

# Study Tour in Poland

May 15<sup>th</sup>–18<sup>th</sup>, 2011



## Aim of the Study Tour

Polish study tour provided the opportunity to get to know by the stakeholders local/national conditions and regulations, learn problems, which occurred during the operation of the units and exchange experiences from their management. This knowledge may foster the sustainable exploitation of biomass within the EU by eg. creating more effective political measures. Together with project partners the selected group of students from AGH-UST was participating within the study tour. As one of the result of their contribution to the Project is the dissemination activity among their study and/or work places. Among them was one student, who invited us to his agricultural household, heated by small scale biomass boiler. This point previously was not scheduled but it was found by all participants very interesting. This example of sustainable use of biomass (in detail described below) has been the main outcome of the 4Biomass Project considering Polish conditions.

During the study tour from large to small scale units were visited. All site visits are presented in the details below.

## Location #1

Lagisza Power Station

Address: City of Bedzin, Slaskie Voivodeship

## General Information

Lagisza power plant operates in the following areas: electric energy generation; heat production, transmission and sales. Within power plant operates 5 units of 120 MWe each, which were put to operation from April 1967 to December 1970 and 1 unit of 460 MWe, which was put to operation in 2009. The gross power generation efficiencies of the units are, respectively, 35,8% and 44,3%.

Hard coal to fire the boilers is supplied by local coal mines mainly by rail and is characterized by the following parameters:

- Lower Heating Value – 20 MJ/kg
- Ash content – 20%
- Sulphur content – 0,6-1,2%
- Moisture content – 6-13%

## New unit - CFB Boiler

In 2001 the decision about constructing a new supercritical 460 MWe unit was taken. A technology of the supercritical circulated fluidized bed boiler (CFB) was chosen, which is characterized by clean combustion of coal. The construction commenced in 2006 and was completed in 2009. Currently, this CFB unit, due to its dimensions and parameters, is the world's biggest one.



Pic.1  
New unit of Lagisza Power Plant



Pic.2  
Steam turbine

The CFB Boiler is characterized by the following advantages:

- Fuel flexibility,
- Low SO<sub>2</sub>, Nox and dust emission,
- Uniform temperature along the combustion chamber,
- Relatively low furnace temperature.

The engine room for the new unit is provided with a turbine and generator manufactured by Alstom Power (Pic.2). New unit, as presented in Pic.1, is not equipped with a stack. Flue gasses are discharged by the cooling tower. Due to such solution flue gas is better diluted in the atmosphere.

One of the most important issue for the management staff of Lagisza Power Plant is environmental protection. Dust emissions have been reduced by 99,9% due to introduction of four-zone Electrostatic Precipitators (ESPs). To prevent nitrogen oxides emission low nitrogen oxide burners (HTNR) have been installed. Moreover, in 1998 the flue gas desulphurization plant was put to operation. Finally, Lagisza Power Plant has own water, soil and noise protection and waste management departments, which are responsible for protecting the neighborhood against its unfavorable influence. Currently, Lagisza Power Plant is making first preparations for co-firing biomass with hard coal.

## Location #2

Municipal Heating Station in Luban  
Address: City of Luban, Dolnoslaskie Voivodeship

## General Information



Pic. 3: The city of Luban. Source: Regional Environmental Center Luban

The city of Luban is located in southern west Poland and has ca. 23,000 inhabitants. The town was recognized as the most environmentally friendly municipality in Poland in 1994. Heat to the heating network is provided by two local coal/straw-fired boiler plants. The straw-fired facility constructed in 2001 is the largest unit burning straw in Poland.

## The Municipal Heating Station

PEC Luban - the Municipal Heating Station of the city of Luban was established in 1992. Previously heat to the grid was provided by two local coal-fired boilers: one smaller boiler (Srod miescie) with 7.5 MW capacity and one larger boiler (Piastr) with 17.5 MW capacity. In 2001 the straw-fired boiler plant was constructed. Till now those new units are treated as additional energy sources to the existing coal-fired boiler plant. This diversification of fuels provides the assurance of the heat demand and help in negotiating prices with farmers.

## Investment

The total investment cost amounted to ca. 1.6 million EURO. It was financed by own funds (0.6 million EURO or 38% of the total), but it was also co-financed by EcoFund (0.7 EURO million or 43%) and a preferred loan from Voivodeship Fund for Environmental Protection and Water Management in Warsaw (0.3 EURO million or 19%).

The whole project included:

- the purchase of the equipment (tractor, press and trailer) to collect and transport straw

- the construction of a straw warehouse
- modernization of the existing heating infrastructure (heating substations and in-house connections)
- the construction of one 1 MW and two 3,5 MW straw-fired boilers in a new boiler-room

## Green jobs

PEC Luban has 60 employees who are collecting the straw, operating the boilers and maintaining the heating system. Collected straw is then baled into large straw bales (as presented in Pic.6). Considering large straw bales (at least 500 kg each) the direct employment impact of harvesting straw with tractors and other equipment is estimated to be 350 jobs/TWh.

According to the data provide by PEC Luban, in the 2004/2005 season, the total cost of operations for the 7 MW straw boiler included 13.6% for employee wages and 17.6% for the straw. In the case of the 17.5 MW coal dust boiler, wages were at the level of 7.9%, but the cost of culm (coal dust) was 44.9% of the total operating cost. This proves the fact that straw operations are more labor intensive, what leads to increase of local employment.



Pic.4

Automatic feeding line with the shredder



Pic.5

The straw storage building

## Fuel

During 2005, PEC Luban collected ca. 5,000 tonnes of straw from almost 3,000 ha. Straw is also delivered regularly by external providers (farmers). Most of the straw is stored in the stacking yards and the straw storage building (Pic. 5). From there straw is transported to the boiler room using automatic feeding line with the shredder (Pic.4), which cuts straw into pieces 6-8 cm long. The straw requirements are about 300 kg per hour during peak times.

The straw supplied to PEC Luban is checked in the matter of moisture content which has to be below 25%. Above that value the combustion efficiency decreases. Moreover, high moisture content may cause storing problems.

The combustion efficiency of the straw-fired boiler plant vary between 84% and 90% depending on the quality of the fuel. After the straw-fired boiler technology was implemented, approximately 30% of Luban's heat comes from straw and 70% from coal,

what correspond to the yearly savings of 2,500 tonnes of coal as concludes from Table 1 (below).

**Table 1: Heat Production in PEC Luban**

|                      | Year | 1999   | 2001   | 2003   | 2005   |
|----------------------|------|--------|--------|--------|--------|
| Heat from straw      | GJ   | 6725   | 30836  | 54824  | 53789  |
| Amount of used straw | Mg   | 718    | 2831   | 5069   | 4917   |
| Heat from coal       | GJ   | 161334 | 146331 | 117654 | 129090 |
| Amount of used coal  | Mg   | 9781   | 7734   | 5965   | 6931   |
| Total heat           | GJ   | 168795 | 178744 | 173976 | 184702 |

Source: PEC Luban

One of the main barrier identified on site is the fact that there is no financial incentive for producers of green heat although there are such for producers of green electricity (green certificates). Moreover, although farmers are very interested in the possibilities of selling straw for energy purposes, they have financial problems with investing in the necessary equipment for proper preparation of straw eg. compressing it into cubes.

## Location #3

Willow plantation in Zatonie  
Address: Zatonie Village, Lubuskie Voivodship

## General Information

The size of the willow plantation in Zatonie is 300 ha. It is the biggest field with the crops dedicated especially for energy purposes in Europe. Currently, only 125 hectares is under cultivation.

Some facts about the willow:  
Lower Heating Value – 12-14 GJ/tonne  
Average yield per hectare – 30-60 tonne  
Selling price – ca. 100 PLN/tonne

3 years-old willow is harvested in January or February, when willow has the lowest moisture content, all the leaves have fallen and the plants are dormant. In the next step, it is baled and stored in the stacking yard (Pic.7). Almost all willow is exported abroad (mostly to Germany). Some part of the willow (Pic.6) is used as an input for the production process of pellets. No part is intended to be used for heating purposes in Poland. Mostly due to lack of financial incentive for heat producers and lack of heating stations, which may effectively use such kind of fuel.



Pic.6  
Loading and transport of willow



Pic.7  
Stacking yard

## Location #4

Small scale biomass heating system  
Address: Wichow Village, Lubuskie Voivodship

## General Information

Small scale biomass heating system for residential and agricultural purposes was visited in the Wichow Village. The investment was realized in 2010 and it was financed in 100% by own funds. The power capacity of the boiler is 40 kW. Behind the boiler presented in Pic.8 the water buffer is installed with the volume of 5m<sup>3</sup>. Because the burning process of straw is very rapid, the heat from the combustion chamber (Pic.9) is transferred to the water buffer and then from there to the in-house heating circuit. The fuel for the boiler comes from own agricultural holding (6 ha of grain). According to first experiences, such area is more than enough for heating purposes of 200m<sup>2</sup> agricultural holding, although it is not insulated. During summer, biomass is used for heating DHW. The overall investment costs, which include: the construction of boiler room and chimney; purchasing of the boiler and water buffer; hydraulic and electric connections estimate around 40,000 PLN (ca. 5,000 EUR).



Pic.8  
Small scale biomass boiler



Pic.9  
Combustion chamber

## Location #5

Municipal Heating Station in Zabor  
Address: City of Zabor, Lubuskie Voivodeship

## General Information



Pic. 10: the city of Zabor

Zabor District has population of 3 617 people and area of 93.34 km<sup>2</sup>. 15% of its total budget (ca. 11 million PLN ~ 2,75 million Euro) is going for investments. In the picture above the city of Zabor is shown. The Municipal Heating Station is marked by the red "circle".

## The Municipal Heating Station

Conversion from coal based heating station to the straw based heating station has taken place in 2003/2004. The overall investment cost was 1,2 million PLN and was co financed by the National Environmental Protection Fund in 60%. The rest was financed by the commercial loans. According to the estimates the loans had been paid back after 5 years due to the savings obtained by burning cheaper fuel (straw).

The Heating Station provide heat for space heating and DHW to the nearby public school building, kindergarten, sports hall, municipal building and 60 flats. As present in Pic. 12 the heating station is equipped with 3 biomass boilers with the capacity 350 kW each.



Pic.11  
The straw storage building



Pic.12  
The biomass boilers

Straw is delivered by the local farmers to the straw storage building (Pic.11) according to the schedule, which has to be previously accepted by all fuel providers. The straw is collected from the range up to 30 km. The further distances lead to the higher prices of fuel and consequently to lose the tender for the supply. Currently, the price of straw estimates around 120 PLN per ton (LOCO Heating Station). For comparison, the present price of culm (coal dust) estimates around 600-650 PLN per ton. The yearly consumption of straw is estimated around 1000 tonnes.

The heating station is supplied with a buffer tank (50 m<sup>3</sup>) and heat exchangers for heating up the domestic hot water. Heating network is controlled by the return temperature of the heating medium.

In 2010 the grant for the solar heating system was awarded to the municipality. The solar system was designed to provide energy for heating DHW during summer season and consequently save biomass for the heating period. Unfortunately, due to the political decisions, the investment was not realized.