected asset-rated profit to be 5.5 %. The results of the calculations are summed up in the Table below.

Minimum mandatory delivery price according to the investments and operating costs given	
Hungary	0,13 €/kWh
Czech Republic	0,48 €/kWh
Germany	0,08 €/kWh
Greece	0,17 €/kWh
Poland	0,41 €/kWh

The acceptance/delivery price minimally necessary for a return is the lowest in Germany compared to the other countries. The low price can be explained by a well-developed a biogas market. It is, however, something to think about that while the prices in Hungary and Greece are close to identical, in the Czech Republic and Poland, in order for the investment to yield a return, an approximately three times higher acceptance/delivery is needed (as compared to the Hungarian and Greek prices).

The University of Miskolc will be grateful to the REDUBAR partners for any contribution to the above part report by adding financial-economic figures about the biogas – bio-methane chain in their own countries.

Part III

Processing the responses to the questionnaire on the obstacles and barriers to the proliferation of biogas and the conclusions drawn

As mentioned in the introduction, in order to solve the task WP04 D10, the University of Miskolc compiled a questionnaire of 25 items on the obstacles and barriers to the proliferation of biogas and the effects of their elimination or reduction.

1. Processing and evaluation of the Hungarian responses to the questionnaire on the obstacles and barriers to the proliferation of biogas

The University of Miskolc first invited its Hungarian partners cooperating in the REDUBAR project to give answers to the questionnaire. The Hungarian partners represented almost all substantial segments in the complete natural gas – biogas set-up. In other words, the University managed to reach by means of the questionnaire the Hungarian representatives of the REDUBAR target groups.

The University of Miskolc takes this opportunity to thank all the eight partners for their contributions to exploring the obstacles and barriers to the proliferation of biogas and to their qualification. In processing the responses to the questionnaire it was notable that there were hardly any unanswered questions and comments were only made on a few questions by the experts. The responses at the same time reflected to some extent the professional situations of the respondents (e.g. practising industrial experts, researchers, experts in public administration) and the extent of their proficiency in the individual issues. This latter fact is a warning that there are contradictions within the profession and there are subtle differences in the opinions of the experts concerning the future of biogas in Hungary.

Nobody argued against the initial thesis: *"The cost of unit energy produced from biogas is higher than that of energy produced from any fossil energy resource."* But concerning the most efficient tools of overcoming the price disadvantage, the opinions were somewhat divided.

According to more than two thirds of the answers, in Hungary the proliferation of biogas were most efficiently served by the following,

a) if in the long term the obligatory acceptance of biogas were guaranteed by legislation at a price higher than the production price as a public supply gas, in the form of 'green heat' and in the form of 'green electricity',
b) if the authority licensing procedures concerning biogas were easier and faster than they are now.

Using the terminology discussed in Part I of deliverable D10, this means that the Hungarian experts confirmed the thesis of the University of Miskolc: *"the development of biogas supply requires complex, government-financed financial – regulation programs"*. The guaranteed acceptance of biogas set out in legal regulation and guaranteeing the acceptance for the total lifetime of the biogas project and the appropriate delivery price appeared with the same weight in the answers.

The current Hungarian situation is well reflected by the fact that together with the financial-regulation aspects, the current quality of the authority – public administration procedures was indicated as the main barrier.

Next to the most efficient tools, we qualified as efficient tools the conditions the fulfilment of which was considered by more than half the respondents to be necessary for the proliferation of biogas. The proliferation of biogas in Hungary may be enhanced

a) if there is a comprehensive and practicable biogas policy in the national energy strategy,
b) if there is regulated and predictable financial support for investment in biogas producing plants connected to sewage plants and waste deposits as well as for investment in facilities upgrading the quality of raw biogas and for the facilities of injecting biogas into the natural gas system.

Both of the main elements of intervention into the competitive market mechanisms have presented themselves here as well: there is need for financial support and there is need for its predictable and practicable regulation – irrespective of the activity providing the raw material for biogas.

For them it was not predictable that the determination of energy policy, including the place of biogas in the energy policy would get such a prominent role in the expert opinions.

Finally the Hungarian experts regarded as the least efficient tools for the proliferation of biogas the following:

a) If there were tax benefits connected to the production and use of biogas.
b) If there were detailed and practicable legal regulations and realistic quality requirements regarding the injection of biogases into the natural gas system.
c) If there were government R&D programs connected to the production and use of biogas.
d) If there were efficient government measures for reducing emission and in the interest of the cultivation of plants serving as the raw material of biogas production.
e) If the information for the general public in the media on renewable energies – including biogas – were more accurate and authentic.

In summary it can be stated that Hungarian experts regard as necessary for the proliferation of biogas the statutory provision for the mandatory acceptance of biogas in the long term and at the appropriate price (irrespective of the fact whether biogas is a direct public supply gas or 'green heat' or 'green electricity'). Moreover, they consider it essential that the current Hungarian authority and public administration procedures are simplified and made faster.

2. Processing and evaluation of the responses by the REDUBAR partners to the questionnaire on the obstacles and barriers to the proliferation of biogas

Parallel with asking for the opinions of the Hungarian experts, the University of Miskolc sent the 25-item questionnaire to all the 15 REDUBAR partners with the request that the partners within the same country should reconcile their responses to the questionnaire with each other.

The University of Miskolc received responses to the questionnaire from the following countries:

Germany,
Lithuania,
the Netherlands,
Poland.

The University of Miskolc expresses its thanks to the partners who filled in and sent back the questionnaire exploring the obstacles and barriers to the proliferation of biogas, and

expresses its special thanks to the Lithuanian partner, LEI, which according to the REDUBAR work program is not a cooperation partner in WP04 D10, yet it contributed valuable information by means of its responses to the questionnaire to the preparation of the deliverable.

Thus for preparing deliverable D10 the standpoints of four of the eight REDUBAR countries and as the fifth, the Hungarian opinion were available to us. The final Hungarian standpoint was developed jointly by the University of Miskolc and ETE in possession of the responses by the Hungarian experts.

The first unexpected experience in processing the questionnaires sent back by the REDUBAR partners was that the questions were by far not so clear for the non-Hungarian partners than for the Hungarian experts. This forecast immediately that in qualifying the obstacles and barriers there would also be substantial differences between the individual countries. The partners made comments on several questions in the questionnaire sent back, which enhanced greatly our understanding of the differences between the countries. It was also remarkable that question 25 on the role of the media, which originated in the characteristics of the Hungarian media situation, gave rise to some reactions finding it difficult to interpret the question in the countries where the media situation can be assumed to be totally different.

All respondents agreed with the initial thesis referring to the situation of biogas: *„The cost of unit energy produced from biogas is higher than that of energy produced from any fossil energy resource."* And the answers showed that where the state in some way intervened in the economic processes, where the state does not rely exclusively on the self-regulating principle of the market (e.g. Germany and Lithuania), there the obstacles and barriers to the proliferation of biogas are different from those in e.g. Hungary, where the role assumed by the state is not of sufficient efficiency concerning renewable energies.

According to the representatives of the REDUBAR countries, <u>the favourable conditions necessary for the proliferation of biogas</u> are as follows:

a) If the acceptance of 'green gas' is mandatory as stipulated by legal regulation.
b) If the acceptance of biogas is guaranteed in the long term at a price above the production price.
c) If there is regulated and predictable support for the injection of biogas into the natural gas system.
d) If there are tax benefits connected to the use of biogas.

e) If there is an independent, comprehensive and practicable biogas policy within the national energy strategy.
f) If there is a priority order regarding the energetics use of biomass in the national energy strategy.
g) If there is efficient encouragement by the government for the cultivation of plants serving as the raw material of biogas production.

The conditions allow for a general conclusion similar to the Hungarian one: the proliferation of biogas requires state guarantees and financial - regulation intervention into the elements of the biogas chain.

One of the important barriers to the proliferation of biogas is that the acceptance of biogas as ‘green gas’ (or the heat generated from it as ‘green heat’) is not regulated by statute. Therefore it has to be achieved in all EU member countries that biogas as ‘green gas’ should fall under the same mandatory acceptance as ‘green electricity’.

The barrier to the injection of biogas into the natural gas system is the lack of support and precise regulation. The regulation has to cover the quantity and quality conditions if injection. The questionnaire did not include it specifically, but it can be stated that the elaboration of the regulation is a pre-condition of biogas injection, and the elaboration of the regulation requires the intention of public administration and work by experts (together with the costs incurred). The question is ‘who foots the bill’: those with an interest in injecting biogas into the natural gas system or central budget funds are to be provided for elaboration the regulations (and for the possibly necessary further R&D projects).

For biogas to have a larger share in the energy balances, beyond the mandatory acceptance it also requires a delivery price ensuring the return on the biogas project, and for the complete period of return. For the appropriate price the financial covering costs are to be allocated from central funds.

The REDUBAR partners consider it necessary for the elimination of the obstacles and barriers that the national energy strategies should include independent, comprehensive and practicable biogas policies simultaneously with determining the priority order of the energetics use of biomass within the national energy strategy.

In the economically more developed countries of the European Union the demand appeared as an essential element in the proliferation of biogas that there should be efficient encouragement by the government for the cultivation of plants serving as the raw material of biogas production. Achieving this objective, the central support for the cultivation of plant cultures required for biogas production would mean deconstructing a large barrier: the raw material would not limit the amount of biogas that can be produced.

Finally we have to note that on the basis of the responses received from the REDUBAR partners it seems that the concepts analysed in Part I of this deliverable D10 and the differentiated examination of the biogases received from different sources and having different levels of preparation do not always harmonise with the approach of the range of problems by the REDUBAR partners.

The Hungarian members of REDUBAR are convinced that there are various obstacles and barriers to the proliferation of biogases produced from various raw materials and upgraded to different levels, and that the obstacles before the projects with energetics objectives and primarily with environmental objectives have to be investigated on a differentiated basis so that they can be overcome.

Summary

In the present deliverable D10 the University of Miskolc clarified some fundamental concepts in its analysis of the obstacles and barriers to the proliferation of biogas, then formulated theses and hypotheses in an attempt to explore the obstacles and barriers. In order to confirm (or refute) the theses and hypotheses, it used a 25-item questionnaire to collect information both from the Hungarian partners and from the REDUBAR countries.

The majority of the responses to the questionnaire determined the conditions for the proliferation of biogas assertively:

- central complex, financial and regulation measures,
- mandatory acceptance of 'green gas' (or the 'green heat' produced from it) at an appropriate price for the appropriate period,
- independent biogas policy in the national energy strategies,
- government encouragement and support for plant cultures serving as the raw materials of biogas.

The proliferation of biogas is a complex problem with many sides, the constituent elements of the problem are closely linked with each other and it is not sufficient to investigate the individual elements in themselves. The barriers to the proliferation of biogas constitute an organic system and the individual elements can be hardly separated from the other barriers. The elimination of the individual barriers separately offers little possibility and the impact of eliminating a particular barrier on the biogas supply cannot be quantified.

Summary on financial aspects of the barriers and obstacles in the field of production and use of biogas, upgraded biogas, and bio-methane:

- there are only very few business–economic data publicly,
- the financial issues in general as confidential to the business,
- costs are incurred under any conditions at raw materials of biogas, but if the purification technology includes biogas production, the expenditure is partially returned,
- the investment costs of a bio-methane production facility are approximately half the investment costs of a biogas production facility,
- the prime cost of bio-methane, its amortisation and capital costs are significantly higher than the market price of natural gas,

- the bio-methane business would require an appropriately high price and in addition to guaranteeing the mandatory acceptance,
- computable business conditions and precise legal regulation are needed for eliminating or reducing BaOs in biogas chain.

The development of biogas supply requires many-sided government-financed financial – regulation programs in the REDUBAR countries.