BioProm – BioEnergy Promotion

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Report on economic factors

Work Package 3

Executing Region

Universitat Rovira i Virgili (CREVER) – Spain

Coordinator

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1 – Introduction and objectives

The economic factors analysed in this report are defined as to include capital investment factors and production costs.

The investment will include at the same time the project construction costs:

- The initial costs incurred in project development (feasibility studies, permitting, legal/administrative costs of securing power sales and other agreements)
- Financing costs (loan initiation costs and interest during construction)
- Construction costs through final change orders
- Initial funding of operating costs until the revenues are generated

The production costs comprise different kinds of costs like fuel costs, costs for the payback of credits, maintenance costs and others. The proceeds are related to the market prices of the energy market. When the plant is operating the produced energy should at least cover the production costs. If so the plant is operating economically.

Usually the cost of bioenergy equipment, for example, biomass fired boilers are characterised by significantly higher investment costs and lower running costs than equivalent fossil fuel based systems.

In this report the economic factors will be described comprising the overall market situation for energy generated from biomass and will be analysed to show how the production of bioenergy is situated from the point of view of economics.

2 - Description of economic barriers for bioenergy projects in condensed urban areas

The objective of this section is to make a brief presentation and analysis of the economic barriers identified in the questionnaire done in Workpackage 2 of this project.

The cost of biomass conversion technologies varies according to a range of factors including the types of biomass and conversion process and the scale of operation. The competitiveness of bioenergy will also depend on the availability of alternative energy options, relative costs and prices, and regulatory frameworks. As the policy environment around the Kyoto protocol develops, for example, the trade in “carbon credits” will impact positively on the economics of bioenergy projects.

The bioenergy project like any other power project must face and successfully overcome several uncertainities. The main uncertainties faced are:

- Total project construction cost
- Security of fuel supply and price
- Ability to secure financing

The following general comments on economic barriers in bioenergy projects can be made:

- Sources of biomass that are already concentrated in one location, often as a waste product of another process, tend to be the cheapest since they require least collection and handling and no crop production costs. The almond shell plant in Catalonia can be a good example of this.

- Many forest and crop residues are not competitive with fossil fuels when they are dispersed over large areas in small volumes. Costs will be minimised if biomass can be sourced from a location where it is already concentrated, such as a sawmill or sugar mill, and converted nearby.

- Another issue to deal with is the low energy density of the biomass fuel producing a bulky storage and logistic problems. Generally, this problem needs to be faced case by case and has an important impact on the project economics.

- A basic requirement for the technologies used is their robustness and their operational safety. With some types of biomass technologies such as, gasification this is still a weak point. As they are not regarded as not yet mature technologies the costs remain still high.

- Another disadvantage that has also not only economic but social implications is that the oil and gas sector is able to spend infinitely more on public relations than the bionergy sector.

Next are presented the main conclusions of a survey carried out by the project partners among bionergy experts to identify barriers for bioenergy projects related with economic issues with special emphasis on urban areas. The conclusions regarding other factors rather than economic can be find in the corresponding project deliverables.

2.1 - Stuttgart region (Germany)

The main conclusions on economy related issues in bioenergy projects in the Stuttgart region according to the questionnaire carried out in this project are:

- Economic aspects are the most relevant non-technical barriers in urban areas according to the ranking

- The long term security of bio fuel prices and the level of prices are very important for project decisions.

- The public money and the national and local/regional politics are considered to be very important for project realisation.

2.2 - Upper Austria (Austria)

The main conclusions on economy related issues in bioenergy projects in the Upper Austria region according to the questionnaire carried out in this project are:

- For more than half of the persons questioned, public money is most relevant for the realisation of bioenergy projects

- Asked about their assessment of the following assumptions concerning costs and prices for urban bionenergy projects, the results were stated as mentioned below:

    - Investment costs (compared to fossil plants) are a main constraint for bioenergy projects in urban areas.
    - Prices of biomass fuels (compared with fossil fuels) are a main aspect for project decisions.
    - The long time security of prices for biomass fuels are a main topic for biomass project decisions.

- The stability of biofuel prices and the higher investment costs are considered more important barriers than the prices for biomass fuels

- Nearly more than a half of the respondents said that public money was the most important frame condition for bioenergy project realisation followed by local or regional politics

2.3 - Rhône-Alpes region (France)

The main conclusions on economy related issues in bioenergy projects in the Rhône-Alpes region according to the questionnaire carried out in this project are:

- Economic and financial matters are the main barrier according to questioned persons, even if they consider it to be a competitive energy

- Wood chip is the biomass which is developed and will develop more in urban areas.

- NIMBY (Not In My Back Yard) syndrome is often quoted as a main barrier for the development of bioenergy projects in urban areas.

2.4 - Catalonian region (Spain)

In the Spanish case the questionnaire was distributed for the whole Spain not only in the Catalonian region. The main conclusions on economy related issues in bioenergy projects in Spain according to the questionnaire carried out in this project are:

- According to the ranking of factors, economic factors are the most important, and the less important barrier are considered to be the legal factors.

- Bioenergy projects are considered less economic competitive than fossil fuel solutions

- Politics and public money is considered to have a great influence on bioenergy projects

Other issues pointed out for the experts consulted in the mentioned questionnaire in Spain are the following (not ranked by importance or number of opinions received):

- It is not only important the unitary cost of the biomass with respect to other fuels or the stability of this cost along the plant live time but also the investment related with the biomass in origin, mainly the equipment for recollection, treatment, etc.

- It can be very hard for biomass in urban areas to compete with the electric and gas distribution companies because these companies can even provide the necessary particular installation and connection to the grid to their clients.

- The higher space required for biomass technologies in comparison with fossil fuel counterparts could be an important problem especially in urban areas where the space cost is very high. Medium to large size bioenergy projects are only potentially viable in non-urban areas where the cost of soil is considerably lower.

- The logistic problems causing higher transport costs for biomass in certain cases can be worse in urban than in rural areas.

- It is pointed out that the economic saving due to the fact of using a local energy instead of primary energy coming from abroad should be stressed.

- One interesting point indicated for one of the consulted experts was the retrofit of existing facilities to use biomass.

- Also the public financing has to be devoted to promote the use of biomass but also it is indicated that a greater effort is needed to develop the research and development in the field of bioenergy.

- An economically related barrier that is very important for biomass users is the technical guarantee of the bioenergy plant in the case of using some new more energy efficient technologies.

- The distribution network for biofuels is very weak and this contributes to increase their cost.

- Another factor that can contribute to the higher cost of biomass projects is the design of the building and their services not always well adapted to the use of biomass.

- One inconvenient for the development of the biomass in Spain is the very low level of forestry management so a great potential for energy revalorisation of biomass is lost.

- The presence of an important biomass facility in the neighbourhood is regarded as a devaluation of the real estate value of the buildings in that area because it is seen as a combustion facility with an “industrial activity” causing annoyances.

2.5 - Slovenia region (Slovenia)

The main conclusions on economy related issues in bioenergy projects in Slovenia according to the questionnaire carried out in this project are:

- High investment cost is judged as the main constraint for bioenergy projects

- Local/national policies and public money is most relevant for the realisation of bioenergy projects

3 - Economic incentives in each region

The objective of this section is to provide a summary of the economic incentives offered by each partner region and country for the implementation of bioenergy projects. The information presented was obtained from all the project partners and also from previous EU and national projects.

3.1 – Stuttgart region (Germany)

Background

The stability of political support since 1998 has stimulated continuous and high levels of growth especially in the case of wind energy, PV and solar thermal installations. But the sectors of liquid biofuels, geothermal energy and to a lesser extent biomass electricity, and biomass heat have also shown relevant growth rates, With the enactment of the amended Renewable Energy Law (REL) in August 2004 tariffs for wind on-shore where lowered, but

tariffs for offshore wind, biomass electricity and geothermal electricity increased. For the first time a feed-in tariff is introduced for the refurbishment of large hydro.

RES targets

The RES target to be achieved by Germany in 2010 is 12.5% of gross electricity consumption (in 2020 10% of total energy consumption and 20% of electricity consumption). In 2003 8% of the electricity, 3,8% of the heating and 0,8% of fuels were derived from renewable sources.

Status of the renewable energy market

The renewable energy market in germany is mature and showing large growth rates even at high penetration rates. Biomass might be considered as the only source that is significantly lagging behind expectations. Biomass development is slower than expected due to fuel price uncertainty and high infrastructure costs. Most of the low-cost potentials (wood wastes) have already been exploited. The new Renewable Energy Law will have a major impact on wind, biomass and large hydropower. The feed-in tariffs combined with reasonable investment subsidies and loans have generated a considerable renewable energy market.

Main supporting policies

The main promotion schemes for renewables in germany are the following:

- Renewable Energy Law – feed-in tariff (REL amendment Aug 2004):

  Biomass: up to 150 kW: 11,5 c€/kWh, up to 5 MW: 9 c€/kWh, up to 20 MW: 8,6 c€/kWh
  Landfill gas, sewage gas: up to 500 kW: 7,7 c€/kWh, up to 5 MW: 6,6 c€/kWh

- Market incentive program: Investment subsidy fo solar thermal, biomass heat and geothermal (200 Mio.€ in 2004).

- Full exemption from mineral oil tax and enviromental tax for all pure liquid and solid biofuels in heat and transport.

3.2 – Upper Austria (Austria)

The regional government of Upper Austria committed itself to sustainable energy production and use by developing a comprehensive and concrete energy policy framework:

- the “Energy Action Plan”, 1994-2000, set very concrete targets in the field of energy efficiency and renewable energy sources. It led, among others, to an increase of the share of renewable energy sources from 25 to 30 % (half biomass, half hydro).

- the “Energy 21” programme, 2000-2010, continues the regional energy strategy into the 21st century and aims - among others - to double the biomass and solar energy use.

- the “Energy Efficiency Programme”, 2004-2010, aims at achieving a 1 % annual energy saving in the region and at increasing energy efficiency for public buildings by 1.5 % every year.

Numerous programmes and projects are implemented to meet these energy policy targets, including information, financial and legal measures, and an annual report monitors the progress that is being made.

In the region of Upper Austria there is a great number of subsidies for biomass projects. Next it is presented a brief summary.

Subsidies for particular users

Pellets and wood chips facilities

- For non-farmers the not repayable subsidy amounts to 30 % of the investment cost.

Individual pellets stove

- Stove located in residential areas using only biogenous heat sources and installed in low energy consumption or passive houses. The net eligible costs have to be at least of 3700 Euros.

Wood boiler

- Subsidy of 25% of the costs relevant for the environmental protection (excluding VAT), masimum 1500 €, and in the case of old boiler replacement, maximum of 1940 €.

Substitution of boilers and old heating systems for biomass systems

- The boiler or heating system has to be at least 15 years old.

- 30% of the net eligible costs for wood chips and pellets systems, maximum 2640 € per installation

- 25% of the net eligible costs for special wood boiler, maximum 1940 € per installation

- If in case of exchanging a fossil fuel boiler to a biomass heating boiler, the old oil or gas tank is removed (this has to be done by specialised companies and the tank has to have a capacity of at least 1,000 liter), then the subsidy can be increased by 500 Euros (however the total support must not exceed 30 respective 25% of the total investment).

- The maximum total subsidy is limited to 3140 € for pellet and wood chips boilers and 2440 € for special wood boilers.

Subsidies for companies

The environmental promotion from the Austrian Government supports different environmental protection measures after promotion actions. At present there are among others the following environmental actions in the field of biomass:

- District heating
- Biomass CHP
- Local heating
- Individual biomass plant
- Connection to a heating network

In the case of "De-minimis" subsidies (= all as "de-minimis" subsidies granted to favour a company up to a maximum extent of 100.000 € within three years) the entire environmental relevant capital applies for subsidies, set usually at 30 %.

However when the susidies go beyond the "de-minimis" limit the additional investment costs are used as the base to calculated the subsidies. The subsidies are set usually at a maximum of 40 %, however with a limit of maximum 30 % of the entire environmental relevant capital investment.

Subsidies for agricultural companies

- Promotion of individual facilities of pellets, wood, and wood chips in the framework of the program on the development of rural areas.

- Subsidy of 30% of the net eligible cost, maximum 2200 € for pellets plants (in the case of boiler replacement, maximum of 2640 €).

- Subsidy of 25%of the net eligible cost, maximum 3700 € for wood chips plants (in the case of boiler replacement, maximum of 4140 €).

- Subsidy of 25%of the net eligible cost, maximum 1500 € for wood chips plants (in the case of boiler replacement, maximum of 1940 €).

- In the case of elimination of a storage vessel of gas-oil or gas, maximum of 500 € additionally.

To facilitate the funding of biomass plants, there are also beside public subsidies, different financing and operating models that allow the realisation of a project without your own investment.

3.3 – Rhône-Alpes (France)

The investment involved in a wood-fired boiler plant is considerably greater than that for a conventional boiler plant. For a public client, a wood-fired boiler plant costs around three times as much as a natural gas boiler plant.

The questionnaire shows that public clients would like to be able to outsource their investment.
As far as boiler plant operators are concerned, even if they invest in a concession they are not keen to make the investment and finance the installation for smaller projects (not likely to be run as public utilities).
It is true that bioenergy projects do qualify for financial assistance but this is not specific to urban areas.

Wood energy and biogas qualify for assistance:

The Rhône-Alpes Regional Council has been supporting this industry sector for 20 years. Also, all collective projects run by a public authority are supported financially by the Regional Council:

- at the feasibility study stage: 70% of the cost of the services provided by the engineering consultant
- for the investment, for up to 30% of the net cost of the investment. A few years ago the financial assistance granted was always 30% of the cost, but the increase in demand combined with a limited budget now means that the profitability of a project is examined and an adjustment is made to the percentage of the subsidy depending on profitability. Furthermore, financial assistance is capped in the case of facilities generating more than 2 MW (see appendix).

As far as property landlords are concerned, financial assistance varies depending on the type of landlord. Those providing welfare housing are subject to the same conditions as the public authorities, otherwise the maximum assistance is 20%.
As far as individuals are concerned, up to two years ago the Region paid a grant as a percentage of the total investment. In view of the sharp increase in the number of applications, a fixed sum was introduced, and every year since then this has been reduced.

Other regional players have shown willingness to help those with projects, whether public authorities or not. These are the Councils of some of the départements in Rhône-Alpes (Isère, Savoie and Drôme), which provide financial assistance for investments or studies.

At the national level, through its regional delegation ADEME (the Agency for the Environment and Energy Management) provides co-finance for public authority projects for up to 30% of the investment. The project's profitability is studied in comparison with a reference situation. The amount of the subsidy is calculated so as to bring the overall cost per KWh for wood

(purchase of fuel, servicing, major maintenance, debt and loan repayments) down to the reference price. This subsidy therefore reduces the debt and loan repayments. The limits of the system have been reached. Budgetary restrictions at national level now mean that demand is greater then the credit available, with the result that budgets are exhausted within 6 months.

As far as individuals are concerned, a national scheme based on a tax credit was introduced in 2005.

Other measures that could benefit wood energy and heat generated from bioenergy sources.
In urban areas the problem of urban renewal is a key concern of the government. At stake is the future of the large residential areas built in the 1970's that form areas of dense welfare housing and large high-rise group housing developments involving large heating networks. The National Agency for Urban Renewal (ANRU) was therefore set up to organise the demolition and rebuilding of housing and the development of an urban fabric which among other things would increase social security and bring about more social integration. In this programme, each public authority proposes a renovation project to qualify for loans and financial assistance with demolition and reconstruction. This system is limited in that although the approach is one of urban renewal, the question of energy was not considered and the future of the heating networks was not taken into account. This situation results in heating networks being given less importance in reconstruction projects. With less dense housing, individual natural gas heating is used and heating sales are reduced.
These programmes enable providers of welfare housing in particular to rebuild housing and use a different energy source without giving consideration to wood energy (in terms of cost). Finance is available for 90% of the cost of rebuilding boiler plants and loans at an interest rate of 1% are available.

Biogas

Biogas from subsurface containment centres and agricultural sources:
As far as biogas is concerned, for captive production from subsurface containment centres the cost price per KWh of biogas is fairly low when one takes the subsidies into account. But what remains is the problem of using the heat or electricity produced. Electricity buyback prices are fairly low. They may be sufficiently high to enable some subsurface containment centres to build cogeneration facilities but they are not enough to encourage the development of methane production from agricultural sources (€0.068/KWhe).

Biogas from methane production from household waste:
Methane production from household waste is governed by a waste policy that does not tie in with energy policy. It requires considerable upstream investment for the separation of the fermentable fraction and this technology has not been adopted in Rhône-Alpes due to the culture prevalent among the region's (pro-incineration) elected officials and the lack of maturity among the population when it comes to rubbish sorting.

Wood

From an economic point of view, the profitability of urban wood energy products at the public authority level depends mainly on the price of natural gas, competing energy sources and the purchase price of wood. Wood energy projects implemented by urban public authorities depend on the cost of the existing energy source and exist where the cost is lower than or equal to the current price paid by the public authority or customers of a heating network. The costs of servicing, major maintenance, installation and paying off the investment in a wood-fired boiler plant have to be deducted. The sum left over must buy a sufficient quantity of wood. If the price of wood is too high the project is not feasible. The increase in the cost of fossil energy sources is beginning to make it feasible to buy wood other than waste wood, which is starting to become rare in Rhône-Alpes, resulting in the use of forestry wood chips of which there is a large supply.

Regarding the purchase of wood, P1:
The price of reject wood (waste) and/or sawmill by-products was around €10 per MWh on arrival at the boiler plant. With the increase in demand the price is increasing and the most recent price proposals are approaching €15/MWh.
Regarding forestry wood chips, the minimum price is €18-19/MWh.
By way of comparison, the price of natural gas at the industrial rate is €32/MWh.
As far as purchasing wood is concerned, in the new farming blueprint bill the phrase "for domestic use" has been deleted from the provision for a reduced rate of VAT payable on the purchase of wood, which enables anyone buying wood to qualify for the reduced rate. For the end client this will result in a saving of 15% on fuel. Because up to now only wood purchased for personal use was subject to the reduced rate, thereby penalising clients using an operator who was buying the wood himself.

It is apparent at regional level that some operators will try to increase their margin on the price of wood fuel by sourcing low-cost fuel from for example subsidiaries in their group, which in some cases will be detrimental to the technology and local suppliers.

The wood energy activity of public authorities in urban areas does not currently allow the use of forestry wood chips because of their cost. The successive increases in the cost of reject wood caused by the exhausting of this resource and that of gas make it likely that there will be a role for this type of fuel in the future.

Regarding routine servicing, P2: a wood-fired boiler plant requires more maintenance and more staff to fun the facility. This costs three times as much as for a gas-fired boiler plant.

Regarding major maintenance and full cover: P3,
Compared to a gas-fired boiler plant these cost between 3 and 4 times as much due to the high cost of the equipment and the requirement to change some of the refractory materials.

The investment involved is three times greater than that for a gas-fired boiler plant, which implies bigger debt repayments and loans.

The increase in the average investment costs observed can be explained by a number of factors:

- economic conditions related to boiler manufacturers, which are reaching the limit of their production capacity
- civil engineering costs are greatly increasing
- the price of steel is increasing, particularly the kind used in heating networks.

In addition, the pressure for and price of land in urban areas is such that it can put wood energy projects at a great disadvantage because they require three times as much room as a gas boiler plant and access for lorries. Wood energy can be excluded in the case of very densely populated areas, where every square metre is instead needed for housing, business premises or more profitable activities.

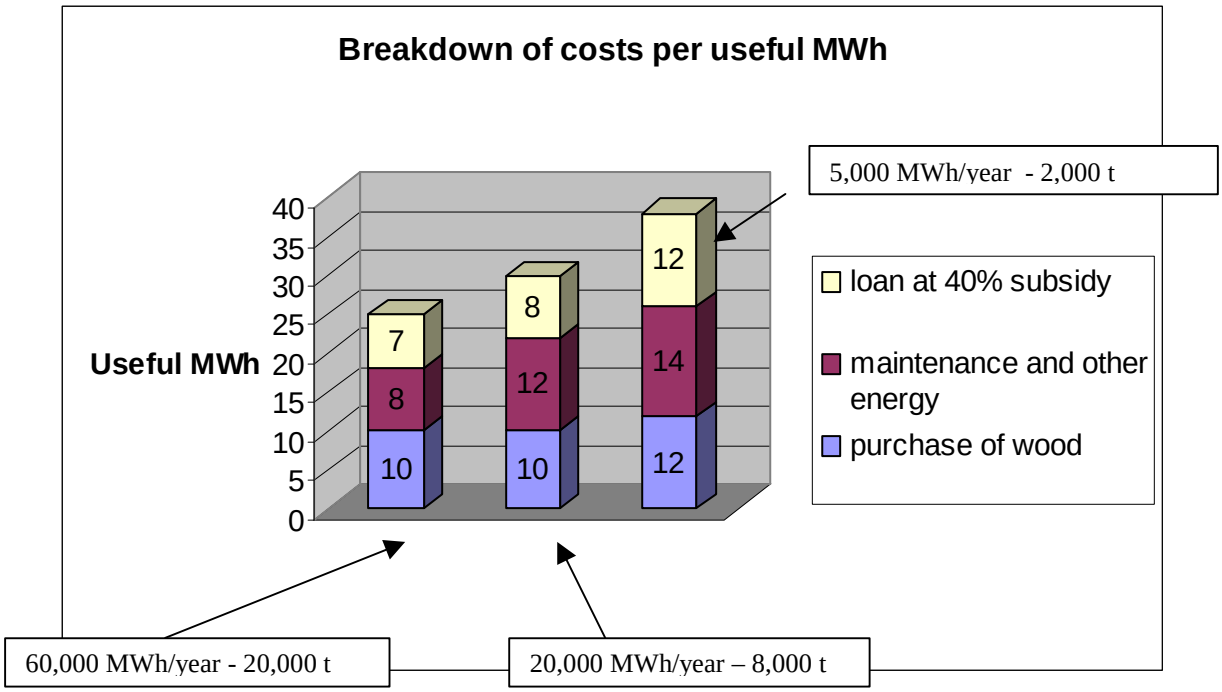

Figure 1 – Breakdown of costs per useful MWh.

Heating networks and VAT:

VAT on heating network charges penalises heating networks because it is applied at 19.6% compared with 5.5% on charges for natural gas and electricity supplies. The European Commission has accepted the principle of a reduced rate of VAT on heating networks, but this has not yet been adapted to French law.

3.4 – Catalonia (Spain)

The support to renewable energy sources and cogeneration in Spain has proved to be efficient in general taking into account the great development of the wind energy source, and at a lower extent, the development of biofuels and cogeneration. However, so far it has been insufficient to develop as expected other areas such as solar energy or biomass.

The Spanish electricity market is completely liberalised since January 2003 and is regulated by the Electric Power Act 54/1997, of November 27th of the electricity sector and incorporates the Electricity Directive 96/92/CE. This law sets rules for the internal market of electricity and is the norm that regulates the bases for the liberalised market of energy. Also it allows that the producers of electricity using renewable sources have guaranteed the access to the grid and that the technical and economic conditions between producers and distributors are clearly defined. Among other regulations in this law the electricity production facilities are differentiated into two groups. One of them is the so-called “Regimen especial” facilities that enjoy a special juridical and economic framework different from the big and centralised power station plants belonging to the electricity companies. The law that regulates the methodology for the application and update of the juridical and economic framework for the production of electricity in the “regimen especial” is the Real Decreto 436/2004. RD 436/2004 is previous to the EU Directive 2004/8/CE on the promotion of the highly efficient cogeneration but the main guideline of the law is to be fully confluent with the objectives of the EU directive. In this law it is stated the bonus for the electricity sold to the grid coming from biomass cogeneration plants.

The Real Decreto 436/2004 establishes the methodology for the update and systematisation of the legal and economic regime of the electrical energy production in Special Regime. This Regime deals with the energy production in cogeneration plants in general and also with cogeneration plants supplied by renewable or waste sources. The purpose of the law is to improve the energy efficiency, the reduction of the energy consumption from non-renewable energy sources and the protection of the environment. It is stated also that the economic incentives will be applied to cogeneration systems of high efficiency or using renewables whenever the installed capacity is below or equal to 50 MW of electricity.

In the article 2 of RD 436/2004 the different groups of biomass applications are described. Thus the biomass facilities producing simultaneously electricity and heat and that can be included in this Special Regime are the following:

- Group b.6: Cogeneration systems that use as main fuel source biomass originated from energy crops, waste from agricultural or gardening activities, forestry waste and other forestry activities.
- Group b.7: Cogeneration systems using as main fuel biomass coming from biofuels and biogas originated by anaerobic digestion of agricultural and farm wastes, biodegradable industrial wastes, waste water treatment plants and landfills.
- Group b.8: Cogeneration systems using as main fuel biomass coming from industrial facilities of the agricultural and forestry sectors, or a mixture of the previously mentioned biomass fuels.

RD 436/2004 establishes premiums and incentives for each one of these types of facilities. The Ministry of Industry and Energy annually updates these premiums and incentives based on a series of parameters reviewed every four years. This Royal Decree establishes two alternative options for the remuneration of the electric kWh in the special regime:

- Direct sale to the distribution company: regulated price, depending on the capacity and year of commissioning

- Open sale in the market: 'Pool' price + premium + incentive

In table 1 (next page) are presented the electric tariffs applicable to renwable energy sources. The percentages are applicable to the yearly average tariff (TMR), 7,6588 c€/kw for 2006. Thus the final price is the TMR multiplied by the corresponding percentage. As a comparison between different european countris table 2 shows the price for electricity from biomass in different countries and the average value.

Table 2 - Price of electricity generated from biomass in Europe (Bas, 2004).

	Euro/MWh
Italy	146
Belgium	128
Holland	116
Austria	102
Germany	101
United kingdom	86
Greece	71
Spain	71
Portugal	62
France	61
Ireland	58
Average	**91**

In addition to the central government incentives, all the Autonomous Communities of Spain can grant subsidies for the promotion of renewable energy technologies. Each Autonomous Community publishes every year or every two years a series of incentives for renewable energy plants, and among them it is usually included the thermal and/or electrical application of biomass and, in some cases, its application in buildings. The quantity of these incentives varies according to the zone in the range of 10 to 40 % of the investment.

In some Autonomous Communities the importance of the thermal applications using biomass has lead to the development of specific promotion programs of these facilities, mainly in Andalucía and Castilla.

Also, specific lines of incentives in many Spanish municipalities exist, like the change of old coal boilers by cleaner energies, where the biomass facilities have an important market.

Table 1 – the electric tariffs applicable to renwable energy sources in Spain according to RD 436/2004 (Hernández, 2005).

Two options for selling power:		**Option a):** Fixed price (regulated tariff) calculated as a % of yearly average tariff (same for every hour)	**Option b):** Free sale onto the organised market plus an incentive and premium (when applicable) calculated as a % of the yearly average tariff: different price for each scheduling period (for each hour)		
		Fixed price=Regulated Tariff c€/kWh	**Premium c€/kWh**	**Market Participation Incentive c€/kWh**	**Total = Premium+Incentive c€/kWh**
SOLAR (b.1.)					
Photovoltaic (b.1.1.)	**≤ 100 kW**	**575%**			
	> 100 kW	**300%**	250%	10%	**260%**
Solar Thermoelectric (b.1.2.)		**300%**	250%	10%	**260%**
WIND (b.2.)					
Onshore Wind power (b.2.1.)	**≤ 5 MW** **> 5 MW**	**90%** **90%**	40% 40%	10% 10%	**50%** **50%**
Offshore Wind power (b.2.2.)	**≤ 5 MW** **> 5 MW**	**90%** **90%**	40% 40%	10% 10%	**50%** **50%**
GEOTHERMAL (b.3.)					
	< 50 MW	**90%**	40%	10%	**50%**
HYDROPOWER					
(b.4.)	**≤ 10 MW**	**90%**	40%	10%	**50%**
(b.5.)	**> 10 MW and ≤ 25 MW**	**90%**	40%	10%	**50%**
	> 25 MW and ≤ 50 MW	**80%**	30%	10%	**40%**
BIOMASS					
(b.6.)	**Energy crops (≥ 70%)**	**90%**	40%	10%	**50%**
	Agricultural and forestry wastes (≥ 70%)	**90%**	40%	10%	**50%**
(b.7)	**Sludges/biogas (≥ 70%)**	**90%**	40%	10%	**50%**
(b.8)	**Agricultural and forestry industries (≥ 90%)**	**80%**	30%	10%	**40%**

3.5 – Slovenia region (Slovenia)

The Energy Act adopted by the National Assembly (September 1999) gives a special emphasis to promotion of the use of renewable energy resources and giving priority to utilisation of renewable resources before supplying energy from non-renewable resources. The Energy Act decides, that the efficient use of energy and encouraging the use of RES are constituent parts of

The very important document adopted by the National Assembly in May 2004, is the Resolution on the National Energy Programme (ReNEP). The Resolution on the National Energy Programme (ReNEP) defines the long-term development goals, orientation of energy supply, energy systems and mechanisms for stimulation of the use of RES.

The targets of Slovenian policy defined in the Resolution on the National Energy Programme (ReNEP) are increasing the share of RES in primary energy balance to 12% in 2010:

- increasing heat supply from RES from 22% in 2002 to 25% in 2010,
- increasing electricity from RES from 32% in 2002 to 33,6% in 2010,
- achieving 2% share of biofuels for transport at the end of 2005.

Proposed financial support in the ReNEP for utilization of RES is 16,274 Euros per year, of them:

- 7,303 Euros per year for biomass and
- 2,086 Euros per year for biogas.

The Ministry of Environment, Spatial Planning and Energy prepared in 2001 a proposal for the government “Program of energy use of biomass wood in Slovenia and the operation programme”. In the proposal, they planned investing in district heating systems, individual small boilers for heating and large capacities boilers for heating. They took into consideration installing 50 district heating systems, 100 large boilers and 5000 individual small boilers.

The targets (goals) of the Resolution on the National Energy Program (ReNEP) are to increase the renewable energy sources in the primary energy balance to 4,0 PJ in comparison to the year 2002 of them 3,1 PJ wood biomass and 0,4 PJ biogas. To reach this target it is needed to install 1500 small boilers for households heating, 50 industrial boilers and 3-5 district heating

A major driving force for renewable development may come from the Kyoto process. In expectation of the difficulties that Slovenia will encounter in reducing CO_2 emissions to the Kyoto target, a CO_2 tax has been introduced. The tax is paid by all users of fossil fuels, except transport (where fuel is subject to high excise tax). A scheme of massive exemptions from the CO_2 tax is in place for electricity production, industry and public services.

Financing support of the investment in project for utilisation of RES in energy purposes is one of the main mechanisms, which impact the development of the use of RES. The financial supporting mechanisms in Slovenia are:

- feed-in tariffs,
- soft loans – Eco Fund,
- subsidies as public scheme,
- third party financing (TPF) as private scheme.

Government supports through the Agency for Efficient use and Renewable Sources of Energy –AURE (within the Ministry of Environment and Spatial Planning) the development and the use of renewable energy sources through its public competition program with which it promotes energy efficiency and renewable energy investments and programs for increasing their use.

The national budget for supporting the utilisation of renewable energy sources in Slovenia from 1992 is shown in Figure 2.

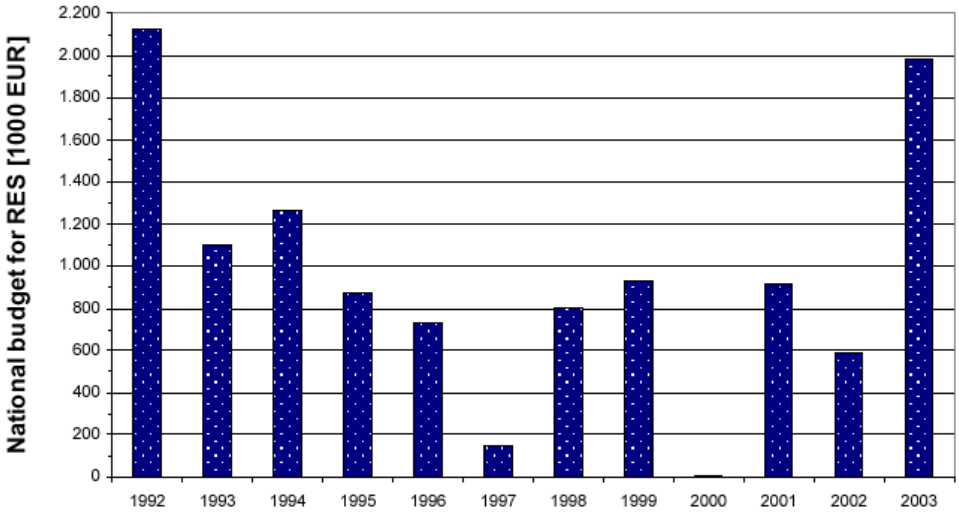

Figure 2 – National Slovenian budget for supporting RES.

The rules about assignment of funds for stimulation of the utilisation of RES, energy efficiency and CHP define the financial support between 40 % and 60 % of the investment in wood biomass heat boilers for district heating systems and / or individual heating system.
The government adopted a Decree about the rules of defining the purchase price for the electricity from the qualified producers (QPs) on 14 March 2002: The decree defines the rules and origin for contractual relation between QPs and the network manager. The second document defines the premium (subsidies) and the purchase price for the electricity from wood biomass and from other RES and CHP.

Feed-in tariffs

The government adopted a decree (on 14 March 2002) on the price and premium for the purchased electricity from the qualified producers (or electricity from RES). The new decree defines a new fixed price and premium (feed-in tariff) for the purchased electricity from qualified producers (QP) of electricity from renewable energy resources (small hydro, biomass, wind, geothermal, solar, waste and all other RES for power plants with capacities up to 10 MW) as shown in Table 3. Uniform prices and uniform premiums do not include VAT.

Table 3 - The current feed-in tariffs in Slovenia

Type of QPP regarding the primary energy source	Capacity/Electricity Power	Uniform price	Uniform premium
		EUR cent/kWh	*EUR cent/kWh*
Small hydro PP	up to 1 MW_e	6,2	2,8
	over 1 MW_e to 10 MW_e	5,9	2,6
Biomass PP	up to 1 MW_e	7,0	3,6
	over 1 MW_e	6,7	3,4
Wind PP	up to 1 MW_e	6,1	2,7
	over 1 MW_e	5,9	2,5
Geothermal PP		5,9	2,5
Solar PP	up to 36 kW_e	37,4	34,1
	over 36 kW_e	6,4	3,1
Others (biogas,..) QPP		12,1	8,7
Combined CHP and RES	up to 1 MW_e	6,7	3,4
CHP use waste as fuel	up to 1 MW_e	5,3	2,0
	over 1 MW_e to 10 MW_e	5,0	1,6
District Heating CHP	up to 1 MW_e	5,8	2,5
	over 1 MW_e to 10 MW_e	5,6	2,2
Industrial CHP	up to 1 MW_e	5,4	0,0

PP – power plant QPP –qualified power plant Exchange rate: 1 Euro is 239,762 SIT (15 December 2004)

The difference between the market price and the feed-in tariff is to be covered by network charges, paid by all electricity consumers. Network operators are obliged to conclude long-term feed-in contracts with QP's.

According to the Energy Act [8], the network operators are obliged to purchase electricity from "qualified producers" at prices, which are fixed by feed-in tariffs. To benefit from the preferential feed-in tariffs, a producer has to obtain the status of a "qualified producer", according to Article 29 of the Energy Act [8].

A producer who generates electricity and thermal energy in an individual production facility with an exceptional/above average efficiency in cogeneration of electricity and thermal energy, or a producer who uses renewable energy resources in a manner which is in accordance with environmental protection standards, may acquire the status of a "qualified producer". The uniform price and premium are valid for qualified producers connected to low or medium voltage network.

The following main stipulations modify the feed-in prices:

- if a power plant is connected to the transmission network, the price or premium is reduced by 5 %,
- for plants in operation for 5 or more years the price or premium is reduced by 5 %,
- for plants in operation for 10 or more years the price or premium is reduced by 10 %,
- if the qualified producer has received a non-refundable subsidy from the state, the price is reduced by 5 % for each 10 % of investment cost, for which the plant has been subsidized.

Subsidies of RES

The government subsidizes through the Agency for efficient use and renewable sources of energy (AURE) the following:

- the feasibility study of the RES power plants,
- RES power plants under 10MWe if they are not connected to the public (electricity) network,
- RES power plants under 10MWe if they use new unavailable advanced technology with
- high investment cost,
- the investment in biomass-fired boilers for individual[1] or small system heating.

Other support

Law of forests[2] manages protection, cultivation, utilisation and use of forests (adopted by the Slovenian Parliament in May 1993). The law includes financial support to the investments in wood production processes (machine) like wood chips and co-financing other activities.
The Ministry of Agriculture, Forestry and Food also decided to subsidise the production of cereals, rapeseed and some other crops. The subsidy for production of rapeseed is defined at 310 €/ha in 2002 and at 280 €/ha in 2003 and 2004.
The government supports the biofuel with the exchange of Excise law to discharge the biofuel of excise and other taxes (in force from May 1, 2004).

[1] The subsidy ranges from 440 EUR for simple log-fired furnaces to 1300 € and 2200 EUR for wood-pellet installations. The scheme has been fully established in the last two years and is favourably accepted.
[2] Law manages protection, cultivation, utilisation and use of forest.

4 - Examples of economic costs in different regions

Next are given some examples of economic costs of bioenergy plants in different regions including other details of the plant: technology details, useful products, biomass consumption, etc.

4.1 - Stuttgart region (Germany)

Name of the facility	
Stuttgart city indoor swimming pool	
Owners of the plant	
City of Stuttgart	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Heat and Domestic Hot Water from biomass for the indoor swimming pool (self production self consumption). Hot water boiler, wit fossil peak load boiler.	
Location (city, region, country)	
Stuttgart, Germany.	
Start of operation (year)	
2005	
Functioning hours per year:	
3800 h/year	
Consumption of biomass (toe/year)	
3570 tons/year; 5100 m3/year; 3060 MWh/year	
Unit price of biomass (Euros per unit):	
0,05 €/kWh biomass	
Comments on the supply of biomass:	
Landscape conservation wood and green biomass (grass, leaves, bark)	
Consumption of fossil fuels	
Type: natural gas X	diesel X other renewables
Consumption:	
722 MWh/year	
Production of heat	
Type of heat: Steam	Pressure Temperature
Hot water X	Temperature 60 - 70ºC
Production (MWh/year)	
3.803 MWh/year	
Unit price for heat (Euros/unit of heat)	

Production of Electricity	
Production (MWh/year)	

Unit price for electricity (Euros/unit of electricity)	

Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	

Investment costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Boiler	740.000
other	100.000
Operational costs (detailed by concept if its possible):	
Concept	Cost (Euros)
operating	2500 €/year.
Ash disposal	1500 €/year
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Maintenance	3000 €/year
Number of employees (detailed by concept if its possible):	
0,1	
Subsidies received or requested	
From:	
Programme:	
Concept:	
Total amount:	

Name of the facility	
CHP-plant Scharnhauser Park, (ORC technology)	
Owners of the plant	
Stadtwerke Esslingen (local public energy supplier)	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Heating, domestic hot water and electricity distribution	
Location (city, region, country)	
Ostfildern, Stuttgart, Germany	
Start of operation (year)	
2004	
Functioning hours per year:	
6750	
Consumption of biomass (toe/year)	
20.000 t/year; 50.000 MWh/year	
Unit price of biomass (Euros per unit):	
8,18 .€/MWh	
Comments on the supply of biomass:	
60% landscape conservation wood, 40% forest wood	
Consumption of fossil fuels	
Type: natural gas X diesel other renewables	
Consumption:	
5.000 – 10.000 MWh/year	
Production of heat	
Type of heat: Steam Pressure Temperature	
Hot water X Temperature 90ºC	
Production (MWh/year)	
38.000	
Unit price for heat (Euros/unit of heat)	

0,023 €/kWh	
Production of Electricity	
Production (MWh/year)	
5.400	
Unit price for electricity (Euros/unit of electricity)	
0,154 €/kWh	
Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs (detailed by concept if its possible):	
Concept	Cost (Euros)
combustion system	2.120.000
ORC-module	1.607.000
construction and infrastructure costs	925.000
side costs	550.000
Operational costs (detailed by concept if its possible):	
Concept	Cost (Euros)
personnel costs	32,400
consumption of electricity	32.450
working medium	3000
technical surveillance	1.300
insurance and administration	10.500
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Maintenance	106.000
Number of employees (detailed by concept if its possible):	
Subsidies received or requested	
From: State of Baden-Württemberg	
Programme: (name of the regional, national or European programme)	
Concept: (for which concept, i.e: per kWh, per kW installed capacity, etc)	
Total amount:	
750.000 Euros	

Name of the facility	
Stuttgart city market garden	
Owners of the plant	
City of Stuttgart	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Heat and Domestic Hot Water from biomass for the market garden (self production self consumption). Hot water boiler, with fossil peak load boiler.	
Location (city, region, country)	
Stuttgart, Germany.	
Start of operation (year)	
2004	
Functioning hours per year:	
3300 h/year	
Consumption of biomass (per year)	
2300 tons/year; 3345 m^3/year; 2007 MWh/year	
Unit price of biomass (Euros per unit):	
0,05 €/kWh biomass	
Comments on the supply of biomass:	
Landscape conservation wood and green biomass (grass, leaves, bark)	
Consumption of fossil fuels	
Type: natural gas X diesel X other renewables	
Consumption:	
880 MWh/year	
Production of heat	
Type of heat: Steam Pressure Temperature	
Hot water X Temperature 60 - 70ºC	
Production (MWh/year)	
2.585 MWh/year	
Unit price for heat (Euros/unit of heat)	

Production of Electricity	
Production (MWh/year)	

Unit price for electricity (Euros/unit of electricity)	

Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	

Investment costs (detailed by concept if it is possible):	
Concept	Cost (Euros)
Biomass boiler	598,489
Pipes and gas boilers	163,631
Operational costs (detailed by concept if it is possible):	
Concept	Cost (Euros)
operating	2500 €/year.
Ash disposal	800 €/year
Maintenance costs (detailed by concept if it is possible):	
Concept	Cost (Euros)
Maintenance	3000 €/year
Number of employees (detailed by concept if it is possible):	
0,1	
Subsidies received or requested	
From:	
State of Baden-Wuerttemberg, Ministery of Alimentation (MLR)	
Programme:	
Energy-wood Baden-Württemberg	
Concept:	
Total amount:	
Euros 64.800	

Name of the facility	
Stuttgart city school center	
Owners of the plant	
City of Stuttgart	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Heat and Domestic Hot Water from biomass for the school center (self production self consumption). Hot water boiler, wit fossil peak load boiler.	
Location (city, region, country)	
Stuttgart, Germany.	
Start of operation (year)	
2004	
Functioning hours per year:	
3300 h/year	
Consumption of biomass (per year)	
2240 tons/year; 3200 m^3/year; 1920 MWh/year	
Unit price of biomass (Euros per unit):	
0,05 €/kWh biomass	
Comments on the supply of biomass:	
Landscape conservation wood and green biomass (grass, leaves, bark)	
Consumption of fossil fuels	
Type: natural gas X diesel other renewables	
Consumption:	
350 MWh/year	
Production of heat	
Type of heat: Steam Pressure Temperature	
Hot water X Temperature 60 - 70ºC	
Production (MWh/year)	
2.357 MWh/year	
Unit price for heat (Euros/unit of heat)	

Production of Electricity	
Production (MWh/year)	

Unit price for electricity (Euros/unit of electricity)	

Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	

Investment costs	
Concept	Cost (Euros)
boiler	595.000
other	430.000
Operational costs	
Concept	Cost (Euros)
operating	2500 €/year.
Ash disposal	1000 €/year
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Maintenance	3000 €/year
Number of employees (detailed by concept if its possible):	
0,1	
Subsidies received or requested	
From:	
Programme:	
Concept:	
Total amount:	

4.2 - Upper Austria region (Austria)

Name of the facility	
Biogas plant Landfrisch Molkerei Wels reg.Gen.m.b.H.	
Owners of the plant	
Landfrisch Molkerei reg.Gen.m.b.H. Schubertstr. 30 A-4600 Wels	
BIOENERGY TECHNOLOGY	
	Biomass
	Energy crops
X	Biogas
	Biofuels
Comments on the technology	
The 500 kW_e electric and 565 kW_{th} biogas plant of the creamery Landfrisch Molkerei Wels uses whey and sewage water from the production process of the creamery. The produced electricity is feed into the grid and the produced heat is used for the hot water supply in the production process.	
Location (city, region, country)	
City Wels, Upper Austria, Austria	
Start of operation (year)	
January 2006	
Functioning hours per year:	
8.500 hours per year	
Consumption of biomass (per year)	
Ca. 129,600 m^3 whey and sewage water per year ~ 10,000 tons per year	
Unit price of biomass (Euros per unit):	

Comments on the supply of biomass:	
In the production process of the creamery Landfrisch Molkerei Wels whey and sewage water accrue which will be used for the biogas plant.	
Consumption of fossil fuels	
No fossil fuels used	
Production of heat	
Type of heat:	
Hot water, temperature 90 ℃	

Production of Electricity	
Production (MWh/year)	
Ca. 4,037,500 kWh per year	
Unit price for electricity	
Ca. 14 Cent/kWh	
Production of Cooling	
No cooling	
Investment costs:	
Concept	Cost (Euros)
Total investment costs	Ca. 1.9 Mio. Euro
Operational costs:	
Concept	Cost (Euros)
Staff, maintenance, insurances, overhead costs, etc.	Ca. 400,000 Euro/year
Maintenance costs:	
Concept	Cost (Euros)
Included into operational cost/see above	
Number of employees:	
1 person for operation and maintenance	
Subsidies received or requested	
From: (name of the public body)	
Regional Government of Upper Austria	
Programme: (name of the regional, national or European programme by which the incentive is received)	
1) ÖKOP – Ökostrom Programm (green electricity programme of the regional government of Upper Austria) 2) Guaranteed feed-in tariffs of the Austrian compensation for electricity fed into the grid from 1 January 2003	
Concept: (for which concept, i.e: per kwh, per kW installed capacity, etc)	
1) Investment assistance based on the investment costs, up to 25 % of the total project costs 2) Guaranteed feed-in tariffs in Cent per kWh depending on the installed capacity in kW	
Total amount:	
100,000 Euro	

Name of the facility	
Biomass heating plant "Bäuerliche Bioenergie Fröling Grieskirchen GmbH & Co.KG"	
Owners of the plant	
BÄUERLICHE BIOENERGIE FRÖLING GRIESKIRCHEN GMBH & CO KG Johann Wildfellner (Managing Director) Parz 26 A-4710 Grieskirchen, AUSTRIA	
BIOENERGY TECHNOLOGY	
X	Biomass (wood chips)
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
In Grieskirchen, a municipality in Upper Austria with about 5,000 inhabitants, several companies are situated and in the next years a big school centre and a new residential quarter are planned, which are all potential end users. Therefore, the company Fröling GmbH decided to build a biomass heating plant and to cooperate with the farmers in the surrounding for the delivery of wood chips. The plant has a 3 MW URBAS boiler and– if necessary – additional boilers can be added. Also, a 500 kW Fröling boiler was installed. The wood chips are stored in a storage depot with a capacity of about 6,000 – 7,000 m³ and with an automatic in-door crane that forwards the wood chips to the boilers. At the moment, 3,000 meters of pipelines are installed. It is expected that in the year 2007 the installed length of pipelines will be 4,000 meters.	
Location (city, region, country)	
District capital city Grieskirchen, Upper Austria, Austria	
Start of operation (year)	
2004	
Functioning hours per year:	
3 MW boiler: ca. 5,000 hours per year; 500 kW boiler: ca. 3,500 hours per year	
Consumption of biomass (toe/year)	
Ca. 2,700 tons/year	
Unit price of biomass (Euros per unit):	
Depends on the humidity of the wood chips, prices are between ca. 8 and 15 Euro per m³	
Comments on the supply of biomass:	
The biomass heating plant uses wood chips for heating. They are produced by 26 farmers in the surrounding of the plant. The farmers produce the wood chips from trees of own forests and deliver them by tractors and tipping trailers directly to the storage depot of the plant.	

Consumption of fossil fuels	
No fossil fuels used	
Production of heat	
Type of heat: Hot water; temperature 95 ℃	
Production	
9,000 MWh/year	
Unit price for heat (Euros/unit of heat)	
Ca. 45 Euro/MWh – 60 Euro/MWh	
Production of Electricity	
No electricity produced	
Production of Cooling	
No cooling	
Investment costs	
Concept	Cost (Euros)
Total investment costs	2.7 Mio. Euro
Operational costs	
Concept	Cost (Euros)
Electricity, water, insurances, ash disposal	ca. 22,000 Euro
Maintenance costs	
Concept	Cost (Euros)
Boiler, strainer, chimney	ca. 2,500 Euro
Number of employees	
8 employees/together ca. max. 700 hours per year 1 managing director/fixed salary, 1 maintenance worker/1-2 hours per week, 5 persons cleaning staff/2-3 times per year for one day, 1 accountant/ca. 5 hours per month	
Subsidies received or requested	
Total amount: ca. 2.1 Mio. Euro	

Name of the facility	
Pellets boiler of a family home in Linz	
Owners of the plant	
Family Haberkorn, 4020 Linz	
BIOENERGY TECHNOLOGY	
X	Biomass (Pellets)
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
10 kW Ökofen pellet boiler for heating the house and hot water supply; also combined with a solar plant (8 m²) and a storage water boiler (1,000 liter)	
Location (city, region, country)	
Capital city Linz, Upper Austria, Austria	
Start of operation (year)	
2004	
Functioning hours per year:	
Ca. 4,000 hours per year	
Consumption of biomass (toe/year)	
Ca. 3 toe/year	
Unit price of biomass (Euros per unit):	
Ca. 150 - 160 Euro/ton	
Comments on the supply of biomass:	
The pellets are delivered by a lorry from the local pellets supplier.	
Consumption of fossil fuels	
No fossil fuels used	
Production of heat	
Type of heat:	
Hot water, temperature: min. 60 ℃; room heat, temp erature ca. 20 ℃	
Production of Electricity	
No electricity produced	
Production of Cooling	

No cooling	
Investment costs	
Concept	Cost (Euros)
Total investment costs	ca. 10,000 Euro
Operational costs	
Concept	Cost (Euros)
Electricity	ca. 50 Euro/year
Maintenance costs	
Concept	Cost (Euros)
Chimney	ca. 60 Euro/year
Number of employees	
No employees	
Subsidies received or requested	
From: (name of the public body)	
Regional Government of Upper Austria	
Programme: (name of the regional, national or European programme by which the incentive is received)	
Financial support for biomass boilers in one family homes from the regional government of Upper Austria	
Concept: (for which concept, i.e: per kwh, per kW installed capacity, etc)	
30 % of the net investment costs, max. 2,200 Euro per plant, no repayment	
Total amount:	
2,200 Euro	

4.3 - Rhône-Alpes region (France)

Name of the facility	
Vénissieux	
Owners of the plant	
City of Venissieux	
BIOENERGY TECHNOLOGY	
×	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Four boilers for High viscocity fuels, fat and heavy oil, a cogeneration and two wood boilers.	
Location (city, region, country)	
Vénissieux, France	
Start of operation (year)	
2004	
Functioning hours per year:	
n.a.	
Consumption of biomass (per year)	
34 000 tons per year for a capacity of 12 MW, i.e. 13% of the total capacity of the district heating system. It provides service to 9.800 dwellings, schools, public buildings and a clinic.	
Unit price of biomass (Euros per unit):	
21,78	
Comments on the supply of biomass:	
wood chips, sawdust, bark, chippings, pieces	
Consumption of fossil fuels	
Type: natural gas	
Consumption:	
Production of heat	
Type of heat: Steam Pressure Temperature	
× Hot water Temperature 180℃/ 18 bars	
Production (toe/year):	
Unit price for heat (Euros/unit of heat):	

Production of Electricity	
Production (MWh/year)	
Unit price for electricity (Euros/unit of electricity)	
Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs	
Concept	Cost (Euros)
Global investment cost	7.109.219 € (tax included)
Operational costs	
Concept	Cost (Euros)
...	...
Maintenance costs	
Concept	Cost (Euros)
Number of employees (detailed by concept if its possible):	
1,5	
Subsidies received or requested	
From: (name of the public body)	
Region Rhône-Alpes: 10%	
Programme:	
Concept:	
Total amount:	
From: (name of the public body)	
ADEME	
Programme: FEDER 20%	
Concept:	
Total amount:	

Name of the facility	
Brignais	
Owners of the plant	
OPAC Rhône (social housing manager)	
BIOENERGY TECHNOLOGY	
×	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
The wood boiler has a capacity of 1200 kW and operates on pallets waste. The back-up energy comes from 2 natural gas boilers, with a capacity of 1540 kW for the first one and of 1740 kW for the standby one. The silo has a capacity of 200 m³. It is filled up on a regular basis by 2.5 trailer trucks of 90 m^3 per week in the core of the heating period.	
Location (city, region, country)	
Brignais, France	
Start of operation (year)	
2003	
Functioning hours per year:	
n. a.	
Consumption of biomass	
220 m^3/week	
Unit price of biomass (Euros per unit):	
n. a.	
Comments on the supply of biomass:	
Wood chips	
Consumption of fossil fuels	
Type: natural gas	
Consumption: The back-up energy comes from 2 natural gas boilers, with a capacity of 1540 kW for the first one and of 1740 kW for the standby one.	
Production of heat	
Type of heat: × Steam Pressure Temperature	
× Hot water Temperature 90℃	
Production: 4025 MWh / year	
Unit price for heat (Euros/unit of heat)	

Production of Electricity		
Production (MWh/year)		
Unit price for electricity (Euros/unit of electricity)		
Production of Cooling		
Type of cooling:	absorption	adsorption
Production of cooling (MWh/year):		
Unit price for cooling (Euros/unit of cooling):		
Investment costs (detailed by concept if its possible):		
Concept	Cost (Euros)	
Global investment cost	1.906.880 € (tax included)	
Operational costs (detailed by concept if its possible):		
Concept	Cost (Euros)	
...	...	
Maintenance costs (detailed by concept if its possible):		
Concept	Cost (Euros)	
Number of employees (detailed by concept if its possible):		
1		
Subsidies received or requested		
From: The French State		
Programme: Programme PALULOS		
Concept: Prime à l'amélioration des logements à utilisation locative et à occupation sociale		
Total amount: 253 224 €		
From: Region		
Programme:		
Concept:		
Total amount: 300 063 €		
From: ADEME		
Programme:		
Concept:		
Total amount: 220 641 €		

Name of the facility	
Hauteville-Lompnès	
Owners of the plant	
City of Hauteville	
BIOENERGY TECHNOLOGY	
×	Biomass
Comments on the technology	
Heating system fuelled with a 3,4 MW wood boiler and a gas cogeneration	
Location (city, region, country)	
Hauteville (France), Small city (4.000 inhabitants), 850 m altitude	
Start of operation (year)	
2000	
Functioning hours per year:	
The wood boiler operates all year long. From April to October, it meets 100% of heating and sanitary hot water needs. From November to March, the natural gas cogeneration operates as back-up energy to wood boiler.	
Consumption of biomass (per year)	
5.000 to 6.000 tonnes / year (about 5.800 tonnes) that is to say 9.000 MWh	
Unit price of biomass (Euros per unit):	
Comments on the supply of biomass:	
The wood boiler burns barks coming from local sawmills and wood chips coming from cut crushing or pruning for forestry keeping purposes.	
Consumption of fossil fuels	
Type: natural gas	
Consumption: 15.000 MWh	
Production of heat	
Type of heat: Hot water, temperature: 100℃	
Production: 7.500 MWh of heat	
Unit price for heat (Euros/unit of heat):	
Production of Electricity	
Production (MWh/year): 4.500 MWhe	
Unit price for electricity (Euros/unit of electricity):	
Production of Cooling	
Type of cooling: No cooling	
Investment costs:	

Global investment cost	3.811.300 € (tax included)
Heating system + sub-stations	1.753.200 €
Wood energy plant	987.900 €
Cogeneration	841.500 €
Proj. management + provisions + miscellaneous	228.700 €
Operational costs:	
	...
Maintenance costs:	
Number of employees:	
Subsidies received or requested	
From: Région Rhône-Alpes	
Programme:	
Concept:	
Total amount: 800.373€	
From: European Union	
Programme: FEOGA	
Concept:	
Total amount: 382.000€	
From: ADEME	
Programme: Wood energy plan	
Concept: National programme designed to promote wood use in automated boiler plant and to structure local fuel production.	
Total amount: 760.000 €	
From: General council	
Programme:	
Concept:	
Total amount: 115.000 €	
From: Energy municipal corporation - Régie Municipale des Energies de Hauteville-Lompnès	
Programme:	
Concept:	
Total amount: 1.750.000€	
Comments: The Energy municipal will make a loan to finance the balance of the investment, this means € 1,75 millions on 15 years at a 4,5% rate, equivalent to an annuity of € 0,15 millions.	

Name of the facility	
Bourg-en-Bresse	
Owners of the plant	
ASSURC- Association of Users of the Bourg-en-Bresse district heating system in the Ain region	
BIOENERGY TECHNOLOGY	
×	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
The wood boiler allows to heat more than 3000 dwellings and premises of every type thanks to a heating system: dwellings, offices, businesses, old people homes, social centres, sport installations… Installed in the old coal boiler building, the 4 MW capacity wood boiler allows to heat 230 000 m² with a yearly consumption of 8.000 tonnes of raw wood with about 2,5 millions litres of fuel per year saved.	
Location (city, region, country)	
Bourg-en-Bresse (France)	
Start of operation (year)	
1999 (finished end of 2005)	
Functioning hours per year:	
24h/24h - 8 months per year	
Consumption of biomass:	
8.000 tonnes per year At full capacity, the boiler consumes 100 m^3 of wood each day, which represents a 4-day autonomy taking into account the storage capacity.	
Unit price of biomass (Euros per unit):	
The MWh price in 2003 was around € 60 tax included. It consists of a 73% in heavy oil and natural gas and of a 27% through recovery on a cogeneration system. Further to the wood boiler installation, the energy total cost is 46 €/MWh, i.e. a 23% reduction in the energy global price.	
Comments on the supply of biomass:	
The wood energy is supplied from sawmill residues and non spoiled fuel wood (pallets, casings).	
Consumption of fossil fuels	
Type:	natural gas and fuel
Consumption:	
The wood boiler operates with two central boilers using several fuels: natural gas cogeneration, wood, natural gas and fuel oil.	

Production of heat	
Type of heat: Hot water, temperature 90℃	
Production: A 19.000 MWh capacity	
Unit price for heat (Euros/unit of heat)	
Production of Electricity	
Production (MWh/year):	
Unit price for electricity (Euros/unit of electricity):	
Production of Cooling	
Type of cooling: No cooling	
Investment costs (detailed by concept if its possible):	
Global investment cost	2.964.000 € (tax included)
Wood heating plant construction	2.200.000 €
System extension	500.000 €
Project management	220.000 €
Miscellaneous	44.000 €
Operational costs (detailed by concept if its possible):	
	...
Maintenance costs (detailed by concept if its possible):	
Number of employees: 1,5	
Subsidies received or requested	
From: Region Rhône-Alpes	
Programme:	
Concept: (for which concept, i.e: per kwh, per kW installed capacity, etc)	
Total amount: 432.000 €	
From: ADEME	
Programme:	
Concept:	
Total amount: 432.000 €	
From: Credit bail Leasing	
Programme:	
Concept:	
Total amount: 1.800.000 €	

Name of the facility	
Tullins	
Owners of the plant	
OPAC Isère (social housing public corporation/manager)	
BIOENERGY TECHNOLOGY	
×	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
The set up wood boiler has a 500 kW capacity, with a push scraper system and allows to fuel 100 social housings.	
Location (city, region, country)	
Tullins (France), (about 7.000 inhabitants)	
Start of operation (year)	
1999	
Functioning hours per year:	
Functioning 8 months per year	
Consumption of biomass	
About 220 m^3 per week	
Unit price of biomass (Euros per unit):	
12.55 €/ unit	
Comments on the supply of biomass:	
Wood chips	
Consumption of fossil fuels	
Type: natural gas (boiler with a capacity of 900 kW)	
Consumption:	
Production of heat	
Type of heat: Hot water	
Production (per year): 4.000 MWh	
Unit price for heat (Euros/unit of heat)	
Production of Electricity	
Production (MWh/year)	
Unit price for electricity (Euros/unit of electricity)	

Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Global investment	1.532.063 € (tax included)
Operational costs (detailed by concept if it's possible):	
Concept	Cost (Euros)
...	...
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Number of employees (detailed by concept if it's possible):	
1	
Subsidies received or requested: (31,34%)	
From: ADEME	
Programme: Wood energy plan	
Concept:	
Total amount: 343.019 €	
From: The French State	
Programme: PALULOS	
Concept: Premium for renovating dwellings for rent use and social occupancy i.e. designed for social housing	
Total amount: 137.403 €	

4.4 - Catalonian region (Spain)

Name of the facility	
Energia Natural de Mora, S. L.	
Owners of the plant	
PERE ESCRIBÀ, SA	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Biomass gasification plant of 750 kWe (3 x 250 kWe) using almond shells. It uses a cylindrical fluidised bed gasification reactor working at atmospheric pressure. Electrical efficiency: 30%.	
Location (city, region, country)	
Mora la Nova, Catalonia, Spain	
Start of operation (year)	
1997	
Functioning hours per year:	
16 hour/day and 5 days/week	
Consumption of biomass (per year)	
2.500 tons/year (1 kg of almond shell is equivalent to around 1 kWh of electricity)	
Unit price of biomass (Euros per unit):	
Comments on the supply of biomass:	
Almond Shells, waste residue from local companies	
Consumption of fossil fuels	
Type: Diesel	
Consumption:	
5-8% of the fuel supplied to the engines, 74.000 l/year	
Production of heat	
Type of heat: Hot water	
Capacity: 3500 kW	
Unit price for heat (Euros/unit of heat)	

Production of Electricity	
Production (MWh/year): 2500 MWh/year	
Unit price for electricity (Euros/unit of electricity)	
Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs (detailed by concept if its possible):	
Concept	Cost (Euros)
...	...
...	...
Operational costs (detailed by concept if its possible):	
Concept	Cost (Euros)
...	...
...	...
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Number of employees (detailed by concept if its possible):	
The facility doesn't require staff exclusively devoted to it. Daily ignition and stop operations, for instance are fully automatic.	
Subsidies received or requested	
From: ICAEN (regional energy agency)	
Programme: (name of the regional, national or European programme by which the incentive is received)	
Concept: (for which concept, i.e: per kwh, per kW installed capacity, etc)	
Total amount:	

Name of the facility	
Tractaments de Juneda, S.A. (TRACJUSA)	
Owners of the plant	
Sener, SGT Corporació Age, Energy E-2, ADS, Gas Natural and ICAEN	
BIOENERGY TECHNOLOGY	
	Biomass
	Energy crops
X	Biogas
	Biofuels
Comments on the technology	
A pig slurry waste-to-energy plant to produce biogas consumed in a cogeneration plant of 16,3 MWe based on reciprocating engines (6 engines of 2724 kW each one). The treatment capacity is 110000 ton/y of pig manure.	
Location (city, region, country)	
Juneda (Les Garrigues), Catalonia. Spain.	
Start of operation (year)	
2001	
Functioning hours per year:	
8.000 hours/year (24 h/day, 330 days/year)	
Consumption of biomass	
110.000 tons/year, 330 m^3/day of pig slurry	
Unit price of biomass (Euros per unit):	
Comments on the supply of biomass:	
Pig slurry supplied by surrounding pig farms	
Consumption of fossil fuels	
Type: Natural gas	
Consumption: 38148 kW per year	
Production of heat	
Type of heat: Steam and Hot water	
Production (toe/year)	
Unit price for heat (Euros/unit of heat)	

Production of Electricity	
Production (MWh/year): 119.900 MWh/y (self consumption of 677,5 kWe)	
Unit price for electricity (Euros/unit of electricity)	
Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Total Investment (20% given by the owners the rest by Project Finance)	17,25 million
	...
Operational costs (detailed by concept if its possible):	
Concept	Cost (Euros)
...	...
...	...
Maintenance costs (detailed by concept if its possible):	
Concept	Cost (Euros)
Number of employees (detailed by concept if its possible):	
Subsidies received or requested	
From:	
Credit from Institut Catalá de Finances with the involvement of Caixa Catalunya, La Caixa and Caja Castilla La Mancha	
Programme: (name of the regional, national or European programme by which the incentive is received)	
Concept: (for which concept, i.e: per kwh, per kW installed capacity, etc)	
Total amount:	
14 million Euros	

Name of the facility	
Molins Energia, S. L.	
Owners of the plant	
Grup CASSA (Companyia d'Aigües de Sabadell, S. A.) and Hidrowatt, S.A. (55%), Municipality of Molins de Rei (15%), Entitat metropolitana de Medi Ambient (15%) and ICAEN (15%). The company SERVEDAR, S.L. belonging to the grup CASSA, operates the plant.	
BIOENERGY TECHNOLOGY	
x	Biomass
	Energy crops
	Biogas
	Biofuels
Comments on the technology	
Biomass combustion plant to produce hot water for a heating and domestic hot water distribution network. The network delivers hot water to 695 houses (2000 inhabitants). Network length (supply and return): 4734 m. Biomass boiler: 2250 kW. Back-up natural gas boiler: 1634 kW	
Location (city, region, country)	
Molins de Rei, (Barcelona, Spain)	
Start of operation (year)	
2001	
Functioning hours per year:	
The hot water and heating service is continuous 24 hours a day. Although the power plant itself works about 12 to 16 hours per day, the hot water storage guarantees a steady supply of water all the time. During the night the plant shuts down and the heat storage system supplies the required heat.	
Consumption of biomass (toe/year)	
2200 tons/year, (540 kg/h maximum per boiler)	
Unit price of biomass (Euros per unit):	
Comments on the supply of biomass:	
Pine fruits, fruit shells and wood waste	
Consumption of fossil fuels	
Type: natural gas	
Consumption:	
Production of heat	
Type of heat: Hot water, temperature 90ºC	

Production: 6.800 MWh/year	
Unit price for heat (Euros/unit of heat)	
Production of Electricity	
Production (MWh/year)	
Unit price for electricity (Euros/unit of electricity)	
Production of Cooling	
Type of cooling: absorption adsorption	
Production of cooling (MWh/year)	
Unit price for cooling (Euros/unit of cooling)	
Investment costs	
Concept	Cost (Euros)
Total investment (Central plant + network)	1.622.733
Operational costs	
Concept	Cost (Euros)
...	...
Maintenance costs	
Concept	Cost (Euros)
Number of employees:	
Subsidies received or requested	
From: European Union, and Spanish and Catalan government	
Programme: Thermie Programme and other local programs	
Concept:	
Total amount: 456.769 Euros	

5 - Suggestions to overcome economic barriers

In this section it will be given some suggestions to overcome economic barriers based on the basis of the previous findings and the different information sources consulted for this project.

The required economic and financing measures to promote bioenergy projects can be categorise as follows:

- Subsidies to the investment
- Subsidies to the interest rate for credits
- Adequate incentive to the price for the production of electricity from biomass
- Tax incentives
- Tax exemptions
- Subsidies to energy crops
- Direct subsidy to the biofuel price

The cost of biomass conversion technologies varies according to a range of factors including the types of biomass and conversion process and the scale of operation. The competitiveness of bioenergy will also depend on the availability of alternative energy options, relative costs and prices, and regulatory frameworks. It is expected that as the policy environment around the Kyoto protocol develops, the trade in “carbon credits” will impact positively on the economics of bioenergy projects. By pricing the greenhouse gas emissions, especially CO_2, environmental benefits become part of business planning on the revenue side.

Only a small part of biomass plants are used for CHP. Electricity production increases the plant utilisation rate in comparison to the “heat only” option improving in this way the plant economics.

EU Directives with clear targets like those for renewable electricity and biofuels, provide a useful framework and incentive for governmental action, as they keep coming up as a reference to the public in the appraisal of progress in most member States. Extending this approach to renewable heat could be a good point.

Small capacity Biomass CHP systems (< 2 MW) are characterised by relatively low electric efficiency so only heat controlled operation is economically meaningful. Maybe with the unique exception of the processes involving gasification of biomass.

The specific capital costs per unit of capacity increase with decreasing plant capacity (“economy of scale”). Subsidies should differentiate between the different biomass plant sizes that face different types of problems.

The biomass CHP plants are usually design for base load coverage in district heating systems. These plants only seem to be reasonable if acceptable feed-in rates are secured

for long terms guaranteed over a time period of at least 10 years. The different countries seem to move in that direction.

For urban areas it seems that the best option are biomass pellets. This is the biomass fuel that seems to be less problematic from the point of view of space available and logistics.

For urban areas it will be important to make the public aware about the benefits of using biomass that surpass the problems that can cause a wood combustion facility close to home. This will have beneficial economic implications.

Specific solutions for some regions can be also concluded. For example for the region of Rhône-Alpes (France):

Biogas:

- Increase the buyback price of electricity generated from biogas. There is a clear political will for this at national level, and the relevant authority is to set the new rates in the medium term.

Wood energy:

- Confirm the reduction of VAT on the purchase of wood and charges to heating networks.
- Develop the market to produce more competition between equipment suppliers.
- Anticipate ex-urbanisation by creating zones for the installation of collective facilities for energy production. Greater involvement in energy issues by the authorities responsible for urban development.
- Develop heating networks or retain existing wood-fired networks in order in certain cases to establish the boiler plant in a less densely populated area. But heating networks at what cost?

In the Catalonian region it has been observed that the successful projects have required the involvement of all the implicated agents in the project:

- Biomass supplier
- Plant technology provider
- Plant operator
- Regional / national government
- among others ...

and also it has required the implication of different kinds of economic resources (public, at al levels even European and of course, private investment).
Another important point should be the promotion of waste wood from the forestry management that so far is underused for energy production.

Bibliography

BIOHEAT, Promoting Biomass Heating in Large Buildings and Blocks, Final report, January 2003.

Bas, F., Conexión a red y financiación de proyectos de energías renovables, Sesión OPET renovables, Sevilla, 2004.

California Energy Commission, Economic and financial aspects of landfill gas to energy project development in California, Consultant report, April, 2002.

Decree on the Rules for Setting prices and for purchasing electricity from qualified electricity producers: Official Journal of the Republic of Slovenia, No. 25/2002

Energy Act: Official Journal of the Republic of Slovenia, No. 79/1999 and No. 51/2004

Excise law: Official Journal of the Republic of Slovenia, No. 84/1998 and 42/2004

Government Decision on prices and premiums for purchasing electricity from qualified electricity producers: Official Journal of the Republic of Slovenia, No. 8/2004

Hernández, C., Renewable Energies in Spain, IDAE, Amsterdam Sustainable Energy Forum, October, 2005.

Ministry of Environment and Spatial Planning: Programme of energy use of wood biomass in Slovenia and the operation programme for the period 2001-2004 (proposal), Ljubljana, May 2001

Obernberger, I., State-of-the-art and future developments regarding small-scale biomass CHP systems with a special focus on ORC and Stirling engine technologies. Bios Bioenergiesysteme GmbH, Austria.

Pérez Arriaga, J. I., Libro blanco sobre la reforma del marco regulatorio de la generación eléctrica en España, 2005.

Pravilnik o dodeljevanju sredstev za spodbujanje u è inkovite rabe energije in izrabe obnovljivih virov energije: Official Journal of the Republic of Slovenia, No. 49/2003

SenterNovem, REACT Project, Renewable Energy Action, Altener 2002-157.

The resolution on the National Energy Programme (ReNEP): Official Journal of the Republic of Slovenia, No. 57/2004