BIO-HEAT – Promotion of Short Rotation Coppice for District Heating Systems in Eastern Europe

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Deliverable 2.2 – SRCs as a source of energy: successful stories and best practices

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Project Coordinator: BIOAZUL S.L.
Project Manager: Ms. Pilar Zapata Aranda
E-mail: pzapata@bioazul.com
Tel: +34 951 047 290
Fax: +34 951 047 353

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1 INTRODUCTION

Alternative sources of energy with potential enough for substituting fossil fuels are urgently required. Amongst all existent Renewable Energy Sources (RES), bioenergy is considered as the most promising source of sustainable and secure energy in Europe. Its availability is not a problem as in the fossil fuels case, and it is flexible enough to be applied to a wide range of services, being heating and cooling some of its most important applications.

In Eastern European countries is a high energy demand for heating. The use of biomass as a combustible source of heat instead of fossil fuels would mean an important reduction in greenhouse emissions of these countries. This could significantly contribute to fulfilling the EU targets. However, biomass-based RES are not currently being used as much as it would be desirable.

The most common type of biomass, used by human is wood. The increased use of biomass from energy crops requires the creation of the entire system, including production, distribution and utilization of biomass. Thus, efforts should be focused not only on the plantations, but also to organize a system for storage and distribution of fuel and ensuring efficient use of biomass. Biomass from SRCs can be used to produce electricity or heat, as well as the manufacture of liquid and gas fuel. However we should remember that only the parallel development of all elements of the system based on biomass can ensure success.
### 1.1 Outputs of deliverable 2.2

The purpose of this report is to confirm that the use of biomass from SRC as a renewable source of energy for heating systems has been successfully verified in some European countries. Unfortunately, it is not as consolidated as desired in Eastern Europe. The reasons are multiple and complex, involving usually a combination of social, institutional and technical factors, so the report could be reviewed as well as socio-economic impact of SRCs on the agricultural sector and their future influence on the district heating sector.

In order to compare the development, the review was conducted on one side in western European countries as Austria, Denmark, Germany and Spain and on the other side in eastern European countries such as Poland, Czech Republic, Slovakia, Lithuania and Romania. Own experience, available information and publications were used in preparing the report and analysis on best practices and success stories of the use SRC biomass as a renewable source of energy for district heating sector in these countries.

It is important to highlight that it was not possible to find success stories in which SRCs are feeding DH systems in all countries. The main reason is that, in many occasions, it is very difficult to find out if the biomass feeding the systems proceeds specifically from SRCs. That is why after discussing about this issue with the project officer, it was decided to report two types of success stories:
- Success stories covering the whole chain to which the project refers, that is, DH systems fed specifically by SRCs.

- Partial stories for those countries in which it was not possible to find the whole chains mentioned above. These partial stories are referred to those DH systems fed by biomass in which it is known that this biomass does not come from SRCs and/or the origin of the biomass sources is not clear/specified. These stories could be considered as pre-competitive success stories, as they would suppose a preliminary step in order to achieve the objectives proposed by the project. If the systems are already conditioned to burn biomass in an equivalent form of such coming from SRC instead of other kinds of fuels, the technology will be proven and so the substitution of this biomass with SRCs could be easily achieved and would mean a significant step towards the achievement of the project aims.

There are specifically two partial stories that do not follow the premises previously described. These stories have been registered in Romania, and they are concretely the stories called “Energy. For today and tomorrow – Rebina Group” and “SC AMBASADOR Plus SRL– the real promoter of efficient biomass boilers”. The first one deals with a biomass production company which is going to be the first one in Romania producing SRCs, while the second one refers to the most important Romanian company commercialising biomass boilers and other related equipments. Thus, they were really significant for us and therefore we considered that these two examples should be also mentioned in this report, as they also represent part of the whole chain of SRCs to DH.

This report is organised per countries. In each case, a short social-economic assessment has been carried out, being focused on the regional agricultural sector in the country, the employment and other institutional aspects. Afterwards, each country has reported several success stories framed within one of the scenarios previously described. Nevertheless, it would be important to classify them according to the categories mentioned. Thus, the success stories presented in this report are the following:

1. Whole chain stories
   - SRC in Feldbach, Austria
   - Heating supply in Ihlowerfehn, Germany
   - Biomass power plant in Brunsbüttel, Germany
   - Bioenergie Hof Böhme, Germany
   - The Saxony City Colditz, Germany
   - DH Plant in Bystřice nad Pernštejnem, Czech Republic
   - The modernization of the heating system in DH plant in Plonsk, Poland
   - The agreement between CHP and the farmer to supply biomass - the best practice to use biomass for heat production in DH plant Zeran (PGNiG TERMiKA), Poland
   - One of the most powerful heating plant - Zvolen CHP Inc. with co-firing brown coal and wood chips in Eastern and Central Europe launched in Zvolen, Slovakia
   - District heating plant fired wood chips from SRC plantation as the demonstration of an alternative fuel and heat supply system, Slovakia
   - Woody biomass based heating plant as the demonstration of an alternative energy supply system at University in Zvolen, Slovakia
2. **Partial stories**

- Biomass Power Plant in Güssing, Austria
- Biomass Power Plant in Mödling, Austria
- Amv1 CHP plant in Amager, Denmark
- Avv2 Power plant in Avedoreverket, Denmark
- DH plant in Cuéllar (Segovia), Spain
- DH applications – heating and Sanitary Hot Water (SHW) from biomass in three buildings of Concello de Riós (Ourense), Spain
- Ciudad del Medio Ambiente (Environment City), Garray, Soria (under construction), Spain
- Biggest heating plant in the Czech Republic using biomass, DH in Plzeň, Czech Republic
- Holzindustrie Schweighofer - Romanian cogeneration power plant in Radauti, Romania
- Sawdust heating plant – Gheorgheni, Romania
- “Energy. For today and tomorrow” – Rebina Group, Romania
- SC AMBASADOR Plus SRL– the real promoter of efficient biomass boilers, Romania
- The company Eneco Ltd. engaged in the cultivation, harvesting and selling willow to DH plant, Poland
- Modernization of district heating system based on biomass in Borne Sulinowo, Poland
- New co-fired CHP plant commissioned in Czestochowa, Poland
- One of the most powerful biofuel boiler in Eastern and Central Europe launched in Vilnius, Lithuania
- New biofuel boiler house in Radviliškis, Lithuania
- Double celebration at Tauragės district heating company, Lithuania

**Outputs of this work package:**

- Analysis of the state-of-the-art regarding district heating technologies and the renewable energy systems and fuel sources currently used for their supply.
- Assessment of the biomass sources currently available and needed for district heating in the targeted Eastern European countries.
- Revision of the current national and regional legal and institutional frame.
- Detection of the main institutional, economic, technical and social barriers and limitations for the implementation and/or extensive use of SRCs as a source of biomass for cogeneration district heating plants in Eastern Europe.
- Revision of the most significant success stories and best practices found in Western and Eastern European countries with regards to their direct transferability to the targeted countries of the project regarding the use of SRCs as a source of energy for district heating.
- Socio-economical assessment of the best practices compiled.

The present deliverable 2.2, "SRCs as a sources of energy : success stories and best practices" was prepared by SITR and CZ Biom, which were strongly supported by, BIOAZUL, UPT, TTZ, SK-BIOM and LDHA+LITBIOMA.
2 SRCS AS A SOURCE OF ENERGY: SUCCESSFUL STORIES AND BEST PRACTICES IN SOME SELECTED WESTERN COUNTRIES

2.1 Austria

2.1.1 Social-economic assessment in Austria

- Regional agriculture sector in Austria

The Austrian production and consumption of bio energy is constantly increasing. The total energy consumption has risen from 9% (1990) to 15% (2009).

79% of the biomass is used for heat, 12.4% for bio fuels and 8.6% for green electricity.

Wooden biomass for the heat supply can be produced by Short Rotation Coppices (SRC) or be waste material in the wood industry. In 2009, 1,000 hectare in Austria were planted with SRCs and 800 hectare with Miscanthus. The main species of fast growing trees are poplar and willow. Every 2-6 years a SRC can be harvested and will remain between 20-25 years.

Also in Austrian dwellings biomass is used for the heat supply, in a ratio that comes to 83% of biomass single consumption and 17% of biomass district heating. There is an opportunity for farmers to sell woods chips in the form of heat by installing and operating a district heating plant (Energy Services Company).

Austria is going further in the use of biomass technologies for heat and energy supply. As to not be in competition with the food and fodder production the amount of waste materials like straw, woody core of corn and/or hay is increasing.

- Employment

In 2009 28,200 people were employed in the renewable energy technologies like biomass, photovoltaic, solar heat and heat pump systems. Furthermore the statistic defines solid biomass fuels, biomass boiler and biomass ovens. There were 17,500 working positions including 12,230 people in forestry and the trade and distribution of biomass.

In the region of Upper Austria were more than 4,500 people employed in the biomass heating industry in the year 2010 (population of Upper Austria: 1.4 million).

- Institutional aspects

Austria is one of the leading European countries using renewable resources and new technologies. From the beginning on the government tried to integrate renewable energy resources by research and promotional policies (including subsidies). Furthermore the Austrian citizens always supported the idea of using renewable energy.

Austria’s next aim in the “Kyoto Protocol” is to reduce their total energy consumption around 13% and increase the utilization of renewable energy about 18%. Those have to be reached during 2008-2012.

One example for a regulation of the government for the renewable energy consumption is the “Ökostromgesetz”. To reduce the use of fossil fuels the Austrian government has following plans:

- More decentralized biomass district heating systems.
- Substitution of old technology and of fossil fuel heating systems.
• Action program for existing biomass power plants (higher efficiency, more network connections).
• Higher tax on fossil fuels.

At the moment the country tries to raise the utilization of biomass for district heating. Therefore there is the idea of a-four-points-plan to introduce more renewable energy in the heating sector for Austria.  

• Control of currently used heating systems in Austria.
• Information campaign for Austrian citizens to reduce the heat leakage with fossil fuels and introduce the subsidies which can be used for new heating technologies with renewable energy.
• Optimizing the idea of using fossil oil taxes for the investment in renewable energy heating.
• From 2012 on tariff for heating with renewable resources.

2.1.2 Review of the most significant success stories and best practices found in Austria regarding the use of SRCs as a source of energy for district heating

2.1.2.1 SRC in Feldbach
In 2008 the farmer Mrs. Schnaderbeck got the idea of cultivating SRC. Originally the farm was for pigs and growing maize, but over the years the prices of the products were getting lower while the cultivation costs became higher. Now the family has 9 hectares surface cultivated with the variety of Monviso and AF 2 plants and 6 000 plants /ha. The advantage is that it is a low-demanding cultivation and most of the agronomic management can be conducted by the farmer family.

The family Schnaderbeck works with the supply contractor Energie Steiermark for heating purpose in the heating plant Feldbach.  

2.1.2.2 Biomass Power Plant in Güssing
In a dual fluidized bed reactor biomass chips are combusted for a combined heat and power production on steam gasification. The gas is produced in gasification and a combustion zone and then used in a gas engine.

The wood chips for the combustion are coming from local wood farmers in a radius of 25 km.

The Biomass Power Plant has an overall efficiency about 85 % and an electrical efficiency about 28 %.

Over 90% of the households in Güssing get their heat from the biomass district heating system.  

2.1.2.3 Biomass Power Plant in Mödling
From 1960 on there has been a district heating system in the community of Mödling. Firstly the energy was produced from fossil fuels until 2006 when the biomass power plant was built. The biomass is mostly wood chips which are transported by trucks to the power plant. The power plant can produce energy up to 5 MW. With the biomass the plant can supply 20,000 households with electricity and heat. So that local biomass is a primary energy supply resource.  

Deliverable D.2.2 – Compilation, review and social-economical assessment of the available success stories and best practices regarding the use of SRCs as a sources of biomass for cogeneration district heating plants in Eastern Europe.
2.1.3 Socio-economical assessment of the best practices in Austria

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
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<tbody>
<tr>
<td>• The general public supports the government from the beginning in using renewable energy systems.</td>
<td>• Slow development in using renewable energy sources for the district heating system.</td>
</tr>
<tr>
<td>• Already good working district heating systems in rural areas.</td>
<td></td>
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<tr>
<td>• The government supports the implementation of renewable energy resources with regulations and subsidies.</td>
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<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
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<tbody>
<tr>
<td>• There is the space for using more biomass from Short Rotation Coppice.</td>
<td>• Demoralization of the general public due to missing the Kyoto aims and maybe paying penalty.</td>
</tr>
</tbody>
</table>

2.1.4 Summary

There are good regulatory framework incentives for the use of SRC in DH in Austria. This chain is already implemented in a small scale.
2.2 Denmark

2.2.1 Social-economic assessment in Denmark

- Regional agriculture sector in Denmark

Denmark has a strong agricultural tradition. In 2007 it had 2,663,000 ha of usable agricultural area – 62% of the country’s total of 4,310,000 ha. Far and away the largest share of this cropland is devoted to grain cultivation, which extends across 1,506,000 ha; of this, wheat and barley account for 1,217,000 ha.

The number of Danes actively employed in farming is 56,862 – 2.1% of the total active population.

The number of farms is constantly shrinking. There were 43,066 farms in 2007, compared with 45,804 in 2006, a 6% decline. However, the size of these farms is increasing. The average area of agricultural holdings has more than doubled over the past 25 years, from 29 ha in 1963 to 60 ha in 2007. The number of farms with at least 100 ha has remained constant, accounting for 18% of the total. There are currently some 14,000 full-time farms.

Exports of agricultural and food products rose to €8.2 billion in 2007 and make up 11% of Denmark’s total exports. The principal export markets are Germany, Britain, and Sweden.

Crop production totalled €8.2 billion in 2007. The primary focus is grain farming, but 80% of all crops are used in animal feed. Denmark also produces large quantities of sugar beets, potatoes, and rape.

Denmark’s renewable energy production rose to 130 PJ in 2007, an increase of 9.2% over 2006. Renewable energy accounts for 17% of Denmark’s total energy consumption.

We have not found statistics regarding the production of SRC during the production of this study.

Regarding biomass consumption as fuel for DH applications, one in three of the decentralized DH plants and one in seven of the decentralized CHP plants use biomass to produce heat. Regarding the type of biomass used, we find mainly straw, wood chips, wood pellets, biogas or waste.

Figure 1: Used biomass in DH network

We have not obtained the origin of the wood chips and pellets in this study, but however SRC could perfectly be the source of this biomass.
The consumption of biomass in Danish industry and households is continually growing. Since 2007 the biomass burning in households for the heating has risen:

Therefore already some power stations are using biomass with coal to produce energy.

Heat Power Plant Studstrup direct co-firing: separate feeding and combustion in combined coal straw burners

Heat Power Plant Ensted indirect co-firing: separate combustion with steam side integration

Heat Power Plant Acedore direct co-firing: same furnace

CHP plant Grena fluid-bed combustion with mixed fuels

CHP plant Herning grate firing of biomass with gas burner above

- Employment

In Denmark, 71% of the agricultural area was owned by farmers in 2007.

Amongst the sole holders in 2007:

- 12% were women,
- 45% were aged 55 or more, and 6% were younger than 35 years,
- 48% of the sole/main holders had another gainfully activity.

The agricultural labour force in Denmark follows the scheme mentioned below:

**Figure 2: Description of the labour force in Denmark**

Once again, we couldn’t find the breakdown to see the relation to SCR activity.

- Institutional aspects

Since 1974 on, the energy supply in Denmark was regulated by policy. The following agreements made it possible to be today one of the leading European countries in efficient energy use and producing heat and electricity with renewable resources.
1976 Energy Research Program
1979 Save Energy Plan for the consumer
1981 Development Program for Renewable Energy
This program was to support the expansion of CHP and increase the use of natural gas and the use of environmentally friendly fuels. Special note was set on straw, wood chips, wood pellets, biogas or waste for a renewable energy source.
1993 Biomass Agreement
This agreement concentrates of the use of biomass in centralized and decentralized CHP plants. The mandatory obligation on large CHP and power producers was to increase the used biomass amount per year. This was 1.2 million tons straw per year and 0.2 million tons woodchips per year.
1996 Energy 21
Till 2000 the aim was to reduce the CO₂ emissions to the level of 1988. Furthermore the renewable energy should grow to 12-14% of energy supply.

During all these plans the politics supported the development of efficiency energy and the use of renewable sources with taxes and subsidies. For example there are subsidies for investment and electricity production and taxes on fossil fuels, so that it is more attractive to use biomass as an energy resource.

Nowadays 70% of renewable energy consumption in Denmark is biomass and it is getting more and more important to heat-districting. This is supported by CO₂ duty to look for new technologies and more alternative sources against too many emissions.

2.2.2 Review of the most significant success stories and best practices found in Denmark regarding the use of SRCs as a source of energy for district heating

2.2.2.1 Amv1 CHP plant in Amager
Amv1 CHP plant is located in Amager, Denmark. AMV1 was commissioned in 2009 as the first plant in Denmark designed as biomass-based CHP. AMV1 has a heat maximum output of 250 MW and 71 MW electricity output. The fuel consumption is based on biomass (wood pellets and straw pellets), with coal as a back-up. The project takes advantage of CO₂ quota-costs and subsidies for biomass-based electricity production, as well as the lack of taxes in biomass-based heat production in Denmark. The costs of biomass bases CHP production will be lower than if using coal, for the above mentioned reasons (existing subsidies for biomass-based electricity production, tax break for biomass heat production, and CO₂ quota costs). Additional benefit is the reduction on CO₂, SO₂ and NOₓ emissions. To increase the efficiency of DH systems, it is better to have the heat generation system close to the consumers. This is only possible if the emissions are low, like in this case.
2.2.2.2 **Avv2 Power plant in Avedoreverket**

Avv2 Power plant is located in Avedoreverket, Denmark. It is an example of an existing power plant revamped to cope with co-firing of wood pellets as well as gas & oil. The commissioning took place in 2001.

During the preparation of this study, we could access the following lessons learnt.

Loesche mills used for wood pellets milling:
- Milling table was needed: operation > 300,000 tons wood pellets. High availability.
- Most frequent stop due to contaminants in the pellets or worn-out dust pipes.
- Milling 10 kWh/t.

Burners:
- Modified coal burner was used.
- CO-level fluctuate but typical <100 mg/Nm\(^3\).
- Effective burn-out 1.4 % on energy basis eq. to carbon in fly ash at 6-7 %.

DeNO\(_x\): No significant degradation of the catalyst, due to dosing of coal fly ash.

2.2.3 Socio-economical assessment of the best practices in Denmark

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical use of DH in the country.</td>
<td>No particular weakness was encountered.</td>
</tr>
<tr>
<td>Awareness in citizens of the need to increase RES.</td>
<td></td>
</tr>
<tr>
<td>Support from Authorities.</td>
<td></td>
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<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing network of coal DH that can be revamped to co-fire biomass</td>
<td>Existence of a fully-developed DH network leaves small space for new systems.</td>
</tr>
<tr>
<td>Good regulation framework: existing subsidies for biomass based electricity generation, tax break for biomass-based heat generation.</td>
<td></td>
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</table>

2.2.4 Summary

Denmark has a well-established DH sector, with good regulatory framework that supports and incentivizes the use of biomass. There is also a social-awareness regarding the need to expand the use of renewable energy sources.

However, we found no detailed data regarding the use of SRC in Denmark.
2.3 Germany

2.3.1 Social-economic assessment in Germany

- Regional agriculture sector in Germany

In Germany 17 million hectare are for agricultural use and over 11 million hectare are forest. In 2007 just 1.7 million hectare were used for energy crops. If the percentage of self-supply with food product and fodder stuff is constant than it’ll be possible to use 2.5-4 million hectare for cultivation of energy crops. Every year it would be possible to use between 13-35 million m³ without influence the sustainability of the forest.

In Germany the farmers are often using energy crops like wood, corn (like miscanthus, sweet corn, poplar), canola, sugar beet and grass for biogas. Some of these energy crops can be produced in Short Rotation Coppices (SRC) for heat, electricity and fuel consumption.

Some of the wood of SRC can be used for co-firing in power plants. In Germany, co-firing is just starting. There are some power plants who have a running experiment with firing coal and biomass together. But there are already 41 biomass power plants and the number is growing. Per hectare SRC it is possible to substitute 5 000 l mineral oil or 5 500 m³ natural gas, which are 180 GJ/ha and year.

- Employment

In 2010 totally 367 000 employees were working in the renewable energy sector. In 2004 it was just 160 000 places of employment, so in 6 years the number more than doubled.

Nowadays around 122 000 people are working in the bio energy part of the renewable energy resources. The bio energy is used for producing electricity, heat and fuels out of solid, liquid and gaseous biomass.

- Institutional aspects

The German government tries to implement more and more the use of biomass as a renewable energy source for the production of heat and electricity. One of the regulations to reach this aim is the biomass-action plan. The draft is the 2005 recommended plan from the European Union. This plan should help to use all the capacity for biomass which is in Germany for the heat, electricity and fuels production.

Since 2008 there are subsidies for the investment in local district heating systems and for biogas pipelines.

The government supports the growing sector of SRCs. So they can invest money for researching SRCs. For example there are different experiments for diverse cultivation, types of energy crops and their efficiency.

Also there is a plan of the German government that is called “Hightech-Strategie” which are including the use of bio energy in different sectors of the energy use. There are researching programs and subsidies in all those parts.

For energy crops: Developing new ways in agriculture and raw-material supplier in the industry.

For energy technologies: The aim for the future is to have energy which is safe, efficient and sustainable.

For transportation technologies: Germany as logistic point in Europe.
There are as well government plans like a “Climate-and Energy program”, “EEG Wärme” and “Marktanreizprogramm” all these plans shall help to implement more renewable resources in the energy consumption, especially biomass.

2.3.2 Review of the most significant success stories and best practices found in Germany regarding the use of SRCs as a source of energy for district heating

2.3.2.1 Heating supply in Ihlowerfehn
One of TTZ partners, helped the farmer Mr Flessner to become an “energy contractor”. Since 2006 the farmer owns a biogas plant and nowadays he supports the local heating network with it.

Since 2007 Mr Flessner has as well SRC to produce wood chips for the biogas plant. The SCR is 100 hectare large and grows poplar and willow. He can then use it himself or sell it for other heating systems.\(^\text{15}\)

2.3.2.2 Biomass power plant in Brunsbüttel
It is a 30 MW biomass power plant which is producing heat and electricity for their industry costumer. They only use biomass to provide “green energy”.

Every year the plant combusts around 100,000 ton of landscape material. Sometime in this biomass power plant biomass from SRC is also used.

The produced energy is CO\(_2\) neutral and produced in an efficient combined heat and power.\(^\text{16}\)

2.3.2.3 Bioenergie Hof Böhme
This is one company in Saxony who is planting Short Rotation Coppices. They support other companies or farmers from the cultivation of energy crops to the marketing of their wood. The biomass farm was founded in March 2010 and they have different types of energy crops like different poplar species, robusta, etc. The wood chips are used for fuels, paper industry and power and heat production.\(^\text{17}\)

2.3.2.4 The Saxony City Colditz
Since 2007 the borough Colditz, which has 3 500 habitants, is carrying the name “Energy Saving City”.

After a huge flood in 2002 a gym in the district was destroyed and the rebuilding brought the stone rolling for a new energy concept of the city. The new gym has a wood chip heating system from 300 kW which is also used for heating up a school, kindergarten, nursery, local government building and an inn. In the beginning they get the wood delivered from companies in a 30 km radius.

Nowadays the city has an own 6 hectare big Short Rotation Coppice for a part of their heat supply. Furthermore there is a biomass farm to storage and dry the wood before using it in the wood chip heater. A second wood chip heater is plant 50 kW in another building of the city Colditz.

The aim of the local government is to supply every public building in the city with renewable energy till 2050.\(^\text{18}\)
2.3.3 Socio-economical assessment of the best practices in Germany

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• General public is supporting the use of renewable energy resources.</td>
<td>• General public isn’t using less energy for their daily routine.</td>
</tr>
<tr>
<td>• Money from the government in using renewable energy resources in heating</td>
<td>• Negative thoughts in the general public about energy crops because they can be in competition for food and fodder production.</td>
</tr>
<tr>
<td>and power sector.</td>
<td></td>
</tr>
<tr>
<td>• In the industry more and more new technologies with higher energy</td>
<td></td>
</tr>
<tr>
<td>efficiency is used.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• More capacity in using Short Rotation Coppice for the energy supply.</td>
<td>• Nowadays the energy of renewable resources is more expensive than the energy out of fossil fuels.</td>
</tr>
<tr>
<td>• After Fukushima there is the opportunity of becoming independent of fossil fuels.</td>
<td>• Fossil fuels are still getting money from the government to be cheap (not so much high taxes).</td>
</tr>
<tr>
<td>• More employments in the sector of renewable energies.</td>
<td></td>
</tr>
</tbody>
</table>

2.3.4 Summary

Germany has an established industry to undertake SCR into the DH chain. Moreover, there is government support for renewable, and general public are positive with the idea of increasing the use of renewable energy sources. More dissemination is needed to take away the idea that SRC compete with food crops.
2.4 Spain

2.4.1 Social-economic assessment in Spain

Regional agriculture sector in Spain

According to the Spanish NREAP, PER 2011-2020 (Plan de Energías Renovables, elaborated by the Diversification and Energy Saving Institute (IDAE)), most of the 3,655 ktoe of biomass thermal energy consumed in Spain come from the forestry sector, being mostly used at household level and in forestry industries for cogeneration and thermal consume. The existing installed power of 533 MW is mainly fed by agroforestry industries wastes and agricultural crops residues.

Being conservative, available biomass potential in Spain reaches 88 M tonnes of primary biomass according to the Spanish Renewable Energies Plan (PER) 2011 – 2020, including agricultural and forestry residues, as well as existing unexploited stands and energy crops to be implanted. In addition, 12 M tonnes of dry secondary biomass from Agroforestry industries’ wastes should be added to the mentioned biomass potential.

Table 1: Total available non-industrial biomass potential in Spain

<table>
<thead>
<tr>
<th>Origin</th>
<th>Biomass (t/y)</th>
<th>Biomass (tep/y)</th>
<th>Average Cost (£/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Industry residues</td>
<td>2984243</td>
<td>636273</td>
<td>26,59</td>
</tr>
<tr>
<td>Complete tree exploitation</td>
<td>15731116</td>
<td>3414458</td>
<td>43,16</td>
</tr>
<tr>
<td>Herbaceous</td>
<td>14434566</td>
<td>6392631</td>
<td>19,98</td>
</tr>
<tr>
<td>Wood</td>
<td>16118220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbaceous mass, subject for implantation in agricultural field</td>
<td>17737868</td>
<td>3593148</td>
<td>45,62</td>
</tr>
<tr>
<td>Wood mass, subject for implantation in agricultural fields</td>
<td>6598861</td>
<td>1782467</td>
<td>34,73</td>
</tr>
<tr>
<td>Wood mass, subject for implantation in forestry fields</td>
<td>15072320</td>
<td>1468173</td>
<td>42,14</td>
</tr>
<tr>
<td>Total biomass potential in Spain</td>
<td>88677193</td>
<td>17286851</td>
<td></td>
</tr>
</tbody>
</table>

Data in tonnes green wood (45% humidity). Cost of green wood.

Nevertheless, period 2005-2009 meant a transition stage in Spain, in which the basis for boosting the biomass sector were discussed and settled. Although during these years the expectations created were not finally met, knowledge gain, public awareness and introduction of the biomass to the business sector and related administration were achieved. After a period of doubts, amendments and clarifications on potentiality, procedures, premiums and tariffs initiated with the RD 661/2007, two essential points are still being discussed: the biomass certification process and, once SRCs are clearly defined, the designation of the steps to follow to finally consider them as SRCs.

According to the Spanish Biomass Technology Platform Implementation Plan 2015, which represents the outcomes of the BIOPLAT’s Strategic Lines of Implementation published in 2009 for the Spanish bioenergy sector, unlike traditional crops, SRCs are experiencing their first development state in the country: varieties selection, genetic improvement, specific machinery design, establishment of the agro-climatic requirements and optimal agronomic conditions and crop management practices, etc. Thus, it is necessary to continuously develop and improve agricultural practices related to SRCs production in order to acquire bigger theoretical and practical knowledge, mostly in the agricultural sector, which is actually a key for the biomass development and the consecution of the RES objectives in Southern Europe.

Both Directive 2009/28/CE on the promotion of RE and the report from the European Commission on sustainability requirements for using solid and gaseous biofuels as energy source for the electricity, thermal and transport sectors establish criteria on the origin of biomass to be
accomplished in order to guarantee the sector sustainability, paying special attention to SRCs and the lands where they are produced. Both documents, as well as Royal Decree 1597/2011, promote the production of biofuels in degraded and/or highly contaminated lands, as well as in remedied or unexploited lands for agriculture before January 2008. Nevertheless, the Commission has not determined yet the concrete criteria that a specific land should fulfil in order to be classified as any of the previously mentioned. Moreover, the studies on biomass production potential made up to now have not considered the assessment of these lands in which the Commission wants to carry out this biofuels production sources growing. Consequently, SRCs behaviour, adaptation and productivity in these degraded and/or polluted lands remain unknown.

In any case, it is clear that SRCs production should be maximised in parallel to the consecution of the PER 2011-2020 objectives.

The European Environmental Agency (EEA) highlighted by 2006 the enormous long-term development that SRCs could experience. It foresaw that UE crops could provide 142 toe by 2030 and the 85% of the agrarian production would be concentrated in seven countries, being Spain one of them. The objective is to occupy 12% of the land by 2030, cultivating different species according to the 13 climatic zones identified (there are several within Spain). In general, perennial crops will substitute annual crops, mainly when second generation biofuels, based on lignocellulosic materials as wood or grass, can be commercialised. In any case, biofuels launching is a real option for SRCs.

On the other hand, according to the Spanish Agrarian Guarantee Fund (FEGA), the amount of SRCs has been increased during campaign of 2006-2007, reaching 223,467.3 ha. The Renewable Energies Producers Association (APPA) states that thistle, sorghum and Ethiopian rape, together with poplar and eucalyptus at minor extent, are the SRCs more frequent in the country, being Castilla y León, Castilla La Mancha, Andalucía and Aragón the Autonomous Communities in which 80% of these SRCs are cultivated. The success of poplar as SRC in Spain is substantial because of the lack of water that limits the cultivation of SRCs in countries of Southern Europe. Under dry conditions, poplar and other woody biomass crops are more competitive than grasses due to their deep roots, and can use the winter humidity for longer in spring. In Spain, the ON CULTIVOS Project (2005 – 2012) represents the principal national initiative where, energy crops include: carinata (Brassica carinata), poplar (Populus spp), forage sorghum (Sorghum bicolor) as well as cereals for bioethanol production and rapeseed (Brassica napus). The estimated demonstration area at the end of the project (2012) is about 10,000 ha involving regions in north (Navarra, Aragon, Cataluña, Castilla y Leon), central (Castilla la Mancha, Madrid) and south-eastern (Andalusia, Extremadura) Spain. Applications under this initiative include energy production for heating, power generation, development of biofuels and gasification.

Nevertheless, both farmers and the Government think financing is insufficient. According to the Small Farmers Union (UPA), the increase detected is due to a food sector demerit, foreseeing a decrease in the cultivation of SRCs due to food sector best prices. Because SRCs chains, from cultivation to power plant, are quite complex and investment costs for the plants are higher than for fossil fuel plants, it is clear that utilisation of energy crops cannot be profitable without financial support. Different countries have adopted different kinds of support systems; until last year, top incentives in Spain included mainly the “regulated tariff”, using SRCs for electricity generation. According to this the regulated tariff for the ≤2MW producer for the first 15 years was 0,1696 €/kWh and 0,1559 €/kWh for the > 2MW producer.

In any case, SRCs are a promising business opportunity in Spain because of the potential consumers and the available raw material, although their development in the country is being much slower than in Sweden, Finland, Austria, Denmark, Italy, Germany, France and, at minor extent, England. All these countries are fostering bioenergy through the improvement of legislation, awareness rising of the population and support of the industrial initiatives. On the other hand, United States is also convinced of bioenergy advantages, considering it a mean for diminishing their dependency on oil from abroad and an economic source for farmers.
• Employment

  o Employment in the agricultural sector

2010 was a complicated year in Spain due to the economical crisis that battered Europe. According to the Farmers Associations’ Coordinator, the economical crisis changed the dynamics regarding unemployment in the country, as many people loosing their job looked for a new opportunity in the agricultural field.

According to the Economically Active Population Survey (EPA), the number of gainfully occupied population (the fraction of a population that is either employed) in the agrarian sector in 2010 registered an increase of 11 700 people in comparison to 2009, reaching 755 330 workers. The gainfully occupied population in the agrarian sector represented therefore 4,1 % of the total gainfully occupied population, meaning an increment of 0,2% with regards to 2009 mainly due to the general decrease of the total gainfully occupied population caused by the economic crisis. 22 % of the primary sector in 2010 was foreigners. The rate of unemployment in the agrarian sector in 2010 was 22,2 % (14,4% in 2008), higher than the general rate of unemployment (20,1 %). This means that this rate was increased 7,8 % in only two years.

The number of economically active population (the fraction of a population that is either employed or actively seeking employment) has increased in 40.000 people within 2010, reaching nearly 1.000.000 people. This increment was particularly significant in Autonomous Communities of Canarias (27 %), Aragón (21 %), Murcia (19 %), Cataluña (16 %) and Andalucía (6 %), and it highlights the hypothesis that the agrarian sector has acted as a refugee for those people losing their job in other sectors.

Nevertheless, the biggest problem in the sector during 2010 was the effect of the economic crisis on the working farms economic viability, with very low prices for the agricultural products and very high production costs.

It is worth to mention that according to the National Institute of Statistics (INE) Spain occupies the fourth position in the EU ranking on working farms. More than 50 % of these farms have less than 5 hectares, while those with more than 100 hectares represent 5 % of the total. They are mostly owned by the people working on them, but leased lands represent 36 % of the working farms between 50 and 100 hectares. More than 50% of the working farms managers are older than 55 years, One from each five managers of the working farms is a woman.

Furthermore, Spain occupies the second position within the Member States regarding agricultural lands extension, using nearly 25 millions hectares for agricultural purposes. Herbaceous crops occupy most of the hectares, although its proportion is lower than in the EU. They are followed by the woody crops, representing 35 % (in comparison to 7 % in the EU). Olive grove remains being the most frequent crop regarding cultivated extension, what puts Spain in the first position at worldwide level.

  o Employment in the renewable energy sector

On the other hand, regarding the bioenergy sector, Spanish Business Board for Sustainable Development, all previsions manifest that the total number of jobs in the field of renewable will be tripled by 2020. While the number of jobs generated in Spain in the renewable field was 85.000 by 2010, and despite the current difficulties, it is estimated that 270.000 people will be working on renewable by 2020. It was difficult to find renewable professionals by 2008, as the formation of specialists was not as fast as required due to the work demand. Nowadays, although the employability situation has changed, experts agree on the fact that the energetic model evolution towards sustainability will generate these work opportunities, and this model change will be one of the most exciting challenges of the decade. The target for Spain is that renewables produce 20,8 % of the total final energy consumed, so the country is forced to adopt this new model in order to accomplish the objective fixed, as stated by the President of the Renewable Energies Producers Association (APPA).
• Institutional aspects

The needs of increasing the energy consumption, increasing dependency on energy sources brought from outside the country, preserving the environment and ensuring sustainable development led to the development of an economic, social and environmental strategy to increase RES use, improve energy efficiency and fulfil international environmental commitments. This strategy was the Spanish Renewable Energies Plan (PER).

The Spanish Renewable Energies Plan (PER) 2005 – 2010 was the revised version of the Promotion Plan for Renewable Energies in Spain 2000 – 2010. It maintained the commitment of covering at least 12% of the total energy consumption with renewables by 2010 established in the previous Plan\(^\text{22}\).

In addition, it established two important goals for 2010:

- 29,4 % of total electricity produced from RES.
- 5,75 % of total fuels for transport produced from RES.

In order to achieve this, PER estimated an investment of 23 599 MM. € (681 MM. public funding and 22 918 MM. to be assumed by private investors).

The objectives for biomass production specified 40% for energy crops. According to the plan they should have reached 1,9 M toe per year in electrical and thermal applications by 2010 and 2,2 Mtoe per year as bio fuels.

Ministries of Environment and Industry discussed during months with many stakeholders, as they were trying to find the balance between guarantee renewable energy investments through a profitable legislation framework and subsidies reduction in order to lower the electricity costs. According to the government, that Royal Decree meant a push to reach the renewable energy goals for 2005-2010, so as the commitments set by Spain at EU level. With the development of these technologies, renewable energy was aimed to cover 12 % of energy consumption by 2010 and prevent 27 million tonnes of CO\(_2\) by then.

The new clauses did not have retroactive effect. Those facilities that enter into operation before January 1\(^{\text{st}}\), 2008 were able to get the existent tariff throughout their lifetime. When they took part in the electricity market, they were able to keep the former rules until the end of 2012. However, facilities could opt for the new rules on a voluntary basis.

Feed-in tariffs were to be revised again, according to the level of achievement of the goals set by the 2005-2010 Renewable Energy Plan and the Energy Saving Strategy of Spain, taking into account the new goals for 2011-2020. The increase in the biomass tariff varied between 50 % and 100 %, and there was a cap and floor system for renewable energy facilities taking part in the electricity markets. The tariff will then be adjusted on an hourly basis. All the feed-in tariffs, caps and floors will be updated with the inflation rate minus 0,25 % until 2012 and the inflation rate minus 0,5% from then on.

On the other hand, according to Directive 2009/28/EC of April 23\(^{\text{rd}}\), 2009 on the promotion of the use of energy from RES, targets for the shares of energy from RES at Community and Member State level have to be set. This was the basis for the creation of the National RES Action Plans (NREAPs), being the Spanish one called Spanish RES National Action Plan (PANER).

The mandatory national targets had to be consistent with a 20% share of energy from RES and a 10% share of energy from RES in transport in Community energy consumption by 2020, being necessary to translate the Community 20% target into fare and adequate individual targets for each Member State – different starting points, potentials and existing levels of energy form RES and the energy mix.
In parallel, the new Spanish Renewable Energies Plan (PER) 2011 – 2020 was intended to include the PANER’s basics, as well as additional analyses like detailed analyses by sectors including technological evolution perspectives and foreseen costs evolution.

2.4.2 Review of the most significant success stories and best practices found in Spain regarding the use of SRCs as a source of energy for district heating

2.4.2.1 **DH plant in Cuéllar (Segovia)**

**Contact and Location**
Mr. Octavio Cantalejo Olmos, Major of Cuéllar
Mr. Santiago Díez Castilla, Researcher from CARTIF Technological Center, Valladolid – main responsible of the plant located in Cuéllar
Ayuntamiento de Cuéllar
Plaza Mayor, nº 1
40200 Cuéllar, Segovia (Spain)
+34 921 14 00 14
aytocuellar@aytocuellar.es

**Basic description**

A plant of municipal central heating fed with residual biomass was created with the aim of having an exemplar DH in Spain using renewables as a source of energy in contrast with those using fossil fuels, demonstrating its technical viability and providing comfort to the population.

The plant was constructed in Cuéllar, within Segovia province (from Castilla y León Autonomous Community), a small town in the centre area of Spain (its population rounds 9,200 inhabitants) and, therefore, a very cold area in winter, what justifies the necessity of a DH plant. It covers the energy demand of:

- A neighbourhood with 16 houses and five apartment blocks (accounting 200 houses in total).
- A school with 600 students.
- A covered sports hall.
- A cultural centre.

These buildings were previously heated by oil systems and they suffered important calorific losses, and they also have very deficient isolation systems.

Cuéllar is a town surrounded by forests, what makes forestall activity very common in the area. The plant uses residual biomass as fuel, biomass coming from pine seeds, key industry in the area. The calorific energy generated by combustion of those pine seeds is used to heat the water to be sent through some pipes across the town. Thus, heating services and sanitary hot water are used during different seasons of the year.

The study of the operative plant, the optimisation and the parameters adaptation allowed to real a total thermal yield of 60%. Therefore, its technical and economic viability with regards to traditional fuels, its environmental benefits regarding renewable energy production and the social advantages (creation of new jobs and agricultural and forest alternative activities, amongst others) have contributed to the success of this plant, being considered as a model to be replicated in other areas with biomass potential enough.
The plant construction was promoted by the Spanish Institute for Energy Diversification and Saving (IDAE), the Castilla y León Energy Agency (EREN) and the Cuéllar Town Hall. The first steps were given in 1997, when these three entities signed an agreement for constructing a DH plant in this location.

The agreement consisted in an investment of IDAE and EREN through two subventions from IDEA, framed within the annual national plan of subventions of 1997, and another one from EREN, framed within the energy annual plan of subventions as well. Management and maintenance of the plant would be undertaken by the municipality. The Town Hall had to return the investment until the plant was totally amortised during a period of 20 years, and therefore the contract would expire this last year.

The started to be planned by September, 1998, while the construction began in August, 1998. It toll 8 months, being the plant finished by April, 1999 and working during some months on several tests.

**Technical aspects**

The technical characteristics of the installation are the following:

- One main boiler of 5 233 kW (4 500 000 kcal/h) for heating and domestic hot water during the winter and heating periods.
- One auxiliary boiler of 698 kW (600 000 kcal/h) for domestic hot water in summer and periods without heating.
- On storage tank of 100m$^3$ for fuel produced by biomass.
- Network length of 3 km (two pipes, one for distribution and another for return) of steal isolated with polyurethane and buried at 1 meter of profundity. The isolation conditions of the pipe guarantee thermal losses of 1 °C when temperature reaches -5 °C outside.
- Substations are an exchanger for heating and a storage tank for domestic hot water.
- Fuel consumption: 644 toe/year (2 300 t/year).
- Yield of the system: 56,4 %.
- Thermal power: 4,5 + 0,6 Gcal/h
- Water supplying conditions: 85-90 °C
- Water return conditions: 75-80 °C
- Average flow: 201 m$^3$/h
- Biomass is stored in a silo of 30 tonnes capacity.

**Actors**

Biomass supply is carried out by the Town Hall, as well as all tasks related to the management of the installation. It comes from the nearest companies working in the sectors of wood, agriculture, wood from packaging and also wood waste from the cleaning works of the forest.

**Inputs**

Biomass used for feeding the plant is pine and pine cone bark, which existing surplus of them in the region; this would allow an extension of the plant. There are around 16 000 hectares of forests in the region, and sequential pruning seasons are scheduled in order to prevent the life of these forests. Thus, the wastes of these prunes could be also used for energy purposes in this plant.

- Biomass consumed: 2 800 t/year
Outputs
- Power: 4 500 000 kcal/h
- Transformation yield: 60,0 %
- Transportation yield: 95,0 %
- Useful lifetime: 20 years
- Gross energy production: 789 toe/year

Economy
- Savings on the energy costs reach around 10% (an average from all users).
- Savings from fuel transportation have to be taken into account, as they are not included in the energy saving calculation.
- Energy savings: 644 toe/year (2 300 t/year) of primary energy.
- Exploitation costs: 85 644,22 €/year (108,55 €/toe)
- Total investment of the installation: 1 202 024,21 € (26,71 cent/(kcal/h))
- Total IDAE financing: 220 252,91 €
- Total EREN financing: 137 162,71 €

Benefits on quality of life of the actors involved, environmental benefits
The plant installed in Cuéllar brings many benefits to the users:
- It directly provides energy to the user, avoiding the necessity of manipulating and storing fuels.
- The energy costs for users have been reduced around 10% with regards to the expenses of other years. One of the biggest costs that have disappeared is the maintenance costs of old boilers and the chimneys cleaning.
- Temperature in houses has been maintained and has reached higher values, as it has been possible to use heating during more hours.
On the other hand, the use of biomass from forests, a renewable and local energy source, has different kinds of benefits, but two could be highlighted:
- Environmental benefits due to the reduction of fossil fuels’ use.
  Social, as biomass production and harvesting to feed the plant have caused the creation of new economic activities in the area.

Lessons learnt
The construction of this installation found no barriers due to the agreement and support from the administration. It faced only some social barriers at the very beginning, as neighbours seemed not to be very convinced.

The beginning of this process was a little bit hard for the three entities involved because of this suspiciousness from the population, as the heating system being used until that moment had to be totally replaced and it worked really well, so the neighbours did not see the necessity of changing it for a new and completely unknown one.

So, the first challenge was convincing all population that this DH project would improve their heating systems from the economical and the environmental point of view, bringing therefore social advantages. This public awareness process was a little difficult because of the absence of any close reference of this kind of systems.

Nevertheless, once the population was convinced and willing to construct the plant, they faced no further problems, what make the promoters aware of the vital importance of promotion and awareness raising initiatives.
2.4.2.2 DH applications – heating and Sanitary Hot Water (SHW) from biomass in three buildings of Concello de Riós (Ourense)

Contact and Location

Mr. Francisco A. Veiga Romero, Major of Concello de Riós
Praza de José Antonio 139
32610 Concello de Riós, Ourense (Spain)
+34 988 42 50 32
alcalde@concelloderios.es
concello@concelloderios.es
Atlántico Proyectos e Instalaciones
Polg. Ind. Do Tambre, Parc. Nº-43,
5790 Santiago de Compostela (Spain)
+34 981 56 09 23
cenitalantico@cenitalantico.com

Basic description

Concello de Riós is a town with more than 2,000 inhabitants located in Ourense province (Galicia Autonomous Community), in North-West Spain. It is therefore a cold area of the country, with specific heating necessities (cold and rainy winters and warmer summers).

The Town Hall of Concello de Riós decided to bet for DH in order to avoid energy losses in several buildings from the municipality and service buildings. They analysed different possibilities for both the buildings to which supply heating, as well as for the location of the plant and the distribution network according to the resources available and the funding possibilities (like ESOL programme).

In any case, the use of a renewable source of energy was indispensable from the very beginning. The planners wanted to use local energy sources, generating higher services and having a positive effect on local economy.

Thus, the buildings finally selected were the following:

- Medical Centre building. It needed heating and SHW.
- Multiservices building for administrative issues and leisure activities. It needed heating.
- Agrarian Chamber building for administrative issues. It needed heating.

Technical aspects

The most relevant technical characteristics are the following:

- Biomass boiler (KWB, Austria; model TDS 150)
- Automatic boiler feeding from a silo with agitator
- Fuel: pellets, chips (up to G50 and W45), stones and bark (after previous analysis)
- Power: 150 kW
- Consume power; 164 (pellets) and 166 (chips)
- Maximum noise level: 66 dB
- Turbulent combustion
- Automatic cleaning of ashes and heat exchanger
- Thermal yield: 93,6 % (pellets) and 92,9 % (chips)
- Self-ignition
- Vertical exchanger without turbulators
- Air flows: primary, secondary and tertiary
- Extraction ashtray: 66 litres
- Automatic regulation through micro-processors (two)
Inputs
Biomass consumption:
   Silo refill (first refill): 5 000 kg

Outputs
Total production: 12 399 kWh (measured on January 17th, 2011)
   - Medical centre: 9 108 kWh (calculated for 31 days)
   - Multiservices building groundfloor: 2 542 kWh (calculated for 14 days)
   - Multiservices building first floor: 734 kWh (calculated for 5 days)
     Cámara Agraria: 15 kWh (calculated for 1 day)

Economy

   - Silo refill (first refill): 5 000 kg → 1 142,54 €
   - Estimated consumption: 35% from refill → 399,89 €
   - Alternative oil consumption: total energy supply / PCI oil: 1 240 litres
     Estimated oil costs (0,82 €/l): 116,72 litres
     Monthly savings: 616,83 €

Therefore, taking as working period a natural month (30 days) for all installations, the total savings for that month would reach 1 369,82 € per month, what means an amortisation period of 4,6 years for the system.
Actually, the real savings would be higher, as in two of the buildings they were originally consuming electricity and not oil, so following the premises of the Joule effect, it could be stated that the costs of a kWh would be higher.
The system has not suffered any unscheduled stop.

Lessons learnt
Advantages:
   - Higher thermal yields
   - Lower fuel consumption
   - Lower greenhouse gasses (GHG) emissions
   - Lower exploitation and maintenance costs
   - Fed by renewable energy sources
   - Better position to negotiate the fuel price
   - Space release at clients' houses
Disadvantages:
   - Higher initial investment costs
   - Thermal losses because of energy distribution processes
Cultural reticence because of the lack of knowledge on these technologies and systems
Inconveniences of the neighbours regarding the network construction
2.4.2.3 Ciudad del Medio Ambiente (Environment City), Garray, Soria (under construction)

Contact and Location
Mrs. Mª José Jiménez Las Heras, Major of Garray
C/ Los Mártires, nº2
42162 Garray (Soria)
+34 975 25 20 01 // +34 975 25 20 06
secretaria@garray.es
Gestamp Biomasa
C/ Titán, nº 15 planta 8ª, Edificio Nozar
28045 Madrid (Spain)
+34 911 77 06 00

Basic description
The Environment City (La Ciudad del Medio Ambiente, CMA) is a project conceived having sustainability as its main pillar, both in the construction process and in its further development once it is finished. It is located in Garray, a small town (more than 600 inhabitants) city located in Soria Province (Castilla y León Autononomous Region).

The CMA has an extension of 502 hectares and it is divided into 8 different areas called “campus”, which are devoted to specific functions (houses, leisure, research, business activities, etc.). It will host 120 business projects related to renewable energies (especially bioenergy), forestry resources and wood, agro-food and clean production processes. In addition, it is foreseen to construct 800 houses (from which 30 % will be state-subsidised houses), 2 hotels and some leisure areas.

CMA is a project promoted by the Autonomous government, i.e., the Junta de Castilla y León. The plants belong to Gestamp Biotérmica, which will be in charge of managing the plants trough a company created for that purpose, “Bioeléctrica de Garray”.

Technical aspects
- The CMA will have a heating network produced from a DH plant of 41 MW fed by biomass, with a seasonal yield of 80 %. It will have two boilers of 3,5 MW and four boilers of 8,5 MW, which will be installed in cascade to facilitate an efficient and economic adaptation for the expected demand growth during the different occupation stages of the City.
- Pipelines length will reach 11 km. The costs of these pipelines (Logstor) including installation reach 180 €/m, having a lifetime of 25 years.
- Biomass will be stored in an installation with capacity for 25 000 tonnes.
  In addition, a power plant of 15 MWe will be also built, and the heat surplus will be used to dry the biomass feeding the plant. It is expected that by 2010 the heating and cooling demand will be of 2 914 MWh and 2 608 MWh respectively, reaching the maximum expected (33 689 MWh heating, 18 917 MWh cooling) by 2021.

Inputs
The biomass source will be chips of 2,5 x 2,5 cm, 20-25% humidity and a calorific power of 3,7 kWh/kg. Forests of the Comarca de Pinares, between Soria and Burgos, will provide biomass from different varieties of pine.
Outputs
The expected biomass consumption once the CMA reaches its maximum occupancy by 2021 will be 20,512 tonnes/year.

Economy
100 M. € from public money have been invested, while 430 M. € have been provided by private organisations like Gestamp Biomasa, Iberdrola and Telefónica. It is foreseen to generate 1,500 jobs, and the first stage of this ambitious project is expected to be finished by 2012-2013.

The needed investment for the DH plant reached 5 M €, and it will create 4 direct jobs, while the power plant will have a budget of 45 M. € and 35 people will work in it. The DH distribution works will be funded by the Sociedad Pública de Castilla y León, Gesturcal.

Benefits on quality of life of the actors involved, environmental benefits
CO₂ emissions from the plant will be provoked by the pumps electrical consumption. By 2021 these emissions will reach 664 tonnes CO₂, much less than the emissions that could produce a natural gas plant with similar capacity for energy production, which will be 13,347 t/year CO₂. Therefore, the reduction would reach a percentage of 95%.

Lessons learnt
CMA is still under construction

2.4.3 Socio-economical assessment of the best practices in Spain

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Step towards sustainability – fossil fuels dependence reduction</td>
<td>• Important initial investments</td>
</tr>
<tr>
<td>• Making use of local resources</td>
<td>• Usually, initial reticence due to the lack of knowledge on the proposed technologies</td>
</tr>
<tr>
<td>• CO₂ emissions reduction</td>
<td>• Lack of funding sources</td>
</tr>
<tr>
<td>• Reductions in the energy bills</td>
<td></td>
</tr>
<tr>
<td>• Reinforcing of local economy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Opening of a new market</td>
<td>• Competition among different sectors to use the biomass resource</td>
</tr>
<tr>
<td>• Creation of jobs</td>
<td>• Immaturity of the biomass market</td>
</tr>
<tr>
<td></td>
<td>• Lack of links between biomass and energy producers</td>
</tr>
</tbody>
</table>

2.4.4 Summary
Biomass and, more particularly, SRCs can represent an alternative to some of the most important problems of the traditional agriculture in Spain, as well as a significant source of endogenous energy. Some of their advantages are:

- Fossil fuels dependence reduction.
- Environmental advantages: biomass energy use, and in particular biomass from energy crops, produce a reduction of most of the greenhouse gas emissions caused by the fossil
fuels. The substitution of traditional agricultural crops by SRCs can significantly reduce the fertilizers, pesticides and water requirements, therefore being an important alternative to improve the sustainability of the agrarian production. Moreover, SRCs can be introduced in alternance with traditional crops, often contributing to reduce the environmental impact of these, particularly the fertilizers’ requirements.

- Economic and social advantages: SRCs can be an opportunity for farmers to use non profitable agricultural and forest lands, as well as for diversification of the agrarian production, thus contributing to increase their income. The use of SRCs’ biomass can generate one direct employment per 600-800 ton of dry primary biomass, more of 80% in the agrarian sector.

Nevertheless, there are several barriers hindering their use:

- Lack of links between the biomass producer and the energy producer. Biomass supply should be carried out by several producers, mostly for big installations, what increases the risks of the investments and makes difficult promoting projects, mostly taking into account that biomass market in Spain is not mature / strong yet. In many occasions, producers do not use their biomass for energetic applications and there are no strong contractual links to assure the supply.

- Management of the resource in competition regime. Biomass is one of the few sectors within renewables in which there is or there could be competition among the different agents (energy or non energy agents) to get this resource.

- Immaturity of the biomass market. The lack of a developed marked for many types of biomass is the cause of the inexistence of reference market prices that could allow the establishment of cap and floor offer prices regulated by demand and production costs, what creates discordances on prices.

- Lack of coordination between the different administrations involved. Due to the heterogeneity of biomass sources and their origin, there are many administration departments involved in their regulation and control. Agricultural wastes and SRCs depend on the agricultural and rural development department; biomass from forests depend on forestry departments; subproducts of agro forestry industries depend on the agricultural and industry departments; etc. in addition, there are also differences between the national and regional regulation. This situation makes difficult the coordination between the different actors, generates problems while developing action plans due to the different criteria that could be therefore taken into account and creates confusion regarding the funds devoted to agroforestry and energetic activities, not being clear which of them ask for.

- Absence of incentives for the biomass developing in origin. This is the reason due to which the development of areas with huge potential for biomass is hindered.

- Competition with conventional fuels. Conventional fuels are socially accepted for thermal use years ago. Therefore, the use of new systems based on new fuels / sources of raw material generates reluctance among potential clients, what eliminates the possibility of taking them into account as an option for these potential users. This lack of knowledge also exists in financing entities representatives, what stops their investments in these technologies.

- Lack of technological development, implantation and maturity of determined technologies and projects. Although there are several R&D projects on SRCs at national, regional and local level under development, these experiences require some time to obtain concussing results. In addition, even though there are several projects on SRCs, there are some underdeveloped steps in the SRCs implantation learning process (genetics, ways of cultivation, machinery, exploitation methods).
- Economical support to fossil fuels. There is economical support, sometimes even higher than support for renewables, for installations using fossil fuels that are direct competitors for renewables. This cause the decline of renewables' projects promotion.

- Lack of tradition in the use of thermal biomass. In Spain, thermal use of biomass has been limited to chimneys and stoves during years. Due to this, there is a huge lack of knowledge on these technologies for both general public, professionals of the sector and administration technicians. The lack of DH networks also blocks the development of the sector.

- Low profitability with regards to the risk for some investors.

- Complexity and delay of administrative procedures.

- Barriers in the introduction of biomass cogeneration. It is very difficult to find realistic opportunities to use the thermal energy produced.

- Difficulties for co-combustion development. There are few plants were this technology could be implanted, and those existing ones are quite far from the areas in which the resource to feed them is generated, what creates reluctance to these plants managers, that are not confident on the raw material supply and also because the market prices.

- Technical limitations of the Special Regime. Limitations included in the RD/661/2007 have limited the improvement of production systems.
2.5 **SRCs as a source of energy: successful stories and best practices in eastern countries**

2.6 **Czech Republic**

2.6.1 **Social-economic assessment in Czech Republic**

- **Regional agriculture sector in the Czech Republic**

  The short rotation coppice planting and use is not very developed in the Czech Republic. There is not a tradition of energy biomass production from agricultural land. This is not only the case of SRC but as well of other energy crops. Energy crops in general are being harvested mostly only for experimental or PR purposes, but without major impact on the share of energy production from biomass. In total there is estimated to be 600 ha of short rotation coppice plantations. The plantations are of a small area with the biggest plantation in the Czech Republic being apex. 20 ha large.

  Another reason for such a small area of SRC is that there are other crops, which bring more revenues in shorter period. Aside from food production, where cereals, poppy and oil crops provide higher revenues, there has been a significant development in rape seed harvesting areas. The rape seed oil is being used for production of liquid bio fuels and has been in the past years a secure source of income.

- **Employment**

  The employment in agriculture in the Czech Republic has been declining continuously ever since 1989. This has been given by the change of economy in the Czech Republic and especially by stronger development of industry and services.

  Agriculture has been as well losing in the gross value added to national economy. In the year 2003 the share had been still 3,64 %. In the year 2010 has this share represented only 2,7 %. Similar has been the share of employment. There has been a drop from 2,33 % in 2003 to 1,76 % in 2010.

  The employment in agriculture has dropped by 5 % in the last year. High unemployment in agriculture is especially in the rural area, where it reaches 10,2 %. Further, there is a disproportion of age of employees in the agriculture. Compared to other areas of Czech economy, agriculture has a higher age average.

  The estimation of jobs connected with biomass in the Czech Republic is very difficult. As the biomass market is not very developed and most of the biomass is produced as a by-product or residual product of other branches, there is no statistical data gathered. However it is only marginal. This is considering the total area of SRC in the Czech Republic even more the case for jobs connected directly to SRC.

  The total number of jobs in energetic in 2011 has been according to the Czech Statistical Office 31 465. However, this covers all jobs connected with electricity, gas and heat.
The support for SRC and energy use in DH systems is provided by several major institutions. SRC are under the competence of Ministry of Agriculture of the Czech Republic and Ministry of Environment. The SRC use for heat production is then regulated by the Ministry of Industry and Trade.

Under the coordination of above mentioned ministries have been established several institutions directly supporting biomass development and providing different measures as subsidy systems or price decisions.

One of those is the State Intervention Fund which has been providing subsidy from SRC plantation establishment.

Energy Regulatory Office is providing price decisions about feed in tariffs for electricity production from biomass. The biomass has been by the Decree 482/2005 Col. divided to 5 different groups depending on the environmental impact. SRC, which in the first category is being recognized as most positive source of energy and receives the highest feed-in tariffs for electricity production.

Conditions for SRC use for DH systems might change significantly in the next few months. There is a new act similar to green bonus system for electricity being discussed. This act will provide system of direct support for heat production from SRC and from biomass in general.
2.6.2 Review of the most significant success stories and best practices found in the Czech Republic regarding the use of SRCs as a source of energy for district heating

2.6.2.1 **DH Plant in Bystřice nad Pernštejnem**

**Contact and Location**
Bystřická tepelná s.r.o.,
Hornická 746
593 01 Bystřice nad Pernštejnem
Tel: 00420 566552711
E-mail: teplobystrice@seznam.cz

**Basic description**
One of the biggest heating plants using biomass in the Czech Republic. The heating plant is located in the city Bystřice nad Pernštejnem which has about ten thousand inhabitants. In the year 1999 has been decided to provide heating and hot water to local households by district heating using biomass as a source of energy. The formal heating plant which has been using coal for heat production has been reconstructed to combust biomass and gas. The planning has taken 2 years and the reconstruction has been finalized within one year in 2001.

As a source of biomass have been contracted SRC wood chips from agricultural land from the region and residual biomass of agricultural production. It represents a good example of cooperation between farmers, city and heating company.

The plant combusts annually 4 000-8 000 tons of biomass and saves 10 500 tons of emissions.

**Technical aspects**
The heating plant has two boilers with heat output 4,5 MW (in total 9 MW). For fuel supply, as well as chips from SRC, cereal straw, bark, saw dust and wood waste are used.

For the storage of the material has been constructed a storage place which can provide fuel for at least 18 days (both boilers working on maximum) and in normal winter conditions for 25-35 days.

The heating network consists of 8 000 m pipes.

The SRC is being harvested in density of 7 000 – 10 000 trees on hectare. The average distance is 60 cm, and the distance between rows is 2 m in a single row scheme.

For harvesting, transportation and ingathering is being used machinery used as well for other agricultural production. The ingathering is being done manually with a chain saw and SRC is then further chipped in order to have a better fuel handling.

**Actors**
The SRC is harvested on total area of 35 ha. Biggest share of the production is provided by company Zemservis zkušební stanice Domanínek, s.r.o. which has already previously gained experience with SRC production.

The city is however contracting biomass as well from other sources. The SRC coppice is provided by additional two sources, the own harvesting area of the the city and from second farmer in order to secure the fuel supply.

The heating plant is operated by company Bystřická tepelná which is by 100 % owned by the city.
Inputs
For the combustion is being used wooden biomass from different sources and agricultural residues as cereal straw. Major share of the wooden biomass represent SRC.

The city has made experiments with different SRC clones and with different harvesting methodologies in order to find the most suitable for the condition in Bystřice. The most suitable clones of have been both poplars, J105 a P494. The estimated production is 120 tons of SRC from one hectare in 6 years.

Outputs
The heat output is in maximum level 9 MW. Boilers are producing only heat as for combined electricity and heat production there has not been found any use of heat in the summer.

Legal aspects
Legal aspects have been mostly relevant in obtaining subsidies for reconstruction and further for heat production. Obtaining subsidies for reconstruction and for further heat production has been the most relevant outcome regarding legal aspects.

Economy
The cost for reconstruction has reached 130 mil. CZK. Half of the costs have been used for reconstruction of boilers. Further costs have covered mostly the reconstruction of hot water grid. The biggest share of those costs has been covered by subsidy from the State Environmental Fund (SFŽP) who has provided 55% of applied costs. This gave a subsidy covering 74 mil. CZK and further loan of 47 mil. CZK with payment in 8 years. In total has been the subsidy 121 mil. CZK.

The operating costs are strongly dependant on the cost of biomass purchase. As the heating plant need to combust as well other materials aside from SRC, it is important to secure deliveries for a price which guarantees long term profitability of the heating plant.

Benefits on quality of life of the actors involved, environmental benefits
The benefits are mostly in emission reduction in production of new job and in securing heat production from local resources.

Lessons learnt
For the reconstruction has been crucial the subsidy provided by the State Environmental Fund. Without this help, the whole project would not be feasible.

The heating plant has undergone a long development process. As there has been only minimal experience with SRC harvesting in the conditions of Czech Republic, the city had to run their own experiments to find best harvesting material and best methodology. During this project has the city been cooperating with researches and experts from the Czech Republic. During this long term process have been selected two suitable poplar clones and harvesting methodology has been defined. This has been the major barrier to overcome.

During this stage and as well due to the fact, that the plantations of SRC can not cover the whole fuel supply, it has been important to secure other sources of biomass for heat production.

However this is as well the major risk of heating plant operation. With increasing prices of biomass can the heat production become more expensive, than production from other sources.25
2.6.2.2 Biggest heating plant in the Czech Republic using biomass, DH in Plzeň

Contact and Location
Plzeňská teplárenská, a.s.
Doubravecká 2578/1
304 10 Plzeň

Basic description
Biggest heating plants using biomass in the Czech Republic. The heating plant is located in the city Plzeň in the western part of the Czech Republic. The biomass combustion has started in 2003 and in 2010 has been put in operation a new specialized biomass boiler.
As a source of biomass has been used SRC from 15 ha of agriculture land which belongs to the city Plzeň. Additionally wood chips, residues of agricultural production, residues from beer production, green and wood wastes and other biomass are being used.
The plant combusts annually up to 300 000 tons of biomass and produces one fifth of total production of electricity from RES in the Czech Republic.

Technical aspects
The heating plant produces 45 t/h of steam with a pressure of 6.7 MPa and temperature 485 °C.
The boiler has a capacity of 10.3 MWₑ or 15 MWₜ.
The SRC is being harvested on 15 ha of agricultural land. Apx 110 thousand trees have been harvested. The plantation has been established in 2009 using poplar clones.

Actors
The heating plant is owned by the company Plzeňská teplárenská, a.s., which is a company of the city Plzeň.
SRC is being harvested on agricultural land belonging to the city Plzeň. However the management of SRC plantation is done by contracts with external company which is as well providing the plant with residual biomass from greenery. For this reason there has not been any need for additional investment in mechanization.
The heating plant has contracts for biomass delivery with more than 20 companies.

Inputs
For the combustion is being used wooden biomass from different sources and agricultural residues as cereal straw. SRC represents only marginal part and is so far in experimental stage. The total production of SRC can cover the fuel need of the heating plant only for 1.5-2 days. However, as the city have over 800 ha of agricultural land it is probable, that the share will increase.

Outputs
The output is in maximum operation 10.3 MWₑ or 15 MWₜ.

Legal aspects
Legal aspects have been mostly relevant in obtaining subsidies for reconstruction and further for heat production.
Economy

The construction of a new boiler for biomass has taken 865 million CZK.
The State Environmental Fund provides subsidies for SRC plantation.

Benefits on quality of life of the actors involved, environmental benefits

The benefit is the reduction of emissions and reduction of coal combustion by 200 000 tons of coal. Additionally there is a positive effect of providing farmers from the region with new business opportunities of selling their biomass to the heating plant. At the moment apx. 30,000 tons of biomass are being provided by farmers from the region. However the biomass is mostly residual biomass from agriculture and not from energy crops.

Lessons learnt

The lesson learnt is that for starting a SRC utilization chain it is favourable to have already existing experience of biomass combustion and to have contracts with local farmers about biomass delivery. This secures stable biomass deliveries even in the starting period of SRC harvesting, before reaching any significant yields.

Another lesson learnt is, that there is not enough experience in the Czech Republic with SRC harvesting. This results in the need of experimental testing of SRC harvesting and its feasibility for heat production.

The SRC utilization is a positive signal, however for a serious SRC to heat chain the area of plantations would have to be significantly increased.

2.6.3 Socio-economical assessment of the best practices in Czech Republic

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Saving natural resources-fossil fuels.</td>
<td>• Depending on subsidy system.</td>
</tr>
<tr>
<td>• No harm or harm to a small society.</td>
<td>• A small price competitiveness with conventional fuels.</td>
</tr>
<tr>
<td>• Reducing greenhouse gas emissions.</td>
<td>• Need for different technology.</td>
</tr>
<tr>
<td>• Reduction of ash production.</td>
<td>• Relatively high investment.</td>
</tr>
<tr>
<td>• Don’t cause climate change.</td>
<td>• Lack of adequate technical infrastructure.</td>
</tr>
<tr>
<td>• Allow the acquisition of new, quality jobs.</td>
<td>• Low experience of SRC harvesting.</td>
</tr>
<tr>
<td>• Stimulate the development of the whole economy, especially agriculture.</td>
<td>• Small areas of SRC harvesting.</td>
</tr>
<tr>
<td>• Allow regional promotions.</td>
<td>• Mainly support of electricity production.</td>
</tr>
<tr>
<td>• Stimulating the development of new technologies.</td>
<td>• Small number of best practices for SRC.</td>
</tr>
<tr>
<td>• Uncultivated agricultural land use.</td>
<td>• Need to take into account soil and climatic requirements.</td>
</tr>
<tr>
<td>• The development of many sectors of the economy to improve living conditions.</td>
<td>• Hard competition with classical crops.</td>
</tr>
<tr>
<td>• Testing of SRC suitable for the given region.</td>
<td></td>
</tr>
<tr>
<td>Opportunities</td>
<td>Threats</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>• Reaching environmental goals for heat and electricity production from RES.</td>
<td>• Political barriers</td>
</tr>
<tr>
<td>• Stimulation of economic development.</td>
<td>• Legal barriers.</td>
</tr>
<tr>
<td>• creating jobs and combating unemployment.</td>
<td>• Technical barriers.</td>
</tr>
<tr>
<td>• Greater energy independence of the region.</td>
<td>• Subsidy system.</td>
</tr>
<tr>
<td>• Great interest to the public and investors SRC plants.</td>
<td>• Barriers to information and education.</td>
</tr>
<tr>
<td>• Increases the number of establishments using pellets and briquettes, wood chips.</td>
<td>• Climate change and soil.</td>
</tr>
<tr>
<td>• Development of eco-systems modernization.</td>
<td>• Lack of acceptance of society and lack of trust for the establishment of crops.</td>
</tr>
<tr>
<td>• Realizing the potential of biomass energy.</td>
<td>• Lobbying.</td>
</tr>
<tr>
<td>• Remediation of brownfield sites.</td>
<td>• Shortage of biomass resources.</td>
</tr>
<tr>
<td>• Using agricultural land with low input on fertilizers.</td>
<td>• Price competition.</td>
</tr>
</tbody>
</table>

2.6.4 Summary

The SRC to heat chains are almost not present in the Czech Republic. There are only two cases of chains established which are based on a long term concept. The development of SRC in the Czech Republic is very limited and even those cases presented are rather in experimental stage. The chain could not been established if those heating plants would not have been using for heat production as well other sources of biomass.

This bares as well the biggest danger for further development. As the existing biomass resource of the Czech Republic is widely used, there is a high competition for biomass. The market for biomass produced in Czech Republic is not relevant only for Czech players, but those have a strong competition from other EU countries, especially from Germany and Austria. This has caused significant price increase of biomass which further on endangers the feasibility of new projects.

Possible change might come with a newly prepared law based on green bonus scheme, however used for heat production from biomass. This new act could make it feasible to invest to new plantations of SRC.
2.7 Romania

2.7.1 Social-economic assessment in Romania

- Regional agriculture sector in Romania

The Romania has a high agricultural potential, having an arable surface of about 9,422 ha, from which at the end of 2009, only 7,884 ha were used for agriculture, the rest of 1,538 was not used (about 16% of the arable land). The numbers refer only to the arable land and do not take into account the lands that are not suitable for agriculture, but they can be used for SRC like river beds etc.

The climate is suitable for SRC offering the opportunity to achieve higher output than in the Nordic countries where this type of culture is widely used.

- Employment

According to the Romanian national institute of statistics the population structure by occupation is presented in table 2.

The population involved within agriculture domain is relatively high, about 2,689 persons, from the total occupied people of about 9,243 persons. This happens because of the subsistence agriculture practice and because of the lack of equipment and agricultural machinery. There are no information concerning the involved people within the SRC but since the cultivated surfaces with this kind of culture is small few hundreds hectares we can say that a very small number of people are involved within this domain. The number of people involved in the biomass processing is also small but, we estimate that in the future the number of people involved in the biomass and specially in SRC will increase since the improvement of the legislation and because of the business opportunities offered by the Romanian market. In the energetic sector the number of involved people is about 129 persons.
### Table 2: Employment structure, by activity of national economy in 2009

<table>
<thead>
<tr>
<th>Activity</th>
<th>Employment (Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9243</td>
</tr>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>2689</td>
</tr>
<tr>
<td>Mining and quarrying</td>
<td>100</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1751</td>
</tr>
<tr>
<td>Electricity, gas, steam and air conditioning production and supply</td>
<td>129</td>
</tr>
<tr>
<td>Water supply; sewerage, waste management and decontamination activities</td>
<td>68</td>
</tr>
<tr>
<td>Construction</td>
<td>726</td>
</tr>
<tr>
<td>Wholesale and retail; repair of motor vehicles and motorcycles</td>
<td>1157</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>455</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>165</td>
</tr>
<tr>
<td>Information and communication</td>
<td>123</td>
</tr>
<tr>
<td>Financial intermediation and insurance</td>
<td>122</td>
</tr>
<tr>
<td>Real estate activities</td>
<td>16</td>
</tr>
<tr>
<td>Professional, scientific and technical activities</td>
<td>148</td>
</tr>
<tr>
<td>Activities of administrative services and of support services</td>
<td>150</td>
</tr>
<tr>
<td>Public administration and defiance; social insurance of public sector</td>
<td>490</td>
</tr>
<tr>
<td>Education</td>
<td>386</td>
</tr>
<tr>
<td>Health and social assistance</td>
<td>395</td>
</tr>
<tr>
<td>Shows, culture and recreation activities</td>
<td>45</td>
</tr>
<tr>
<td>Other activities of national economy</td>
<td>128</td>
</tr>
</tbody>
</table>

- Institutional aspects

The bio-energy is a multidisciplinary topic starting from the crops, the processing and energy production. Therefore, there are involved a lot of institutions, starting from the political ones that can influence the development and funding of this sector, the research institutes, that cover all the bio-energy topics and which can disseminate the information and can develop new and more efficient technologies.

#### Governmental and public stakeholders

Bio-energy is a cross-cutting topic, bringing together a range of policy areas, including agriculture, forestry, energy, transport, rural development, and climate change. Each area recognizes the importance and benefits of developing the biomass sector as part of their overall policy.

#### Governmental bodies

*Ministry of Economy, Commerce and Business Environment* contributes to the development and implementation of the strategy and governance in the economy and energy, ensuring the use of...
financial leverage and foreign exchange in accordance with the requirements of market economy and to stimulate business initiative.

Ministry of Environment and Woods is responsible to enforce the environment legislation and is handling carbon financing / joint implementation issues. Further they are responsible for the energy-related aspects of financing parts of the energy sector through Sector Operational Program 'Environment' (SOPE). Financing under SOPE will focus on meeting Romania's commitments to reduce emissions per unit of fuel used rather than renewable energy projects that reduce absolute emissions by displacing fossil fuels.

Ministry of Transports and Infrastructures. The emergence of bio fuels and the high proportion of transport fuel in the national energy balance involve the Ministry of Transport as significant stakeholder in this renewable energy assignment.

Ministry of Agriculture and Rural Development is in charge to the deployment of policies related to agriculture main sources for biomass.

**National Regulatory Authority for Municipal Services (ANRSC)**

ANRSC was established in 2002 as a public institution of national interest under the subordination of the Ministry of Administration and Internal Affairs. The Authority has the aim to regulate, monitor and control at the central level the activities from the community services field, including production, transport and distribution of the thermal energy in centralized system and public lighting. They are defining the price for thermal energy.

**Romanian Energy Regulatory Authority (ANRE)**

ANRE - is a public independent body of national interest whose mission is to create and implement the appropriate regulatory system to ensure the proper functioning of the electricity and heat sector in terms of efficiency, competition, transparency and consumer protection. In discharging its competencies and tasks, ANRE works together with other central or local public administration bodies, electricity and heat undertakings, with international organizations in the field, so that interests of all sector players may be harmonized and transparency of the regulatory process assured. ANRE is an important stakeholder in Renewable Electricity in two major respects. Firstly, ANRE oversees the Green Certificates Scheme, which is Romania's primary tool to promote the use of RES at the present time. Generators producing power from biomass may benefit from the scheme. ANRE's role in ensuring that interests of all sector players may be harmonized is likely to be tested in the coming years, as more biomass use will come online.

**Power Market Operator (OPCOM)**

OPCOM operates as well the Green Certificates Market, meaning that it is the legal person who assures Green Certificates trading and determines the prices on the Centralized Green Certificates Market, performing the functions established by the Regulation for organizing and functioning of the Green Certificates Market (Order no. 15 / 2005 issued by ANRE).

**The Academy of Agricultural and Forestry Sciences (ASAS)**

"Gheorghe Ionescu-Sisesti" (A.A.F.S.) is a public specialized institution of academic recognition and scientific coordination with juridical personality, financed through extra budgetary income, functions according to its own statute, under the coordination of the Ministry of Agriculture, and Rural Development (M.A.D.R) and collaborates with the Ministry of Education, Research, Youth and Sports (M.E.C.T.S). They perform studies related to biomass market, and energy from biomass.
University of Agricultural Sciences and Veterinary Medicine (USAMV)

Profile USAMV for research in Cluj-Napoca is reflected in the priority areas set by the faculties and parts that will be promoted in future. They relate to: agriculture, horticulture, animal husbandry and Biotechnologies etc). USAMV performs also studies related to the technical and economic analysis of biomass production.

2.7.2 Review of the most significant success stories and best practices found in Romania regarding the use of SRCs as a source of energy for district heating

In Rumania, the full chain connecting SRC used for DH is not developed. However, parts of this chain are already working, and so show that the business model could work in the country. There are companies that are producing heat for district heating and electricity using sawdust or wood chips which can work with no changes with products from a SRC. There are also agricultural companies that are producing wood chips from SRC and also there are some companies that are involved in manufacturing equipments for processing or utilisations of wood chips resulting from a SRC.

Some examples concerning these companies are presented here.

2.7.2.1 Romanian cogeneration biomass plant – success from the beginning

The topic of energy from renewable sources has steadily increased in interest over the years in Romania. It is known that Romania has quite some experience with hydroelectric power plants and also several successful wind projects have been implemented in the South over the past three years. Also, there is a good potential for other RES like geothermal, biomass and solar as energy sources. Romania is currently struggling to implement a clear legal framework that gives RES energy a definitive advantage versus the conventional energy sources.

RES energy producers are awarded a mean price of 42 Euro for 1 MWh. During 2008 and 2014, the price decided for one GC ranges between 27 and 55 Euro. The indicated regulation (GC) is under present discussion, to be modified.

As result in table 2 are presented in comparison the detailed costs that are supported by owners/investors, when their systems are implemented by own means, with no support from the Government, as it theoretically should be implemented (for the CO₂ reduction at least), under Romanian conditions. The unit energy production based on biomass is, in comparison to the fossil fuel case, higher (annual costs, based mainly on fuel costs, investment costs).

Table 1. Comparative alternatives using fossil fuel and biomass for a 30 MWh thermal capacity

<table>
<thead>
<tr>
<th></th>
<th>Variant 1 – Natural gas</th>
<th>Variant 2 – Pellet</th>
<th>Variant 3 – Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat demand in MWh</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Investment cost</td>
<td>1,700.00 €</td>
<td>2,861.00 €</td>
<td>3,122.00 €</td>
</tr>
<tr>
<td>Service life in years</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Rate of interest</td>
<td>4.95%</td>
<td>4.95%</td>
<td>4.95%</td>
</tr>
<tr>
<td>Fixed costs/a</td>
<td>85 €</td>
<td>2.83 €/MWh</td>
<td>345 €</td>
</tr>
<tr>
<td>Variable costs = fuel costs</td>
<td>500 €</td>
<td>16.66 €/MWh</td>
<td>414.4 €</td>
</tr>
<tr>
<td>Annual costs</td>
<td>585 €</td>
<td>19.5 €/MWh</td>
<td>804.4 €</td>
</tr>
</tbody>
</table>

Deliverable D.2.2 – Compilation, review and social-economical assessment of the available success stories and best practices regarding the use of SRCs as a source of biomass for cogeneration district heating plants in Eastern Europe.
2.7.2.2 Holzindustrie Schweighofer - Romanian cogeneration power plant in Radauti

Contact details: Saw mill Radauti
Holzindustrie Schweighofer S.R.L.
Strada Austriei Nr. 1, 725400 Radauti, ROMANIA
Tel. +40 230 207 400, +40 230 207 400,
Fax +40 230 207 399 radauti@schweighofer.ro

Table 3: Facts & Figures

<table>
<thead>
<tr>
<th>Established</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant size</td>
<td>50 ha</td>
</tr>
</tbody>
</table>
| Raw material origin | 80 % Romania  
20 % Ukraine |
| Species      | 90 % spruce  
10 % pine |
| Sawing       | 1,3 Mio. m³ round wood |
| Planning     | 460 000 m³ |
| Kiln drying  | 650 000 m³ |
| GLT          | 90 000 m³ (glue laminated timber) |
| CHP          | 24,0 MW caloric  
4,9 MW electric |

It is important to include following data as well, contributing as well to the acceptance and dissemination of the results and activities of success of the group:

**Schweighofer Prize**: Innovators wanted! The European Innovation Award for the Forest Based Sector - the Schweighofer Prize - is looking for new proposals - every year!

**Schweighofer scholarship awarded**: At the Faculty of Forestry & Exploitation of Forest at the University of Transylvania in Brasov yearly, 3 one-year scholarships were awarded, each worth 300 Euro/monthly is offered. The future scholarship holders were determined in a competition where theoretical and practical skills were demanded.

**Donation for school in Comanesti**: The generous sponsoring of Holzindustrie Schweighofer Group in Romania for School No. 7 in Comanesti made possible replacement works for windows, heating pipes and radiators

The data in this presentation have been sent by e-mail, and are thus open for high lightening and dissemination of technical and economic achievements, including the success results presentation.

At Radauţi the largest cogeneration plant biomass in Romania (Figure 5), owned by the Austrian company Holzindustrie Schweighofer has been launched by 2008. The power plant has the capacity of 29 MW total, of which 24 MW heat and 5 MW electric-power, and the investment was about 20 million €. Further at Sebeş another biomass cogeneration plant with a power half that of Rădăuţi, which will have a capacity of 8.5 MW of electricity was opened.
Figure 8: Romanian cogeneration power plant in Radauti, based on biomass input

Table 4: Wood briquette and pellet composition used

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Methods</th>
<th>Value</th>
<th>Measurement unit</th>
<th>Limit value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wood briquette</td>
<td>Pellet</td>
<td></td>
</tr>
<tr>
<td>Standard shape</td>
<td>DIN EN ISO 7887</td>
<td>round</td>
<td>round</td>
<td>-</td>
</tr>
<tr>
<td>Length</td>
<td>Measured</td>
<td>120-170</td>
<td>4-33</td>
<td>150-300</td>
</tr>
<tr>
<td>Diameter</td>
<td>Measured</td>
<td>8,2</td>
<td>6</td>
<td>60-100</td>
</tr>
<tr>
<td>Density</td>
<td>DIN 52182</td>
<td>0,93</td>
<td>1,31</td>
<td>1,0-1,4</td>
</tr>
<tr>
<td>Humidity</td>
<td>DIN 51582</td>
<td>8,3</td>
<td>3,6</td>
<td>12</td>
</tr>
<tr>
<td>Ash</td>
<td>DIN 51719</td>
<td>1,40</td>
<td>0,8</td>
<td>1,5</td>
</tr>
<tr>
<td>Lower heating</td>
<td>DIN 51900</td>
<td>18,04</td>
<td>18,24</td>
<td>17,5-19,5</td>
</tr>
<tr>
<td>value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>DIN 51400</td>
<td>0,014</td>
<td>&lt; 0,01</td>
<td>0,08</td>
</tr>
<tr>
<td>Chlorine</td>
<td>DIN 51727 / IC</td>
<td>0,004</td>
<td>&lt; 0,01</td>
<td>0,03</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>DIN EN 25663</td>
<td>0,26</td>
<td>0,21</td>
<td>0,3</td>
</tr>
<tr>
<td>Arsenic</td>
<td>DIN EN ISO 17294 - 2</td>
<td>&lt; 0,1</td>
<td>0,31</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Cadmium</td>
<td>DIN EN ISO 11885</td>
<td>0,29</td>
<td>0,22</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Chromium</td>
<td>DIN EN ISO 11885</td>
<td>1,7</td>
<td>1,1</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Copper</td>
<td>DIN EN ISO 11885</td>
<td>3,8</td>
<td>2,4</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Mercury</td>
<td>DIN EN 1483</td>
<td>0,05</td>
<td>&lt; 0,05</td>
<td>0,05</td>
</tr>
<tr>
<td>Lead</td>
<td>DIN EN ISO 11885</td>
<td>7,4</td>
<td>1,8</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Zinc</td>
<td>DIN EN ISO 11885</td>
<td>22</td>
<td>6,6</td>
<td>mg/kg</td>
</tr>
</tbody>
</table>

The cogeneration plant operating in Radauți consumes biomass sterile 40 m³/h, and the heat produced is currently used to dry timber in the self owned factory (also Holzindustrie
Schweighofer), but also to heat the 7,000 apartments in Radauti (by DH and cogeneration), the electric electricity being supplied to the national energy system.

Biomass characteristics are shown in table 4.

In Sebes – Alba county, another biomass cogeneration plant was developed, with half of power of the Radauti plant, with a power of 8,5 MW of electricity. Pellets production in Holzindustrie Schweighofer - Sebes in 2007 was of 30,000 tons for 2008 increasing to 70,000 tons, sufficient for the annual needs of 12 000 to 20 000 households in Romania. For domestic consumption, the pellets are packed in bags of 15 kg, and for older consumers, in units of one tone. Mr. Schweighofer – the owner of the company, showed that pellets are the cheapest source of energy from renewable materials that can be stored and transported in tanks, indicating that a cubic meter of gas has the same calorific value with two kilograms of pellets and marking that pellets production eliminates the waste resulting from wood processing.

Through these investments, Schweighofer Holzindustrie wants to strengthen its position as the main player in the electricity production from biomass in Romania and in the future and wants to expand biodiesel production. Gerald Schweighofer said that the company has bought in recent years large areas of forest, and in 2008 approximately 5,000 hectares of land on which they grow fast-growing vegetation that is harvested in 8-10 years.

2.7.2.3 Sawdust heating plant – Gheorgheni

MUNICIPIUL GHEORGHENI,
535500-Gheorgheni, P-ţa Libertăţii nr. 27,
Tel: 0266-364.494,
Fax: 0266-364.753,
E-mail: primaria@gheorgheni.ro, www.gheorgheni.ro
Contact person: Ilyés Szilárd
The company that exploit the plant: E-star
Mobil: 0754-202.243;
Technical manager, d-l Bordi Levente:
Mobile: 0754-202.904;
Fax: 0266-363.595.

Aim of the project was to develop of central heating systems in five cities (Vatra Dornei, Gheorgheni, Vlahita, Huedin and Intorsura Buzaului) based on using of sawdust or other wood waste as fuel. All five sites are in mountainous areas and have a stable supply of sawdust. The case study covers a single location in the center of Romania, Gheorgheni - Harghita county, where a thermal plant of five existing was changed on sawdust. The project is one that addresses to Romanian heating sector. The main purpose is to substitute fossil fuels (oil and natural gas) with waste wood locally available, such as sawdust, chips and bark from the processing wood industry (sawmills, etc.) and forestry.

Technologies generally used in this project are based on standard technologies of the heating sector in Western Europe, with key elements such as:

- systems of boiler based on biomass with automatic control, with high efficiency and the most modern filtration unit emissions,
- pre-insulated pipes for heat distribution system,
customers connect units with plate heat exchangers for decentralized production of domestic hot water and automatically controlled circuits for supplying of heating hot water,

- pre-insulated pipes in the basement of buildings.

Project cost for Gheorgheni component was 2.2 million Euros; funds were from the Danish Environmental Protection Agency, the Phare Programme, the Romanian Government (through the Romanian Agency for Energy Conservation) and the Municipality of Gheorgheni.

**Biomas boiler at Gheorgheni**

The project introduces a technological solution that makes possible using of wet biomass as fuel (Figure 6). It is in sight as biomass – sawdust, wood chips, bark – with water containing up to 55%. According to heat company Gheorgheni, water content of sawdust reached 80% in some periods, which had an influence on efficiency boiler, but had a insignificant impact on the quality of services offered to consumers.

Changing of pipeline network and introducing of consumer units joining.

Before project implementation, hot water was distributed to consumers through a network built on the principle of a circuit with four components, with a two supply pipes – feed and reflux, a hot water supply pipe and a hot water return pipe. Hot water was produced in central heating plant and the network was placed in concrete channels with very poor insulation, and in some places without insulation. In the project, this four components system was replaced with a system with two components, a standard technology applied in Western Europe, and the comfort level of consumers has been improved, together with the level of efficiency.

**Replacement of pipes in the basement of buildings**

Distribution pipes are located in the basement of apartment blocks. Access in the basement of the building may be difficult and water pipes, heating and sewage often have large losses. All hot water pipes in the basements of buildings in the project have been replaced with new pipes, pre-insulated.

The designed consumption of biomass for Gheorgheni power plant: 6965.2 tons/year and resulting ashes: 35-70 tons/year.

According to some estimations, the Gheorgheni plant used in 2005 about 5,000-6,000 tons of sawdust, and energy production was 7 600 Gcal. Research has shown that the ash contains on average about 800 ppm zinc, 100 ppm lead, 15 ppm cobalt and 8 ppm cadmium. According to surveys, it is advisable to use the ash as fertilizer in forestry plants to ensure that heavy metals do
not reach the human diet. Following standard comparisons between ash and fertilizers, mineral content of one ton of ash (from sawdust) is equal to that of about 200 kg of fertilizer.

The crediting period for this project is 14 years. Total emission reductions will be 715 000 tons of CO$_2$ equivalent for all the 5 locations of the project, for the period 2004-2017, the quota for Gheorgheni component being 153 000 tons.

Gheorgheni heating plant produce thermal energy at a cost of 29 Euro/Gcal, most thermal power plants has production costs of 48-57 Euro/Gcal, the price difference being subsidized by national and local national budget.

Data for Gheorgheni five public institutions show a reduction of 230 000 RON (approximately 65,000 Euros) for the expenses with thermal energy in 2004-2005 interval.

The project led to significant improvements in environmental and living conditions.

There are no major problems with the biomass project from Gheorgheni. It should be mention that there is enough sawdust to supply the power plant, and probably all of the thermal energy needs of Gheorgheni could be covered by plants operating on sawdust. Currently, city hall plans includes a cogeneration power plant (heat and power production) of 30 MW, project which would be implemented in partnership with a company in Hungary.

Gheorgheni heat company reported some sawdust supply problems with the content of larger wood fragments, stones and sand, which means that are necessary more maintenance work. There are 110 contracts with suppliers of sawdust, but now the company must carry the sawdust with its own resources. These problems are mainly caused by the establishment of some companies that export sawdust briquettes, which are in competition with the plant supplying.

Heating company currently does not pay for sawdust, but the situation could change soon. All plant equipment worked perfectly on the sawdust in the two years of operation, except for a failure of some electronic control systems of combustion$^{30}$.

2.7.2.4 “Energy. For today and tomorrow” – Rebina Group Romania

REBINA Group Romania,300704 Timisoara, Romania 7, Norma Street,
Tel: +40.(0)356.102.387, Fax: +40.(0)356.102.389,
E-mail: office@rebina.ro

Contact persons: Wilhelm Hollerbach - CEO, Chief Executive Officer,
Cornelia Mos - Head of Legal department, Flavia Ionescu - PR, Public Relations
Tel: +40(0)728135085, Monday - Friday: 8.00 - 12.00, 12.30 - 16.30

The data presented are offered free by the REBINA group representatives, with thanks, for information and dissemination purposes.

The world including the European Union is looking for long term solutions for the matters related to the fuel reserve termination and the reduction of Greenhouse Gases (GHG) produced by the use of these fuels and industrial activities. This is why there appeared some organizations promoting and supporting applications to find alternative solutions. As answer, REBINA Group Romania was founded as a promoter in Romania and South-Eastern Europe of some combined investments, beginning by energetic plant culture, continuing by vegetal waste processing and their transformation in renewable fuels and finally assuring by bio-fuel renewable primary resource of energy. REBINA Group Romania assumed the role and duty to introduce in Romania a processing – producing integrated system of fuels and energy of renewable sources and to open the new way adopted firmly by the whole European Union to reduce the dependence on fossil resource imports.

**Expected machines:** External use of mechanization equipment

**Expected products:** Willow chips, 30-60 tones/ha$^{31}$. 

Deliverable D.2.2 – Compilation, review and social-economical assessment of the available success stories and best practices regarding the use of SRCs as a sources of biomass for cogeneration district heating plants in Eastern Europe.
Company evolution expressed by Costs evolution since starting including initial investment is presented by Table 6.

### Table 5: Costs evolution since starting including initial investment per hectares

<table>
<thead>
<tr>
<th>No.</th>
<th>Aeromechanics works</th>
<th>Costs [€/ha]</th>
<th>Year0 [€]</th>
<th>Year1 [€]</th>
<th>Year2 [€]</th>
<th>Year3 [€]</th>
<th>Year4 [€]</th>
<th>Year5 [€]</th>
<th>Year6 [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tilling</td>
<td>76,00</td>
<td>76,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Herbicide</td>
<td>50,00</td>
<td>50,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Cultivation</td>
<td>20,00</td>
<td>20,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Herbicide</td>
<td>50,00</td>
<td>50,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Cultivation</td>
<td>20,00</td>
<td>20,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Cutting pl.</td>
<td>1200,00</td>
<td>1200,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Plantation</td>
<td>120,00</td>
<td>120,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Herbicide</td>
<td>50,00</td>
<td>50,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Cultivation</td>
<td>180,00</td>
<td>30,00</td>
<td>30,00</td>
<td>30,00</td>
<td>30,00</td>
<td>30,00</td>
<td>30,00</td>
<td>30,00</td>
</tr>
<tr>
<td>10.</td>
<td>Fertilization</td>
<td>225,00</td>
<td>135,00</td>
<td>45,00</td>
<td>45,00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Harvesting</td>
<td>400,00</td>
<td>80,00</td>
<td>80,00</td>
<td>80,00</td>
<td>80,00</td>
<td>80,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Transport</td>
<td>100,00</td>
<td>20,00</td>
<td>20,00</td>
<td>20,00</td>
<td>20,00</td>
<td>20,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td>2491,00</td>
<td>216,00</td>
<td>1535,00</td>
<td>175,00</td>
<td>175,00</td>
<td>130,00</td>
<td>130,00</td>
<td>130,00</td>
</tr>
</tbody>
</table>

The **Market is represented** by the Banat Region (Romania and Serbia) and not only, assuring primary green fuel energy for heating public systems (DH might be a possibility), small private heating systems, and recycle systems.

REBINA Agrar, as component part of REBINA Group, is willing to collect and acquire all types of biomass and wood waste from the Western and South-Western region. REBINA Agrar supports farmers and other people working in agriculture offering them long term contracts (5 to 10 years) to take over any amount of straw, corn cobs, vegetal mass, wood waste. We also offer collecting, baling and cleaning services for vegetation from agricultural fields, preparing the land for the next agricultural works. REBINA Agrar offers a unique chance to farmers by valuing their vegetal waste and preparing their land after the collecting activities in very good technical and economic conditions. REBINA Agrar will found energetic cultures on a 500 ha surface which will be expanded in a second phase to 1 000 ha by cultivating energetic willow and other plants alike which are appropriate for the climatic and weather conditions from the Western part of Romania.
2.7.2.5  **SC AMBASADOR Plus SRL – the real promoter of efficient biomass boilers**

S.C. Ambasador Plus SRL  
România, Timișoara Str. Circumvalațiunii Nr.1.  
Telefon:0040 0256/422857  
Fax:0040 0256/490567  
E-mail: office@eltim.ro

**Contact persons**
Eng&Ec Adriana TUCU, Administrator, Tel. 0040-0740-172625, Monday - Friday: 8.00-12.00, 12.30-16.30

**Short description**
SC AMBASADOR PLUS SRL keeps “ELTIM” – trade mark, with over 40 year tradition on the market, inherited from S.C. Electrometal S.A. Timișoara. It is one guarantee of quality, reliability and maintenance, of wide range of products from heating systems, boilers, equipment’s for agriculture and food industry, equipment’s for plastic recycling, equipment for fire extinguishing, engine pumps, householder equipment, washing machines for fruits and vegetables etc. All products are certified on quality system SR EN ISO 9001, and yearly increasing of incomes confirms the potential and opportunities of the enterprise, not only on Romanian market. Products and services quality and seriousness, put the enterprise, in the latest years on top position in the competition organized by National Council of SMS.

The data presented in this section are offered free by the AMBASADOR Plus representatives, with thanks, for information and dissemination purposes.

**Scope-Idea of the business. Generalities**

The enterprise aim is to create the sustainable bases for manufacturing simple and cheap equipment for house heating by the use of the renewable energy resources, usually biomass, and to contribute to the social and economic development of the communities where such investments will be established. By applying their products, AMBASADOR PLUS wants to entrust and offer energetic independence to private persons on the country side so that they should be able to use all resources in their area to cover the energetic and fuel needs.

Source and characteristics of row materials is based on typical features in manufacturing process in mechanical technology

Equipment for plastic deformation, machines tools, equipment for welding, different equipment for painting are of current use. Estimated medium incomes about 100,000 €/month.

**Company evolution. Product description**

Initial start dates by 2004, the current medium costs was by that time of 975 RON/1000 RON incomes. Actually, the medium costs are slowly modified being 952 RON/1000 RON incomes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Costs Evolution Including Initial Investment [€/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>800 000</td>
</tr>
<tr>
<td>2005</td>
<td>820 000</td>
</tr>
<tr>
<td>2006</td>
<td>834 000</td>
</tr>
<tr>
<td>2007</td>
<td>852 000</td>
</tr>
<tr>
<td>2008</td>
<td>887 000</td>
</tr>
<tr>
<td>2009</td>
<td>812 000</td>
</tr>
<tr>
<td>2010</td>
<td>750 000</td>
</tr>
</tbody>
</table>
The ELTIM bathroom boiler type 90 S / Re (Eltim 90S, Eltim 90S/Re, Eltim 90S/Re/var.1, Eltim 90S/Re/I/var1), have a cylindrical outfit and consists of subassembly for the boiler stove and chimney pipe. The boiler is designed to produce hot water using solid fuel (wood, wood waste, coal, coke, briquettes, sawdust, agricultural residues). The funnels boiler is equipped with an electrical resistance thermostat. The tank bath boiler of flue pipes type is realized of welded steel plate construction, the only market protected by galvanizing inside and outside. The stove is made of welded steel plate construction, with walls lined with insulating refractory outbreak of special combustion chamber has a barbecue grill and cast iron support and has shaken the ashes. Choke size allows large wood supply. Outer shell of the stove is made of metal covered with heat resistant black paint type Thermodur 600. Boiler flue pipes bath has built pressure tank caps stamped sheet of 2.5 mm and resistant to 6 bar (being tried at 12 bar). Outer shell of the boiler is made of metal powder protected by painting in electrostatic field white or brown. Thermal insulation mineral wool is made with laminated with aluminum foil. Providing boilers with thermostat electrical resistance allows their use for water heating, maintaining it at a certain temperature or frost protection. Boiler type ELTIM bathroom ensemble 90S/Re is certified by EN 60335-1:2001 SR. It comes with multiple adapter to the flue gas channel (112/140 mm), thermometer, ash collection drawer, cleaning chicanes. The assembly is equipped with safety valve set to 6 bar.

ADVANTAGES: Reliability due to the chosen solution for the construction of tanks; Maintenance of hot water for 24 hours, because thermal insulation; Modular construction, major advantage in transportation, handling, erection and commissioning; Due to protection by galvanizing hot boiler life is high, reducing the phenomenon of corrosion in hot water installation; Firebrick stove is not necessary because another source of heating in the bathroom; Easy to maintain and repair; Service network covers all over the country, allowing prompt intervention; Large outbreak, allowing large wood; Shortened water heating boiler, stove construction and due to large surface parts of the boiler; Ensure protection against overheating by installing safety valve; Easy to clean tar and soot, because of vertical pipe smoke;

TECHNICAL SPECIFICATIONS: Diameter of connection to the cart: 112/140 mm. Number of Funnel: 3, boiler water volume: 90 litres. Connection size / O: 1 inch. Power electrical resistance: 2 kW. Weight: 38 kg + stove boiler assembly 52 kg. Dimensions (overall): 1668x524x512 mm.

Figures 7 and 8 present a view of the family biomass boilers for hot water.

Figure 10 Bathroom Boiler with two sources and 2 circuits.

Figure 11 Bathroom Boiler with two sources and 2 circuits, covered with brown
Central heating boilers (Figure 10-15) are designed to produce a maximum hot water temperature 90 °C, necessary for the central heating and domestic hot water production in the secondary circuit (coil) for different consumers. They are fuelled with solid fuel, including a waste range of biomass and biomass waste, and have the peculiarity to maintain the temperature above 4 °C with the help of electricity.

**Nominal Power:** 50 KW,
**Pres. max.:** 3 bar,
**Hydraulic press test:** 6 bar,
**Max temp heat water:** 105 °C,
**Diameter for external link:** 200 mm,
**Burned gas temp.:** max 250 °C

- **Volume of water in boiler and outbreak:** 200 l,
- **Medium solid fuel consumption:** 8 Kg/h,
- **Maximum load of outbreak:** 20 kg,
- **Heating surface:** 350-450 m²,
- **Dimensions:** 1800 x 680

**Nominal Power:** 17 KW,
**Pres. max.:** 3 bar,
**Hydraulic press test:** 6 bar,
**Max temp heat water:** 90 °C,
**Power of electric resistance:** 1900 W,
**240V/50Hz**,  
**Diameter for external link:** 140 mm,
**Burned gas temp.:** max 250 °C,
**Volume of water in boiler:** 90 l,
**Volume of water in outbreak:** 15 l,
**Warm water flow (T=40 °C):** 8 l/min,
**Heated volume:** 160-250 m³,
**Efficiency:** min 75%,
**Dimensions:** 1400 x 580 x 534
Milling machines are also object of the fabrication. This equipment is intended for granulation of waste plastics from thermoplastic materials, low and high pressure polyethylene, PVC, ABS, polyamide, etc. in order to introduce them in a new productive cycle (recycling). Granulation low speed allows full recovery of the grounded material!

As ENERGY represents a problem for a sustainable Europe, the company invests currently in renewable energy research, sought to enhance the powerful new possibilities to cover the energy needs in competition with fossil fuels. Wood and other forms of biomass that include energy crops, agricultural and forest biomass residues are viable solutions for energy primary resource, securing the future, and stopping at least the present tendency to global warming knowing that these elements generate a CO$_2$ quantity equal to that consumed by the plant during the growth (through photosynthesis) – according Source: Agency of Renewable Resources FNR – Germany 33.

Comparative costs for heating 1 kWh, expressed in € / kWh are given in Table 4. It is evident that biomass use is economic, both also environmental friendly (CO$_2$ neutral).

### Table 7: Comparative costs for heating 1kWh, expressed in € / kWh

<table>
<thead>
<tr>
<th>Primary energy supply</th>
<th>Costs in € / kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquefied gas GPL</td>
<td>0.09</td>
</tr>
<tr>
<td>Electric energy, night tariff</td>
<td>0.0831</td>
</tr>
<tr>
<td>Diesel</td>
<td>0.0707</td>
</tr>
<tr>
<td>Central heating</td>
<td>0.0671</td>
</tr>
<tr>
<td>Central heating through cogeneration</td>
<td>0.0507</td>
</tr>
<tr>
<td>Natural gas</td>
<td>0.0479</td>
</tr>
<tr>
<td>Wood briquettes</td>
<td>0.0476</td>
</tr>
<tr>
<td>Wood pellets</td>
<td>0.0432</td>
</tr>
<tr>
<td>Coal</td>
<td>0.04</td>
</tr>
<tr>
<td>Heating pump systems air/water</td>
<td>0.035</td>
</tr>
<tr>
<td>Wood sawdust</td>
<td>0.0296</td>
</tr>
<tr>
<td>Massive wood</td>
<td>0.0284</td>
</tr>
<tr>
<td>Heat pump soil/water</td>
<td>0.0276</td>
</tr>
<tr>
<td>Heat pump direct vaporization/water</td>
<td>0.025</td>
</tr>
<tr>
<td>Heat pump water/water</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Future plans of the company are ambitious, they refer to:

- Automation of fuel (biomass or briquettes, pellets, waste biomass) supply,
- Using of salix (willow), chips,
- Gasification of biomass residues.
2.7.3 Socio-economical assessment of the best practices in Romania

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High agricultural potential for cultivating SRC</td>
<td>• The know-how is not enough disseminated</td>
</tr>
<tr>
<td>• All the big cities have a DH system</td>
<td>• The potential of the business is not known</td>
</tr>
<tr>
<td>• There are high number of power plants (providing heat to the cities)</td>
<td>• Missing grants for stimulating the business (DH systems are not stimulated to use biomass)</td>
</tr>
<tr>
<td>(working with coal (does not need big changes to use biomass)</td>
<td>• No logistics</td>
</tr>
<tr>
<td>• There is the necessary institutional base</td>
<td></td>
</tr>
<tr>
<td>• The SRC were classified as non food energetic plants</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The business is not developed</td>
<td>• The price of gas and coal still low</td>
</tr>
<tr>
<td>• Big market place</td>
<td></td>
</tr>
<tr>
<td>• Need for such technologies</td>
<td></td>
</tr>
</tbody>
</table>

2.7.4 Summary

According to the data presented for biomass production, Romania has a big potential. The future efforts has to be targeted onto increasing the exploitation of the existing biomass, together with a more efficient usage of arable surfaces. There is also a need for implementing the new technologies for electricity and heat production (CHP) that uses biomass as fuel.

- There is only one company that assures a complete production chain starting from crops to raw material, processing and energy production. In this case, their crops are not the main source of raw material, they also use the residues resulted from the timber production;
- In Romania there are only few companies that produce bio-fuels from raw material;
- The production of solid bio-fuels it is mainly concentrated around existing companies that have as a main activity the wood processing (timber, furniture producers etc) solving in this way the problems of the resulted residues;
- There are two big companies (S.C. AGRI FARM SRL, REBINA GROUP) which have some on-going projects for implementing a complete production chain starting from SRC to raw material processing and energy production; They are Romanian companies with foreign capital and the technologies used are imported from countries with high knowledge and development within this field (Austria, Germany, Holland, Sweden);
- The surfaces used for SRC are small in comparison with the Romanian potential.

The examples provided as best practice shows that there is a potential to create a complete SRC to DH chain. In our days, in Romania we have the knowledge to implement each part from SRC to DH but there are still needed some stimulations and dissemination of the knowhow and of the energetic potential of SRC and biomass in generally

The administrative, research and market infrastructure exist in Romania. There are institutions from all levels that can influence this field, but there is needed to emphasize the benefits (financial, pollution, energy production and so on) of biomass usage and to stimulate by grants all the involved parts not only some of them (the green certificates are provided only for electricity and not for heating for example).
2.8 Poland

2.8.1 Social-economic assessment in Poland

- Regional agriculture sector in Poland

Poland successfully transformed its farm economy to market principles following the end of communism but has now entered a period of greater state control of the market due to its membership in the European Union. Poland’s agricultural policy is dominated by the EU’s Common Agricultural Policy and by its open borders with the other 26 EU members. Land prices have increased dramatically, but less than 1% of farmland is traded each year due to the single area payment scheme for the EU’s direct subsidies, intended initially to ease EU compliance with World Trade Organization (WTO) rules and to simplify payments in countries with limited administrative capacity. This approach assigns subsidies based on land use and thus encourages small farmers to hold onto land or lease it rather than sell to neighbours. For this reason, Poland has a large potential to cultivate SRC.

Figure 16. Average size of plantation SRC in Poland

In 2009, the average area declared by farmers, permanent crops in Poland amounted to 8.3. This group is dominated by the willow (780 plantations) with a total area of 6,480 hectares, which represents 95% of permanent crops. In 2009, the largest crop acreage claimed stand out willow in the province Wielkopolskie (1,178 ha).

It can be concluded there is no fear that the production of raw materials (energy crops) will not be in demand because it is guaranteed. Analyse the potential that is cost-effective production, profits, however, is delayed in time. Farmers unprepared for the new crop, without the knowledge, skills, technology and equipment expected that they will do a quick business on a small area, producing mainly seedlings, as they consider the most profitable business. Meanwhile, Willow is growing profitable business for people with sufficiently large land resources, who want to invest today and wait for a guaranteed profits.
• Employment

Agriculture employs 14.8% of the workforce but contributes 3.8% to the gross domestic product (GDP), reflecting relatively low productivity. Unlike the industrial sector, Poland's agricultural sector remained largely in private hands during the decades of communist rule. Most of the former state farms are now leased to farmer tenants. Lack of credit is hampering efforts to sell former state farmland. Currently, Poland's 2 million private farms occupy 90% of all farmland and account for roughly the same percentage of total agricultural production. Farms are small – 8 hectares on average – and often fragmented. Farms with an area exceeding 15 ha accounted for 9% of the total number of farms but cover 45% of total agricultural area. Over half of all farm households in Poland produce only for their own needs with little, if any, commercial sales.  

• Institutional aspects

It is necessary to stress that particular elements of Polish DH systems are owned by different entities and that heat is produced in different heat sources. Thus the restructuring of the DH sector is quite a complex process and its implementation needed change of existed legislation in favour of a market oriented economic framework. It was initiated by the Energy Law of 1997 (EL), which deals with security of national energy supplies, efficient and rational use of energy and fuels, utilization of renewable energy, promotion of competition, protection of customer interests and minimization of costs. It has to be underlined, however, that the implementation of the EL into practice was possible only after several ordinances had been issued in the years 1998-2002.

The most important ordinances concerning DH sector are listed below:

2. Connection to DH network, trade of heat, transmission services, network dispatching and operation, as well as quality standards of customer’s service.
4. Forming and calculation, as well as principles of accounting with customers.
5. Ordinance of 2000 (replaced by Ordinance of 2003) on detailed scope of obligation to purchase electricity from renewable energy sources and produced in cogeneration with heat, as well as heat from renewable energy sources.
6. Ordinance of 2000 on carrying of supervision by energy enterprises.
7. Ordinance of 2001 on the requirements of the energy efficiency.

These ordinances determined detailed rules for energy company operations in a market oriented economy, conditions for connection to networks, transmission service rules as well as principles of tariff setting, settlements with customer’s etc. Since 1997, the EL has been changed several times; either to improve a specific provision or to adjust a provision to some modified economic or organizational conditions (and sometimes-political needs). The amendment of the EL in 2000 caused a necessity of replacing several ordinances by new ones and issuing an ordinance regulating principles of obligatory electricity and heat purchase from renewable sources, and electricity produced in cogeneration with heat. However amendment of 2002 was connected with achieving conformity of the EL with EU legislation.

More over in February 2000 the Council of Ministers adopted new “Assumptions to the Energy Policy in Poland till 2020” (ASEP 2020) in which main above mentioned social and political objectives of energy policy remained in force. These objectives are determined as “creating conditions of sustainable development of the country, assuring energy security, economical and rational utilisation of fuels and energy, development of competition, counteracting negative effects of natural monopolies, considering environmental protection requirements and obligations stemming from international agreements, protection of customer interests, and minimization of costs.”
At the time of elaborating macroeconomic state development scenarios determined in this document, it was endeavoured to follow similarity with scenarios prepared by experts of the European Commission (European Energy to 2020: a scenario approach and European Union Energy Outlook to 2020). Assumptions of energy policy determined on these bases, within the scope of heat supply, are as follows:

- higher standards of thermal protection (insulation) for new buildings and thermal modernisation of existing ones will lead to moderate decreasing tendency in heat supply, however, substantial increase in combined heat and power generation is foreseen, especially in small scale sources, what will bring essential improvement in efficiency of usage of fuels chemical energy, and decrease in pollution emissions into environment,

- decentralisation of energy systems will follow, as well as assistance to self-governments in determining local heat, power and gas fuels supply plans, aimed at:
  o development of small scale dispersed sources producing power and heat in cogeneration,
  o accelerated utilisation of local RES (biomass, geothermal energy) and waste as well as gas from small non-system deposits,
  o development of local energy markets (creation of multi-utility energy companies) and services in these markets (financial and consulting institutions, performance of works etc.),
  o co-operation of self-governments with energy companies and division of competencies
  o and responsibilities of self-governments and energy companies in the process of realisation
  o of company plans and energy planning by the communes,
  o determination of realisation principles of state policy on rational utilisation of energy, cogeneration RES, as well as introduction of obligatory purchase of electricity from CHP and RES and heat from RES, and also unification of criteria and rules of conducting tariff policy taking into consideration a necessity of conducting by the energy companies current activities and development planning according to least costs principle.

The ASEP 2020 stated, that European Energy Charter Treaty will be ratified, and participation in the EU programs will be continued, as well as that Polish energy policy will be in compliance with the EU energy Policy39.

**National support:**

National support for CHP/DH sub-sector (DH Companies) is mainly connected with environment protection. Following institutions financing environmental protection projects can support CHP/DH projects:

- **The National Fund of Environment Protection and Water Resources Management (NFEP)** is the largest institution financing environmental protection projects in Poland. Special attention is given to ecological activities adapting Poland to the EU standards. Through subsidies and preferential loans the NFEP provides financial support for undertakings of a national or interregional scale. The Provincial Founds of Environmental Protection and Water Resources Management (PFEP) primary aim in pollution reduction. These funds are financed from emission fees and fines as well as charges for “mineral use” licences, collected on local and provincial level. Grants compose greater part of NFEP and PFEP support. The loans cover up to 50% of total project costs (for communes up to 70%).
In the last time those funds supported installation of gas turbines in existing CHP plants (steam-gas blocks).

- **The Environment Protection Bank (EPB)** is a commercial Bank specialised in activities connected with environment protection and water resources management. The EPB is 40% owned by the NFEP and is a banking partner providing commercial finance to invest with NFEP money. Loans are available for local authorities and companies, regardless of their nature or specific kind of business, but soft loans are available only for environmental projects. Many of these projects regard to DH sector (e.g. local coal fired boilers replacing by gas fired boilers). Main areas of EPB activity are loans for project concerning among others realisation of RES, utilisation of waste products and improvement of household energy efficiency.

- **ECOFUND** is a foundation established in 1992 for effective management of funds obtained through the conversion of a part of Polish foreign debt with the aim of environment protection supporting. The ECOFUND is co-financing environment protection-related projects and best technologies transfer from donor countries to Poland. Financial support is available as a preferential loans and/or non-refundable grants - mainly for projects aiming to air and climate protection (reduction of pollutants emission) as well as water protection. ECOFUND supports projects related to energy saving and promotes RES development. It concerns among others improvement of coal incineration technologies in energy sources, energy saving in DH systems, utilisation of „waste” energy from industrial processes etc. ECOFUND provides grants from 10 to 30% of the total project costs (up to 50% for municipalities). In the last time ECOFUND supported installation of gas turbines and steam-gas blocks in communal, industrial and utility CHP plants.

- **The Bank of National Economy (BNE)** is providing commercial financing energy saving projects in housing and public buildings supported according to the Act on Support for Thermo-Modernisation Investment.

**Other financing possibilities:**

- Third party financing by the ESCO companies (investment repayment through achieved savings and income allocation between owner and “ESCO” company),
- Leasing of equipment and appliances for heat supply sector.

### 2.8.2 Review of the most significant success stories and best practices found in Poland regarding the use of SRCs as a source of energy for district heating

#### 2.8.2.1 The modernization of the heating system in DH plant in Plonsk

**Contact details:**

Przedsiębiorstwo Energetyki Cieplnej w Płońsku Ltd.  
09-100 Płońsk, Przemysłowa 2 Street  
mobile: (023) 662 33 88, 662 49 37  
fax.: (023) 662 26 22  
e-mail: pecplonsk@mail.lcs.net.pl  
website: www.pecwplonsku.li.pl
After 18 months of implementation on 17th April 2008, solemnly put to use one of the largest biomass-fired power plants and completed the modernization of district heating system. The ceremony was attended by host cities, municipalities and provinces, and representatives of contractors and funding institutions invest the whole enterprise: the National Fund for Environmental Protection and Water Management and Eco-Fund Foundation. The modernization of the heating system in Plonsk is an example of a model solution, which aims to reduce emissions to the atmosphere of carbon dioxide, particulates and other gases, and production of clean energy is consistent with the objectives of energy policy that promotes the production of renewed energy sources. The primary objective of the construction of combined heat and power based on biomass combustion is to reduce greenhouse gas emissions by changing the type of fuel burned with coal dust on biomass - wood chips.

![Figure 17: Line to transport wood chips to the boiler](image17)

![Figure 18: DH plant in Plonsk](image18)

The modernization of the heating system in Plonsk using biomass needed a 17.8 million PLN loan financed by the National Fund (53 % of investment costs) and a grant of 11.3 million PLN from EcoFund (33 % of project costs). The cost of the entire project is approximately 33.7 million PLN. The most important element of the completed project was the modernization of the existing central heat source in order to adapt it to the combustion of biomass, upgrading transmission networks and substations. The National Fund partially funded the delivery and installation of a biomass-fired steam boiler with a capacity of 10.2 MW, supply and installation of steam turbine and the majority of works and supply of equipment for modernization of power plants and district heating system.
The Power Plant in Plonsk is designed to be fired with wood chips. Annual production of green energy will be about 11 thousand MWH. During the year over 25 thousand tons of biomass is burning, and small coal consumption is decrease by 70%. CHP will be able to manage during the year and to burn biomass to about 800 ha area of energy crops. The demand for biofuel will manage and use land set aside, with great potential that have been abandoned for agriculture. Alpha According to the PECLTD. in Plonsk new investment and all the associated infrastructure will help to create 50-70 new jobs.40

The use of renewable energy sources and the installation of combined heat and power based on biomass combustion in heating station in Plonsk will reduce coal consumption and reduce emissions, including dioxide emissions by more than 35 thousand tonnes per year.

2.8.2.2 The company Eneco Ltd. engaged in the cultivation, harvesting and selling willow do DH plant

Contact details:
78-446 Silnowo, Dąbie 16
mobile: (094) 375 15 68
e-mail: biuro@eneco.pl
website: [www.eneco.pl](http://www.eneco.pl)

Eneco Ltd. is a company with national capital, in existence since February 2003 for the production and sale of firewood and willow cultivation. The company is growing very dynamically. The offer is addressed to the growers and wholesalers (specialized timber production, agricultural plantations, transport of raw materials). Company was founded in 2003.

The company ENECO also sells woodchips to DH plant in Borne Sulinowo, that has modernized district heating system based on biomass.

Total number of persons employed is 29 employees. Most of them are people living in the village Dabie. The company has its own plantations of willow on the surface of 500ha. The chipping of the willows takes place in the autumn. The company uses two ways of chipping: stationary chipping and using the combine.

Machinery used in the company:

**Chipper TR-70 "URBAN"**

Chipper TR-70 "URBAN" is designed for shredding branches and carpentry waste from plants and sawmills. Very good chipping effect is a willow. Processed in / on solid fuel wood is the perfect length of 6 - 13 cm suitable for combustion in all types of solid fuel boilers and particularly to organic boilers.

The diameter of crushed branches:

- 50-60 mm hardwood-power demand of a minimum of 25 horsepower
- 60-75 mm softwood-power demand of a minimum of 50 horsepower
- Length of received chips: 60-130 mm is not regulated
- Capacity: 20-80 bags per hour 57x104cm-0.08m³ (13 bags = 1m³)
- Weight: 210 kg
HackBlitz 500
Crusher mounted on tractor three-point lift system. Designed for chopping branches, wood chips from sawmill with a diameter of about 10 cm. Wood is drawn into the throat by hydraulically driven cylinder. Grinding followed by knives (2 pcs) fastened to the wheel with a diameter of 500 mm. Discharge height of 2.2 m. Power requirement 30-37 kW (40-50 hp)

PackFix 1.0
Creates a well formed packet wood. Wood packaging is done automatically in one process. Accurately and cost of wood stacked packages are suitable for drying, storage and shipping. On a pallet at the end of the conveyor drum is placed, which then is filled with wood. When the drum is full, the swivel arm fastens at the side of the drum mesh attached to the pallet. The operation begins with strapping downwards. Simultaneously, the drum is slowly pulled up and the mesh is placed directly on the wood. After winding the mesh is cut off. Ready "bundle of wood" is suitable for storage and shipping. PackFix is designed to work with machines producing logs ready for burning and disposing of the tape loading. They are so machines such as CUTMASTER, AutoCut, Spaltfix and circular saws with a conveyor belt.

The calorific value of wood chips is 6-16 MJ / kg, humidity 20-60% and ash content, which increases the potential contamination of rocks, soil and sand is from 0.6 to 1.5% dry weight.

Company ENECO Ltd. sells about 5 000 tons of wood chips per year. The recipients are different entities in the biomass-fired, mainly DH plant in Borne Sulinowo. The company Eneco Ltd. took first place in the category of the best sales growth.
2.8.2.3 The agreement between CHP and the farmer to supply biomass - the best practice to use biomass for heat production in DH plant Zeran (PGNiG TERMIKA)

Contact details:
03-216 Warszawa, Modlińska 15 Street
mobile: (022) 587 44 13
e-mail: pawel.malyska@termika.pgnig.pl
website: www.termika.pgnig.pl

DH plant Zeran is the second largest source of heat for Warsaw, has been working since 1954. The most interesting and most modern technical solutions are the two fluidized bed boilers. They reduce significantly emissions of particulate matter, sulphur oxides and nitrogen, without the need of outside plant construction. They are one of the most ecological types of boiler in Europe.

The plant is currently installed:
- These two fluidized boilers
- 5 steam boilers
- 4 hot-water boilers
- 8 heat turbines

DH plant Zeran has a heat of 1 560 MW and 364 MW of electricity, which means that they could warm up about 40% of buildings in Warsaw and the light around 5 800 000 incandescent bulbs of 60 W.

Currently, the large quantities of biomass are co-firing in fluidized boilers in DH Zeran.

The biomass is provided to the DH plant from SRC plantations. There is a possibility signing of the contact between DH plant Zeran and the farmer to supply biomass.

Long-term cultivation contract for 15-17 years (5 sets)

Funding plantation establishment
- Cover the cost of seedlings and planting.
- Funding for the farmer: (1 200 PLN/ha).

Figure 21: Certificate of quality willow
Covering the cost of a set of fragmentation on the basis a contract with the Operator:

- Guarantee the entire collection of biomass produced.
- Implementation of plantings; harvest biomass by Operator:
  - 13 000 – 14 000 plants / ha
  - Proven, registered in COBORU / CPVO variety of willow
  - 5 sets (every 3-4 years, admitted every 2nd year)
  - A collection of willow mechanized (chips L <35mm)

**The role of plantation operator**

- Licensed, high quality seedlings, registered varieties.
- Manufacturing plants, the composition of cold -4 °C.
- Effective planter planting (0,5 - 1 ha / hr.).
- Mechanized collection of biomass (while chipping or 2-stage).
- Supervision of the plantation.

**The role of land owner (the manufacturer)**

- Preparation (autumn soil cultivation, growing spring)
- Care of plantations:
  - The use of herbicides, the elimination of mechanical weed
  - Fertilization of N, P, K, Mg, liming if necessary
  - Crop care (for the first winter)
  - Transport to DH plant

**Selection criteria – for high yields, expected revenue**

- Distance from Warsaw <200 km.
- land in good agricultural land (agricultural land, fallow land).
- Class of land excluding the best and worst (IIIb – V), VI in the case of positive tests.
- Plantation of over 15-20 hectares, with convenient commute to operate heavy equipment.
- Positive results in terms of suitability for willow cultivation and determination needed to perform procedures for good yields.42

Such contracts ensure the supply of biomass for DH plant and ensure, steady income for the plantation owner.
2.8.2.4 Modernization of district heating system based on biomass in Borne Sulinowo

**Contact details:**
Urzad Miasta i Gminy w Bornem Sulinowie
Niepodleglosci 6 Streer
78-449 Borne Sulinowo
mobile. (94) 37 34 120
fax (94) 37 34 133
website: www.bornesulinowo.pl
e-mail: bornesulinowo@bornesulinowo.pl

The owner of the district heating system is a municipality Borne Sulinowo. User of the Municipal Services Company Ltd. in Borne Sulinowo that from 30 January 2002 is licensed for transmission and distribution of heat in the city Borne Sulinowo.

Heating system of the city was based on two sources of energy production i.e. heat water boiler with a capacity of \( Q = 7,44 \text{ MW} \), which was fired with coal and water boiler with a capacity of \( Q = 6,6 \text{ MW} \) which was fired with fuel oil- fired. Total installed capacity of boiler was operated by \( Q = 14,04 \text{ MW} \). Heat demand is \( Q = 7,1 \text{ MW} \), and the needs of about \( Q = 13,5 \text{ MW} \).

Efficiency and technical level of the two boilers were extremely different. State technical (lack of metering and heat production, and fuel consumption) and chewing possibility boiler operating at this gym had new challenges related to environmental protection, makes this boiler facility was a facility without investment prospects.

The modernization of heating system:

Modernized boiler to the existing two boilers from Viessmann oil and gas burners with a total capacity \( Q = 6,6 \text{ MW} \) (2x3,3 MW) and **three boilers fired with biomass (wood chips)** with a capacity of \( Q = 6,0 \text{ MW} \) (3x2 MW). Total capacity is \( Q = 12,3 \text{ MW} \). Concentration of production in one facility, the modernization of district heating and the use of automation throughout the system created an opportunity to reduce cost of production of heat to the needs of the city Borne Sulinowo.

**Sources of funding**

The total project value was 10 101 232,05 PLN

The funding from the European Regional Development Fund (75 % of eligible expenditure) amounted to 7 316 172,01 PLN.

**Prospects of modernization**

As a result of the investment will be fulfilled the requirements set by international environmental regulations to reduce emissions. Modernisation of the system results in lower operating costs can generate a significant reduction in heat prices for consumers compared to the current situation. In the longer term will increase the attractiveness of the region as a place to live and work. Through the production of biomass, the potential exists for activation of the region, creating new jobs for obtaining fuel and the emergence of new actors aimed at producing woodchips.

An important element is that the municipality are the specific possibility of obtaining fuel or wood chips and crops, both of the existing willow plantations or from plantations, the presumption declared, farmers and local businesses. The Municipal Council has expressed its willingness to enter into negotiations with the company "ENECO" ltd. the supplier of biomass, namely willow wood chips for boiler in Borne Sulinowo.

Also, the local forest district undertook to provide the material for chips for the boiler room. The investment will contribute to improving the standard of living, improve access to technical infrastructure guiding the development opportunities of the region and to increase investment opportunities, particularly in the field of tourism.
2.8.2.5 “New co-fired CHP plant commissioned in Czestochowa, Poland”

Contact details:
Fortum Power and Heat Polska Sp. z o.o.
50-413 Wrocław, Walońska 3-5 Street
Mobile: + 48 71 34 05 555
fax: + 48 71 34 05 510
website: www.fortum.pl

Figure 22: CH plant in Czestochowa

The Finnish energy major Fortum continues to invest in Poland and recently commissioned a new biomass co-fired combined heat and power plant in Czestochowa. The total value of the investment is around 135 million Euros. The company entered the Polish heat market in 2003. Since then Fortum has acquired several district heating companies and currently has district heating operations in over 40 Polish municipalities. In 2009, Fortum’s heat sales in Poland were 3.7 terawatt-hours. The largest networks are in the cities of Wrocław, Czestochowa and Plock.

The construction works of the new project in Czestochowa, took 880 days, from the first dig to the last moment of inauguration. The CHP plant produces 550 GWh of heat energy supplying 50,000 inhabitants and sends 450 GWh of electricity to the grid.

This is one of the most modern and efficient installations in this part of Europe. From the beginning, it was designed so that both coal and biomass could be used, says Peter Gornik, director of production and distribution of Fortum Power and Heat Poland. Fortum ltd. employees 640 people of whom 44 work in the CHP plant in Czestochowa.

Technologies
Provided by Foster Wheeler, the 120 MW circulating fluidized bed boiler supplies steam to the turbine at 515 °C and at a pressure of 110 bar. The 64 MW turbine and generator was supplied by Alstom. At full load the system reaches 80% efficiency with the boiler efficiency of about 90 %. The power plant is estimated to run 8 000 hours a year with the thermal energy will be produced during the heating season and electricity through-out the year. In the summer, the heat demand is only 7 MW and to be able to produce electricity during this off-peak period two cooling systems of 100 MW each will be used.
**Fuel**

An estimated 200,000 tons of coal and 100,000 tons of biomass per year will be used in the plant which gives about a 25% bio energy share. 60% of the biomass will be supplied from forests and 40% will be agricultural crops, mainly willow. In the cooperation with the Technical University in Czestochowa, there is an on-going project on the use of other types of biomass of agricultural origin. The supply of biomass contracts were signed with 10 companies.

**Biomass handling system**

The biomass handling, shredding and storage system was provided by the Finnish company BMH. The system consists of a wood crusher, a conveying transport system and three storage silos, each with a capacity of 2,500 m$^3$.

The use of biomass in the energy production process by Fortum is a step towards reducing CO$_2$ emissions and the development of energy production from renewable sources in Poland.

**The cleanest emissions in Poland**

The CHP plant already meets stringent EU requirements to be applied from 2016 for emissions of nitrogen oxides, sulfur and particulate emissions. Maximum emissions shall not exceed 30 mg/m$^3$ for dust, for sulfur SO$_x$ 200 mg/m$^3$ and 200 mg/m$^3$ for NO$_x$. Today, these values are 300, 1,500 and 300-400 mg/m$^3$ respectively for a typical Polish coal-fired boilers.

The use of biomass will reduce greenhouse gas emissions. The old boiler house still consists of old coal-fired boilers with a capacity of 173 MWh. After starting the new plant, the older boilers will operate only four months a year which will also reduce the negative impact on the environment.

### 2.8.3 Socio-economical assessment of the best practices in Poland

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saving natural resources-fossil fuels.</td>
<td>Priority by the state of conventional energy.</td>
</tr>
<tr>
<td>No harm or harm to a small society.</td>
<td>Small price competitiveness with conventional fuels.</td>
</tr>
<tr>
<td>Reducing greenhouse gas emissions</td>
<td>High technical and operational risks.</td>
</tr>
<tr>
<td>Don’t cause climate change.</td>
<td>Relatively high investment.</td>
</tr>
<tr>
<td>Increase the alternative forms of energy.</td>
<td>Lack of adequate technical infrastructure.</td>
</tr>
<tr>
<td>Use of natural phenomena.</td>
<td>Need to prepare the ground for the cultivation of SRC.</td>
</tr>
<tr>
<td>The possibility of the use of wasteland.</td>
<td>Little opportunity to potential investors-equity farmers.</td>
</tr>
<tr>
<td>Allow the acquisition of new, quality jobs.</td>
<td>Lack of national laws and legal scope of SRC for energy crops.</td>
</tr>
<tr>
<td>Stimulate the development of the whole economy, especially agriculture.</td>
<td>Small number of best practices for SRC.</td>
</tr>
<tr>
<td>Allow regional promotions.</td>
<td>Need to take into account soil and climatic requirements.</td>
</tr>
<tr>
<td>May lead to the development of tourism.</td>
<td>Lack of education and training programs for renewable energy in the targeted use of energy crops for farmers, engineers, designers, architects, representatives of the energy sector, banking and decision makers.</td>
</tr>
<tr>
<td>Reduce maintenance costs of buildings and rural households.</td>
<td></td>
</tr>
<tr>
<td>Stimulating the development of new technologies.</td>
<td></td>
</tr>
<tr>
<td>Uncultivated agricultural land use.</td>
<td></td>
</tr>
<tr>
<td>The ability to easily remove the plantation</td>
<td></td>
</tr>
</tbody>
</table>
where otherwise we use the agricultural land.

- Creation of green belts in the protective.
- The development of many sectors of the economy to improve living conditions.
- Implementation of international commitments to reduce emissions of harmful substances into the atmosphere.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Environmental performance of production factors.</td>
<td>• Lack of appropriate regulatory framework clearly defining the program policies for energy crops.</td>
</tr>
<tr>
<td>• Stimulation of economic development.</td>
<td>• Insufficient economic mechanisms, including in particular fiscal, which would allow to obtain adequate financial benefits in relation to the amount of capital expenditure incurred on property, plant and equipment for the production of biomass from energy crops.</td>
</tr>
<tr>
<td>• Creating jobs and combating unemployment.</td>
<td>• Relatively high investment costs of technologies using renewable energy, as well as the high cost of preparatory work (e.g., geological) necessary to obtain energy from these sources.</td>
</tr>
<tr>
<td>• Opportunities for local government.</td>
<td>• Lack of universal access to information on the distribution of the energy potential of different renewable energy sources, potential for technical use.</td>
</tr>
<tr>
<td>• Greater energy independence of the region.</td>
<td>• Lack of information on production companies and design consulting to companies dealing with the issue.</td>
</tr>
<tr>
<td>• Great interest to the public and investors SRC plants.</td>
<td>• Lack of widely available information about the procedures of the proceedings in making such investments, and the standard cost of the investment process and the benefits of economic, social and environmental impact of the implementation of investment of energy plants.</td>
</tr>
<tr>
<td>• Increases the number of establishments using pellets and briquettes, wood chips.</td>
<td>• Lack of information on manufacturers, suppliers and contractors systems using energy from the growing SRC.</td>
</tr>
<tr>
<td>• Development of eco-systems modernization.</td>
<td>• Insufficient number of national organizations engaged in the industrial-scale production of equipment in the processing and use of biomass from energy crops.</td>
</tr>
<tr>
<td>• Realizing the potential of biomass energy.</td>
<td>• Insufficient scope of curricula taking into account energy crops SRC, in primary and secondary.</td>
</tr>
<tr>
<td>• Remediation of brownfield sites.</td>
<td></td>
</tr>
</tbody>
</table>
2.8.4 Summary

Biomass DH projects have typically a long payback period, and there is a lack of a clear long-term regulatory framework to help the investors make long term investments. Biomass projects involving heat generation often face problems with grid accession and have difficulties with selling. Existing mechanisms are not sufficient to guarantee RES-e sales to the grid at a price reflecting environmental and social benefits of bio energy projects.

Very slow decision-making in the case of biomass projects is one of the crucial barriers in Poland. Lack of experienced bio energy professionals: local project developers do not have good and experienced professionals to carry out biomass projects that typically require more effort to maintain than any other fossil fuel project since the local fuel supply system must be well operated. This means that in Poland exists a need for the transfer of European technologies, know-how and experience especially relating to municipal solid biomass CHP and optimization of biomass fuel supply systems.
2.9 Slovakia

2.9.1 Social-economic assessment in Slovakia

- Regional agriculture sector in Slovakia

Currently, there are almost 500 ha of SRC willow Salix or poplar plantations growing in Slovakia. However, considering that vast majority of the plantations are still young, a few of them have been harvested – approx. 25 % (125 ha). The first industrial harvest of SRC plantations was carried out at the end of winter (2010, MENERT company, Sala - town), for this reason there are still no valuable and reliable results to be indicated (the average yield of dry biomass in t.ha\(^{-1}\) in the fertilized variant was approx. 17 t.ha\(^{-1}\)).

Based on The Energy Policy of Slovakia (2006) one of the national energy development targets is further development of variety of primary energy resources and rapid increase of the share of renewable and local energy sources. Biomass from SRC plantations is indicated as one of the resources for this increase. According to the Energy Policy, the potential of SRC plantations in Slovakia is around 300 000 toe/a (tonnes of oil equivalent per year), which equals to approximately 50,000 ha of SRC plantations planted. According to the National action plan for energy from RES (2010), this goal has to be reached until 2020.

The Rural Development Programme of the SR 2007 – 2013 offers a lot of opportunities for activities concerning production and exploitation of renewable and especially biomass from SRC plantation as local raw material for energy sector and production of bio fuels.

In Slovakia is available surplus land – in total: 369 088 ha, which is recommended for growing SRCs via plantations, see next page – table and surplus area for Slovak regions.

Small and medium-sized projects for the development of SRCs on agricultural and non-agricultural soil fund constitute an offer of new jobs and the engagement of manpower resources with minimal work experience. Use of phytomass for selected agricultural and non-agricultural soil fund the production of energy in various forms processing is the most accessible way to implement new energy sources.

<table>
<thead>
<tr>
<th>Region of</th>
<th>Area in ha</th>
<th>% (of Land Fund)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bratislava</td>
<td>10 103</td>
<td>11</td>
</tr>
<tr>
<td>Trnava</td>
<td>12 718</td>
<td>4</td>
</tr>
<tr>
<td>Nitra</td>
<td>34 378</td>
<td>18</td>
</tr>
<tr>
<td>Trenčín</td>
<td>27 217</td>
<td>6</td>
</tr>
<tr>
<td>Žilina</td>
<td>61 700</td>
<td>25</td>
</tr>
<tr>
<td>Banská Bystrica</td>
<td>85 587</td>
<td>20</td>
</tr>
<tr>
<td>Prešov</td>
<td>87 673</td>
<td>23</td>
</tr>
<tr>
<td>Košice</td>
<td>49 713</td>
<td>15</td>
</tr>
</tbody>
</table>

- Employment

According to the Slovak DHA information, the number of employees in DH companies has been constantly reducing during last year’s.
The reason for this decrease is modernization of DH systems and boilers that started with Slovakian membership in European Union and Europe's structural funds support. The statistics for employment in biomass sector in general or in SRC sector particularly, is not available, because of small number of plantations and relatively small plantations (15-150 ha).

### Institutional aspects

Up till now, Slovakia has been applying two support schemes. The electricity produced from RES is supported by applying higher procurement tariffs than average electricity price, as to the provider of the public service obligations (PSO). The connection costs to the power grid and some other power system services necessary for the production of the “green” energy are partially subsidized from the PSO fund. Unreserved procurement of the “green” energy is planned until 2020. Afterwards the procedure may change. The financial resources necessary for the PSO fund are collected by all the users of the power system as a special component in the final electricity price or as a part of the system.

Rural Development Programme of the Slovak Republic 2007 – 2013: supporting activities, which deal with use of all form of renewable energy.

The investments into the construction of facilities using RES are partially subsidized by using the financial resources of the EU Structural funds and other resources. The national grant is mainly allocated through the Slovakian Environmental Protection Investment Fund (SK-EPIF) or the Ministry of Environment of the Slovak Republic.

Partial funding of planting the SRC plantations is indicated in the Rural development facility for Years 2007-2013. Under the Rural development facility for years 2007-2013 “Modernization of agricultural holdings and rural development” Activity III - “Growing of short rotation coppice” the support for planting the SRC plantation is between 50-70 % (depending on various conditions) of costs incurred. However, this support is not sufficient in order to obtain constant growth of SRC plantations, because it is necessary to provide at least 50–70% support for maintaining the plantation during the second year after planting, and in case if the willows are used for the expansion of the plantation, the support should be provided also for the third year of their growth.

<table>
<thead>
<tr>
<th>Location/year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zvolen CHP</td>
<td>236</td>
<td>2018</td>
<td>217</td>
<td>194</td>
<td>183</td>
<td>180</td>
<td>175</td>
<td>173</td>
<td>172</td>
<td>168</td>
</tr>
<tr>
<td>Martin CHP</td>
<td>278</td>
<td>287</td>
<td>272</td>
<td>264</td>
<td>262</td>
<td>259</td>
<td>254</td>
<td>249</td>
<td>247</td>
<td>242</td>
</tr>
</tbody>
</table>

Source: ANNUAL REPORT of a company

### 2.9.2 Review of the most significant success stories and best practices found in Slovakia regarding the use of SRCs as a source of energy for district heating

#### 2.9.2.1 One of the most powerful heating plant - Zvolen CHP Inc. with co-firing brown coal and wood chips in Eastern and Central Europe launched in Zvolen

Zvolen CHP Inc. - the main heat supplier for inhabitants and industry - approx. 90 %

Zvolen CHP plant was originally commissioned in 1954. Overall installed output is 311 MW in heat production and 44, 3 MW in power production. There were two pulverised firing boilers, each of them with the output 108 MW, combusting low quality brown coal (lignite), two 38 MW gas and oil burning boilers and one mobile 19 MW gas boiler. For electricity production there were three back-
pressure turbines (25, 5.8 and 4.4 MW) and one 9.1 MW condensing turbine. As fuel coal, natural gas and oil were used in 2005.

Annual supply to the consumers was 788 910 GJ of heat and 102 459 GJ of electricity in 2004. Some 60 % of the heat production was used for heat and hot water supply to more than 9,000 houses and apartments. Supply to industrial consumers represents 40 % of produced heat, of which 9 % to public buildings (schools, administrative and social buildings) and 31 % to industrial enterprises. Heat is also used in industry mainly for buildings heating. Only a very small portion of heat is used for technological purposes. That causes operational problems because of two very different peaks in heat production in winter and in summer and, thus also influence the efficiency of the plant. The plant used pulverised lignite with up to 1 % of sulphur content as fuel. Annual consumption is 180 thousand tons of lignite with the energy content 11,09 GJ.t-1. The content of sulphur in emitted flue gas is as high as 3,500 – 4,000 mg SO₂/m³. It causes serious environmental problems in the region. New national limits for greenhouse gases emissions are 1.700 mg SO₂/m³ and 600 mg NOₓ/m³ with the effect from 1 January 2007. It was clear, that old boilers were not able to achieve those limits without substantial technical improvement and large investments. Therefore the power plant ordered a study analysing different technical solutions from the point of view of their impact on environmental acceptability and economical feasibility of the operation in the future.

<table>
<thead>
<tr>
<th>Table 10: Concentration’s limits after reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions limit</td>
</tr>
<tr>
<td>SO₂</td>
</tr>
<tr>
<td>NOₓ</td>
</tr>
<tr>
<td>CO</td>
</tr>
<tr>
<td>fly ash</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emissions [t.a⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
</tr>
<tr>
<td>23003</td>
</tr>
<tr>
<td>2004</td>
</tr>
<tr>
<td>2005</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2010</td>
</tr>
</tbody>
</table>

Production of greenhouse gas:

- Higher equipment efficiency – lower brown coal and gas consumption
- Partially substitution of brown coal and gas by wooden chips

**Table 11: Production of emissions:**

<table>
<thead>
<tr>
<th>Period</th>
<th>year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Greenhouse gas - CO₂</strong></td>
<td>tonnes</td>
<td>244 148</td>
<td>206 693</td>
<td>216 150</td>
<td>161 595</td>
<td></td>
</tr>
</tbody>
</table>
Recent situation at the Zvolen CHP plant

The Zvolen CHP plant is recently **100 % state owned** joint-stock company. The government has decided on privatization of four recent CHP plants which are recently state joint-stock companies, including the Zvolen power plant. The process of its privatization has not been yet concluded. This does not have any impact on the decision to implement the project of boilers conversion regarding their impact on environmental acceptability and economical feasibility of the operation in the near future.
The primary objective of this project was to ensure fulfilment of stricter emission standards valid in the EU and the SR after 1st January 2008, which was demonstrated by examinations – a complete operational test of AMFG and by single-shot measurements of emitting pollutants in sense of valid legislation.

An equally important goal of the reconstruction was to ensure long-term sustainable competitiveness in the open market with heat in the area of Zvolen. The achieved results confirm that this goal has been fulfilled, too. Zvolen belongs to one of those towns in which there is long-term development of a district heating (DH). The heat supply from DH brings reliability, safety, certainty of deliveries, comfort, service and renewal of facilities in the price of heat and also lower loading of environment (1 200 mg SO$_2$.m$^{-3}$). In the last couple of years the often repeated question was whether this way of central heating and preparation of hot service water is favourable for households, as well as deliveries of technological heat to industrial consumers. These questions were answered in the communal energy concept of town Zvolen.

The new Regional energy concept evaluated heat from DH as the most effective as well as the most favourable for the final consumer. The experience from recent years has proven these claims to be right. Zvolen belongs among one of the towns with the lowest price of heat and the lowest heat consumption per equivalent housing unit, which means, that the citizens of Zvolen belong to those with the lowest payments for heat. The cost of heat is mainly influenced by prices of applied fuels or actually energy carriers (65 %). The competitive comparison is also complicated by the usage of different units, in which the contained heat energy is measured. By the new standards, the price of gas is set for delivered kilowatt-hours (kWh) of energy, the distribution companies set consumption of electricity directly in kWh, the heat supply is measured in GJ and solid fuels are bought in tons. For
better orientation and comparison the prices of individual energy carriers are recalculated into the same unit (kWh) and same delivery standard in the next graph, i.e. on the primary distribution outlets.

![Comparison of Calorific Value of Fuels](image)

*tariff rate of electricity for heating

From the graph it is obvious that the price of the heat from SCSH of Zvolenska teplarenska Inc. is competitive, the main reason of the favourable price is the fact, that ZT uses fuels with lower cost (coal, wood chips) and it is able to transform them into final products (heat and electricity) effectively in its facilities.

**Discussion**

By the implementation of the project the main problem, which is the reduction of greenhouse gas emissions, will be solved. Greenhouse gases emissions after the conversion will be lower than allowed limits which will be force after January 2008, i.e. 1 637 mg SO$_2$/m$^3$, 600 mg NO$_x$/m$^3$, 250 mg CO/m$^3$ and 50 mg fly ash/m$^3$.

**Main environmental effects will be as follows:**

- reduction of SO$_2$ emissions by 1 000 tons, e.g. 47 % comparing to 2004
- achievement of SO$_2$ emissions limits after 2008 and thus possibility to continue in operation
- reduction of CO$_2$ emissions by 37 000, e.g. 17 % in comparison to 2004
- automatic continual control of emissions level and production process control
- reduction of ash production by one third – from 25 000 tons to 16.700 tons annually
- by improvement of the automatic control of the combustion process production of all pollutants will be significantly.

**Presently are environmental effects comparable with 2008.**

Future activities are directed to replace all coal by biofuels – mainly wood chips.

Main supplier of wood chips is also utilizing woody biomass from SRC plantations – oven plantations or from farmers.
2.9.2.2 Woody biomass based heating plant as the demonstration of an alternative energy supply system at University in Zvolen

Contact
Prof. Dr. Jozef Viglasky, local project coordinator
Technical University in Zvolen,
T. G. Masaryka 2117/24, 960 53 Zvolen, The Slovak Republic
Telephon & Fax: +421 45 5206 875, E-mail: viglasky@vsld.tuzvo.sk

Short description
Most important for bio-energy is the low temperature heat market. The ways of heating, however, are different from country to country.

The Technical University in Zvolen and the Dutch Company BTG Biomass Technology Group in Enschede (NL) have identified the University Forest Enterprise (the UFE) of the TU in Zvolen as a promising site for the demonstration of an alternative energy supply system - a woody biomass based heating plant.

This Contribution deals with an application of wood chips as biofuel in an energy system of a small size enterprise. A practical example shows and explains the possibility of biofuel application in an up-to-date heating system, which at present works fully loaded. The boiler was installed at the University Forest Enterprise (the UFE) of the Technical University in Zvolen under the framework of the Dutch Program for Co-operation in Central and Eastern Europe (PSO-programme). The total investment costs come to about EUR 450 000. The boiler has a capacity of 605 kWth and is fired by clean wood residues from sawmills owned by the UFE. The special furnace design ensures that woody biofuel burns in an environmentally sound way. Emissions of dust and CO are extremely low and meet the Slovak standards and European norms.

Scope-Idea of the business
One of the possibilities of how to replace, at least partly, the conventional energy carriers - fossil fuel in district heating systems (a high percentage of them are fired by coal, others by oil or natural gas) is offered by biomass. Biomass fired boilers could offer an attractive solution.

The SR has only a number of large cities but a relatively high number of municipalities with 3 to 10 thousand inhabitants. An impressive large number of these municipalities are heated by district heating systems. A high percentage of them are fired by coal, others by oil or natural gas. Boilers are mainly well maintained but old, require imported fuel. The amount of biomass, which could be annually used in these conditions in the SR for heat and electricity generation, is enormous.

The impulse to reconstruct the boiler plant at the UFE of the TU in Zvolen was considered by several circumstances, e.g. the end of the life-time of engineering equipment, „discovery“ of possibility to use own wood residue „waste“ as a fuel, expected efficient performance of a new boiler plant and possibility to reduce emissions.

The decisive impulse to go into reconstruction started with the winning project of the TU in Zvolen, in the competition „Project on energy saving and energy utilisation of biomass, or how to implement ideas of Kyoto ’97 Conference“, announced by the Dutch Government within the framework of the Programme PSO 1999/2001 for the SR in 1998. The winning project obtained a grant of one million Dutch guilders from the Dutch Government for its implementation in period January 1999 – June 2001.

The aim of the project was to switch from brown coal to own wood residues (wood chips) – biofuel with significant improvement of boiler plant performance considering environmental protection.
Source and characteristics of raw materials

Renewable energy sources (RES) like biomass, hydro and solar energy form a promising alternative to fossil fuels. Especially biomass energy offers good opportunities. Biomass energy has the potential to combine economic, environmental and social benefits.

UFE activities cover 11,792 ha of forest with planned annual harvesting of 45,000 m³ of woody logs, of that after the first stage processing approx. 16,650 m³ remain as wood residues used only in limited way. After the sizing and moisture content (MC) processing the part of this amount is able to cover fully the demand of the new biofuel fired boiler plant. 500 – 600 tons of woody chips in quality as specified in the next part is necessary to cover one year's operation.

Fuel specifications:

- Fuel will consist of clean wood material in the form of wood chips or mixture of wood chips and sawdust.
- Required minimum of LHV of woody fuel is 8.5 MJ·kg⁻¹, which is equivalent to maximum MC of the biofuel of approximately 50 % on a wet basis (wb).
- Maximum of ash content of the fuel is 2.0 % on a dry basis (db).
- Maximum of size of wood chips is 35 mm.
- Not allowed as fuels (neither for co-combustion purposes) are:
  - contaminated wood with heavy metals, paint residues, plastics and other materials;
  - fossil fuels: coal (brown and hard), natural gas, etc.
- It is allowed to replace part of the woody fuel by bark and/or leaves as the total fuel mixture meets the fuel quality requirements (minimum LHV, maximum ash content, maximum size) as above specified.

Technology

Biofuel fired boiler plant as specified further can be considered as the pilot plant of its type, which can be used as the example for further similar projects, where there are suitable conditions for its implementation.

Hot-water three-draught boiler KARA with heat capacity 605 kWth. Fuel is supplied from next-to-boiler stock in boiler plant by hydraulic advance motion conveyer "walking floor" into screw conveyer, this one automatically batches the fuel to burning chamber, where the fuel is burned at the stage grate. Burning air is supplied by fan to several burning zones, where burning quality and air/fuel ratio is controlled by "lambda" probe.

A burning chamber is equipped by moving stage grate with hydraulic drive. Grate was specially designed for burning of fuels with high MC (up to 50 %), and of course the manufacturer provides guarantees to meet emission limits of our legislation as well as the legislation of the European Union. A boiler is operated automatically under supervision only and they are very well regulated in range of 40-100% of capacity. In after-burning chamber the flue-gas is fully mixed up with the slight delay at the temperature above 1000°C, kept in order avoiding excessive generation of NOx. Flue-gas heat exchanger ensures, the flue-gases are cooled down to 200 °C. The parts of flue-gas heat exchanger, exposed to increased corrosive influence in operation, can be easily and quickly replaced with minimal labour.
Flue-gas cleaning

Flue-gas fans transport flue gas via multi-cyclone dust separator into stack. Trapped ash is supplied via clamp carrier feeder into container. The parameters of flue-gas cleaned mechanically are in compliance with emission limits.

Emissions achieved under reference conditions:
Particulate = 80-120 mg.Nm\(^{-3}\) (<150 mg.Nm\(^{-3}\) at the 11 % O\(_2\)),
CO = 80-150 mg.Nm\(^{-3}\) (<850 mg.Nm\(^{-3}\)),
NO\(_x\) < 200 mg.Nm\(^{-3}\) (<650 mg.Nm\(^{-3}\)),
VOC < 10 mg.Nm\(^{-3}\) (<50 mg.Nm\(^{-3}\)), it is unburned organic matter indicated as total organic carbon (C in flue-gases), SO\(_2\) does not considered because sulphur content in dendromass is negligible.

Measurement and control

The boiler and the whole engineering part are fully automated from the fuel supply part to the flue-gas takeoff. Measuring devices and control system - monitors controls and optimizes mainly the burning process in itself.

2.9.2.3 District heating plant fired wood chips from SRC plantation as the demonstration of an alternative fuel and heat supply system

Company data

Company name: MENERT-THERM Ltd., (MENERT-THERM, s.r.o.)

Contact

Contact persons for references: Prof. Dr. Jozef Viglasky (speaking languages - English)
Ing. Gabor Smatana (speaking languages - English)

Address: Hlboka 3, 927 01 Sala, Slovak Republic;
Email addresses: viglasky@vsld.tuzvo.sk ; smatana@menerttherm.sk
Phones: +421907874420, +421455206875; +421317706047; +421907748977
Fax: +421455206875; +421317705795;
Skype ID: Viglasky Jozef, Prof. Web pages: www.menerttherm.sk
Short description

One of the possibilities of how to replace, at least partly, the conventional energy carriers - fossil fuel in DH systems (a high percentage of them are fired by coal, others by oil or natural gas) is offered by biomass. Biomass fired DH boilers could offer an attractive solution for today as well as for tomorrow energy sector of Slovakia.

Slovakia has only a number of large cities but a relatively high number of municipalities with 3 to 30 thousand inhabitants. An impressive large number of these municipalities are heated by DH systems. A high percentage of them are fired by coal, others by natural gas. Boilers are mainly well maintained but old, require imported fuel. The amount of biomass, which could be annually used in these conditions in Slovakia for heat and electricity generation, is enormous.

The decisive impulse to go into reconstruction started with buying this boiler house in Sala, in June 2006. Support impulses to reconstruct the boiler plant of 0.7 MWt in Sala were considered by several circumstances, e.g. the end of the life-time of engineering equipment, „discovery“ of possibility to use industrial wood residue - „waste“ as a fuel or agro-biomass, expected efficient performance of a new boiler plant and possibility to reduce emissions.

The initial aim of the new owner – company MENERT Ltd. was to switch from brown coal to more environmentally friendly fuels, e.g. industrial wood residues (wood chips) or wood chips from SRC plantations – biofuels with significant improvement of boiler plant performance considering environmental protection.

Source and characteristics of raw materials

Renewable energy sources (RESs) like biomass, hydro and solar energy form a promising alternative to fossil fuels. Especially biomass energy offers good opportunities. Biomass energy has the potential to combine economic, environmental and social benefits within regions.

Company MENERT Ltd. has rented land of 160 ha for establishment of SRC willow plantation (in 2006) as a sustainable resource of woody biomass – feedstock for wood chips production in vicinity of the town Sala for period of ten years (Dolne Saliby, area – Valley of river Vah). This SRC plantation was the first established in connection with feedstock production to be used for local DH network in Slovakia.

Lessons learnt

It is assumed that the pilot project of DH in Sala will initiate similar projects in West Slovakia as well as all over Slovakia. As mentioned above it can be expected, that the project in Sala can represent a key contribution to further development of not only local utilisation of biomass – biofuels but in other energy sectors as well. Parallel to the transition of the property on the district heating system, the communities and some private people get forests back in the restitution process. Same situation is in the dwellings sector.

So fuel, energy production and distribution system and the consuming part is in one hand. But still traditional fuels are used for the systems and the communities fuel bills are getting higher and higher. This leads many of the city councils to the idea to substitute coal and natural gas by biomass from SRC plantations.

Parallel to the transition of the property on the district heating system, the communities and some private people get forests or land back in the restitution process. Same situation is in the dwellings sector.

So fuel, energy production and distribution system and the consuming part is in one hand. But still traditional fuels are used for the systems and the communities fuel bills are getting higher and
higher. This leads many of the city councils to the idea to substitute fossil fuels - coal and natural gas by biomass from SRC plantations.

2.9.3 Socio-economical assessment of the best practices in Slovakia

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ The resources of biomass in Slovakia are more than sufficient to achieve its set objectives for year 2020 which are also stipulated in the EU Directive 2009/28/EC on the promotion of the use of renewable energy carries;</td>
<td>✔ Significantly higher investment demand into the construction of biofuels fired heat &amp; power plants, compared to the power plants burning fossil fuels – capital costs increase the cost price of the energy produced;</td>
</tr>
<tr>
<td>✔ The major part of the investments into the development of the biomass (purchasing local biofuels, building heat plants, buying the produced green heat and electricity) in the DH sector will remain in Slovakia;</td>
<td>✔ In the course of biofuels projects, the following barriers and limitations of the administrative procedures for the construction of biofuels-fired power plants can be faced:</td>
</tr>
<tr>
<td>✔ Most of the energy companies possess the possibility to use different types of fuel. The use of biofuels at district heating plants is constantly growing. The heat produced by district heating plants burning biofuels is cheaper than the heat produced using fossil fuels;</td>
<td>o Complicated planning procedures. Long-lasting issuance of energy production permits. Long territory planning procedures (from 1 to 2 years). The preparation process of the design documentation is slowed down by drafting the detailed plans, coordination procedures with the community and the assessment of the impact upon the environment.</td>
</tr>
<tr>
<td>✔ The existing incentives of the profit tax for companies investing into scientific research, development or performing investment projects, could be also applied to the companies engaged in the energy production base on renewable energy carriers;</td>
<td>o The development of biofuels is regulated by many institutions, but the lack of coordination among different institutions and in issuing of licenses is obvious.</td>
</tr>
<tr>
<td>✔ Information, education and consultation activities, preparing and releasing to the society publications about the wider use and benefits of biofuels, seminars, conferences, competitions, TV and radio shows and other kind of educative media programs are currently carried out.</td>
<td>o Local and regional authorities lack the knowledge about the advantages of the biofuels use within the DH sector. Besides, the public knowledge and understanding of the renewable energy curriers, technologies applied and benefits is insufficient too.</td>
</tr>
<tr>
<td>✔ Fossil – non renewable from saving</td>
<td>o The use of forest-cutting residue for fuel is limited by environmental requirements, excessive restrictions associated with biofuels production set forth in the Basic regulations for forest harvesting.</td>
</tr>
<tr>
<td>- practically it is not possible to exploit RESs</td>
<td>o The detailed statistic information (no regional statistics is actually available) on all biofuels resources, forest residues, straw and grassland biomass resources and their utilization for energy production is not sufficient enough. No statistic</td>
</tr>
<tr>
<td>- do not contribute to greenhouse effect</td>
<td>- money saving for fossil fuels payment</td>
</tr>
<tr>
<td>- do not contaminate environment with ashes, sulphur and nitrogen oxides, etc.</td>
<td>- state culture maintenance – reward on</td>
</tr>
<tr>
<td>- money saving for fossil fuels payment</td>
<td>- fossil – non renewable from saving</td>
</tr>
<tr>
<td>- state culture maintenance – reward on</td>
<td>- fossil – non renewable from saving</td>
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<tr>
<td>Opportunities</td>
<td>Threats</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>- chance inutilted and unsuitable land for food production exploitation</td>
<td>- information is sufficient on the extent of biofuels, employed in each municipality and the needs of every economy sector.</td>
</tr>
<tr>
<td>- processing and exploitation of unimportant vegetable products and residuals from VP (straw and others)</td>
<td>o There is also lack of support for establishing small enterprises in rural areas producing biofuels (wood chips) from straw and grass, as well as for the modernization of the heating systems of public buildings located in rural areas – adapting them for burning local straw, grass or reed biofuels (wood chips), i.e. using the cheapest local fuels in the rural regions.</td>
</tr>
<tr>
<td>- exploitation of pulverized residuals from different activities (public greenery maintenance, country maintenance, industry, packaging’s, pellets and containers)</td>
<td>o The manufacturing of the equipment used for the biofuels burning in the heat &amp; power generation facilities is not promoted as well.</td>
</tr>
<tr>
<td>- long term price stabilization of heating</td>
<td>o Municipalities are not directly involved in the implementation of the promotion policies of the biofuels utilization.</td>
</tr>
<tr>
<td>- increase of anti erosion land prevention and minimizing of nitrate leakage from soil to ground waters and surface waters by energy plants growing.</td>
<td>o Energy appearance is in law density – concentration and often harvesting has to be realized from large areas.</td>
</tr>
<tr>
<td></td>
<td>o In numerous cases energy has to be stored to eliminate deflection in energy production.</td>
</tr>
<tr>
<td></td>
<td>o Some energy types RES can have negative impact on environment.</td>
</tr>
<tr>
<td></td>
<td>o Considering the deflections and various unpredicted circumstances is necessary to have standby energy source from fossil fuels.</td>
</tr>
<tr>
<td></td>
<td>o RECs are not able to cover the whole energy consumption. Estimation is 20 % of current consumption.</td>
</tr>
<tr>
<td></td>
<td>o Non comfortable transport against gas.</td>
</tr>
<tr>
<td></td>
<td>o High initial investments, required funding support.</td>
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</tbody>
</table>
The biofuels development in the Slovakian DH sector would enable to:
- Reduce the relative environmental pollution in the country;
- Create additional new jobs;
- Improve energy safety of the country (reducing the dependency on the fossil fuel imports);
- Improve import/export balance;
- Balance the development of regions;
- Stabilize the heat prices;
- Positive attitude of the authorities towards the development of the biofuels use, the interest of business people and the society in the implementation of biofuels projects creates presumptions of more favourable conditions for biofuels utilization and realization of new promotion measures;
- Slovak energy dependence on one energy source and one energy supplier, considerable increase of natural gas prices within recent years (comprising 80 percent of the fuel balance of district heating companies; after the decommissioning of Jaslovske Bohunice Nuclear Power Plant, the demand of natural gas in the power generation sector increased by 50 percent), approximately twice lower biofuels price compared to the natural gas prices, commitments to the European Union on reducing greenhouse gas emissions as an incentive to develop the use of biofuels and to implement new promotion measures;
- Modernization of the existing district heating systems would enable to expand heat and power generation in cogeneration plants, hence using biofuels more effectively. Expansion of low-power cogeneration plants, the use of alternative types of transport fuel makes it possible to reduce the use of fossil organic fuels and the directly-related air pollution. The increase of biofuels use in the district heating sector would reduce the heat prices for the consumers;
- The financing of the biofuels development could be carried out by taxing fossil fuels;
- There is a possible cooperation with other European Union Member States and third

Without settlement of legal and economical issues on the implementation of the heat production using biofuels, the potential of increasing the biofuels use can be missed;
- Low level of the government support for the implementation of biofuels projects and bureaucratic barriers will hinder the development of the resources. The delay in mastering the most modern technologies for using the resources will not allow in the future to use them in due time and effectively;
- The growing use of biofuels in the DH systems and its increasing demand may increase the biofuels prices, especially if the gas prices continue to rise;
- The increasing volume of wood-based biofuels production, would lead to the employment of more expensive and less accessible wood waste resources. This can also increase the prices of biofuels.
countries through joint projects related to the heating and cooling production base on biofuels;
✓ In the event that the part of the renewable energy carriers exceeds 14 percent (or results to be achieved) of the total final Slovakia's energy consumption, this kind of surplus could be transferred to other European Union countries, and the revenues received could be used for financing biofuels projects.
✓ creating new jobs
✓ Interesting program for agriculture and industry
✓ contribution to region development by keeping the money saved on spending for fossil fuels in the region, ability of exploitation them for renewal and development
✓ Strengthening the prosperity of local farmers and foresters, executors and entrepreneurs in biomass on local level
✓ Economy improvement of population in rural areas

2.9.4 Summary

To increase the part of the renewable energy carries of the total energy consumption to not least than 14 percent, the greatest contribution could be brought in by the biofuels use in the district heating sector, because approx. 50% of consumed energy is used for heating and DHW. According to the economy factor, the lowest relative investment volume into one power unit belongs to the district heating plants, and they have the best possibilities to use different types of solid biomass and its mixtures.

This would enable to reduce the heat price for the consumers, hence reducing the dependence of this sector from the fossil fuel imports. In view of the technological possibilities and economical feasibility of the district heating sector, by year 2020 it would be possible to increase the heat production base on renewable energy carriers up to 50 percent.
2.10 Lithuania

2.10.1 Social-economic assessment in Lithuania

• Regional agriculture sector in Lithuania

Currently, there are almost 1,000 ha of SRC plantations growing in Lithuania. However, considering that vast majority of the plantations are still young, very few of them have been harvested. The first industrial harvest of SRC plantations is planned for the end of winter 2012, for this reason there are still no valuable results to be indicated.

Based on The National Energy Strategy of Lithuania (2007) one of the national energy development targets is further development of variety of primary energy resources and rapid increase of the share of renewable and local energy sources. Biomass from SRC plantations is indicated as one of the resources for this increase. According to the National Energy Strategy, the potential of SRC plantations in Lithuania is around 70 000 toe/year (tons of oil equivalent per year), which equals to approximately 11 000 ha of SRC plantations planted. This goal has to be reached until year 2020\(^1\).

• Employment

According to the LDHA information (see chart below), the number of employees in DH companies has been constantly reducing during last years. The reason for this decrease is modernization of DH systems, that started with Lithuania’s membership in European Union and Europe’s structural funds support. The statistics for employment in biomass sector in general or in SRC sector particularly, is not available.

Figure 30: Employment in Lithuania

![Employment Chart]

• Institutional aspects

The experience of Lithuania and other European Union countries shows that the development of RES for energy production is not possible without special support schemes. On the other hand, the renewable energy often provides the society with considerable “external” benefits, like creation of new jobs, improvement of import-export balance, dependency reduction from foreign energy resources, reducing global warming and etc. The state simply transfers part of the “external"
benefits to the energy producers from RES, motivating the investors to behave in the best interest for the state itself. For example, the experience of Scandinavian countries shows that this kind of policy promotes the competitiveness of the countries.

The investments into the construction of facilities using RES are partially subsidized by using the financial resources of the EU Structural funds and other resources. The national grant aid is mainly allocated through the Lithuanian Environmental Protection Investment Fund (LEPIF).

Partial funding of planting the SRC plantations is indicated in Rural development facility for Years 2007-2013. Under the Rural development facility for years 2007-2013 “Modernization of agricultural holdings“ Activity III - “Growing of short rotation coppice“ the support for planting the SRC plantation is between 50-70 % (depending on various conditions) of costs incurred44. However, this support is not sufficient in order to obtain constant growth of SRC plantations, because it is necessary to provide at least 50–70% support for maintaining the plantation during the second year after planting, and in case if the willows are used for the expansion of the plantation, the support should be provided also for the third year of their growth.

2.10.2 Review of the most significant success stories and best practices found in Lithuania regarding the use of SRCs as a source of energy for district heating

2.10.2.1 One of the most powerful biofuel boiler in Eastern and Central Europe launched in Vilnius

In October 2006, one of the most powerful in Eastern and Central Europe cogeneration boiler operated on biofuel was launched in Vilnius. The boiler is able to produce 9 % of the heat energy supplied to the capital of Lithuania and 50 % of the hot water produce during the non-heating season. In total, “Vilniaus energija“ has invested into the construction of this boiler house about 40 million LTL.

This investment enabled not only to decrease the pollution rate in the city but also contributed to the increase of the state independence from the Russian natural gas imports. Besides, the boiler house operated on the local Lithuanian biofuel enabled “Vilniaus energija“ to reduce the annual consumption of natural gas by 7 %. This is extremely important when the natural gas prices are increasing.

The heat energy, produced in the 60 MW steam boiler, equipped with fluidized-bed technology, in the form of steam is forwarded to the turbo generator. The turbine unit produces 48MW of heat and 12 MW of power energy. The electricity produced by the heat supplies is sold to the company “Lietuvos energija“. The fuel mix may also contain 10 % of straw and up to 30% of peat.

The boiler consumes about 23 t per hour of wood biomass – logging waste, wood chips, including wood chips from SRC, cuttings and sawdust. The fuel mix may also contain 10 % of straw and up to 30% of peat.

The biofuel boiler was installed at Vilnius Thermal Power Plant No.2, replacing one of the four boilers operated on mazout and natural gas. This power plant is operating already for 55 years and is the oldest energy utility in Vilnius.
The project management for the erection of the new biofuel boiler was consigned to the Finish company “Enprima” and the specialists of “Vilniaus energija”. The biofuel boiler was manufactured and installed by the Finish company “Kvaerner Power OY”. The design work, manufacturing and installation of the boiler house facilities, fuel supply, electric, automation and auxiliary equipment were carried out by the “Axis Industries” the biggest enterprise in Lithuania, implementing industrial and energy projects. The specialists of this company also installed the imposing fuel belt-conveyor of 125 meters length, lifting biofuel to 24 meters altitude. The electro-static precipitator with its auxiliary equipment was manufactured by the well-known German company “Balcke Dürr”. Part of the boiler house installation works were performed by other Lithuanian civil construction and installation companies.

“Vilniaus energija“ belongs to “Dalkia“ - the biggest group of companies providing energy services in Europe. On February 1st 2002, Vilnius district heating networks were leased to “Dalkia“ for the period of 15 years. “Dalkia“ is the only Western European energy enterprise that manages energy companies in Lithuania.

Figure 31: The new biofuel boiler and the adjacent modern storage of green fuel

Table 12: Technical characteristics of new biofuel boiler

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Wood, peat, straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler type</td>
<td>Reconstructed BKZ-75-39 to boiler with boiling sand layer (BFB type)</td>
</tr>
<tr>
<td>The ignition of biofuel</td>
<td>90 m³/h</td>
</tr>
<tr>
<td>Heat capacity</td>
<td>60 MW</td>
</tr>
<tr>
<td>Steam generation</td>
<td>75 t/h</td>
</tr>
<tr>
<td>Steam temperature</td>
<td>430 °C</td>
</tr>
<tr>
<td>Steam pressure</td>
<td>39 bar</td>
</tr>
<tr>
<td>CO (with 6% oxygen)</td>
<td>≤250 mg/Nm³</td>
</tr>
<tr>
<td>Solid fraction (with 6% oxygen)</td>
<td>≤50 mg/Nm³</td>
</tr>
<tr>
<td>NOx (with 6% oxygen)</td>
<td>≤400 mg/Nm³</td>
</tr>
<tr>
<td>Temperature of boiling sand layer</td>
<td>850 °C</td>
</tr>
</tbody>
</table>
2.10.2.2 New biofuel boiler house in Radviliškis

On March 26th 2010, the commission of the State Energy Inspection accepted for operations the new municipal boiler house of Radviliškis.

The new biofuel boiler house is equipped with the condensation economizer and cogeneration unit and is a new-generation boiler house, which will supply cheaper heat energy to the inhabitants of Radviliškis. The produced heat energy in the form of district heating water will be supplied to the town of Radviliškis. The new boiler house will increase the efficiency of electricity generation and utilization of renewable energy resources. The use of biofuel will contribute to the reduction of dependency on the imported fossil fuel and will decrease the heat production costs.

The following facilities are installed in the new boiler house: two 6,5 MW fire-grate biofuel furnaces, two 5 MW water heating boilers, 3,5 MW condensation economizer, 4 MW water heating boiler operated on natural gas and equipped with condensation economizer, 150 kW power and 190 kW heat capacity cogeneration unit with internal combustion engine “Tedom Cento” L150 operated on natural gas, warehouse for biofuel, 60 t car weighing-machine, battery-type multicyclones for the flue gas cleaning from hard particles.

The fire-grate biofuel furnace installed in the boiler house enables to use renewable energy resources as a fuel. The furnaces are designed to burn wood chips and sawdust. As well, up to 30% of straw and peat can be added to the above-mentioned fuel mix. The furnaces are also equipped with automatic mechanized fuel-feeding and ashes-removal systems, primary and secondary air feeding and flue gas recirculation systems. Utilizing the water steam volume of the outlet flue gases and the flue gas temperature, the condensation economizer produces up to 3,0 MW of heat energy.
in this way enabling to reduce additionally the cost of fuel used for the heat production. In addition, about 75 percent of the hard particles existing in the flue gases are collected in the cogeneration unit.

The erected 4 MW gas-fired water heating boiler will enable to utilize the biofuel boiler house for the municipal heat demand of up to 17.5 MW.

The representatives of the JSC “Radviliškio šiluma” were happy that the construction process of the new boiler house was completed without major problems and the construction works were finished by three months ahead the terms estimated in the financing and administrating contract No. S-VP3-3.4-ŪM-02-K-01-002, dated August 25th 2009, regarding the allocation of the EU financial support.

The project “Construction of Radviliškis municipal boiler house with condensation economizer and cogeneration unit” was financed by the EU Cohesion promotion actions program 2007–2013, priority No.3 “Environment and sustainable development”, implementation measure VP3-3.4-ŪM-02-K “Utilization of renewable energy resources for power generation”.

The residents of Radviliškis town and region, who use the district heating services provided by the JSC “Radviliškio šiluma” have already this year experienced the economic benefits of the new biofuel boiler house. The start-up and commissioning works of the two boilers commenced in January and lasted until the end of March. Provided that the biofuel is not started to be combusted in Radviliškis boiler house and further using natural gas, which prices are continuously increasing every month, for heat production, JSC “Radviliškio šiluma” would be forced to raise the heat energy price from the 1st of January of this year. But the company did not raise the heat price, therefore the inhabitants and organizations of Radviliškis saved a lot by paying less for heating. Furthermore, the volume of the greenhouse gas emissions will be known after the heating season 2010 – 2011.

2.10.2.3 Double celebration at Tauragės district heating company

In October 1998, Tauragės district heating company separated from “Klaipėda energy” and started working independently. During the first couple of years there were no economical difficulties due to the low fuel (mazout) prices. In 1999, during the main overhaul of one of the steam boilers DKVR-20-13 at Beržės district heating boiler-house (the inhabitants of Tauragė are provided with heat energy from this boiler-house), low pressure mazout burner from Swedish firm “Petrokraft” was installed, enabling considerably more economic combustion of mazout. When fuel (mazout) prices began to rise (Tauragė is in the zone with no natural gas infrastructure), the administration of Tauragė district heating company started looking for a solution to reduce the price of thermal energy production, to satisfy the consumers needs and to avoid ruining of the company. The prices for the heat energy produced by the company combusting mazout were considerably higher than those operated on natural gas. In addition, various environmental requirements limiting the combustion of heavy fuel oil contributed to the growth of the heat energy prices.

Therefore in 2003, water heating boiler of 8 MW capacity operated on biofuel was constructed and put into operation at Beržės boiler-house of Tauragės district heating company. At that time Beržės district heating boiler-house was equipped with 55 MW water heating boiler, operated on mazout, which was actually not exploited. Under the proposal of the company administration, JSC “Kazlų Rūdos Bioprojektas” completed the design of 12 MW biofuel steam boiler equipped with partial superheated steam furnace and two 250 KW steam turbo generators.

In 2006 Tauragės district heating company took the loan from the bank and from its own funds started exploiting the 12 MW steam boiler, operated on biofuel. The two 250 KW turbine units have not been manufactured and installed.

At the same time condensation economizers were installed in the Lithuanian companies “Klaipėdos timber”, Utenos district heating company and others. After calculations the company administration decided to design and install the 7 MW condensation economiser for both boilers, operated on biofuel, in this way saving 20–30 percent of the heat energy. Since at that time no company in Lithuania could manufacture the turbine, the option of constructing one 750 KW turbine unit was
selected, to produce electricity for auto consumption and sales, although earlier it was planned to produce electricity only for the own needs of the company. Hence in parallel, the condensation economizer and 750 KW turbo generator were constructed. The condensation economizer was put into operation on March 2007.

The testing of the 750 KW turbo generator took a long time and was carried out patiently and with various obstacles. Finally, all requirements were fulfilled and on October 1st 2008 the 750 KW turbine unit was accepted by the state commission. On October 20 2008 the license for the electricity generation was received from the Ministry of Economy.

The same day, October 20th, Tauragės district heating company was awarded the “Crystal chimney” prize for the “cleanest chimney” in Lithuania. The contest, which company would have the lowest CO$_2$ emission rate in 2005–2007, was organized by the Lithuanian Environmental Investment Fund (LAAIF).

In terms of absolute rate of emissions, Tauragės district heating company cannot be compared e.g. to “Vilniaus energija”, which has 60 MW boiler operated on biofuel, but according to the generated production unit rate, its indicators were the best. The fuel consumption rates at Tauragės district heating company are as follows:

- In 2004, 4521 tones of mazout and 18 154 m$^3$ of biofuel were combusted and 87 037 MWh of heat energy was produced; in 2005 – accordingly: 4 425, 24 138 and 81 432; in 2006 – 1 513, 39 126, 94 204; in 2007 - 860, 37 671, 78 906.

- In 2005, CO$_2$ emissions volume – 13 821 t, whereas in 2007 – 2 668 t.

The combustion volume of biofuel decreased because in 2007 the condensation economizer was introduced. In 2007, 85 % of heat energy was produced burning biofuel. This is a significant obligation for the future to comply with environmental protection requirements.

Hence October 2008 was a double celebration for Tauragės district heating company: finally the long-awaited turbine unit was put into operation and the “Crystal chimney” prize was gained.

2.10.3 Socio-economical assessment of the best practices in Lithuania

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<td>Directive 2009/28/EC on the promotion of the use of energy from</td>
<td>fuel – capital costs increase the cost price of the energy produced.</td>
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<td>renewable sources.</td>
<td>In the course of biofuel projects, the following barriers and limitations</td>
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<td>The major part of the investments into the development of the biomass</td>
<td>of the administrative procedures for the construction of biofuel-fired</td>
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<td>(purchasing local biofuel, building power plants, buying the produced</td>
<td>power plants can be faced:</td>
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<td>green heat and electricity) in the DH sector will remain in Lithuania.</td>
<td>- Complicated planning procedures. Long-lasting issuance of energy</td>
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<td>Most of the energy companies possess the possibility to use different</td>
<td>production</td>
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<td>types of fuel.</td>
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</table>
The use of biofuel in district heating plants is constantly growing. The heat produced by district heating plants burning biofuel is cheaper than the heat produced using fossil fuels.

- The existing incentives of the profit tax for companies investing into scientific research, development or performing investment projects, could be also applied to the companies engaged in the energy production form renewable energy sources.
- Information, education and consultation activities, preparing and releasing to the society publications about the wider use and benefits of biofuel, seminars, conferences, competitions, TV and radio shows and other kind of educative media programs are currently carried out.

Permits. Long territory planning procedures (from 1 to 2 years). The preparation process of the design documentation is slowed down by drafting the detailed plans, coordination procedures with the community and the assessment of the impact upon the environment.

- The development of biofuel is regulated by many institutions, but the lack of coordination among different institutions and in issuing of licenses is obvious.
- Local and regional authorities lack the knowledge about the advantages of the biofuel use in the DH sector. Besides, the public knowledge and understanding of the renewable energy sources, technologies applied and benefits is insufficient too.
- The use of forest-cutting waste for fuel is limited by ecological requirements, excessive restrictions associated with biofuel production set forth in the Basic regulations for forest harvesting.
- The detailed statistic information (no regional statistics is actually available) on all biofuel resources, forest waste, straw and grassland biomass resources and their utilization for energy production is not sufficient enough. No statistic information is sufficient on the extent of biofuel, employed in each municipality and the needs of every economy sector.
- There is also lack of support for establishing small enterprises in rural areas producing biofuel (wood chips) from straw and grass, as well as for the modernization of the heating systems of public buildings located in rural areas – adapting them for combusting local straw, grass or reed biofuels (wood chips), i.e. using the cheapest local fuel in the rural regions.
- The manufacturing of the equipment used for the biofuel combustion in the heat & power generation facilities is not promoted as well.
- Municipalities are not directly involved in the implementation of the promotion policies of the biofuel utilization.
<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Threats</th>
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</thead>
<tbody>
<tr>
<td>• The biofuel development in the Lithuanian DH sector would enable to:</td>
<td>• Without settlement of legal and economic issues on the implementation of the heat production using biofuel, the potential of increasing the biofuel use can be missed.</td>
</tr>
<tr>
<td>o Reduce the relative environmental pollution in the country.</td>
<td>• Low level of the government support for the implementation of biofuel projects and bureaucratic barriers will hinder the development of the resources. The delay in mastering the most modern technologies for using the resources will not allow in the future to use them in due time and effectively.</td>
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<td>o Create additional new jobs.</td>
<td>• The growing use of biofuels in the DH systems and its increasing demand may increase the biofuel prices, especially if the gas prices continue to rise.</td>
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<tr>
<td>o Improve energy safety of the country (reducing the dependency on the fossil fuel imports).</td>
<td>• The increasing volume of wood-based biofuel production, would lead to the employment of more expensive and less accessible wood waste resources. This can also increase the prices of biofuel.</td>
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<tr>
<td>o Improve import/export balance.</td>
<td></td>
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<tr>
<td>o Balance the development of regions.</td>
<td></td>
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<tr>
<td>o Stabilize the heat prices.</td>
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<tr>
<td>• Positive attitude of the authorities towards the development of the biofuel use, the interest of business people and the society in the implementation of biofuel projects creates presumptions of more favourable conditions for biofuel utilization and realization of new promotion measures.</td>
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<tr>
<td>• Lithuania’s energy dependence on one energy source and one energy supplier; considerable increase of natural gas prices within recent years (comprising 80% of the fuel balance of district heating companies; after the decommissioning of Ignalina Nuclear Power Plant, the demand of natural gas in the power generation sector increased by 75%), approximately twice lower biofuel price compared to the natural gas prices, commitments to the European Union on reducing greenhouse gas emissions as an incentive to develop the use of biofuels and to implement new promotion measures.</td>
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<td>• Modernization of the existing district heating systems would enable to expand heat and power generation in cogeneration plants, hence using biofuels more effectively. Expansion of low-power cogeneration plants, the use of alternative types of transport fuel makes it possible to reduce the use of fossil organic fuels and the directly-related air pollution. The increase of biofuel use in the district heating sector would reduce the heat prices for the consumers.</td>
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<tr>
<td>• Investment into the production of biofuel and its technologies would increase the employment and would contribute to the</td>
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</table>
economic stimulus. Lithuania could become one of the countries creating and exporting biofuel technologies.

- The financing of the biofuel development could be carried out by taxing fossil fuels.
- There is a possible cooperation with other European Union Member States and third countries through joint projects related to the heating and cooling production using biofuels.
- In the event that the part of the renewable energy sources exceeds 23% (or results to be achieved) of the total final Lithuania’s energy consumption, this kind of surplus could be transferred to other European Union countries, and the revenues received could be used for financing biofuel projects.

2.10.4 Summary

To increase the part of the renewable energy sources of the total energy consumption to not least than 23 percent, the greatest contribution could be brought in by the biofuel use in the district heating sector. According to the economy factor, the lowest relative investment volume into one power unit belongs to the district heating plants, and they have the best possibilities to use different types of solid biomass and its mixtures.

This would enable to reduce the heat price for the consumers, hence reducing the dependence of this sector from the fossil fuel imports. In view of the technological possibilities and economic feasibility of the district heating sector, by year 2020 it would be possible to increase the heat production from renewable energy sources up to 50%.

Another part of the renewable energy sources could be increased in the electricity and decentralized heating sectors.
3 SUMMARY AND CONCLUSIONS

SRC plantations offer additional possibilities, in respect with plantation management, the commercial practice of SRC plantation culture could frequently conflict with the interests of nature and culture conservation. An active dialogue between commercial growers and nature/culture conservationists, as well as the development of guidelines for the establishment and sustainable, environmentally friendly management of SRF plantations on agricultural land will facilitate feasible compromises between the two sides. Environmental risks associated with SRC plantations, if tree plantations are managed according to the principles of best practice, they are unlikely to endanger the environment by means of groundwater contamination. In contrast with the potential risks of nutrient leakage from fertilized plantations, the plantations of SRC – fast growing trees can offer great possibilities for environmental control at a local scale in terms of, for example, phytoremediation. Thus, based on the large nutrient quantities taken up by fast growing trees, the plantations can be used as recipients for municipal wastewater and industrial sludge and simultaneous biomass production – multifunctional biomass plantations. Plantations of fast growing trees for example willow (Salix spp.) offer great possibilities for the efficient use of agricultural land in many regions in Central Europe. If the biomass produced is used as bio fuels, the plantations have a great potential to contribute to carbon managed future economies, because they contribute only marginally to the production of atmospheric greenhouse gases. By combining biomass production and phytoremediation in tree plantations, waste products from society (waste water, sludge, ash) can be used as resources to improve tree growth and generate added values in terms of both environment and economy. Plantations of fast growing trees grown on agricultural land can improve bio-diversity at landscape level, in particular, if the plantations are established instead of cultures of cereals and spruce or fallow ground in homogeneous agricultural landscape. These tree plantations can positively affect soil properties compared to conventional agriculture. Particularly plantations of relatively small size offer great possibilities for landscape design, because they are an exciting new feature in most regions and can enhance the aesthetic value of landscape by adding variation and structure.

This report appeared many advantages and benefits of the SRC crop plants and the use of biomass from SRC as a renewable source of energy, resulting in resource saving non-renewable fossil fuels, stimulating the development of new technologies and increase energy security. Featured success stories in the countries studied, confirm that this is a very good alternative for the DH sector that should be disseminated and promoted on a large scale.
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