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# Feasibility study for a biomass combined heat and powerplant in the Free Economic Zone of Kaunas

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
Dipl.-Ing. Dr. Mario ORTNER

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30 september 2011 Antwerpen

# Affidavit

I, **Freddy Opsomer**, hereby declare

1. that I am the sole author of the present Master Thesis, "Feasibility study for a biomass combined heat and powerplant in the Free Economic Zone of Kaunas".
   233 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

Vienna, _____ _____

Date Signature

# Abstract

Lithuania has a well developed district heating sector covering about 50% of all heat. The RES share in the total heat production in 2010 was 19% (1,9 TWh) with an installed bio fuel boiler capacity of 391 MW. The aim is to produce, by 2020, up to 6,5 TWh from RES with an expanded capacity up to 1.487 MW. An investment program of 319 million euro is needed to achieve this goal. In addition CHP plants on RES, produce 172 GWh electricity with 22 MW installed capacity. Towards 2020 this has to grow to 322 MW and will require an additional 355 million euro investment.

The District Heating Company owned by Kaunas Municipality produced 1407,54 GWh in 2009. The Gazprom owned UAB Kauno Termoficacijos Electrinė has a 15 year contract up to 2018 to deliver 80% of all heat needs in Kaunas.

This study examines the Lithuanian CHP & district heating sector, the latest legal environment as well as the supply chains of biomass in perspective of the 2020 targets. A feasibility study is done for a cogeneration plant on biomass in one of the largest industrial parks in Lithuania: the Kaunas Free Economic Zone. Heat would be delivered to the Kaunas district heating network. In addition, a preliminary assessment is made on the possible instalment of a heat distribution network in the 500 ha park.

**Key words:** CHP, biomass, Lithuania, Kaunas, Free Economic Zone (FEZ), Kauno Energija.

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# List of acronyms

| | |
|---|---|
| APEC | Asia-Pacific Economic Cooperation |
| CFB | Circulating Fluidized Bed Reactor |
| CHP | Combined Heat And Power |
| DCF | Discounted Cash Flow |
| DHS | District Heating Systems |
| ERRA | Energy Regulators Regional Association |
| ETSAP | Energy Technology Systems Analysis Program |
| FEZ | Free Economic Zone |
| GJ | Gigajoule |
| GW(h) | Giggawatt(-Hour) |
| H/I | Harvest/Increment Ratio |
| HGP | Heat Generation Plant |
| IRR | Internal Rate Of Return |
| Ktne | Kilotons To Fuel Oil Equivalent |
| kW(h) | Kilowatt(-Hour) |
| LEIF | Lithuanian Environmental Investment Fund |
| LHV | Lower Heating Value |
| LTL | Lithuanian Litas |
| MARA | Minimum Allowable Rotation Age |
| MHa | Million Hectare |
| MW(h) | Megawatt(-Hour) |
| MWel | Megawatt Electric |
| MWth | Megawatt Thermal |
| NCCPE | National Control Commission For Prices And Energy |
| PPP | Public Private Partnership |
| RES | Real Estate Society |
| SFB | Stationary Fluidized Bed Reactors |
| SHGC | Solar Heat Gain Co-efficient |
| t.o.e. | Tons Of Oil Equivalent |
| TW(h) | Terawatt(-Hour) |

# 1 Introduction

## 1.1 Motivation

In the nineties I used to work for the Belgian National Railway group at one of their specialized companies for station development – Eurostation. My job was challenging, and I got even inspired by a sense of social responsibility. Our core business was about public transport, multimodal transport networks, stations and above all ”rail estate”. The station’s vocation was to become the centre of mobility in the ”rail city”. Urban densification at such transport networks should allow people to make full use of public transport for commuting between home and work. At that time, I did a Master of Real Estate at the University of Antwerp and I discovered that life cost of buildings was closely related to sustainability issues: “extending economic life to the real life cycle of building components and integrating externalities” was at the centre of the debate. The energy consumption of buildings became core issue, and only a few years ago, energy certification of buildings was introduced (Leed, BREEAM). Energy, sustainability and real life cost suddenly started to overwhelm the agenda for every real estate developer.

In 1998 my professional life took a turn and I became the coordinator of a tender consortium for a project launched by the Lithuanian Government: the development of a free trade zone in Kaunas. Members of the consortium were Transurb of the Belgian National Railway group, APEC, the harbour consulting company of the Port of Antwerp and private investors. The idea was to develop an industrial and logistic park at one of the most important transport corridors in the Baltic States. Kaunas region had to become a multimodal inland terminal within a broader freight village. In the urban master plan, a 1031 ha strategic land plot was reserved for our development.

The Kaunas free economic zone (www.ftz.lt) had a very long start-up period. This was due to the fact that the 1031 ha state land plot of the original tender suddenly became under restitution. Owners could reclaim the land they or their ancestors owned before the Second World War. Although we had won the international competition, we suddenly saw our land disappearing in private hands. It took us six

years of intense preparations to get our project back on track: the Lithuanian Government and the Seismas or Lithuanian parliament had to issue new legislation and decrees (including expropriation) to make the Free Economic Zone Kaunas possible. The territory was reduced to 534 ha. All that time, we did not lose our time and were able to convince Ryanair to establish a regional hub at Kaunas International Airport. The airport is our direct neighbour. In 2011 we have implemented first infrastructures: already 12 companies came to the free zone with a total investment of about EUR 50 million and 400 jobs were created.

Today in 2010, the project is at the point of no return. I can now focus on new important issues like sustainability. I became interested by the world's first carbon positive logistics building developed in central England by Gazeley. Gazeley has built more than 5,6 million square meters of warehouses and belongs to the Dubai World group (www.gpark-blueplanet.com). I was moved by such example of good practice and made a new challenge for myself: how to bring EU RES-policy in to the free economic zone of Kaunas. Through my MSc study at the TU Wien, I became aware of the complexity and the multidisciplinarity of such a project. The 2 years at the TU Wien brought me to the real "Universitas Universitarum": one has to be able to integrate economy, law, science, technology and emotional intelligence in order to make things happening!

The Kaunas FEZ is not only located at a major international transport hub, but is also in the centre of Lithuania, where huge forests and agriculture lands are available to contribute to a carbon positive regional planning. This brought me to the idea that maybe our 534 ha land plot could develop into a cluster for the biomass industry and maybe one day see a bio refinery. I contacted people in the bio refinery industry in the Benelux and became aware that such industry needs a large mature market of biomass generation, harvesting and processing. Such security of supply of biomass was not available.

Down to earth again, I took the idea to first attract a biomass cogeneration plant. As we were located at reasonable distance from the Kaunas District central heating supply system, I was told that the idea might work out. The subject was politically sensible as today more than 80% of district heating is delivered to the municipal

central heating company by a cogeneration plant on gas, owned by the Russian Gazprom.

Three Ministers in Lithuania (Economy, Energy and Agriculture) confirmed me to support the idea where needed. A Letter of Intent was signed with the district heating company Kauno Energija on the 29th of July 2010 and I am happy to say that facts have overtaken the timing of my thesis. An international investor recently leased land in our zone to build his own cogeneration plant!

## 1.2 What is the core question?

My thesis will focus on the feasibility of a biomass cogeneration plant in the FEZ Kaunas. I will address five major topics in my thesis:

- What is the actual *status of cogeneration and district heating in Lithuania*? Such background is essential if one likes to invest in a new market in a new country.
- *The legal framework to establish a RES-cogeneration plant in the FEZ*. The free economic zone is established by Law and is considered by the European commission as a form of state aid (clients receive the first 6 years a complete corporate tax holiday and the next 10 years a 50% cut off from the normal applicable tax rate). Can this form of state aid be combined with other support measures in the RES sector? The law includes a list of permissible activities in the free trade zone and this raises the question if energy generation is possible? Finally there is energy legislation and regulatory framework, where one can ask if a heat producer in the FEZ will be able to deliver heat to other companies in the industrial park. In addition, how will legislative acts condition the overall viability of the project?
- *Biomass availability and security of supply*. Although Lithuania has abundant forests and land reserves available for biomass cultivation – the supply market seems to be under-developed. That may put question to the security of supply and even force us to look for alternative fuels. I will therefore take an important part of my study to do an overall assessment of the biomass market in Lithuania.
- *Economic Analysis of the cogeneration plant*. This forms a central part of my thesis and I will integrate around a DCF (discounted cash flow) model the five major aspects:

- The capital investment, O&M aspects of the plant;
- The supply chain of biomass and the conditions of delivery;
- The heat demand of Kaunas District heating company and the conditions to sell the heat;
- The conditions and modalities to deliver electricity into the network;
- The bank-ability of such project s in Lithuania.

As the main question for my thesis handles the economic feasibility of a cogeneration plant in our company park, I ask myself of course an additional question: could my cogeneration plant deliver heat to actual and future companies in the park? It brings me in secondary order to the question of the economic feasibility of establishing a distribution network for heat in the 500 ha territory of the zone.

## 1.3 Citation of main literature

As main literature for my thesis, I like to mention main reference books I consulted in the field of:

- Biomass / Energy / combustion
  - Kaltschmitt et al.: Energie aus Biomasse. Springer Verlag, 2009. This book in German language is a real encyclopaedia and gives excellent information on the cultivation, harvesting, stocking, transport and logistics of biomass. In addition it gives all details about thermo-chemical conversion of biomass and has a good chapter 10.5 on cogeneration.
  - A similar interesting book in English I've read is: van Loo, S. and Koppejan, J.: The handbook on Combustion and Co-firing. The chapters 5 and 6 on combustion and cogeneration gave me good background for my thesis.
- Cogeneration – CHP more specialized books – I have consulted with detailed information on all aspects of technology, operation and maintenance
  - P. Boyce, M.P.: Handbook for cogeneration and combined cycle power plants, ASME press, 2010. This is a real detailed technical manual and the book does not cover the economics of cogeneration.
  - Meckler, M. and Hyman, L.: Sustainable on-site CHP systems, Mc Graw Hill, 2010. This was for me a real hands-on book for the investor containing 8 interesting case studies at the end.

In addition to these books I would like to mention a few standard reference documents that gave me the important background on the overall energy and RES policy of Lithuania:

- Lietuvos Statisitikos Departementas: Energy Balance 2010 (ISSN 2029-5944);
- National Renewable Energy Action Plan (NREAP) for Lithuania, http://ec.europa.eu/energy/renewables/transparency_platform/doc/national_renewable_energy_action_plan_lithuania_en.pdf);
- National Energy (Energy Independance) strategy Government resolution nr. 1426, 06 October 2010;
- Rosende, D. et al.: Renewable Energy Industry Roadmap for Lithuania, Fraunhofer Institute Systems and Innovation Research, Karlsruhe & Vienna University of Technology, Energy Economics Group, Vienna - REPAP 2020 program, http://www.repap2020.eu/fileadmin/user_upload/Roadmaps/Lithuania_RES_Industry_Roadmap.pdf.

All further specific literature sources will be mentioned in due course as you will go through my thesis.

## 1.4 Structure of work

My motivation clarified, the questions being formulated and reference literature cite, I have decided to structure my work as follows:

- *Introduction*
- *Cogeneration and district heating outlook in Lithuania*. As my work is about a large long term capital investment in a new market and a new country, I have given much attention to researching and understanding the actual overall situation of the market for cogeneration and the district heating in Lithuania.
- *Legal analysis for establishing a biomass cogeneration plant in the free economic zone of Kaunas*. Covering aspect of EU state aid, possibilities to distribute heat to clients of the FEZ and legal aspects of heat and power regulations.
- *Biomass market analysis Lithuania*. As this is a long term capital intensive investment, I have taken care of analyzing the actual critical supply chain of woodchips and the long term development perspectives in Lithuania and in Kaunas.

- *Economic feasibility*. I will cover the following aspects: choice of technology, CAPEX, dimensioning, in- and output parameters for the cash-flows sale of heat and power to the network, O&M aspects, the bank-ability of the project and possible state aid schemes. Central will be a discounted cash-flow analysis. In order to make sure the analysis is not theoretical, I have done a market consultation into a real life proposal for such plant. Out of three companies, one company agreed to give its input in this part of the research. I was able to visit them in Finland to have detailed discussions.
- *Preliminary feasibility of heat distribution network in the free economic zone*. As this is not the main topic of my thesis, I have done a preliminary assessment on the feasibility of the instalment of a heat distribution system and made a first calculation.
- *Overall conclusions*.

For easy reading, methodology of approach, used data and literature as well as results will be integrated in each of these chapters.

# 2 Cogeneration and district heating outlook in Lithuania

## 2.1 Lithuania's energy sector, district heating and cogeneration

After Lithuania regained independence in 1990, the heat production enterprises (with only a few exceptions) formed part of the central state energy system of the Republic of Lithuania. A list of special purpose state enterprises approved their regulations and placed those enterprises under the jurisdiction of respective authorities. Heat producing enterprises were placed under the supervision of the Ministry of Energy of the Republic of Lithuania, which became the incorporator of such enterprises pursuant to its regulations. The resolution listed 9 regional heat producing enterprises (including the Kaunas Combined Heat and Power Plant)[1].

The decentralisation of the management of the district heating enterprises started in 1993. Pursuant to a special resolution, the Ministry of Energy transferred the district heating enterprises and heating systems to the municipalities.[2]

On 19 April 1994, the Government of the Republic of Lithuania approved the Complex Development Plan of National Energy (the National Energy Strategy) and the principal directions of the National Energy Strategy were prepared by the

[1] Government of the Republic of Lithuania: List of State Companies of Special Purpose, Resolution No. 75. In: *Official Gazette*, No 8-238, 22 February 1991, http://tar.tic.lt/Default.aspx?id=2&item=results &aktoid=C51F9EAD-E26D-410D-918A-DA5DD72AB15D

[2] Government of the Republic of Lithuania: Improvement of the Heat Sector Management in Cities/Towns and Settlements, Resolution No 478. In: *Official Gazette*, No 26-613, 28 June 1993

Ministry of Energy[3]. The document lays down a course of actions for efficient district and decentralised heating, reconstruction and modernisation of the existing district heating systems, cost-effective installation of heat meters, reduction of heat loss, reconstruction of boiler stations into combined heat and power plants (if cost-effective), and ensuring the accumulation of reserve fuel stocks for each heat source.

Still in the same year, the Government of Lithuania adopted a Resolution on the Improvement of the Operation of the Heat Sector and Engineering Networks[4]. The Resolution instructed to transfer and include all group equipment for hot water preparation and the heating systems connected to the exterior walls of residential buildings in the balance sheet of the state enterprise, Lietuvos Valstybinė Energetikos Sistema. Municipalities were instructed to establish the procedures of operation of all the other hot water and heating systems in buildings that were not transferred to the previous company. The resolution stipulated that all entities operating and maintaining such equipment could claim the expenses from the residents. Relation and rules were determined between Lithuanian municipalities and the aforesaid state enterprise Lietuvos Valstybinė Energetikos Sistema.

The decentralisation of the district heating in Lithuania was difficult. Some municipalities managed their district heating systems (DHS) successfully (in particular the municipalities of larger cities, where the property of heating companies was relatively large and the heat distribution networks were in a relative good condition). Meanwhile the situation in smaller towns was more complicated: the municipalities were confronted with inefficient heat supply systems and consequently high heat supply costs. A number of municipalities chose to solve those problems by entering into long-term distribution network agreements with private operators. Currently, every fifth municipality has a private operator managing the district heating supply and distribution system. Private operators manage 40% of the Lithuanian DHS.

[3] Government of the Republic of Lithuania: National Energy Complex Development Plan (National Energy Strategy), Resolution No 288. In: *Official Gazette*, No 30-545, 19 April 1994

[4] Government of the Republic of Lithuania: Improvement of the Operation of the Heat Sector and Engineering Networks, Resolution No 729. In: *Official Gazette*, No 63-1236, 11 August 1994

The national commitment to the district heating sector development is clearly outlined in strategic documents (National Energy Strategies, 2002, 2007, and the latest 2010).

On 20 May 2003, the Parliament of the Republic of Lithuania adopted the Law on Heat Sector. The Law regulated the following important areas of the national heat sector: competition in the heat sector, cogeneration of heat and electricity as well as heat production from bio fuel and renewable energy sources, special planning of the heat sector, heat supply, maintenance of heating and hot water systems, etc.

Subsequently, the Government of the Republic of Lithuania enacted legislation enforcing the provisions of the Law. On 22 March 2004, guidelines for the development of the Lithuanian heat sector were approved by the Government of the Republic of Lithuania the first time round[5]. Different measures for national heat sector development were set out: indicators for the development of common electricity and heat production capacities, measures to reduce environmental pollution caused by heat production, measures to promote the use of RES in the production of electric power and heat. The first national guidelines for the development of the national heat sector stipulated that in 2010, the share of energy from renewable sources in the gross final energy consumption should be not less than 17% and reach 23% in 2020. In 2009 the percentage was 17% (Statistics Lithuania, 2011)[6].

Taking into account the planned closure of Ignalina NPP, Lithuanian DHS was modernised, i.e. power plants were developed into heating supply systems generating both electricity and heat. The costs of heat production at combined heat and power plants (CHP) are significantly lower. Most cities are still planning to construct CHP's in the future, while others, such as Vilnius, Kaunas, Klaipėda, Mažeikiai, and Elektrėnai already have them.

[5] Government of the Republic of Lithuania: Guidelines for the development of Lithuanian heat sector, Decision No. 307, 22 March 2004, http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=325045

[6] Lithuanian Department of Statistics: Darnaus vystymosi rodikliai, 2011, http://www.stat.gov.lt/uploads/docs/Darnus_vystymasis_2011.pdf?PHPSESSID

Up to 1990 when Lithuania regained independence from the Soviet Union, its power system was centrally organised with 2 major sources, the Lithuanian Thermal Power Plant (1800 MW on natural gas and heavy oil) and Ignalina Nuclear Power Plant (3000 MW). The system was designed for regional supply, including the whole North-West of the Soviet Union. This explains why the transmission grid, even today, is totally orientated towards Latvia, Belarus and Kaliningrad. Up to now only one other line, connecting Estonia with Finland through a submarine cable of 350 MW, allows Lithuania to use this cable up to 25% and to export/import about 500 GWh to and from Scandinavia.

**Table 2-1, International power grid connections of Lithuania**

| | *Number of power lines* | *Voltage* | *Capacities to import export* |
|---|---|---|---|
| *Latvia* | 4 | 330 kV | Lithuania to Latvia: 1500 MW |
| | 3 | 110 kV | Latvia to Lithuania: 1300 MW |
| *Belarus* | 5 | 330 kV | Lithuania to Belarus: 2200 MW |
| | 7 | 110 kV | Belarus to Lithuania: 1400 MW |
| *Kaliningrad* | 3 | 330 kV | Lithuania to Kaliningrad: 700 MW |
| | 3 | 110 kV | Kaliningrad to Lithuania: 700 MW |

In 2006, the Lithuanian electricity system satisfied the national electricity demand in full. The installed capacity of electricity generation in Lithuania exceeded 5000 MW with the major part attributed to the Lithuanian condensing power plant (capacity 1800 MW), Ignalina NPP (capacity 1300 MW), CHP plants (accumulated capacity exceeding 800 MW), and Kruonis hydro power plant (capacity 900 MW). Before the final closure of Ignalina NPP in 2009, Ignalina NPP was the main electricity producer in Lithuania and accounted for approximately 80 to even 88% in 1993 of the final gross electricity production.

There are 28 small CHP plants operating in Lithuania, including 18 CHP with the capacity exceeding 1 MW. The total installed capacity of all Lithuanian CHP plants amounted to 812 MW. In 2006, all Lithuanian CHP plants produced about 2 TWh of electric power.

The first Lithuanian CHP plants were constructed in the 1950s. Those CHP plants are still in operation and produce electric energy and heat. The largest Lithuanian CHP plants in Vilnius and Kaunas were constructed in the 1980s.

5 cogeneration plants, including three biomass CHP plants, were launched in 2005 through 2006. The total capacity of the newly launched CHP plants amounted to 14 MW.

After the closure of the unit 2 nuclear reactor in Ignalina, the Lithuanian Thermal Power Plant with a capacity of 1732 MW is expanded with an additional 444 MW. With a total capacity of electricity plants of 3500 MW and based on a peak load reference year 2009 of 1936 MW, up till today Lithuania has no capacity problem for its electricity production. Main issue however is the dependence on imported energy sources and related high prices for electricity production.

According to the calculations of Inforse-Europe (the International Network for Sustainable Energy), the growth in energy services in Lithuania is expected to continue in the coming decades[7]. The growth in energy services due to the expansion of the national inventory of heated floor space, the growth in volumes of transport of goods and people and of final consumer energy needs, is expected to continue for 2-3 decades and then to level off for most sectors towards the end of 2050.

Such growth scenario in relation to the constraints of the actual power supply structure of Lithuania opens large perspectives. The whole Lithuanian energy policy will, in the next decades, be dominated by the mandatory requirement to attain the overall 23% share of renewable energy in the gross final energy consumption in 2020. In a sectored way this translates to reaching a 21% RES share in the production of electricity and a 50% RES share in the gross heat production by 2020.

In 2009 the total gross production and consumption of electricity amounted 15.358 GWh and 12.426 GWh. Distributed generators, mainly using renewable energy sources, only produced 980 GWh of electricity – which is only 7,9% of gross

[7] Inforse-Europe (International Network for Sustainable Energy): Lithuanian sustainable energy vision 2050, http://www.inforse.dk/Europe/VisionLT.htm

electricity consumption. Small cogeneration plants and bio-fuel plants take up 6% from gross electricity production[8].

A renewable heat electricity and transport energy scenario according to Inforse-Europe Vision 2050 must lead to the following evolution in primary energy supply, fossil fuel supply.

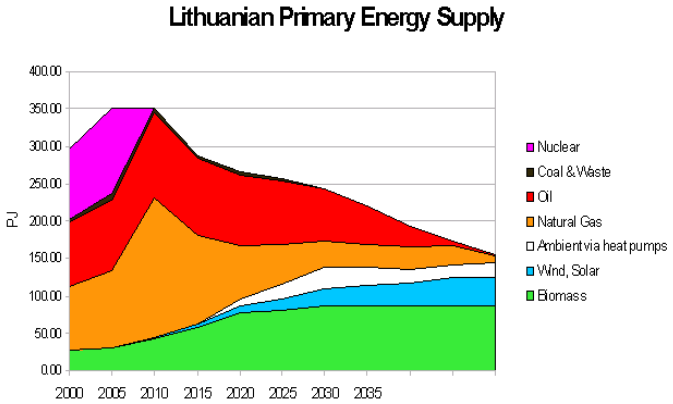



**Figure 2-1 Changes in energy supply (source: Inforse-Europe)** [9]

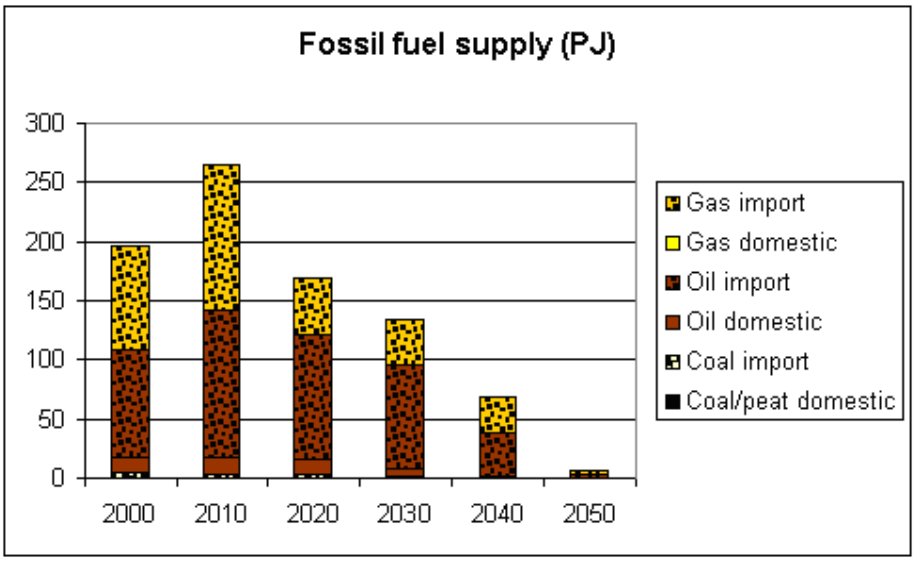



**Figure 2-2 Fossil fuel development in Lithuania (source: Inforse-Europe)** [10]

[8] Miskinis V. et al.: Trends of distributed generation development in Lithuania. In: *Energy Policy 39*, 4656-4663, 2011.

[9] Inforse-Europe (International Network for Sustainable Energy): Lithuanian sustainable energy vision 2050, http://www.inforse.dk/Europe/VisionLT.htm

[10] Ibid.

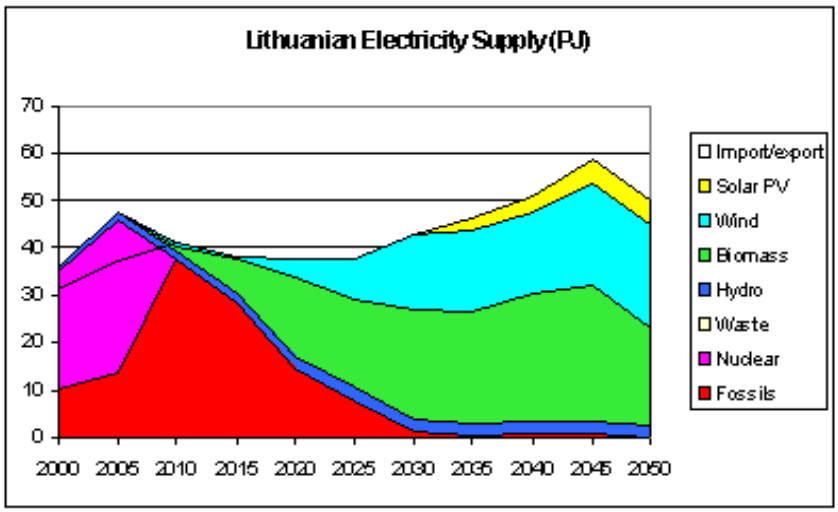



**Figure 2-3 Development of electricity production and sources (source: Inforse-Europe)** [11]

## 2.2 District heating and cogeneration sector outlook

The Lithuanian district heating[12] sector has an installed capacity of 9800 MW and produced, in 2009, roughly 10.000 GWh with a maximum heating demand of 3500 MW. The average fuel input in 2009 was 97,70 kg (o.e.)/MWh; transmission losses in the heat system were 15,7%. The sector counted 638.566 heat consumers and a consumer default rate of 16,51%. The portion of renewables in the overall district heating sector was 19% although the potential is 66,8%.

[11] Inforse-Europe (International Network for Sustainable Energy): Lithuanian sustainable energy vision 2050, http://www.inforse.dk/Europe/VisionLT.htm

[12] Stasiūnas, V.: Lithuanian heat sector: today based on imported fossil fuel, tomorrow – local biofuel and wastes. In: *Energy Developments in Baltic States in 2011,* Talinn, 16 march 2011

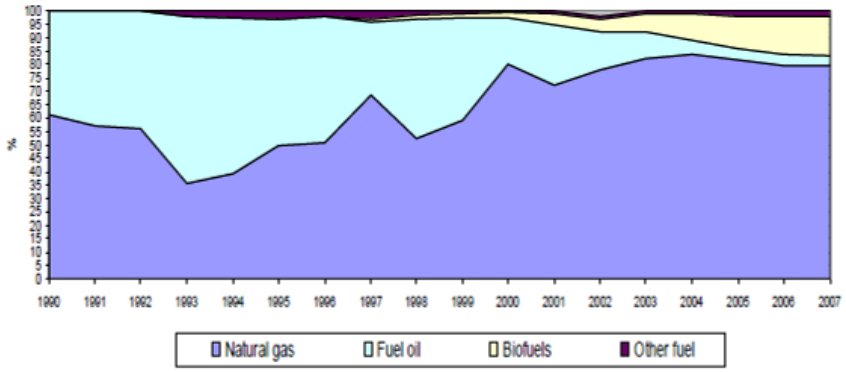



**Figure 2-4 Fuel input in the Lithuania District heating system – 1990-2007 (source: Lithuanian District Heating Association)** [13]**.**

In 2010 Cogeneration plants in the district heating system were for 97% operating on natural gas.

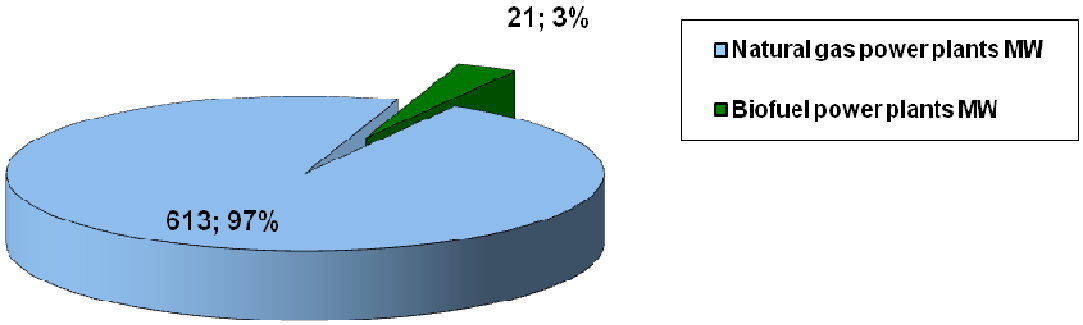



**Figure 2-5 Cogeneration power plants in the district heating system (DHS) of Lithuania, 2010. (Source Lithuanian District Heating Association)** [14]

Over the period 2005-2009, the Lithuanian District Heating Association carefully monitored the natural gas (including transportation and capacity fee) with the biomass prices, and over the whole period substantial differences exist. In February 2011 the price of natural gas is 571 USS/t.o.e. against only 235 USS/t.o.e. for bio fuel. This is reflected in the heat prices to the consumers. For example in Ignalina,

[13] Stasiūnas, V.: Biokuro ir komunalinių atliekų panaudojimo perspektyvos šilumos ūkyje. In: *International Conference on Renewable Energy Sources*, Vilnius, 10 June 2008

[14] Lapinskas, R.: Bendra naudingosios šilumos ir elektros energijos gamybos (kogeneracijos) perspektyva panaudojant biomasę Lietuvoje, 2011, http://www.lsta.lt/files/events/2011-03-04_LPK_konferencija/8_R.Lapinskas.pdf *(document in Lithuanian language)*

heat prices for heat generated through biomass are offered to consumer at prices of EUR 5,12 ct./kWh ex VAT while natural gas generated heat mostly start at EUR 7,39 ct. /kWh up to EUR 8,58 ct./kWh.

Based on today's fossil profile of heat generation, the Lithuanian District Heating Association proposes a massive program to install 1.096 MW in bio fuel boiler systems and 300 MW in bio fuel development. This expansion program should produce 5,77 TWh and the association estimates that it will involve massive investment in the order of EUR 674 million.
It should be noted that since 2000 a number of district heating companies have been given into lease schemes. Now 14 companies are PPP's and 41 are still fully managed by municipalities. Two foreign investors are active in the market: the Finnish group Fortum and the Dalkia group from France. A third group on the market is the UAB"E energija"(local investors).
The big question is how the majority of cities will act in the future. Will further privatisation take place and most important will an un-bundling between the heat supply networks and the heat production take place?

For the consumer of heat, 3 elements are of crucial importance to have competitive pricing:

- The use of more RES in the overall production of heat;
- The lowering of the heat losses in the networks (currently 15,7%). If losses could be limited to 12%, consumers could save about EUR 18,5 million/year;
- The massive renovation of the outdated bad isolated Lithuanian building stock. The majority of people live in buildings with a heat consumption of 15,31 kWh/$m^2$/month (78,1%). After renovation the heat consumption could be diminished to 8,9 kWh/$m^2$/month (now only 4,6% of such buildings). New energy standard buildings could save up to EUR 200 million per year for the consumers.

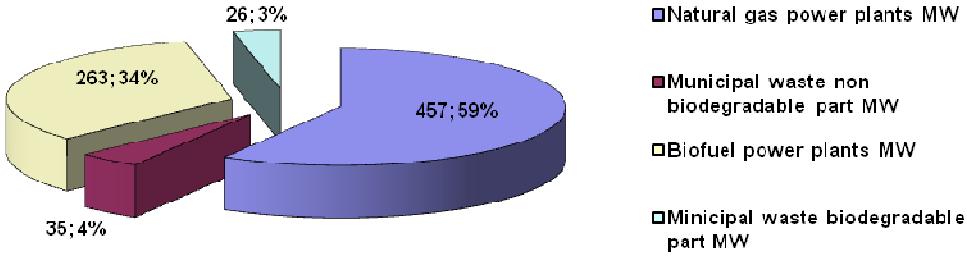



**Figure 2-6 CHP plants planned to be installed in the district heating system in Lithuania up to 2020**[15]

## 2.3 Heat price calculation model

Pursuant to the Lithuanian legislation, the National Control Commission for Prices and Energy (NCCPE) sets the basic heat price for Lithuanian heat suppliers who sell at least 10 GWh of heat per year or independent heat producers who produce over 50% of heat at a single heat supply system and sell at least 10 GWh of heat per year. The procedure for establishing heat price is prescribed in Decision No 03-96, dated 8 July 2009 (as amended on 4 October 2010, Decision No 03-203).

The basic principles of heat price calculation include:

- The fixed constituent of the heat price is established for a basic period of at least 3 years, but not exceeding 5 years;
- During the basic price period, the fixed constituent of the price is revised on a yearly basis with regard to the inflation rate, any changes in the sold heat volumes, the investment depreciation (amortization), and other changes in costs caused by other factors independent of the heat supplier's activities;
- During the basic price period, the structure of the fuel can change if the share of fuel from renewable energy sources in the total fuel consumption increases;

[15]Lapinskas, R.: Bendra naudingosios šilumos ir elektros energijos gamybos (kogeneracijos) perspektyva panaudojant biomasę Lietuvoje, 2011, http://www.lsta.lt/files/events/2011-03-04_LPK_konferencija/8_R.Lapinskas.pdf *(document in Lithuanian language)*

- To promote investment into broader utilisation of renewable energy sources, the investment value is increased by an additional amount equal to 6% of profit for a period of 7 years;
- The variable constituent of the heat price can be adjusted only once a month provided that the price change exceeds 5%;
- A new basic price is established based on the actual data of the last reporting year.

If there is a need for investment into change/modernization of heat generation plants, installation of new technologies, etc., the heat supplier is required to submit a coherent plan of investment to the NCCPE and a relevant municipality for their approval.

The approval is deemed to permit to implement the investment plan and the investment costs therefore can be included into the heating cost price. The basic heat price is based on cost prices that include the actual depreciation costs and the interest rate costs in the last year.

According to the valid heat price calculation method, heat production companies can include depreciation costs into the fixed constituent of the heat price. Interest rate costs can also be included into the fixed constituent of the heat price if the interest is paid for commitments not exceeding 70% of the company's assets reflected in the balance sheet of the reporting period.

Since 2008, the WACC method has been used to calculate the profit rate to evaluate the basic heat production price:

$$NP = (K_{bv} + C) \times \frac{WACC}{100} \quad \text{(LTL thousand)} \qquad (2)$$

Where

***NP*** – standard profit rate

$K_{bv}$ – value of assets (owned or leased) managed by heat production or distribution activities (LTL thousand). The value is based on the balance sheet data of the reporting period (the book value of long-term tangible and intangible assets), with regard of changes in long-term assets before the basic heat price constituents were estimated;

***C*** – Average annual value of the statutory compulsory reserve of fuel stocks in the reporting period, LTL thousand;

***WACC*** – weighted average cost of capital,%.

**Table 2-2 heating cost structure in 2010 (source: National Control Commission for Prices and Energy, NCCPE)[16]**

| *DHS company groups* | *Variable costs* | | *Fixed costs* | | | | |
|---|---|---|---|---|---|---|---|
| | *Fuel costs* | *Other costs* | *Material costs* | *Depreciation costs* | *Salary costs* | *Interest rates* | *Other costs* |
| *Group I (>150 thousand MWh of heat per year)* | 53% | 21% | 7% | 7% | 9% | 1% | 2% |
| *Group II (90-150 thousand MWh of heat per year)* | 66% | 3% | 9% | 9% | 10% | 1% | 2% |
| *Group III (50-90 thousand MWh of heat per year )* | 50% | 9% | 11% | 11% | 15% | 2% | 2% |
| *Group IV (25-50 thousand MWh of heat per year)* | 56% | 4% | 9% | 10% | 18% | 1% | 2% |
| *Group V (<25 thousand MWh of heat per year)* | 47% | 6% | 11% | 12 | 20% | 2% | 2% |

## 2.4 Electricity price calculation model

In the electricity sector, the charged prices can be either contractual or state regulated. The generation (electricity and reserve capacity) and independent supply prices are not regulated, unless the Lithuanian electricity sales market share of electricity producers and independent suppliers exceeds 25%. The prices for electricity transmission, distribution, and public supply services are subject to a price cap. Before 2010, the regulated public tariffs covered all customer categories: individuals and small, medium and large enterprises. The Law on Electricity prescribes gradual abolition of the public (end) electricity price. From 2013, all commercial customers, other than households, will have to buy electricity from

[16]National Control Commission for Prices and Energy: Šilumos tiekėjų lyginamosios analizės 2010 m. rodikliai, 2011, http://www.regula.lt/lt/naujienos/2011/2011-08-11/naujas_2010m%20_imoniu_lyginamoji_analize.pdf *(document in Lithuanian language)*

independent suppliers at contractual prices and the final electricity prices will not be applicable.

**Table 2-3 the average electricity price in 2011 is 44.33 ct/kWh (12.82 Euro cents/kWh). Average electricity price structure (source: National Control Commission for Prices and Energy, NCCPE)[17]**

| | |
|---|---|
| Purchase price | 4.63 Euro cents/kWh |
| Transmission services (high voltage networks) | 0.67 Euro cents/kWh |
| System services | 0.19 Euro cents /kWh |
| Distribution (medium voltage networks) costs | 1.42 Euro cents /kWh |
| Distribution (low voltage networks) costs | 1.85 Euro cents /kWh |
| Public supply costs | 0.11 Euro cents /kWh |
| Value added tax (VAT) | 2.23 Euro cents /kWh |
| PSO: Renewable energy sources PSO | 0.25 Euro cents /kWh |
| Combined heat and power plants PSO | 0.24 Euro cents /kWh |
| Lietuvos Elektrinė PSO | 0.98 Euro cents /kWh |
| Compensation for renewable energy sources (RES) | 0.003 Euro cents /kWh |
| Connection of RES to power transmission or distribution systems | 0.01 Euro cents /kWh |
| Strategic projects | 0.24 Euro cents /kWh |

Since 2002 Lithuania has a feed-in tariff system for the purchase of electricity produced from RES. Feed-in tariffs are revised with regard to inflation and other factors (revisions made in 2007, 2008, 2009)[18]. Determination and revision of the feed-in tariffs is under the responsibility of the National Control Commission for Prices and Energy. According to the newly adopted Law on RES, National Control Commission for Prices and Energy remains the institution responsible for the determination of the feed-in tariffs for the whole Lithuanian RES sector.

The following tables give an overview of electricity production and the relative position of cogeneration plants within the overall electricity supply in Lithuania.

[17] National Control Commission for Prices and Energy: Elektros energijos rinkos stebėsenos ataskaita už 2010 metus, 2011, http://www.regula.lt/lt/naujienos/2011/2011-04 28/Elektros_rinkos_stebesenos_ataskaita.pdf *(document in Lithuanian language)*

[18] Daniel Rosende et al.: Renewable Energy Industry Roadmap for Lithuania, 2010, http://www.repap2020.eu/fileadmin/user_upload/Roadmaps/Lithuania_RES_Industry_Road map.pdf

**Table 2-4 Electricity energy producers in Lithuania, 31 December 2010[19]**

| *Power plants* | *Installed capacity MW* |
|---|---|
| Lietuvos Elektrinė (Lithuanian Power Plant) | 1800 |
| Mažeikių Elektrinė (Mažeikiai Power Plant) | 160 |
| Vilniaus Elektrinė (Vilnius Power Plant) | 372 |
| Kauno Elektrinė (Kaunas Power Plant) | 170 |
| Kauno Energija (Kaunas Energy) | 8 |
| Klaipėdos Energija (Klaipėda Energy) | 11 |
| Panevėžio Elektrinė (Panevėžys Energy) | 35 |
| Private-owned power plants | 96 |
| *Total produced in thermal power plants:* | *2652* |
| Kruonis Hydro Power Plant | 900 |
| Kaunas Hydro Power Plant | 101 |
| Small-scale hydro power plants | 25 |
| Bio fuel power plants | 33 |
| Wind power plants | 161 |
| *Total:* | *3872* |

**Table 2-5 Electricity balance of Lithuania, 1999-2010, TWh[20]**

| | *1999* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Import* | 0.62 | 0.14 | 0.20 | 0.30 | 0 | 0.13 | 1.09 | 1.54 | 1.17 | 1.68 | 0.68 | 7.13 |
| *Other power plants* | 0.06 | 0.10 | 0.07 | 0.15 | 0.18 | 0.37 | 0.42 | 0.39 | 0.41 | 0.27 | 0.43 | 0.4 |
| *Ignalina NPP* | 9.86 | 8.42 | 11.36 | 14.14 | 15.48 | 15.1 | 10.34 | 8.65 | 9.83 | 9.89 | 10.85 | 0 |
| *Hydro power plants(>10MW)* | 0.84 | 0.61 | 0.66 | 0.75 | 0.94 | 0.88 | 0.75 | 0.75 | 0.86 | 0.91 | 1.06 | 1.21 |
| *Thermal power plants* | 2.73 | 2.26 | 2.58 | 2.64 | 2.8 | 2.85 | 3.2 | 2.57 | 2.63 | 2.63 | 2.64 | 3.63 |
| *RES* | 0.02 | 0.03 | 0.04 | 0.04 | 0.05 | 0.07 | 0.07 | 0.10 | 0.27 | 0.26 | 0.34 | 0.46 |
| *Consumption* | 7.24 | 6.91 | 7.24 | 7.51 | 7.94 | 8.45 | 8.82 | 9.20 | 9.55 | 9.88 | 9.16 | 9.22 |
| *The loss of electricity networks* | 1.33 | 1.28 | 1.42 | 1.43 | 1.41 | 1.27 | 1.23 | 1.09 | 1.12 | 1.02 | 0.97 | 0.99 |
| *Own needs* | 1.62 | 1.44 | 1.55 | 1.67 | 1.66 | 1.61 | 1.23 | 1.15 | 1.20 | 1.21 | 1.25 | 0.44 |

[19] National Control Commission for Prices and Energy: Elektros energijos rinkos stebėsenos ataskaita už 2010 metus, 2011, http://www.regula.lt/lt/naujienos/2011/2011-04 28/Elektros_rinkos_stebesenos_ataskaita.pdf *(document in Lithuanian language)*

[20] Ibid

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Kruonis PSP boot* | 0.68 | 0.64 | 0.45 | 0.55 | 0.61 | 0.92 | 0.75 | 0.54 | 0.76 | 0.82 | 1.01 | 1.04 |
| *Export* | 3.30 | 1.48 | 4.16 | 6.79 | 7.53 | 7.32 | 4.05 | 1.98 | 2.54 | 2.63 | 3.61 | 1.14 |

According to the Lithuanian Statistics Department (latest available data are from 2009), the percentage of electricity produced by cogeneration plants in the total electricity production was as follows:

**Table 2-6 Share of electricity produced by cogeneration plants in the total electricity production (%)[21]**

| | *1995* | *2000* | *2005* | *2006* | *2007* | *2008* | *2009* |
|---|---|---|---|---|---|---|---|
| *Electricity produced by cogeneration (CHP) plants* | 9.5 | 20.7 | 24.5 | 24.2 | 22.2 | 20.8 | 20.9 |

**Table 2-7 Program for CHP biomass electricity generation in the DHS, 2010 - 2020[22]**

| | | *2010* | *2011* | *2012* | *2013* | *2014* | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Installed power, MW* | *Strategy* | 22 | 24 | 40 | 68 | 98 | 115 | 135 | 162 | 162 | 162 | 162 |
| | *Potential* | 22 | 22 | 24.1 | 72 | 104.5 | 241.5 | 261.5 | 261.5 | 261.5 | 288 | 322 |
| *Generated electric power, GWh* | *Strategy* | 98 | 115 | 161 | 271 | 416 | 533 | 626 | 743 | 810 | 810 | 810 |
| | *Potential* | 172 | 172 | 185 | 409 | 542 | 1062 | 1107 | 1107 | 1107 | 1224 | 1342 |

## 2.5 Investment program in the Lithuanian District heating system

### 2.5.1 Investment in the heat and power district heating generation system

The actual projects under execution in the CHP sector based on biomass are presented in the following table:

[21] Ibid

[22] National Control Commission for Prices and Energy: Elektros energijos rinkos stebėsenos ataskaita už 2010 metus, 2011, http://www.regula.lt/lt/naujienos/2011/2011-04 28/Elektros_rinkos_stebesenos_ataskaita.pdf *(document in Lithuanian language)*

**Table 2-8 Ongoing projects for biomass based CHP in the Lithuanian DHS[23]**

| | *City* | *Launch date* | *Capacity, Mwe* | *Investment, EUR million* |
|---|---|---|---|---|
| ***1.*** | ***Vilnius*** | | | |
| 1.1. | Municipal Waste Incineration Plant | 2016 | 8 (20) | 19.93 |
| 1.2. | BKZ-75-39FB (12-17 Mwe) | 2014-2019 | 17 | 11.87 |
| 1.3. | TGME-205 | 2015 | 120 | 115.27 |
| 1.4. | BZK-75-39 FB | 2015 | 17 | 18.25 |
| ***2.*** | ***Kaunas*** | | | |
| 2.1. | Municipal Waste Incineration Plant | 2014 | 6.5 (15) | 17.44 |
| 2.2. | BZK-75-39 | 2019 | 17 | 19.69 |
| 2.3. | BZK-75-39 | 2020 | 17 | 19.69 |
| 2.4. | BZK-75-39 | 2020 | 17 | 19.69 |
| ***3.*** | ***Klaipėda*** | | | |
| 3.1. | Municipal Waste Incineration Plant | 2013 | 11 (25) | 27.4 |
| ***4.*** | ***Šiauliai*** | | | |
| 4.1. | Municipal Waste Incineration Plant | 2013 | 11 | 22.6 |
| ***5.*** | ***Panevėžys*** | | | |
| 5.1. | Municipal Waste Incineration Plant | 2014 | 2.5 | 6.66 |
| ***6.*** | ***Alytus*** | | | |
| 6.1. | Municipal Waste Incineration Plant | 2013 | 5.4 | 19.69 |
| ***7.*** | ***Marijampolė*** | | | |
| 7.1. | Municipal Waste Incineration Plant | 2019 | 4.5 | 6.66 |
| ***8.*** | ***Jonava*** | | | |
| 8.1. | Municipal Waste Incineration Plant | 2013 | 4 | 10.72 |
| ***9.*** | ***Mažeikiai*** | | | |
| 9.1. | Municipal Waste Incineration Plant | 2013 | 2.5 | 6.66 |
| ***10.*** | ***Utena*** | | | |
| 10.1. | Municipal Waste Incineration Plant | 2012 | 2.1 | 6.37 |
| ***11.*** | ***Druskininkai*** | | | |
| 11.1. | Municipal Waste Incineration Plant | 2014 | 3 | 8.4 |
| | | **Total:** | **266 (300)** | **356.99** |

For the future, new investments are planned and the tables below provide calculations of future minimum investments into DHS heating equipment. Those calculations are based on the assumption that the Lithuanian DHS heating companies continue their normal operation and develop and upgrade their

[23] National Control Commission for Prices and Energy: Elektros energijos rinkos stebėsenos ataskaita už 2010 metus, 2011, http://www.regula.lt/lt/naujienos/2011/2011-04 28/Elektros_rinkos_stebesenos_ataskaita.pdf *(document in Lithuanian language)*

technological park in response to the changes in the fuel market, energy pricing, availability of subsidies, and deterioration of the existing heating equipment rather than in attempt to meet the requirements of the EU regulation to increase the use of RES in the heating sector.

**Table 2-9 Estimated technological capacity indicators for the development of Lithuanian DHS heating production sources in MW[24]**

| *No* | *Indicator* | *Unit* | *Total* | *2011* | *2012* | *2013* | *2014* | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *1* | Installed new bio fuel HGP* | MW | 545 | 40 | 162 | 68 | 54 | 68 | 42 | 39 | 48 | 24 | 0 |
| *2* | Installed new natural gas HGP | MW | 307 | 0 | 30 | 52 | 34 | 102 | 12 | 8 | 23 | 2 | 45 |
| *3* | Overhauled bio fuel HGP | MW | 469 | 16 | 28 | 99 | 68 | 89 | 61 | 9 | 33 | 0 | 65 |
| *4* | Overhauled natural gas HGP | MW | 4757 | 297 | 374 | 320 | 1129 | 894 | 693 | 555 | 192 | 134 | 169 |
| *5* | Total | MW | 6078 | 353 | 595 | 539 | 1285 | 1153 | 807 | 611 | 297 | 159 | 279 |
| *5.1* | Including newly installed | MW | 852 | 40 | 193 | 120 | 88 | 170 | 54 | 47 | 71 | 26 | 45 |
| *5.2* | Including overhauled | MW | 5226 | 313 | 402 | 419 | 1197 | 983 | 754 | 565 | 226 | 134 | 234 |

**HGP-heat generation plant*

[24] Lukoševičius, V.: 2011-2020 metų kompleksinės investicinės programos centralizuoto šilimos tiekimo sektoriuje parengimas ir įgyvendinimas priemonių sukūrimas, 2011, 160 p. *(document in Lithuanian language)*

**Table 2-10 Estimated indicators of investment into the development of Lithuanian DHS heating production sources[25]**

| *No* | *Indicator* | *Unit* | *Total* | *2011* | *2012* | *2013* | *2014* | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *1* | Investment in bio fuel HGP* | EUR million | 163.34 | 13.61 | 45.76 | 16.22 | 13.9 | 23.75 | 12.45 | 13.9 | 16.22 | 7.53 | 0 |
| *2* | Investment in natural gas HGP | EUR million | 27.51 | 0.58 | 0.87 | 3.48 | 6.66 | 4.92 | 0.58 | 0.58 | 2.32 | 0 | 7.24 |
| *3* | Investment in bio fuel HGP overhaul | EUR million | 9.27 | 0.29 | 0.58 | 2.03 | 1.45 | 1.78 | 1.45 | 0 | 0.29 | 0 | 1.16 |
| *4* | Investment in natural gas HGP overhaul | EUR million | 44.6 | 2.9 | 3.77 | 2.9 | 10.72 | 8.4 | 6.66 | 5.21 | 1.74 | 1.16 | 1.45 |
| *5* | Total | EUR million | 244.44 | 17.38 | 50.68 | 24.62 | 32.73 | 38.80 | 21.14 | 19.69 | 20.56 | 8.69 | 9.85 |
| *5.1* | Total investment in new HGP | EUR million | 190.86 | 14.19 | 46.63 | 19.69 | 20.56 | 28.67 | 13.03 | 14.48 | 18.54 | 7.53 | 7.24 |
| *5.2* | Total Investment in HGP overhaul | EUR million | 53.58 | 3.19 | 4.05 | 4.92 | 12.16 | 10.14 | 7.82 | 5.21 | 2.03 | 1.16 | 2.6 |

**HGP-heat generation plant*

** EUR 1 = LTL 3.4528*

According to the above calculations, if Lithuanian DHS continues its regular development, by 2020 the capacity of newly installed heat generation plants (HGP) will reach approximately 852 MW, including 545 MW bio fuel HGP. Furthermore, it is planned to overhaul approximately 5200 MW of HGP. The required investments for the new HGP account for EUR 190.86 million (including EUR 163.34 million for bio fuel HGP).

In this case by 2020, the share of solid biomass in the total fuel balance of Lithuanian DHS will reach approximately 45% (based on the current DHS needs) and its consumption will amount to 340ktne (under the EU Directive, the consumption should reach 540ktne).

[25] Lukoševičius, V.: 2011-2020 metų kompleksinės investicinės programos centralizuoto šilimos tiekimo sektoriuje parengimas ir įgyvendinimas priemonių sukūrimas, 2011, 160 p. *(document in Lithuanian language)*

### 2.5.2 Investment needs for upgrade and development of DHS heat distribution pipelines

The total length of the existing Lithuanian heat distribution pipelines is 2535 km. A major part of the pipelines was built in the Soviet period, from 1968 to 1988, and only 20% was built after 1991 (i.e. after the restoration of independence in Lithuania).

Approximately 65% of all Lithuanian heat distribution networks were built on impenetrable channels.

Lithuanian heat distribution pipelines are mostly type 70<DN<150 (approximately 40%). The maintenance of the pipelines meets the existing standards, however most of the standards are rather outdated. The heating sector companies regularly monitor the corrosion of the inner surface of the existing pipelines (usually with the help of inner corrosion indicators). The results of the monitoring show a broad range of corrosion rate (from 0.002 to 0.087 mm/year). Some of the DHS companies experience a higher corrosion rate, which is over 0.05 mm/year.

The wear and tear of the existing pipelines is relatively defined by the number of ruptures per 100 km of pipelines in operation. According to the information provided by Lithuanian DHS companies[26], this number varies from 7.9 to 104.2 ruptures per 100 km of a pipeline. The total number of ruptures per year has been increasing (data for 1999-2009), although most of the ruptures occur during hydraulic testing rather than in routine operation.

The useful life of pipelines operated in an appropriate way, i.e. in compliance with the quality requirements, should be 40-75 years. Renovation of 434 km of heat distribution pipelines is planned in 2011 through 2020, and further 1010 km are planned to be renovated in 2020 through 2040. The estimated need for investment is EUR 15-30 million per year (total investment need in 2011-2020 is EUR 281 million). Furthermore, the calculations show that the need for investment into the heat distribution sector will increase after 2018.

[26]Lukoševičius, V.: 2011-2020 metų kompleksinės investicinės programos centralizuoto šilimos tiekimo sektoriuje parengimas ir įgyvendinimas priemonių sukūrimas, 2011, 160 p. *(document in Lithuanian language)*

### 2.5.3 Investments relating to environmental measures

Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emission (integrated pollution prevention and control) sets emission limit values and control measures for different industry areas, combustion plants included. The emission limit values are stricter than before and the compliance with the new requirements requires special preparation and additional investments.

Nevertheless, the Directive proposes a transitional national plan and sets several exemptions from the requirements for combustion plants. District heating plants may be exempt from the compliance with the emission limit values provided that certain conditions are met (the total rated thermal input of the combustion plant does not exceed 200 MW; the plant was granted a first permit before 27 November 2002 or the operator of that plant had submitted a complete application for a permit before that date, provided that it was put into operation no later than 27 November 2003; at least 50% of the useful heat production of the plant, as a rolling average over a period of 5 years, is delivered in the form of steam or hot water to a public network for district heating; and the emission limit values for sulphur dioxide, nitrogen oxides and dust set out in its permit applicable on 31 December 2015, pursuant in particular to the requirements of Directives 2001/80/EC and 2008/1/EC, are at least maintained until 31 December 2022). There is also an exception of limited life time derogation, which can be applicable in case the operator of combustion plant undertakes, in a written declaration submitted by 1 January 2014 at the latest to the competent authority, not to operate the plant for more than 17500 operating hours, starting from 1 January 2016 and ending no later than 31 December 2023. However, in the case of Lithuania, thermal heating plants of Vilnius, Kaunas and Mažeikiai are not subject to this exemption since the exemptions of EU Directive 2011/80/EU are currently in force.

**Table 2-11 Estimated investment needs to implement the above EU Directive in Lithuania (EUR million)[27]**

| *Year* | *2011-2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* |
|---|---|---|---|---|---|---|---|---|
| Maximum investment need, EUR million | 115.85 | 40.55 | 40.55 | 40.55 | 40.55 | 40.55 | 43.44 | 30 |
| Optimal investment need, EUR million | 130.33 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | - | - |

### 2.5.4 Integrated total investment program of the Lithuanian district heating sector for 2011-2020

The Complex Investment Program (CIP) of the Lithuanian DHS includes investments into the modernization and development of heat generation plants, investments for upgrade and development of heat distribution networks, and investments for implementation of environmental measures (EU Directive):

- Ca. LTL 2,081 million (EUR 602 million) for development and modernization of heat generation plants;
- LTL 973 million (EUR 282 million) for development and modernization of heat distribution networks;
- LTL 900 million (EUR 260 million) for introduction of environmental measures in the DHS sector.

The largest flows of investment are expected in 2013-2016.

**Table 2-12 Integrated total Investment Program structure, EUR million[28]**

| *Year* | *2011* | *2012* | *2013* | *2014* | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Development and modernization of heat generation plants* | 14.77 | 14.77 | 130.2 | 130.2 | 91.52 | 91.52 | 30.7 | 30.7 | 30.7 | 36.0 | 601.1 |
| *Development and modernization of heat distribution networks* | 12.45 | 19.7 | 20.6 | 27.8 | 27.8 | 28.38 | 27.5 | 49.53 | 44.02 | 24.04 | 281.8 |
| *Introduction of environmental measures in the DHS sector (EU* | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 26.07 | 260.7 |

[27] Lukoševičius, V.: 2011-2020 metų kompleksinės investicinės programos centralizuoto šilimos tiekimo sektoriuje parengimas ir įgyvendinimas priemonių sukūrimas, 2011, 160 p. *(document in Lithuanian language)*

[28] Lukoševičius, V.: 2011-2020 metų kompleksinės investicinės programos centralizuoto šilimos tiekimo sektoriuje parengimas ir įgyvendinimas priemonių sukūrimas, 2011, 160 p. *(document in Lithuanian language)*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Directive)* | | | | | | | | | | | |
| *Total* | 53.29 | 60.54 | 176.87 | 184.07 | 145.4 | 146 | 84.27 | 106.3 | 100.8 | 86.11 | 1143.6 |

** EUR1 = LTL3.4528*

The implementation of this investment program can be confronted with certain difficulties. The ”second oil crisis” and an approximately threefold increase in the fossil fuel price since 2006 have resulted in large outstanding amounts of fuel costs which later have to be included into the heat distribution price as a ”compensation constituent”. Although the subsequent global economic crisis knocked down the fuel prices, the paying capacity of most of the heat consumers also shrank. As a result of the slow process of apartment building renovation, the consumers suffer from high heating costs in the cold (winter) months due to the application of the single-component heat pricing. The issue of high heating prices is often on the local and national political agenda.

The latest Lithuanian cogeneration development plan (a list of CHP plants to be constructed in 2010-2020) was approved by the Minister of Energy on 22 June 2010 (Order No 1-174). See annex.

### 2.5.5 Subsidies for the investment program

#### 2.5.5.1 National fund financing of investment projects

Both private and public sector can apply to the Lithuanian Environmental Investment Fund (LEIF) for financing of environmentally friendly investment projects (reconstruction of power plants, biogas production from biomass, construction of solar/wind power plants, etc.). Pursuant to an established procedure, investment projects are subsidized by the LEIF. Subsidies are granted to legal entities for projects implemented in the territory of the Republic of Lithuania. The subsidies are granted according to the procedure of financing and supervising environmental investment projects in Lithuania. The maximum amount of financing is LTL 690,000 (EUR 199,838) for a period of three years, however the subsidy may not exceed 80% of all eligible costs of a relevant project. 60% of the subsidy is paid to the applicant after the equipment specified in the application for financing is purchased, installed, and put into service. 40% of the subsidy is paid 1 year later, subject to a final report on the achievement of the environmental indicators of the financed equipment submitted by the applicant. The subsidies are paid in Lithuanian Litas (LTL).

As mentioned above, all the intended investments into the heat production/distribution sector must be coordinated with the National Control Commission for Prices and Energy (NCCPE) and the relevant municipality. The financing application submitted to the LEIF should only include the agreed investments. The procedure of the investment plan coordination with the NCCPE and a municipality is prescribed by Decision No 03-35, dated 17 June 2003, of the NCCPE.

#### 2.5.5.2 Financing of investment projects with EU funds

The private or public sector could also apply for the EU Cohesion Fund financing (EU structural assistance for 2007-2013). A specific part of the program was dedicated to the use of renewable energy sources for energy production. The total amount of funding in this program was EUR 69,4 million and two calls were launched for project applications.
Projects could not exceed a value of EUR 50 million. The minimum amount of subsidy was EUR 28.500 and a maximum of EUR 5,2 million. Projects were funded up to a maximum of 50%. In this measure from 2007 under the operational program for Cohesion, cogeneration and the use of renewable energy resources were main priorities.
As no money is left in this program, it is now waiting for the next round of structural funding.

Another amount of EUR 16.5 million was assigned for energy generation efficiency projects in 2007-2013.

The Ministry of Economy establishes the applicant and project eligibility criteria (Order of the Minister of Economy No 4-442, 29 September, 2008). According to the said Order, an eligible project shall be implemented in the territory of the Republic of Lithuania and shall not be longer than 36 months. If applicant has the status of a large company, it should prove the incentive effect of the project (the incentive effect should be assessed based on the scenarios with and without the EU financial assistance). Furthermore, a large investment project may not be divided into

separate smaller investment projects in order to avoid the necessity to prove its incentive effect.

# 3 Legal Analysis for establishing a biomass cogeneration plant in the Free Economic Zone of Kaunas

## 3.1 Legal environment introduction

The Free Economic Zones in Lithuania are strictly regulated by Law. Two Free Economic Zones exist, one in the harbour city Klaipeda and one in the centrally located city of Kaunas. The legislative framework of the free economic zones in Lithuania regulates very different issues, amongst others their border, custom issues, land leases and –sub leases, permissible activities, tax issues, corporate matters including public –private composition of the Board of Directors etc. In addition, the Free Economic Zones are considered as state aid within the EU accession treaty with Lithuania and therefore have to get an overall agreement from the EU commission every 4 years.

Planning a cogeneration plant in the Free Economic Zone of Kaunas therefore has to be examined within this complex legal context. In addition, the project has to cope with a number of legal acts regarding energy and renewable energy. As part of the feasibility study for a cogeneration plant in the FEZ Kaunas, I have analyzed this complex environment more in detail.

## 3.2 General targets of the energy sector in Lithuania

Production of energy from renewable energy sources is a priority policy in order to increase security and diversity of energy supply, diversification of primary energy

sources, and meeting the sustainable development targets in environmental, economic and social perspective throughout the European Union.

As well as elsewhere in Europe, the renewable energy sector in Lithuania is one of the priority areas of the national energy policy. Effective utilisation of indigenous and renewable energy sources is one of the key targets defined in the National Energy Strategy[29], and furthermore developed in a new draft of National Energy (Energy Independence) Strategy[30], that is submitted to the Parliament for final considerations and adoption at the date of my thesis.

National renewable energy policy targets are in due compliance with the EU legislation, the Energy Charter Treaty, the United Nations Framework Convention on Climate Change, the Kyoto Protocol, as well as other related regional and international framework legislation.

Moreover, the Directive 2009/28/EC[31] on the promotion of the use of energy from renewable sources and the Law on Renewable Energy, implementing and transposing the Directive 2009/28/EC to the national legislation[32], establish the general national target to reach no less than 23 percent share of energy of renewable sources in gross final consumption of energy. In order to reach the established mandatory target, that is rather challenging under present statu,s of the renewable energy in Lithuania, national legislation encourages and support production of energy using renewable energy sources within the framework of this national support scheme.

[29] Parliament of the Republic of Lithuania: National Energy Strategy, Resolution No X-0146. In: *Official Gazette*, No 11-430, 18 January 2007

[30] Parliament of the Republic of Lithuania: Draft Resolutions on Approval of the National Energy (Energy Independence) Strategy. In: *Official Gazette*, No 11-1581-03, submitted to the Parliament on 31 May 2011

[31] European Parliament, Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (text with EEA relevance), OJ L 140, 5.6.2009, p. 16–62

[32] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011

The step-by-step approach in reaching the said 23% objective is widely elaborated in the National Strategy on Development of Renewable Energy Sources adopted by the Government[33]. However recent adoption of the Law on Renewable Energy requires thorough review of this Strategy, including, amongst others, amendments related to supported quotas for renewable energy generation.

Lithuania has established the precise aim and goal – to increase significantly use of renewable energy sources and production of ”clean energy”. The establishment of the biomass CHP plant in the Kaunas Free Economic Zone will definitely contribute to reaching relevant goals.

Because of a certain applicable legal regime and provided advantages, territories of free economic zones in Lithuania may be considered as one of the preferred places for implementation of energy development projects. For the reader, I add some general legal background on the Free zones so that one can understand the specificity of this location for the implantation of my project.

## 3.3 Overview of the FEZ related issues

### 3.3.1 Establishment and purposes of FEZ

Free economic zone (the FEZ) means a territory designated for the purpose of economic-commercial and financial activities, within which economic entities are provided with special economic and legal conditions of operation as established by the Law on Fundamentals of Free Economic Zones[34]. As I mentioned, Lithuania has two FEZs already established – Kaunas FEZ and Klaipėda FEZ.

[33] Government of the Republic of Lithuania: National Strategy on Development of Renewable Energy Sources, Resolution No 789. In: *Official Gazette*, No 73-3725, 21 June 2010

[34] Government of the Republic of Lithuania: Law on Fundamentals of Free Economic Zones of the Republic of Lithuania. In: *Official Gazette*, No 59-1462, 1995 *(as further amended)*

Kaunas FEZ is an industrial development area of 534 ha, located at Biruliškių village, district of Kaunas, Lithuania. FEZ has been established in 22 October 1996 by adoption of the Law on Kaunas Free Economic Zone[35].

The purpose of establishing the Kaunas FEZ was the creation of favourable taxation, production and other preferential conditions of business activities for companies that develop and introduce technical progress, as well as to stimulate foreign investments and create new jobs. Activities of the FEZ are regulated by the Law on Fundamentals of Free Economic Zones, the specific law on the FEZ, the statutes of the FEZ, internal regulations, and other related EU and Lithuanian legislation.

By tender, the State designated a private company as the Management Company of the Free Economic Zone. This company is entitled to a main lease at special conditions for the whole area of the Free Economic Zone. The Management Company will parcel the land, put infrastructures and will sublease plots for 99 years at market value to companies, called the "zone companies", who want to establish theirselves in the Free Zone.

### 3.3.2 Tax advantages applied to the FEZ

The main reason encouraging entities starting business, processing certain commercial activities and providing services within the territory of the FEZ, are the applicable legal, tax, commercial and other advantages.

As referring to the tax advantages in the FEZ, the FEZ enterprise or management company can enjoy the following favourable tax advantages:

- exemption from the land tax;
- exemption from the tax on immovable property of legal entities;
- exemption from income withholdings pursuant to the Law On Financing of the Program for Maintenance and Development of Roads;
- dividends received by foreign investors in the FEZ are exempt from taxation in the procedure and cases established by the on Profit Tax (this exemption

[35] Government of the Republic of Lithuania: Law on Fundamentals of Free Economic Zones of the Republic of Lithuania. In: *Official Gazette*, No 59-1462, 1995 *(as further amended)*

is not applicable if the dividends are paid by the FEZ company to any Lithuanian company);

- The FEZ management company pays a preferential 50 percent less land rental for the leased state-owned land. The FEZ management company has a right to pay the land rental in advance for the entire lease period or a part thereof under the procedure prescribed by the Government or its authorised institution. The funds accrued in such manner for the state-owned land leased in the territory of the FEZ are allotted for repurchasing the land taken for public needs from the landowners in this territory or for other public needs. Private capital of the FEZ management company and of the enterprises active in the FEZ, if invested into infrastructure of the FEZ, is not included to the land value when determining the land rental. If the FEZ management company prepays the land rental or a portion thereof, and later the land value, according to which the amount of the land rental is calculated, or the tariff of the land rental, or any other ground for calculating the land rental changes, the amount of the land rental for the period for which the land rental has been prepaid shall not change;
- Entities active in the FEZ are eligible for a tax holiday regime, which means 6 years of full exemption and thereafter 10 years of 50 percent reduction of standard profit tax rate in Lithuania. In order to use profit tax exemption, the following three conditions should be met:
    - a company should be established in the FEZ;
    - capital investment must be at least EUR 1 million and the amount of investment must be confirmed by the auditor's statement;
    - at least 75 percent of the company's income must be derived from the following activities carried out in the FEZ: production, manufacturing, processing and warehousing of goods in FEZ, wholesale of goods warehoused in FEZ and/or provided services relating to the categories of activity carried out in FEZ (the goods produced, manufactured, processed or warehoused in FEZ), as well as transportation, servicing and construction necessary for the production, manufacturing or processing carried out in FEZ or other categories of services related to above businesses.

For the investment in the FEZ it is essential that the regional State aid schemes do not preclude companies from the receipt of other alternative sources (e.g. from EU Structural Funds and other sources), however the cumulated result of support from different sources must be observed. For the purpose of determining such levels, the aid obtained from alternative sources shall be added to the State aid received under the State aid scheme.

Moreover, it is essential that the State guarantees to the entities the right to bring in the FEZ and to take out of the FEZ the respective capital and profit. Foreign investors have a right to transfer legally earned income (profit) abroad without any restrictions. Foreign investors are also allowed to take the income (profit) or a part of it in a form of goods bought in the internal market or reinvest in the economy of Lithuania. Thus the financial freedom for the enterprises is ensured.

### 3.3.3 Activities allowed to be carried out in the FEZ

According to the Statutes of the Kaunas FEZ[36], the FEZ company is entitled to carry out all main business activities (i.e. manufacture of products, supply of electrical energy, gas, steam and water, wholesale, repair services of motor vehicles, motorcycles and personal and household goods, hotel and restaurant services, transport, storage and communication services, financial intermediation services, real estate, renting and business services, education services, health and social work services, other community, social and personal services, agriculture, fishing).

Notably, there are certain spheres of activities which are prohibited to be carried out in FEZ and these activities are:

- economic-commercial activities connected with ensuring state security and defence, as well as with the production, storage or sale of arms, ammunition or explosives, or having a harmful effect on the environment;
- production, processing, storage and neutralisation of hazardous and radioactive materials;
- production, sale and storage of narcotics or narcotic, virulent and poisonous substances;

[36] Government of the Republic of Lithuania: Statutes of Kaunas Free Economic Zone, Resolution No 1207. In: *Official Gazette*, No 86-2627, 9 October 2000 *(as further amended)*

- processing, sale and storage of crops containing narcotic, virulent and poisonous substances;
- manufacture of vodka, liqueur and other liquors;
- manufacture of securities, paper money and coins, postage stamps;
- founding and keeping of gambling-houses (casino);
- organisation of lotteries;
- preparation and broadcasting of radio and TV programmes, with the exception of technical servicing of printing-houses, radio and television;
- treatment of patients who are ill with dangerous and especially dangerous infectious diseases, including venereal and contagious skin diseases, aggressive forms of mental diseases;
- treatment of animals ill with especially dangerous diseases;
- Settlement of labour migration issues[37].

In addition to activities specified above, the FEZ entities may also perform energy sector activities, including production of and trade in heat and electricity. As I am planning to found a free zone company for the construction and operation of a biomass cogeneration plant, I will now focus on the more relevant legal issues with regard to energy sector activities in the FEZ in my next chapter.

## 3.4 Commercial activities in the heat sector

### 3.4.1 Production, supply and sale of heat

Under the Lithuanian law, no permission or other authorizations are required for commercial activities of production of heat. However, supply of heat is a licensed activity by the national energy sector regulatory authority – National Control Commission for Prices and Energy.

Ability to enter commercial activities for supply and sale of heat depends on the fact, if the territory for which the CHP power plant intends to provide the heat has any licensed heat supplier or not. In case there is no licensed heat supplier, the

[37] Government of the Republic of Lithuania: Law on Fundamentals of Free Economic Zones of the Republic of Lithuania. In: *Official Gazette*, No 59-1462, 1995, Art. 8(1)

enterprise owning the CHP power plant can apply for the said licence and, after duly authorized, may supply and sell the heat to the end consumers directly.

However, in case there is a previously established heat supplier, already possessing a licence to provide the heat in a certain area, my newly established FEZ enterprise owning the CHP power plant will not be able to provide its products to the consumers directly. In such case it will have only one option – to sell its produced heat to this established licensed heat supplier.

Under the Lithuanian law, only the licensed heat suppliers have a right to provide heat in the defined area to consumers directly, and no other entity can compete with this exclusive competence. This principle is also established in the Law on Heat[38], which indicates that heat production shall be based on the competition between the heat producers. Thus the competition is encouraged and allowed just among entities producing heat, but not suppliers that enjoy exclusive competence in the designated territory.

However, there are few alternatives when the FEZ enterprise could be able to sell its produced heat to the other enterprises:

- as it was mentioned previously, in case there is no licensed heat supplier in the territory of the FEZ or in area for which heat is intended to be sold;
- In case there is a licensed heat supplier in the territory of the FEZ or in the area for which heat is intended to be sold. This can be the case:
    - in cases established in the laws when it can be shown that the owner of the licence, repeatedly infringes the conditions of licensed activity or does not eliminate the infringements within the time established by the institution which issued the licence;
    - when a company, despite suspension of its license, has continued to be active;
    - when the legal entity possessing the licence is liquidated or ends because of a reorganisation;
    - When the legal entity owning the licence provides a request to end the validity of the licence.

[38] Government of the Republic of Lithuania: Law on Heat of the Republic of Lithuania. In: *Official Gazette*, No 130-5259, 2007 *(as further amended)*

The other option for the FEZ enterprise intending to produce and to sell heat to end consumers, is to apply for the licence for the territory for which no other entity has a licence for supply of heat.

In Lithuania there are certain areas in which such licences are not issued, however, there are not a lot of such territories and implementation of this possibility can access with financial and/or technical difficulties. It is however important that transportation of heat can be limited due to technological aspects. Heat can only be transported economically within reasonable distances. Distribution competences are therefore directly related to logic geographic area[39].

### 3.4.2 Special provisions related to the delivery and sale of heat to the FEZ enterprises

As I mentioned under 3.1, the possibility to sell produced heat depends on the fact if a license has already been given for the focused territory. The same principle applies to the sale of electricity to other FEZ enterprises. In case no heat supply licence is issued for the FEZ territory, the enterprise carrying out activities of the heat production has to apply for the licence and, after duly authorized, may sell its produced heat to other FEZ enterprises.

Law on Fundamentals of Free Economic Zone establishes certain particular requirements in relation to the retail trade between the FEZ enterprises. It provides that the retail trade in the FEZ shall be permitted only to the extent it serves to satisfy the internal needs of the FEZ[40]. If the FEZ entity is engaging in retail trade breaching the above restriction, theoretically it may cause certain negative consequences, even a suspension of its activities in FEZ. Due to this, it is rather essential for the FEZ entities to follow this restriction. The problem concerning the mentioned restriction is such that the laws do not determine:

[39] Lithuanian Free Market Institute: Competition Opportunities in Lithuanian Heating Sector, http://www.lrinka.lt/index.php?act=main&item_id=3891

[40] Government of the Republic of Lithuania: Law on Fundamentals of Free Economic Zones of the Republic of Lithuania. In: *Official Gazette*, Valstybės žinios, No. I-976, 1995, Paragraph 4 of Art.7

- What exactly does retail trade mean? However, considering this issue from a business approach, the trade would be deemed as retail trade if the commodities are acquired for customer's personal usage and needs having no intent to resell them or use them as parts of the other product. As intentions of customers in certain cases might be difficult to determine, in order to avoid possible allegation regarding engagement in retail trade, it may recommended to establish (in the corporate documents of the company, such as the Articles of Association or respective trade procedure) that the company may engage only in wholesale, to follow in practice the principles of the wholesale market (lower prices comparing with retail trade, orientation on sales quantity, etc.), and, in certain doubtful cases, to request the customer to execute a written confirmation stating that the commodities are not purchased for personal needs;
- Exact notion of internal needs of the FEZ. It can be argued that internal needs of the FEZ should be understood as needs of the FEZ entities related to infrastructure of the FEZ or other organisational conditions for proper operations of the FEZ entities (but not to resale or incorporation of respective goods into other products).

According to the laws, there are no restrictions for the FEZ enterprise to perform wholesale trade in the territory of the FEZ.

Analyzing the current situation of the Kaunas FEZ, it can be indicated that AB Kauno Energija has a license to provide heat to the territory of the Kaunas FEZ, thus, despite the fact that certain FEZ enterprises would build their CHP power plant and produce heat using biomass, generally they will not be able to sell their produced product to the other FEZ enterprises or in the territories where AB Kauno Energija or other heat suppliers have licenses. This was confirmed in my meetings with the CEO Stanislovas Karčiauskas from Kauno Energija.

### 3.4.3 Legal aspects of delivering the heat to the central heating system of Kaunas City

As I indicated previously, the possibility of the FEZ enterprise to sell its produced heat to the consumers inside or outside the territory of the FEZ depends on if there

is a licensed heat supplier in the areas where potential consumers are established. In case the heat supply licence is issued for such territories, the FEZ enterprise is not able to sell its produced heat to these consumers outside this territory directly. In such cases produced heat has to be sold to the licensed heat supplier of Kaunas City.

Following the requirements established by the Law on Renewable Energy and the Law on Heat, the entities authorized for supply of heat in the particular territory are obliged for mandatory buy-offs of the heat produced by independent producers using renewable energy sources active in the area and connected to the grid. The rules for buy-offs are established by the National Control Commission for Prices of Energy[41].

In case all independent heat producers apply different heat prices, the heat supplier has the obligation to buy the heat by giving the priority to the lowest price. The Law on Heat provides that the State shall promote buy-offs of heat produced from bio fuel, renewable sources of energy, waste incineration and geothermal energy[42].

Such buy-offs are regarded as a public service obligation and implemented by having established heat purchase priority order. This means that heat supplier, purchasing heat from independent heat producers, who offer the same (equal) heat price, have to purchase the heat under the following priority order:

- from cogeneration plants using renewable energy sources;
- heat produced from renewable and geothermal energy sources;
- waste heat from industry;
- from efficient cogeneration plants;
- from fossil fuels biomass boilers.

[41] National Control Commission for Prices and Energy: Regulation on Terms and Conditions of Buy-offs of the Heat from Independent Heat Producers, Decision No O3-202 of the National Control Commission for Prices and Energy. In: *Official Gazette*, No 122-6254, 4 October 2010

[42] Government of the Republic of Lithuania: Law on Heat of the Republic of Lithuania. In: *Official Gazette*, No 130-5259, 2007, Art. 4(3)

Another important aspect is that the independent heat producer has to cover the costs of connecting its capacities to grid possessed by the heat supplier unless otherwise indicated in the heat sale and purchase agreement. The heat supplier has an obligation to connect the producer's capacities to its grid, unless the independent heat producer:

- does not provide findings of technical condition of equipment and their exploitation according to the relevant technical requirements;
- does not ensure fulfilment of technical connection conditions;
- refuses to compensate the heat connection cost;
- in findings of the State Energy Inspectorate under the Ministry of Energy it is indicated about the serious infringements of heat production equipment, which can cause impact to security and reliability of provision of heat;
- The National Control Commission for Prices and Energy has not determined the prices of heat sold by independent heat producer or when the National Control Commission for Prices and Energy does not take decision for the compulsory non-application of the price regulation.

The heat supplier purchases the heat produced by independent heat producers, taking into consideration the consumers' necessity of heat and heat purchase priority order. Naturally, the heat supplier can refuse to purchase heat from independent heat producers if the produced amount of heat exceeds the consumers' necessity of heat. Complaints for the refusal to purchase the heat are solved by the National Control Commission for Prices and Energy.

## 3.5 Commercial activities in the electricity sector

### 3.5.1 General remarks

For the new CHP plant to be constructed in the Kaunas FEZ, also taking into account the intended use of biomass and/or biogases for energy production, the following issues are of key importance with regard to commercial activities in the electricity sector:

- authorization for development of power generation capacities;
- granting the support scheme for the renewable energy power plant;
- connection of the power plant to the electricity grid;

- authorization for production of electricity;
- Scenarios and authorizations for trade in electricity.

Following legal and regulatory requirements are currently in force in Lithuania, I add an overview of these most important issues:

### 3.5.2 Development of power generation capacities

Power generation capacities in Lithuania may be developed only after obtaining permission issued by the Ministry of Energy. Generally the permission is being issued to each potential investor in case he can prove that his electrical installations and power generation activities will be safe and reliable, will not cause threats to health, will comply with environmental, land usage, construction site selection and energy efficiency requirements, will match technical, economic and financial capabilities of the investor and will match the requirements for use of intended fuels[43].

The criteria issue of the permit, as specified hereinabove, shall be proven by submission of the documents required by the Ministry of Energy. Procedural requirements are specified in the Rules for Issuance of Permissions for Activities in the Electricity Sector[44] currently in force, though being subject to respective amendments following adoption of the Law on Renewable Energy.

Since I am intending to construct a CHP plant exceeding 350 kW of total installed capacity, the following documents will be required to be submitted to the Ministry of Energy when applying for the development permission[45]:

- application in an official form approved by the Ministry of Energy;
- letter of intent with the grid operator, as specified in Section 5.4 hereafter;

[43] Government of the Republic of Lithuania: Law on Electricity. In: *Official Gazette*, Art.14(2)

[44] Minister of Economy of the Republic of Lithuania: Rules for Issuance of Permissions for Activities in the Electricity Sector, Order No 380. In: *Official Gazette*, No 110-4010, 18 December 2001 (Official Gazette, 2001 *(as further amended)*

[45] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.16(5).

- documents proving ownership right or other right of legitimate possession of the selected land plot for construction of the power plant (e.g. lease or loan for use agreement);
- report of the environmental impact assessment, if required;
- decision on impact for public health; and
- confirmation on granted support scheme, as specified in Section 5.3 hereafter.

The permission for development of power generation capacities shall be issued within 30 days after submission of all required documents. The Ministry of Energy has no right to reject issuance of the permission in case all documents are submitted and the investor meets the established criteria.

The permission for development of the power generation capacities is valid until connection of the power plant to the grid, but no longer than for 24 months after its issuance. Validity of the permission may be extended once for an additional 6 months in case the design of the power plant is finished and at least 50% of the project development works are done. Additional 6 months extension of validity may be applied in case of force majeure circumstances[46].

I like to mention here that the permission for development of the power generation capacities does not replace the construction permission that has to be obtained following the procedures established in the Law on Construction in order to start physical construction of the power plant. The construction permits are being issued by the administration of local municipalities.

### 3.5.3 Granting the renewable energy support scheme

Following the Regulation on Support of Production and Trade in Electricity Produced from Renewable Energy Sources[47] currently in force, the CHP plant may apply for

[46] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.16(8).

[47] Government of the Republic of Lithuania: Regulation on Support of Production and Trade in Electricity Produced from Renewable Energy Sources, Resolution No 1474. In: *Official Gazette*, No 104-37135, December 2001 *(as further amended)*

renewable energy support schemes only in case the biomass and/or biogases constitute at least 70 percent of the total fuel balance. I have been told by the Ministry of Energy that the Regulation in question is subject to complete review following adoption of the Law on Renewable Energy and such requirements may be reconsidered. I received from the Minister the text of a complete new system of auction trading system for renewable energy. As this is an important new situation, I have ordered a non-official translation of this auction system (see Annex).

For biomass power plants the total quota with applicable renewable energy support schemes is equal to 355 MW of the total installed capacity[48]. The quota for renewable energy investors developing the power plants with installed capacity exceeding 30 kW, will be allocated in the auctions organized by the National Control Commission for Prices and Energy[49].

The respective auctions will be organized in designated zones to be established by the Government. At the date of this Report, relevant Governmental resolution is not adopted yet. It may well be presumed that auction zones would be adopted based on power grid areas and available capacities. The auctions may be started by initiative of the National Control Commission for Prices and Energy or by application of the first intended investor to the particular auction zone.

The Law on Renewable Energy introduced the ”market-plus” model, which means that the quota auction bidders compete with their proposed premium to the market price of each kilowatt-hour of electricity produced in the renewable energy power plant[50]. The bidder who proposed the lowest premium wins the auction and obtains the support scheme with its requested premium for entire support period equal to 12 years after issuance of the permission for production of electricity.

[48] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.13(3)(4)

[49] National Control Commission for Prices and Energy: Rules for Allocation of the Support Quota, Resolution No O3-229. In: *Official Gazette*, No 101-4774, 29 July 2011

[50] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.20(3).

The ”market-plus” premium proposed at the quota auction may not exceed the top margins established and reviewed annually by the National Control Commission for Prices and Energy. The top margins shall be established following the methodology adopted by the National Control Commission for Prices and Energy[51]. At the moment of my thesis, the respective top margins for the year 2011 are not established yet. The electricity market price for the year 2011 is equal to LTL 15,5 ct/kWh (approx. EUR 4,5 ct/kWh)[52].

Important is that, irrespective of future recalculations of the top margin of the ”market-plus” premium, the tariff awarded to the winning auction bidder will be applied unchanged during the entire 12 year support period.

The ”market-plus” model changed the previously applied feed-in tariff scheme, which is currently applied only to the existing renewable power generation projects and new power plants not exceeding 30 kW of installed capacity.

Additionally to the ”market-plus” margin, the renewable energy support scheme guarantees for the renewable energy investor the reduced fees for connection to the grid, reservation of the grid capacities for connection to the grid, priority right for transportation of the electricity, release from balancing and backup reserve responsibility and other privileges specifically provided by the laws[53], e.g. tax exemptions.

Release from balancing and backup reserve responsibility is being guaranteed by the grid operator for the 12 year support period only, from the moment the renewable power producer shall rely on his own power balancing capabilities and

[51] National Control Commission for Prices and Energy: Methodology for Calculation of the Tariffs for Electricity Produced from Renewable Energy Sources, Resolution No O3-233. In: *Official Gazette*, No 101-4776, 29 July 2011

[52] National Control Commission for Prices and Energy: Establishment of the Electricity Market Price for the Year 2011, Resolution No O3-247. In: *Official Gazette*, No 128-6569, 28 October 2010

[53]Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.3(2)

shall ensure the required backup reserve whether by his own additional power generation capacities or under the contract with other producers.

Separate from all these support schemes, one may create renewable power generations capacities under the general procedures without any additional regulatory restrictions such as capacity quotas or auction procedures.

### 3.5.4 Connection to the electricity grid

As investor aiming to connect a new-built power plant to the electricity grid, I will need to apply to the grid operator to issue the technological pre-conditions for my connection. All mandatory requirements have to be evaluated by the grid operator and issued not later than 30 days after my application. By request of the investor the grid operator is also required to submit a detailed estimate of the connection costs, schedule for application and evaluation of the required documents and preliminary schedule for connection of the power plant to the electricity grid.

It is mandatory required by the law, that the grid operator may establish only such requirements to be fulfilled for connection of the power plant that are technologically based and essential for reliable, secure and proper operation of the power system and the power plant itself[54].

After issuance of technological pre-conditions for connection the investor needs to apply to the grid operator for signing the letter of intent on connection of the power plant to the electricity grid. The letter of intent must be signed within 30 days after the investor's request to the grid operator. Following requirements established in the Law on Renewable Energy the standard form of the letter of intent is adopted by the National Control Commission for Prices and Energy[55].

[54] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.14(8)

[55] National Control Commission for Prices and Energy: Application of the Standard Form of the Letter of Intent on Connection of the Power Generation Capacities to the Electricity Grids, Resolution No O3-163. In: *Official Gazette*, No 83-4086, 1 July 2011

The connection agreement must be prepared by the grid operator and submitted to the investor for signing, not later than 4 months after the adjustment of the technical project for the power plant, for which the consent by the grid operator has to be obtained. In the other case when no technical project is required for the power plant, the agreement will be signed within 2 months after signing the letter of intent. Normally, for power plants exceeding 350 kW of installed capacity, the technical project will be required.

Signing of the connection agreement is subject to the performance guarantee to be secured by the investor. The Law on Renewable Energy expressly provides that the investor is obliged to secure a performance guarantee equal to LTL 50 (approx. EUR 14,48) for each 1 kW of the new-built power plant[56]. In such case the performance guarantee for a 10 MW power plant would be equal to LTL 500.000 (approx. EUR 144.810).

The performance guarantee shall be made in a form of a bank guarantee or deposit to the bank account of the grid operator. The performance guarantee is being returned to the investor in case he does not win the quota auction, if relevant, as specified in Section 4.3 of this Report, or after the power plant starts operation. In case the investor fails to construct and launch operation of the power plant in time, following the validity term of the permission for development, and such failure is not justified under the force majeure or other uncontrolled circumstances the grid operator is entitled for take-over of the performance guarantee.

Further, the Government ordered that all power plants up to 6 MW of installed capacity are connected to the distribution grid (medium and low voltage), and that power plants equal to or exceeding 6 MW of installed capacity may be connected to the transmission grid (high voltage).

The term for connection of the power plant starts after signing the connection agreement with the grid operator. The requirements and conditions for connection of the power plant shall be equally and on non-discriminatory basis applied to all producers, naturally, taking into account technological specificities of the power

[56] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.15(1)

plant in question. The grid operators are required for public announcement of standard provisions of the connection agreement[57].

Following the Law on Renewable Energy the grid operator is in charge to connect the renewable power generation capacities to the electricity grid not later than in 18 months or otherwise the period during which the investor undertakes to construct a power plant[58]. The renewable energy projects have a guaranteed priority for connection to the grid against other energy producers using fossil fuels, i.e. in case the grids are limited in capacity the priority is given to renewable energy power plant if any competition between several producers is in question.

The parties are free to agree on different terms for connection of the power plant while signing the letter of intent and/or entering into the connection agreement. The term for connection starts on the execution date of the connection agreement and ends after connection of the power plant to the electricity grid for technological testing.

The connection costs to be paid the by investor are equal to 40 percent of the total connection cost for the power plants exceeding 350 kW of installed capacity. The project price is calculated as the total price of the works contract entered by the grid operator with the selected contractor for execution of the connection works. All costs to be incurred at the power plant itself, including construction, installation and preparation for connection, shall be fully covered by the investor itself.

### 3.5.5 Production of electricity

Commercial activities in production of electricity in Lithuania are subject to the permission for production of electricity issued by the Ministry of Energy. Procedural requirements for issuance of the permission are elaborated in the Rules for

[57] For example, LITGRID AB (the TSO): General requirements for connection to the electricity transmission grid, http://www.litgrid.eu/go.php/eng/Connection_to_Transmission_Grid/253

[58] Government of the Republic of Lithuania: Law on Renewable Energy of the Republic of Lithuania. In: *Official Gazette*, No 62-2936, 2011, Art.14(1)

Issuance of Permissions for Activities in the Electricity Sector as I specified in Section 5.2 before.

For the new-built power plants exceeding 10 MW of total installed capacity, the potential producer, together with other required documentation, shall provide the prove of technical capabilities to store the fuel reserves for the power plant. All the documentation is required to be submitted with an application form officially approved by the Ministry of Energy.

The permission for production of electricity shall be issued within 30 days after submission of all required documents. The Ministry of Energy has no right to reject issuance of the permission in case all documents are properly submitted. Normally, validity of the permission for production of electricity is not limited in time and is applicable to entire life-cycle of the power plant.

### 3.5.6 Trade in electricity

Following the Law on Electricity and, more specifically, the Rules on Trade in Electricity[59], each authorized producer may sell electricity based on bilateral agreements or at the power exchange. In particular the following electricity trading options are possible:

- trade in electricity under bilateral agreements with suppliers;
- trade in electricity at the power exchange;
- trade in reserve capacities with the transmission system operator;
- trade in electricity at the retail market with end consumers;
- export of electricity.

Having in mind the ”market-plus” support model applied to the power plants using renewable energy sources, I was informed by the Ministry of Energy that most of the renewable energy producers sell all the electricity produced by their generation capacities to the selected supplier under bilateral agreement for the market price (i.e. LTL 15,5 ct/kWh) and the remaining margin up to the fixed support tariff, for example up to LTL 30 ct/kWh (EUR 8,69 ct/kWh) for biomass-fired power plants, are

[59] Minister of Energy of the Republic of Lithuania: Rules on Trade in Electricity, Order No 1-244. In: *Official Gazette*, No 149-6677, 9 December 2009

being compensated by the grid operator under separate agreement on public service obligations.

However, irrespective of the applicable support schemes, nothing in the laws prevents the electricity producers from electricity trading in other modes allowed by the Law on Electricity and the Rules on Trade in Electricity.

#### 3.5.6.1 Trade under bilateral agreements

Each electricity producer is entitled to sell electricity to the electricity suppliers under the terms and conditions elaborated under bilateral agreements. The contract price and other contractual conditions are not regulated and may be freely negotiated by the contracting parties.

The supported renewable electricity producers here possess their competitive advantage in ability to sell electricity at the market price, as specified above, in comparison to producers using fossil fuels. The latter have to add their profit margin to the contractual price.

Direct trade in electricity with electricity suppliers does not require for the producer to obtain any other additional authorizations.

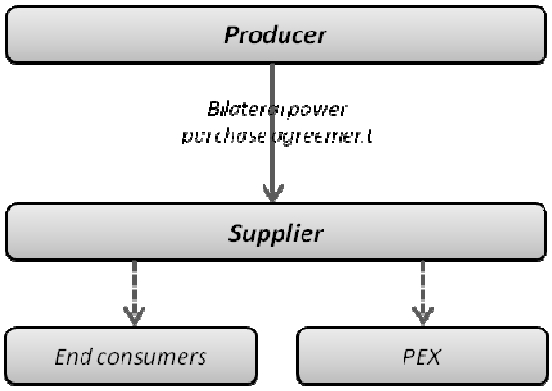



**Figure 3-1 Trade under bilateral agreements**

#### 3.5.6.2 Trade at the power exchange

From 1 January 2010 all electricity market participants in Lithuania may trade in electricity at the power exchange operated by the market operator company BALTPOOL UAB. Electricity trading at the power exchange may be organized as

daily bids at the day-ahead market or as trading under a futures contract entered with another power exchange participant.

General provisions for operation of the power exchange are established in the Rules on Trade in Electricity and further elaborated by the Power Exchange Regulations[60].

In case the electricity producer intends only to sell the electricity produced (partly or in a whole) by its power generation capacities at the power exchange, no other additional authorizations are required. Relevant power exchange participant agreements have to be entered with the market operator to start the exchange trading operations[61].

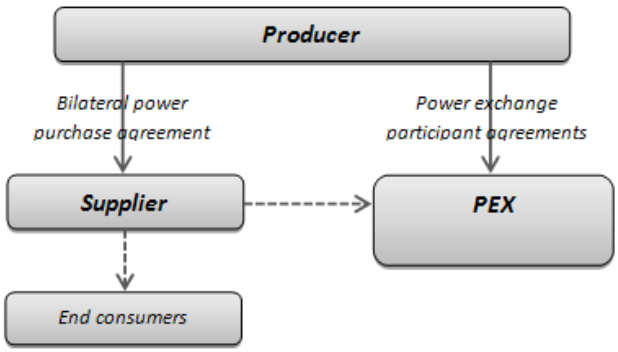



**Figure 3-2 Trade at the power exchange**

#### 3.5.6.3 Trade in reserve capacities

In case the electricity producer has technical capabilities to increase or decrease power generation regime by command of the dispatch centre of the electricity transmission system operator, or to keep certain capacities as a reserve for power system needs, he can trade the balancing or regulation electricity or reserve capacities with the transmission system operator.

Even if this trading scheme is mostly applied by larger fossil fuel-burned power plants, there is no restriction for smaller biomass power plants to compete for

[60] Lithuanian PEX Regulations: http://www.baltpool.lt/index.php?-1866607145

[61] How to become a participant of the Lithuanian PEX: http://www.baltpool.lt/index.php?1820945276

guaranteed power take-off by the transmission system operator; especially having in mind the ability to sell electricity at the market price, as specified above.

Commercial relations with transmission system operator are fully based on contractual arrangements and are not regulated by the State. For this no additional authorizations are required to be obtained by the electricity producer.

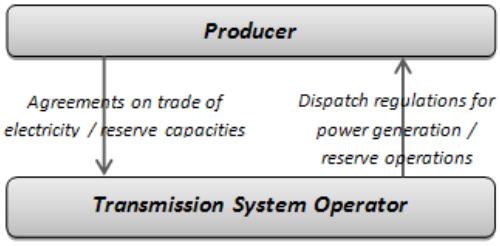



**Figure 3-3 Trade in reserve capacities**

#### 3.5.6.4 Trade with end consumers

The electricity producer may trade in electricity with end consumers only after obtaining the licence for independent supply of electricity. The license is being issued by the National Control Commission for Prices and Energy following the procedures established in the Law on Electricity and the Rules on Licensing of Activities in the Electricity Sector[62].

The trade is organized under bilateral agreements concluded with the end consumers. From 1 July 2007 all consumers in Lithuania are eligible to select the independent supplier.

Contractual arrangements made with commercial consumers fully depend on respective agreements reached between the parties. However, standard terms for

[62] Government of the Republic of Lithuania: Rules on Licensing of Activities in the Electricity Sector, Resolution No 1474. In: *Official Gazette*, No 104-3713, 5 December 2001*(as further amended)*

power purchase agreements to be entered with house-hold consumers are regulated by the Ministry of Energy[63].

After respective authorization for independent supply of electricity the producer (supplier) becomes eligible to sell to the end consumers not only the electricity produced by its generation capacities, but also the electricity purchased from other producers or at the power exchange.

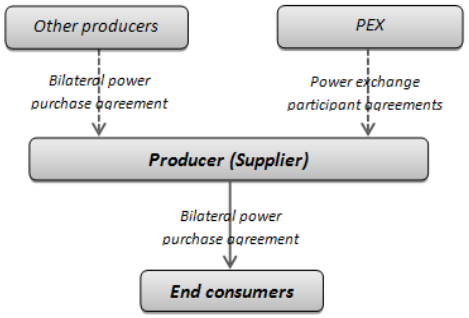



**Figure 3-4 Trade with end consumers**

### 3.5.6.5 Export of electricity

The electricity may be exported from Lithuania only by legal entities having valid licences for supply of electricity, as I specified in 4.6.4 of this chapter. Separate export permissions are required only in case the electricity is exported to the third countries (non-EU Member States).

General provisions on export of electricity are regulated under the Law on Electricity and the Regulation on Import and Export of Electricity adopted by the Ministry of Energy[64].

[63] Minister of Energy of the Republic of Lithuania: Regulation on Standard Conditions for Electricity Sale and Purchase Agreements with Household Consumers, Decision No 1-43. In: *Official Gazette*, No 23-1092, 19 February 2010

[64] Minister of Energy of the Republic of Lithuania: Regulation on Import and Export of Electricity, Order No 1-302. In: *Official Gazette*, No 129-6601, 28 October 2008

It is also mandatory required that the electricity to be exported has to be purchased at the Lithuanian power exchange. This means that producers are not allowed to export directly the electricity produced by their power generation capacities.

All export activities have to be based on contractual obligations with the entity in foreign country to which the electricity is being exported.

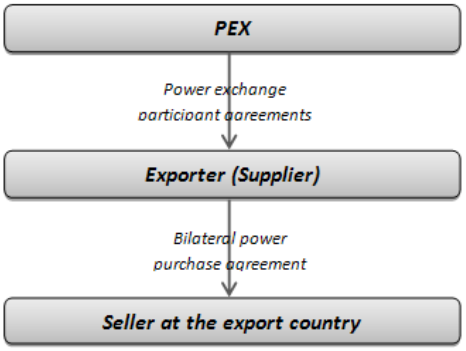



**Figure 3-5 Export of electricity**

# 4 Biomass market potential Lithuania

## 4.1 Introduction

From the total land reserve in Lithuania[65] (6,52 MHa) a large portion is forest (2,13 MHa) and about 3,4 MHa is agriculture land. The remaining 13% is still reserved for restitution to private owners.

Per 1 October 2007, ownership of forests was for 36% in private hands and the state owned 51%. The 227.000 private owners have an average of 3,4 ha and only 200 owners have forest area's above 100 ha. About 60% of forest cuttings come from the state forests.

All these numbers show huge perspectives to develop a biomass economy in this country with only 3,4 million people.

After the closure of the second nuclear reactor in Ignalina in 2009, more than 90% of produced electricity in Lithuania comes from the import of fossil fuels[66] and most of this is contracted from a single supplier Gazprom. Lithuania could combine the need for more energy security with the option to develop a large endogenous biomass forest- and agro industry.

Lithuania produced in 2010: 41.734 terajoule (997,5 thousand t.o.e.) of firewood and wood waste and 228 terajoule (5,4 thousand t.o.e.) of agriculture waste for energy. In 2010 export of firewood and wood waste counted for 5.102 terajoule (121,9 thousand t.o.e.) and import was at a value of 2.008 terajoule (48,0 thousand

[65] Eurostat FAOstat 2009

[66] Miskinis, V. and Galinis, A.: Challenges and options for development of the Lithuanian energy sector. In: , *International Journal Global Energy Issues*, 2010, Vol.34 Nos

t.o.e.)[67]. Consumption of wood and agriculture biomass counted in 2010 for 13 percent of the total gross inland energy consumption.

The Lithuanian Government (2011) wants to bring the share of renewable energy in the balance of heating from the 12% in reference year 2005, to 20% 2010 and finally up to 60% in 2020.
This government bases this ambition on potential feedstock prognosis in million $M^3$:

**Table 4-1 Projected figures for production of solid bio fuels – 2011 Government of Lithuania.**

| *ANNUAL PRODUCTION* | *Figures 2010* | *2020* |
|---|---|---|
| 1. Wood fuel – total (x million $M^3$) | 5,1 | 5,9 |
| - Fire wood | 2,7 | 3,2 |
| - Wood industry wastes | 1,5 | 1,6 |
| - Cutting forest waste | 0,9 | 1,1 |
| 2. Short rotation plantations (x 1000 $M^3$) | 7,0 | 70,0 |
| 3. Waste straw (x million ton) | 0,5 | 0,7 |
| 4. Municipal Waste (x million $M^3$) | 1,0 | 1,0 |

From the macro to the micro picture: my feasibility study for a 66 MW CHP requires about 200.000 ton of wood chips per year. It was told to me that it will not be easy in the Kaunas area to find a secure long term supply of such quantity. I was recommended to look into alternatives, such as peat.

As my feasibility study locates the future plant in Kaunas, I have been searching what the biomass potential is in the Kaunas region.

I therefore did some research to understand actual markets of solid biomass fuel in Lithuania and prospects for the future.

[67] Lietuvos Statistikos Departementas / Statistics Lithuania: Energy Balance 2010, Vilnius 2011

## 4.2 Potential of the forest sector to produce biomass for energy in Lithuania and in Kaunas

According to figures from the Ministry of Environment dated January 1, 2007 the Lithuanian forest sector could be identified as follows:

**Table 4-2 Forest - main parameters in Lithuania – Ministry of Environment -2007**

| | |
|---|---|
| Productive forest area, 1000 ha | 2030 |
| Total growing stock volume, mill. $M^3$ | 405 |
| Mean volume per ha, $M^3$ | 199 |
| Mean volume of mature stands per ha, $M^3$ | 255 |
| Gross annual increment above ground, mill. $M^3$ | 13,1 |
| Annual current increment, $M^3$/ha | 6,5 |
| Annual Forest cuttings 2000-2006 mill. $M^3$ Public and private forest | 5,3 / 5,7 / 6,3 / 6,5 / 6,3 / 6,2 / 6,0 |

The Lithuanian Energy institute[68] came to the conclusion from several studies that the annual potential production capacity of the Lithuanian forests amount 13,78 million $M^3$ wood.

**Table 4-3 Lithuania potential versus actual consumption of fuel wood 2010-2020 – Lithuanian Energy Institute**

| | *2010* | | *2020* | |
|---|---|---|---|---|
| | Potential resources | Actual Consumption | Potential Resources | Consumption |
| *Non authorized cuttings* | 2067,4 | 2067,4 | 2067,4 | 2067,4 |
| *Industrial wood* | 5802,9 | 4844,0 | 5802,9 | 4844,0 |
| *Fire wood* | 2190,9 | 1802,4 | 2190,9 | 2023,7 |
| *Cuttings and thinning* | 3721,4 | 25,7 | 3721,4 | 954,9 |
| *Total* | 13,78 million $M^3$ | 8,73 million $M^3$ | 13,78 million $M^3$ | 9,89 million $M^3$ |

** Figures in 1000 $M^3$*

[68] Galinas, A. and Lekavičius, V.: Preparation of a complex program in the District Heating sector of the period 2011-2020 and establishment of it implementation measures. In: Lietuvos Energetikos Institutas, 2011

From these figures the Lithuanian Energy Institute concludes that huge amount of forest waste could be generated. This can deliver useful biomass for heat in the amount of 2 million $M^3$ per year. It seems therefore easily possible to generate overall 5 and 7 million $M^3$ wood biomass for the heat and cogeneration sector in Lithuania in actual conditions.
What is the situation now on a more regional level of Kaunas, where I am planning to invest in a biomass cogeneration plant?

Under the Baltic Sea Region INTERREG IIIB program, the Baltic Biomass Network has published a Bio energy Atlas for Kaunas County in 2007. Kaunas County has the following characteristics:

**Table 4-4 Land distribution and demography Lithuania Kaunas – Bio energy Atlas 2007. INTERREG IIIB**

| | *Lithuania* | *Kaunas County* |
|---|---|---|
| *Area km²* | 65.300 | 8.089 |
| *Population* | 3.445.875 | 680.913 |
| *Inhabitants/km²* | 52 | 84,2 |
| *Forest land (km² and%)* | 19.687 – 30% | 2.297 – 28% |
| *Agriculture land (km² and%)* | 39.611 – 60% | 4.540 – 56% |
| *Inland waters (km² and%)* | 1.711 – 2,6% | 264 – 3% |
| *Urban settlements (km² and%)* | | 335 – 4,1% |
| *Other land (km² and%)* | 4300 – 6,5% | 469 – 5,8% |

The inventory of forest biomass for Kaunas County gives as figures:

- Above ground biomass: 24,2 million ton
- Underground biomass: 5,5 million ton
- Dead wood biomass: 2,3 million ton

Annually, Kaunas County could generate 202 thousand ton of wood for heat. This includes the thinning of small diameter trees, felling waste from all types of logging and stumps from final felling. In addition to this, Kaunas could utilize about 800.000 $M^3$ pro year from the logging industry. Total waste from the logging industry is forecasted at 2,4 million $M^3$ pro year from 2017 on.

The energy potential of forestry wood in Lithuania and Kaunas can be derived as a yearly percentage of the total biomass. Different sources comment that such yearly

extraction could go from 10 up to 18 percent of the available biomass. Using 18% of the technical potential in Lithuania and in Kaunas County would give an energy potential of forestry wood pro year of[69]:

**Table 4-5 Energy value of fuel wood from forest in Lithuania and in Kaunas (Vrubliauskas 2007)**

| | *Energy value, MWh* | | |
|---|---|---|---|
| | *Small diameter trees from thinning cuttings* | *Logging residuals from all types of felling* | *Stumps from final felling* |
| *Kaunas County* | 38.624 | 247.331 | 218.280 |
| *Lithuania total* | 221.111 | 1.888.275 | 1.516.662 |

The Kaunas biomass atlas examined the maximum potential of forest biomass from the private and state forests, limited to group 3 (preventive forests) and group 4 (economic forests).

If one counts all of the residues from wood felling and cutting (small diameter trees, branches from thinning and current cuttings, branches from clear cuttings, and stumps), the total harvest could amount for Kaunas County 363.123 $M^3$ per year.

As all of the figures given before are mostly theoretical potentials, the question arises how the Lithuanian forest sector is organized to take such challenge and to contribute to a new biomass industry. From several sides, there has been severe critic on the way the forest sector is managed in Lithuania.

The Lithuanian Biomass Energy Association (www.litbioma.lt) puts a major focus on the need to drastically enlarge the biomass heat and co-generation capacities in Lithuania. The umbrella organization of the biomass industry feels that there is plenty of capacity to cultivate and to generate biomass in Lithuania. The organization stresses therefore that the main problem is not in the supply chain but merely the need to find large government support for new biomass heat and power generation plants. The association's focus is mostly on the demand side of biomass. In the debate to make the whole supply chain from production to processing, from transport to stocking biomass more productive and more transparent - little is said

[69] Vrubliauskas, S. et al.: Energy Assesment for Forests, Agriculture and Municipal Biomass. In: *Lithuanian Energy Institute*, 2007

by the association. Lithuania's economy is often monopolized by few companies and they have no interest in having a more transparent and competitive market. One may even say that a demand supply system that generates shortages leads to higher prices of the biomass. This may largely serve short and medium term interests of the biomass producers.

I have met, during the course of my preparatory works, several people who wanted to remain anonymous but were very critical towards the Lithuanian forest sector and the perspectives for Lithuania to develop a biomass industry.

The forests in Lithuania are divided into 4 main categories[70] :

- Group 1: Nature reserves – here cuttings are strictly forbidden (1,2% of forest area's)
- Group 2: Ecosystem protection and recreational forests (12,2% of forest areas). Clear cuttings are not allowed and final felling only after natural maturity (171 years for pine)
- Group 3 Protective Forests (15,7% of forest areas) & Group 4 Commercial forests (70,9% of forest area): for the last two categories restrictions are less strict. However very bureaucratic procedures apply for thinning and felling.

Lithuania still has severe normative bureaucratic organization, strong environmental restrictions, a regional network of state forest companies and a reorganization of land ownership and restitution that has until today not been finalized.

Lithuania uses a minimum allowable rotation age (MARA). MARA defines the minimum age for each tree species within the specific forest group and below which no felling is allowed. For example for pine, the MARA is 101 years in commercial forests, 111 years in protective forests and 171 years in protected and recreational forests. Severe critic is given to the use of MARA as it is not taking into account any financial criteria on cash flow during rotation, it uses no time value of money, and it includes no differentiation of local site productivity. This leads to a delay of harvest (up to 20 years) and to a uniform old class age distribution pattern of Lithuania's wood inventory.

[70] Brukas, V. et al.: Resource availability, planning rigidity and Realpolitik in Lithuanian forest utilization. In: *Natural Resources Forum 35*, 2011, pp. 77-88

The National Forest Institute calculated that for the period 1998-2007, the average annual harvesting of the growing stock was 9,7 million $M^3$ and the increment for the same period was 15,7 million $M^3$. This gives a Harvest/Increment ratio (H/I) of 61%. All experts agree that there is a steady significant accumulation of standing volumes in the Lithuanian forests. The intended forest harvests of 8,94 million $M^3$ by 2021 will not be possible without a new forest policy that will include amongst others: new intensive forest management technologies, improved forest regeneration and better thinning of young stands[71]. The Nordic countries Sweden, Finland could serve as a good practice for such urgent needed reform. These countries have developed a state of the art RES biomass production chain and their forest management and supply chains are merely driven by the wood markets. This is not at all the case in Lithuania.

Information campaigns addressed to the general public will be needed. These campaigns should focus on the need for a RES-energy policy and the share in it from a dynamic sustainable forestation policy. It seems that 77% of the Lithuanians think that forests are decreasing despite net growth of total biomass.

Not only the state but also the private forest sector needs huge reforms in order to unlock the renewable energy potential of Lithuania. Now all cuttings in Lithuanian private forestry must have a forest management plan from a registered expert, even for the smallest plots. The plan must include a 10 year final cutting norm, a reforestation plan and environmental issues. Some authors propose new directions to make the business for small forest owners more attractive by using logging residues and processing woodchips from non-used waste wood in the forests[72].

In the state forest sector, there are 42 independent regional State forest enterprises and they all have their own annual cutting plan. The companies are not market driven and their output is only focused on achieving a profit/expenditure ratio that is

[71] Brukas, V. et al.: Policy drivers behind forest utilisation in Lithuania in 1986-2007. In: *Baltic Forestry 15 (1),* pp. 86-96

[72] Mizaras, S. et al.: Improving incomes from small scale forestry in Lithuania, http://espace.library.uq.edu.au/eserv.php?pid=UQ:108407&dsID=n47_Diana_.pdf

determined for the state enterprises. It is said that these enterprises are not transparent.

A recent state audit[73] on the Lithuanian forest sector performance was very critical and urged for substantial reforms. The report argues amongst others:

- that the new forestry policy guidelines should be fixed by the Lithuanian parliament and not by the Minister of Environment;
- that the optimal number of regional state enterprises should be re-examined (up scaling?);
- that flexibility mechanisms should be built in to adapt yearly forest output to changing market conditions;
- that regional state enterprises should perform in a transparent way ; respect public procurement and publish annual accounts;
- that forest equipment should be utilized much better;
- that land valuation needs to be included in the accounting.

The report asks for the Minister of Environment and for the Directorate of State Forests to be more accountable for policies and supervision of the sector. The severe controversial context of the Lithuanian forest sector was recently mentioned at the Proceedings of the Biennial Meeting of the Scandinavian Society of Forest Economics held in Gilleleje – Denmark in May 2010.[74]

## 4.3 Potential of the agriculture sector to produce biomass for energy in Lithuania and in Kaunas

I have got several interviews with the Cabinet of the Minister of Agriculture of Lithuania – including Minister Starkevicus. It was revealed to me by the Minister that he wants to use the need for a renewable energy policy and energy security, to boost the agriculture economy and to give farmers new opportunities to acquire additional income. As examples of good practice are mentioned the enterprise UAB

[73] National Audit Office of Lithuania: Report on Forest sector performance, N°. VA-P-20-1-7, 31 March 2010

[74] Brukas, V.: Model of State forestry administration and media thriller in Lithuania. In: *Scandinavian Forest Economics 43*, November 2010, pp. 131-145

”Mestilla” (Klaipeda) producing biodiesel with a capacity of 110.000 ton per year and the state of the art company ”Kurana” which produces through anaerobic digestion yearly 22 million $NM^3$ biogas with a content of 60% methane (equivalent to approximately 13 million $NM^3$ of natural gas). This plant will function as the first integrated bio refinery in the Baltics and will produce commercial grade liquid ammonium sulphate fertilizer and heat and power. Compost production may later be orientated into ethanol or other fuels depending on future cost effective advances in cellulosic bio fuel conversion technologies.

Lithuania’s RES agro industry is mainly focusing on liquid bio fuel production. In 2010 the country produced 128,5 thousand ton of bio fuel and this accounted for 4% of the entire fuel consumption in transport. This is under the projected EU level of 5,75% in the National Renewable Energy Action Plan - NREAP. Reason is more attractive export possibilities. However from 1 January 2012, the allowed share of biodiesel in diesel will be increased to 7% and from 1 January 2013 the bio ethanol share in petrol will be brought up to 10%. This will open new market opportunities.

Within the agriculture land potential to develop renewable energy, the bio fuel agro industry occupies about 300.000 ha in Lithuania. This is nearly 10% of the total agriculture land. The Minister stresses that the future development of the sector will have no significant effect on the food market, food prices or on biodiversity in Lithuania.

Above the 300.000 ha for liquid bio fuels, the question for me is to understand Lithuania’s potential to generate solid bio fuels that could be used for heat and power generation. In the rural development program of Lithuania 2007-2013, the focus was on the production of straw and grass pellets (100.000 ton per year) and wood pellet production up to 500.000 ton/year. However in 2010 only 4% of available straw was used for bio fuel. The Ministry accounts the available straw for bio energy purposes at 500.000 ton per year.

Coming back to the regional level of Kaunas where I am planning to invest in a biomass CHP plant. In the ”Bio energy atlas” under the INTERREG IIIB program (2005-2007), the assumptions for straw from wheat, rye and barley are:

- Moisture content: 15%

- Losses: 10%
- Other uses: 50%
- Energy value of straw for wheat, rye and barley: 3,44 MWh/ton
- Share grain-straw 1:1 (wheat, rye) and 1:1,25 (barley)
- Extraction 33% (total percentage that can be employed to supply energy)

This leads to the following result for Kaunas County: (if only one of the three crop species is grown!)

**Table 4-6 Maximum straw energy potential in MWh in Bio energy Atlas INTERREG IIIB**

| | *Maximum straw energy potential in MWh* | | |
|---|---|---|---|
| | *Winter rye* | *Winter wheat* | *Barley* |
| *Kaunas County* | 3.379.729 | 3.111.364 | 2.353.779 |
| *Kaunas County grain energy potential in case 5% of grain harvest would also go to the incineration* | 604.255 | 559.810 | 526.034 |

The Lithuanian Energy Institute[75] mentions in a 2007 publication for Kaunas County from the National Statistics a production capacity of 588.962 MWh (I have derived the energy value from their figures at an average of 3,51 MWh/ton and taken into account that 33% of straw yield will go into the energy model):

**Table 4-7 Kaunas County straw for energy production capacity and energy value**

| *KAUNAS COUNTY* | *Winter wheat* | *Winter rye* | *Winter triticale* | *Common spring wheat* | *Spring barley* |
|---|---|---|---|---|---|
| *In: ton* | 237.977 | 24.781 | 44.435 | 44.435 | 156.538 |
| *33% in: ton* | 78.532 | 8.178 | 14.663 | 14.663 | 51.657 |
| *Energy value calculated at 3,51 MWh/ton in MWh* | 275.647 | 28.705 | 51.467 | 51.467 | 181.316 |
| ***TOTAL MWh*** | | | | | **588.962** |

[75] Vrubliauskas, S. et al.: Energy Assesment for Forests, Agriculture and Municipal Biomass. In: *Lithuanian Energy Institute*, 2007

Currently Lithuania[76] use of straw is minimal and amounts 12-15% of total straw which is the equivalent of 78.000 ton of dry volume for Kaunas region (approximately equivalent to 273.780 MWh).

In practice, and talking to some farmers, I became aware that they are not enthusiast about straw for heat. Several of them have modern harvesters. These machines can, simultaneous to the harvest of grain, crush the straw and spread it into the soil. The advantages are that fewer fertilizers are needed and that the farmer can almost the day after harvesting start preparing soil for sowing of winter crops.

At present, specific straw boiler houses exist in villages in Lithuania with a total capacity of 5 MW (capacities between 15 to 450 kW; one in Gelgaudiškis of 1,84 MW and a large reconstruction of existing boiler house in Akdemija of 2,5 MW).

The future of straw for energy need to focus on local applications and the preferred outcome could be the use of straw boilers by agriculture farms themselves. Transport is expensive because of the low density of uncompressed straw (30-40 kg/M$^3$). For such local heating purposes a Lithuanian company UAB Umega started production of industrial straw fuel burners (http://www.umega.lt/index.php?cid=5821&pid=5590)

On a less local approach, a pilot factory will also start up in October 2011 producing pellets from straw and grasses. Vytenus Daunoravičius, CEO from the company Newheat (www.newheat.lt) introduced me to his project that uses new patented technology to process straw into pellets. The factory will produce 24.000 ton of straw pellets per year and use 1,5 million ton straw and 0,5 million ton grass.

In boiler technology it should be noticed that straw ash has lower melting points and therefore increases risk of slogging. Straw combustion technologies must therefore comprise advanced control of the fuel bed temperature by regulating fuel and air supply and/or cooling. Denmark has huge experience in district heating with straw and processes straw on an industrial scale.

[76] Baltic Biomass Network: Planning Regional Bio energy Resource Use (INTERREG IIIB). In: *Project Handbook Baltic Biomass Network*, 2005-2007

In addition to straw from agriculture a second potential development can be in the cultivation of energy crops. Here only little experience is available. Some small pilot projects have been starting up (one of them I have been visiting):

- Mindaugas Šilininkas, CEO of the company Euromediana, explained to me that they have started from a laboratory cloned hybrid of aspen, to plant the first 80 ha of plantation in 2010. This tree is the fastest growing tree in the Baltics with a rotation of 15-25 years and the hybrid version will generate 20 $M^3$ per ha per year. For the hybrids, the company has a program for micro propagation in laboratory using bioreactors. Tissue is then regenerated in climatic chambers and rooted ex vitro under cool white and led light. Seedlings are finally adapted for second time in greenhouse and after this step the saplings are grown in open air in the nursery and finally planted in the field. The company argues that Lithuania has huge under – and unused land and want to start from 2012 with yearly hybrid plantation of 1000 to 2000 ha/year.
- New initiatives may arise with other energy crops like:

**Table 4-8 Short rotation crops for energy overview**

| | *Specifications* | *Yield in ton/ha dry weight* |
|---|---|---|
| Short rotation:<br>- Willow<br>in Lithuania 300 ha According to Institute of agriculture economy requests for 1000 ha!<br>- Possible danger for damage to the general agriculture irrigation system in Lithuania | - High moisture content at harvest<br>- Successful use in Scandinavia for bio fuels<br>- 20-25 year production cycle<br>- Stem planting: horizontal or vertical | 8-12 |
| Annual:<br>- Hemp Cannabis Sativa | - 2,5 to 5 m height<br>- C3 crop<br>- Fast grow<br>- No herbicides for weed control needed<br>- 12 weeks full maturity<br>- Increases nutrients in soil | 15 |
| Perinnal grass:<br>- Miscanthus | - C4 plant (= low nutrients and water requirements) | 7-10 |

| | | |
|---|---|---|
| | - 15-25 year rotation<br>- Planting by rhizome mechanical division<br>- 2-4 m height | |
| Perennial grass:<br>- Reed canary grass | - native in N-W Europe<br>- Sowing needs light!<br>- Energy potential up to 130.000 GJ/ha! | 7-8 (clay grounds)<br>10 (organic ground) |

The Minister of Agriculture Starkevičius examines several possibilities to cultivate unused agriculture land in the future. A study has been done in this regard by the Institute of Agriculture Economy in 2010. The study calls for more and faster consolidation so that larger economically viable area's can be formed. This total consolidation program should include 112.800 ha by 2013 and the average agriculture plot of 12,3 ha in 2008 should expand to 20 ha. The study also favours the use of land for bio energy purposes.

The Minister of Agriculture and his colleague of Finance are also preparing new taxation rules for land. In general taxation in Lithuania on agriculture value is done according to a rule:

*Land tax = Nominal value of land (taking into account quality of soil and other criteria) X tariff coefficient (1,5%) X lowering coefficient for agriculture land (0,35)*

In the reform process the main idea is to fix the land tax as follows:

*Market value of the land X differential tariff (between 0,01-6,67%: the municipalities will play role to fix the rate)X 0,35 (this factor will only apply for those who declare the land for EU subsidies ).*

Main idea is to activate better use of land and to induce agriculture activities on it.

A national databank based on multi spectrum and ortho analysis is under preparation to monitor in detailed way all wasted lands. Total of waste land is estimated 500.000 ha (state and private). In addition 822.000 ha have not been declared (possible partially in use by farmers) and another 364.094 ha of state

owned land (could be forest or water) could be screened also for agriculture purpose. These figures are above the actual 3,4 agriculture land.

In conclusion: the Lithuanian Institute of Agriculture (www.lzi.lt) foresees that it is possible to grow energy crops on 22% of the agriculture land (740.000 ha). Of this land 52% could be grown for biomass. In addition wasted land could also be integrated in a bio-energy agro industry. However in order to do this, the sector will need to reorganize. Upscaling is desperately needed to come to viable initiatives. In addition a national program to invest in cultivation and processing of solid biomass will be needed.

## 4.4 International trade of solid biomass and Lithuania

As the perspectives for a biomass based agro industry may be good – one can ask if the sector of solid biomass supply has any international element and if competition from outside the country is possible. I am not going to comment here on Lithuania's export of pellets and chips to neighbouring countries. This may be a temporary phenomenon due to better prices that producers can receive on the export markets.

Solid biomass supply and use chains should by preference develop within a regional context. Integration means that the production and the use of biomass in boiler systems should be integrated on regional level. Prices of biomass are very sensible to transport and in addition such a regional approach is a strong argument for sustainability. Regional Forest fuel networks should be developed for supplying regional biomass boiler and CHP plants. For this methodologies have been studied at the University of Natural Resources and Applied Life Sciences in Vienna[77].

As biomass is sensible to transport costs – one can only look at examples where countries are connected by sea and offer cheap supply through sea vessels of 3000-10000 ton. Lithuania being a part of the Baltic Sea area, might therefore be suitable to import large quantities of biomass wood logs, chips or pellets. Russia is a large export market, but prices have been fluctuating previously rated at EUR

[77] Rauch, P. and Gronalt, M.: The terminal location problem in a cooperative forest fuel supply network, http://www.wiso.boku.ac.at/pwl.html

15/solid $M^3$, went up to EUR 50/solid $M^3$ in (although was not implemented due to financial crisis)[78]

Russia is not at all using its biomass potential for its domestic market. In 2008 biomass and waste contributed only for 0,9% of the total primary energy supply. Export opens large possibilities. North West Russia has huge potential in terms of wood energy resources. The cut in 2009 was 50 million m3 and the allowable potential 112 million $m^3$ (equivalent to 224 TWh)[79]

Lithuania is, through its deep-sea port Klaipeda, part of the Baltic basin where a large common market exist for wood trading, including wood for energy applications. However in the whole debate of energy security and sustainability, this could be a possible threat not to develop its own huge endogenous potential.

In addition Belarus may export by rail some of its wood to neighbouring country Lithuania. Belarus produces today about 7 million $m^3$ of energy logs. Production of woodchips amounted 511.000 ton. Export in 2008 showed figures of 201.000 ton of wood fuel at average value of 76 USS/ton including 92.000 ton woodchips at value of 42,3 USS/ton[80]. As distances from Belarus to Kaunas are short and rail connection is well organized, the option of a supply chain from Belarus seems also feasible.

## 4.5 Municipal waste to energy

In 2010 Lithuania produced about 1 million $m^3$ of municipal waste, mostly mixed. Major part is going to landfills. The Environmental Centre for Administration and Technology gives, for 2008, figures of 1,1 million ton household waste (10,45 pet joule) of which 75% is suitable to be transformed into energy.

[78] Vikinge, B.: Trading of woodchips in the Baltic Sea Region. In: *EUBIONET III, Biomass trade – focus on solid biofuels, workshop*, Esboo, 14 april 2011

[79] Gerasimov, Y. and Karjalainen, T.: Energy wood resources and trade of wood chips from Russia. In: *METLA*, 2011

[80] Gerasimov, B.: Energy sector in Belarus: Focus on wood and peat fuels. In: *Working papers nr. 171*, 2010

In its goals for RES towards 2020, the government includes a municipal waste to energy program of 1 million $M^3$ pro year.

Kaunas County would have 169.000 ton municipal waste pro year and has developed plans for a cogeneration plant in 2010.

## 4.6 Conclusion

The Government of Lithuania has the ambitious goal toward 2020 of having 60% renewables in the overall heat balance. This is three times the actual share of 2010. The country has large potential to develop the solid fuel biomass supply chain from forest-, agriculture- and municipal waste sectors. Towards 2020 an annual production of 5,9 million $M^3$ of wood fuel, 70.000 m3 short rotation crops, 700.000 ton waste straw and 1 million $M^3$ municipal waste is needed to achieve that goal.

For this it will be needed to drastically reform the forest sector and to invest in the latest modern harvesting and processing technologies. Also, the agriculture sector needs to find formulas to upscale farms and here also, large investments will be needed.

As Lithuania has a strategic location within the Baltic Sea area, the risk exists that foreign markets, especially from Russia, will penetrate the RES market in Lithuania.

# 5 Economic feasibility of a cogeneration plant in the FEZ Kaunas

## 5.1 Choice for a district heating network configuration

JSC ”Kauno energija” is the main heat supplier in Kaunas City and the region. The company’s shares are 93,5% owned by the Kaunas Municipality. The remaining shares are in the hands of smaller municipalities (1,51% Jubarkas district municipality, 3,77% Kaunas District Municipality) and 1,67% is in private hands. In 2009 the company bought 93% (1.349.897 MWh) of heat from Kaunas CHP (UAB Kauno Termoficacijos Electrine owned by GAZPROM) and 7% (100.501 MWh) from own generation sources. The GAZPROM plant has an installed capacity of 1000 MWh and 170 MWel. The company was bought by Gazprom based on a 15 year heat purchase contract with Kauno Energija for not less than 80% of the total annual heat needs.

The own installed capacity of JSC Kauno energija integrated network amounts to 577 MWh (of which 203 MW are suspended) and 8MWel.:

- The largest source (and also one of the oldest heat plants in Lithuania) is the Petrušiūnai plant. It has 3 steam boilers and 2 water heaters with total capacity of 413,4 MW (operational 289); the boilers burn natural gas and heavy oil. The electric capacity is 8 MW
- Pergalės Boilerhouse: 4 steam boilers (3 suspended) and 2 water heaters. The total heating capacity is 70,3 MW (in operation: 31,3 MW). For warm water preparation there are 3 heat exchangers of 69 MW capacities (in operation 23 MW). Heat sources are natural gas and diesel fuel.

- The Šilkas Boiler house has 6 installed boilers (5 water heaters and 1 suspended). The total heat capacity is 54 MW (of which 42 MW operational). The fuel is natural gas.
- The Inkaras boiler house based on natural gas and heavy oil, has a capacity of 39 MW from 3 steam boilers. For warm water preparation there are 5 heat exchangers of 73 MW capacity. Since 3 years the boiler house is not in operation.
- There exist 14 remote medium and low capacity boiler houses for residential districts with own limited centralized heating network.
- A further 7 boiler houses of medium capacity exist.

The Kauno Energija district heating network amounted to 8,18 km in 1963 and today the company owns 396,6 km (integrated network: 343,9 km, local networks: in Kaunas City: 8,6 km, Kaunas District: 31,4 km and Jubarkas: 12,7 km).

In the period 2004-2009, the company invested an amount of EUR 45,7 million and within this program more than 60 km of pipelines were changed to new ones with polyurethane isolation. In 1997 heat losses were in the order of 930 MWh and these has been substantially reduced to 307 MWh in 2009. In 1997 water losses in the networks mounted to 1.4 million $m^3$. In 2009 these are at the level of 307.000 m3 and that still needs to be reduced substantially.

The Kaunas district heating network today is mainly fed by fossil fuels. In addition Gazprom has the monopoly for 90% of this overall fuel supply and at the same time owns the main production facility for heat. The city network has therefore a double challenge: how to diversify primary energy supply by using more endogenous resources and at the same time how to challenge the monopoly at the heat production side.

When I contacted the management of the company shortly after choosing the current subject of my thesis, I found immediate enthusiasm. I was able to get Kauno Energija to sign a letter of intent for the elaboration of a biomass CHP plant in the free economic zone of Kaunas.

The main drive for such attitude of Kauno Energija was based on:

- The short geographical distance of the Free Economic Zone of Kaunas from their heat transmission networks (2,5 km distance and same area of the Kaunas CHP –Gazprom plant. See implantation map.


**Figure 5-1 Implantation of biomass CHP plant and connection possibility to Kaunas district heating network**

1 - Kaunas FEZ Biomass CHOP plant
2 - Thermal Chamber 1T3/Connection to the heating grid of Kaunas City
3 - Kaunas Heat and Power Plant –Gazprom
4 - Kaunas Hydroelectric Power Plant

- Connection could be done with the existing 1T-3 thermal chamber with a pipeline dimension of 2D700 mm and with the following characteristics:
  - P return: between 1 and 4 bar
  - P supply: between 5 and 11 bar
  - Temperature supply: min. 70° and max 120° C
  - Temperature return: max. 70° C
- The fact that the contractual obligation of Kauno Energija to buy up minimum 80% of its yearly heat will come to an end in 2018 ;
- The willingness to shift from almost total dependency on fossil fuel towards a partially RES based district heating on biomass.

From these preliminary talks, it became clear to me that I would focus on a biomass cogeneration plant in relation to the Kaunas District heating company. I would of course examine if such plant can operate all year round at full load. This means that we would take the option for a cogeneration plant that would deliver maximum of heat.

Based on average values over the period of 2007-2009, I have received from Kauno Energija the possible total supply figures for heat by third party producers to the Kaunas district heating network:

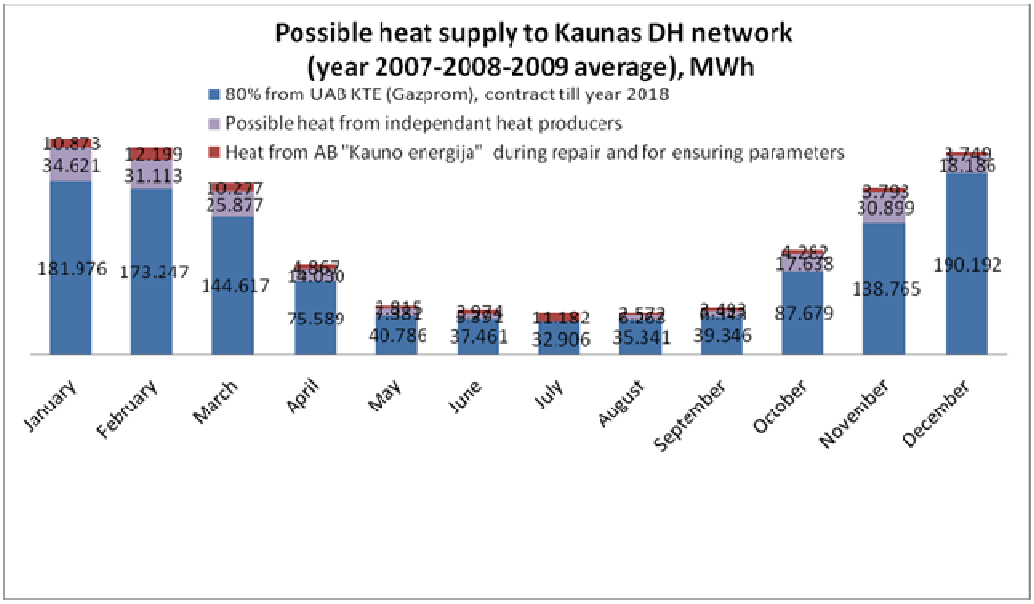



**Figure 5-2 Average heat supply of Kaunas District heating network in MWh over 12 month year period**

This would mean that the new CHP plant could deliver about no heat at all in the summer period (May till September). During two months April and October there could be reduced supply of heat. The 5 winter months November through March the plant could deliver respectively 30.899, 18.186, 34.621, 31.113 and 25.877 MWh of heat.

The summer limit is, in addition, limited for technical reasons related to the difficulty to divide heat production between several geographical distributed producers.

A typical hourly heat demand curve for one week in the summer is given below:

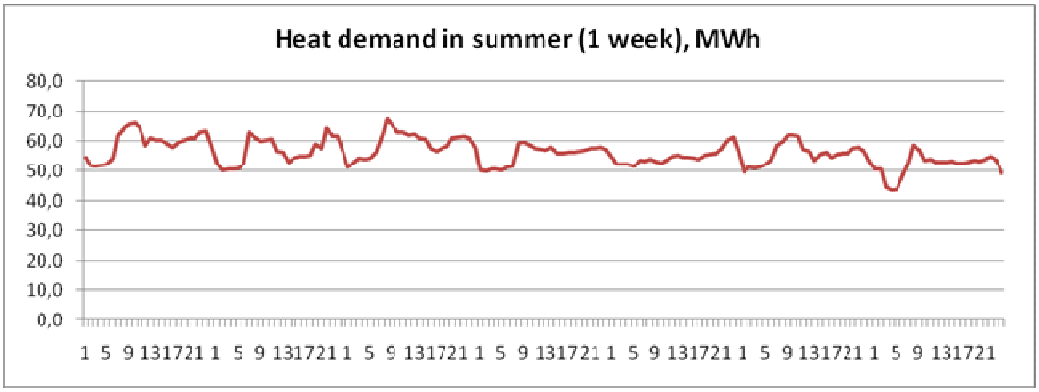



**Figure 5-3 Heat demand curve for 7 day week (Source: Kauno Energija)**

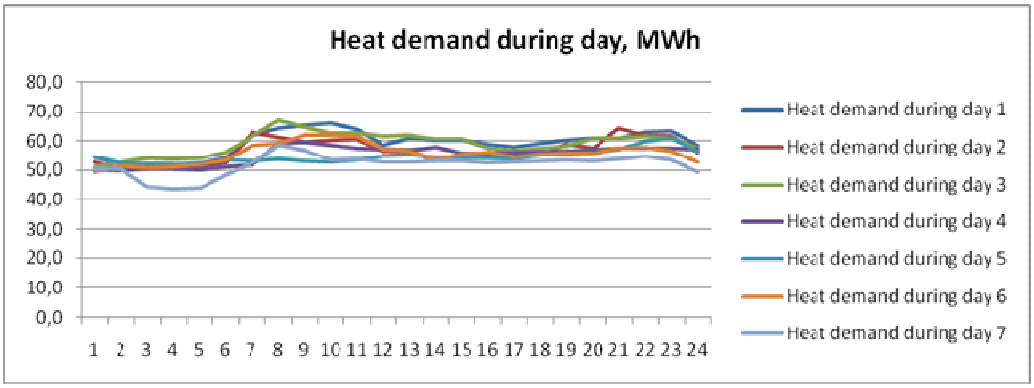
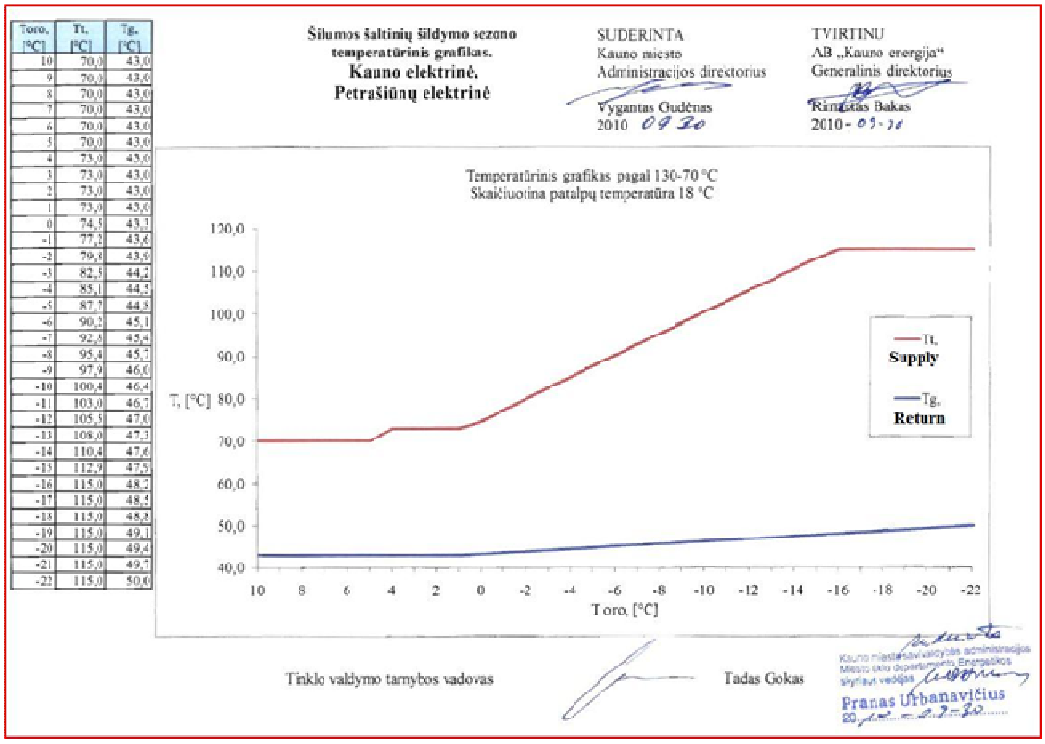



**Figure 5-4 Heat demand curve over 24 hour day of each day of the week (source Kauno Energija)**

Despite the restrictions for heat delivery, Kauno Energija gave me 2 important considerations:

- The contractual obligation with Gazprom will already be finished by the end of 2018. Depending on the start up of the new biomass CHP plant beginning of 2014 or in case of delays (due to planning issues) 2015 – one has to live with reduced (mostly summer) delivery supply during 4 to 5 years. From 2019 onwards Kauno Energija is ready to contract the heat from a 60 MWth capacity biomass CHP plant at full at its full capacity.
- I am also informed that the period of 2014-2018 could be challenged by any biomass heat supplier on the condition that the new plant is ready to deliver heat under the actual price level of EUR 48,07/MWh heat. It means a price under the price level paid by Kauno Energija to Gazprom

The supply and return temperatures of the Kaunas district heating network at various outside temperature conditions are:




| Toro, [°C] | Tt, [°C] | Tg, [°C] |
|---|---|---|
| 10 | 70,0 | 43,0 |
| 9 | 70,0 | 43,0 |
| 8 | 70,0 | 43,0 |
| 7 | 70,0 | 43,0 |
| 6 | 70,0 | 43,0 |
| 5 | 70,0 | 43,0 |
| 4 | 73,0 | 43,0 |
| 3 | 73,0 | 43,0 |
| 2 | 73,0 | 43,0 |
| 1 | 73,0 | 43,0 |
| 0 | 74,5 | 43,1 |
| -1 | 77,2 | 43,4 |
| -2 | 79,8 | 43,9 |
| -3 | 82,5 | 44,2 |
| -4 | 85,1 | 44,5 |
| -5 | 87,7 | 44,8 |
| -6 | 90,2 | 45,1 |
| -7 | 92,8 | 45,4 |
| -8 | 95,4 | 45,7 |
| -9 | 97,9 | 46,0 |
| -10 | 100,4 | 46,4 |
| -11 | 103,0 | 46,7 |
| -12 | 105,5 | 47,0 |
| -13 | 108,0 | 47,3 |
| -14 | 110,4 | 47,6 |
| -15 | 112,9 | 47,5 |
| -16 | 115,0 | 48,2 |
| -17 | 115,0 | 48,5 |
| -18 | 115,0 | 48,8 |
| -19 | 115,0 | 49,1 |
| -20 | 115,0 | 49,4 |
| -21 | 115,0 | 49,7 |
| -22 | 115,0 | 50,0 |

**Figure 5-5 Supply and return temperatures district heating network Kaunas (Source Kauno Energija).**

## 5.2 Choice of technology and dimensioning of the plant

In a cogeneration plant, in comparison to a thermal power generation plant where all heat at the end of the process is wasted in the condensation process of the exhaust steam, the produced heat will be recovered and used for industrial purposes or for domestic heating. Thermal power plants waste more than 50% of the heat in the atmosphere or in rivers by condensing all of the steam at the outlet of the turbine.

The overall scheme of a combined heat and power plant looks therefore much better from the view of rational energy use. The following picture illustrates this:

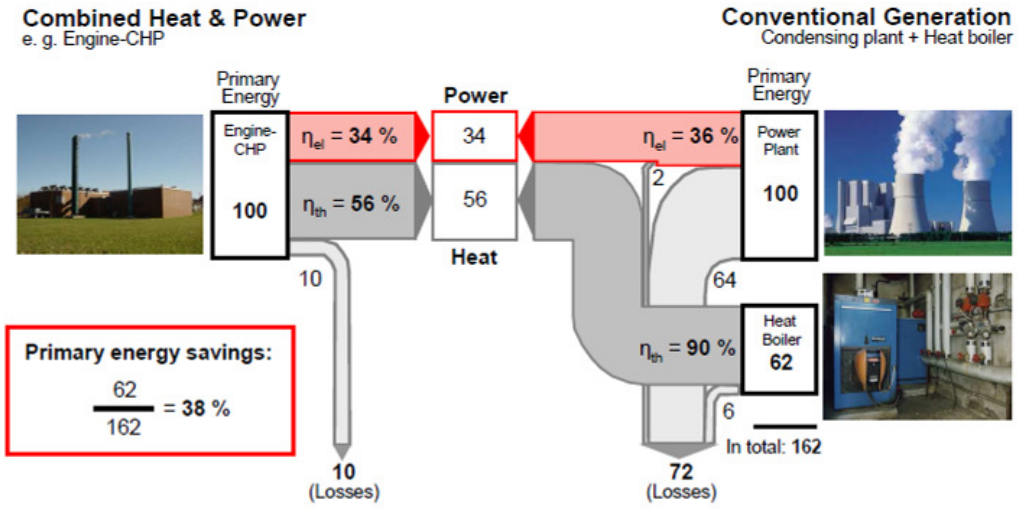



**Figure 5-6 Comparison separated power and heat versus CHP (Source: E.ON Energy research Centre Aachen University: Günther Westner and Reinhard Madlener May 07, 2010 | Investments in new CHP generation| FCN – RWTH)**

According to the Carnot cycle, extraction of power from heat supposes that one gets rid of the heat that cannot be converted to work. In CHP the basic idea is to make use of this heat by raising the condensation temperature of the exhaust steam from for example 40℃ to 120℃. As such this heat can be used for district heating.

The steam turbine can be designed according to:

- A back pressure CHP configuration: steam is delivered at a constant pressure and temperature. This happens by raising the end pressure of the steam turbine.

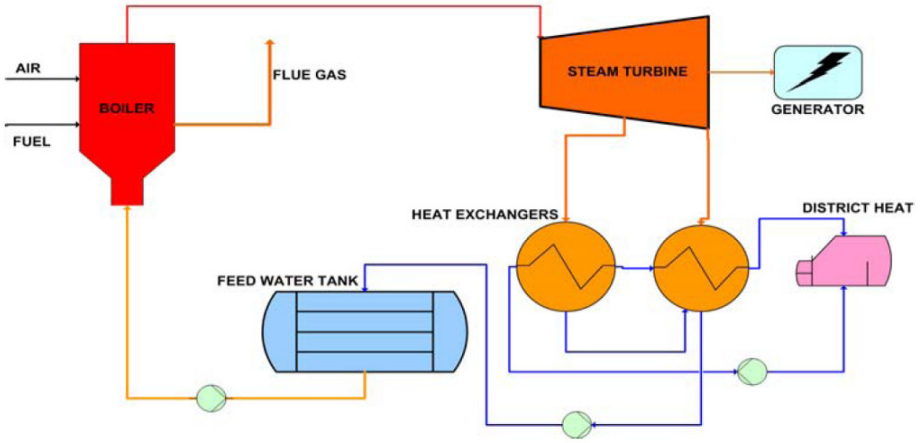



**Figure 5-7 Back pressure CHP configuration.**

- In the extraction turbine one can take steam with different parameters in the turbine at so called bleeding points.

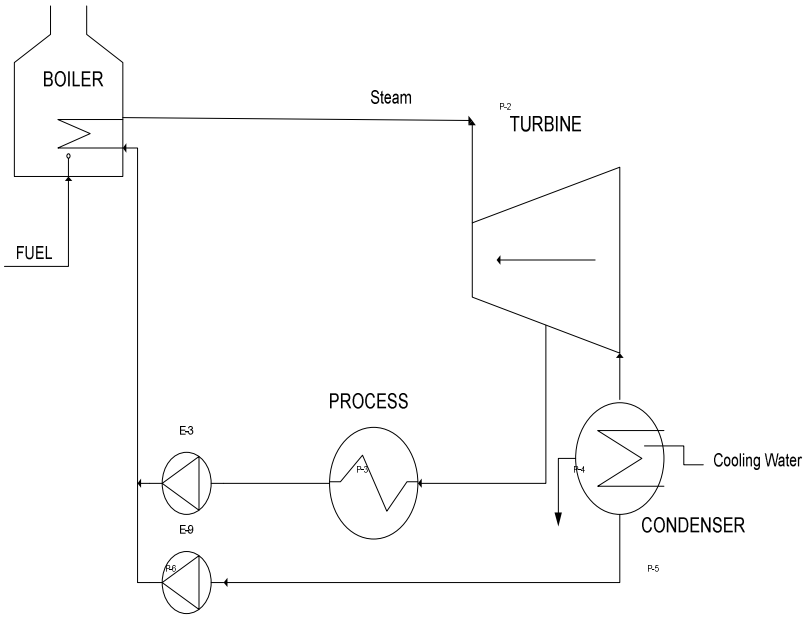



**Figure 5-8 Extraction turbine CHP configuration**

It is clear that the key economic consideration of extracting steam from a turbine is to limit the power generation loss caused by such extraction and one should therefore try to extract steam at the lowest possible pressures.

Such effect can be illustrated by an example expressed as the opportunity cost of heat used from turbine extraction[81]: at 5 Bar steam extraction a power loss of 0,2 MWel/MWth occurs; at the 20 bar extraction point this becomes 0,3 MWel/MWth

The notion power to heat ratio is the relation between power produced and the useful heat. It illustrates the trade off mechanism between heat and power and the following graph illustrates this[82]:

[81] Griffin, K.: Dundee renewable energy plant : combined heat and power feasibility study. In: *Forth Energy*, August 2010

[82] Verbruggen, A.: Combined Hat and power (CHP) essentials. In: *International Journal of Energy Technology and Policy*, vol. 5, No 1, 2007

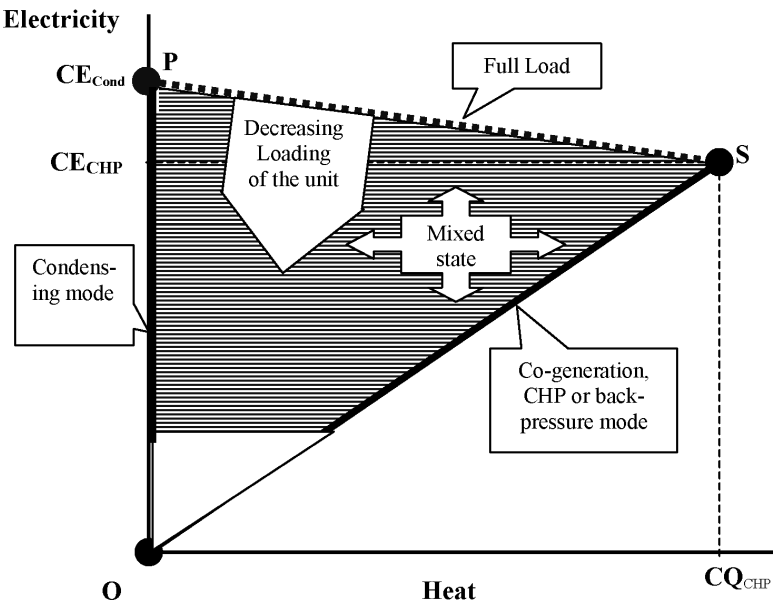



**Figure 5-9 Single back pressure CHP system: heat recovery with trade off for electricity generated**

In this figure one should be aware:

- That all points on the OS line give the optimum cogeneration effect.
- Pure condensing (P – maximum power ; all heat condensed), fully combined (S optimum point for heat and power in cogeneration mode).
- The full line PS slopes down as indication of loss of power by extracting steam above condensing conditions. Loss of power is related to the pressure and t° of the heat extraction.
- The shallowest slope of the PS line is possible when the t° of the heat used for district heating can be as low as possible.

In our application, we will take the option for a back pressure turbine. Design will have to be such that a bliss point is reached whereby priority will be given to the heat loads while maximizing the electric power output. The advantages of such back-pressure designed turbine are numerous:

- more simple design then compared to the extraction turbine as the expensive bleeding points for different pressure stages can be avoided;
- there is no need for cooling water installations;
- the efficiency is higher as there will be no rejection of heat to the environment through a condenser.

However, the turbine may be larger as it operates under lower enthalpy difference.

A back pressure CHP system is designed according to the Rankine cycle. The Carnot cycle is a more theoretical approach and is not realizable in practice because of the slowness of the cycle, the complexity and the difficulty to compress a mixture of steam and water. The Rankine cycle has solved these problems and differentiates itself in 2 points from the Carnot process:

- Vapour is entirely condensed at low temperature. This allows an easy raise of the pressure before entering the boiler through the use of a centrifugal pump.
- The heat supply through the process does not occur at same temperature but at constant pressure.

The result is that steam reaches a higher temperature at lower pressure level, so that the specific work is higher (output per kg steam/water mixture). In addition the water content in the steam will be much lower. The next figure gives a process temperature / entropy diagram for the Rankine cycle with a super heater:

- 1-2: addition of heat in the boiler to the water steam mixture at saturation t° (isotherm, isobar) ;
- 2-2': heat supply to overheated steam (isobar)
- 2'-3': delivery of work (isentropic )
- 3'-4: heat supply to district network (isotherm, isobar )
- 4-5: supply of work through pump (isentropic)
- 5-1: supply of heat to the water under saturation t° (isobar)

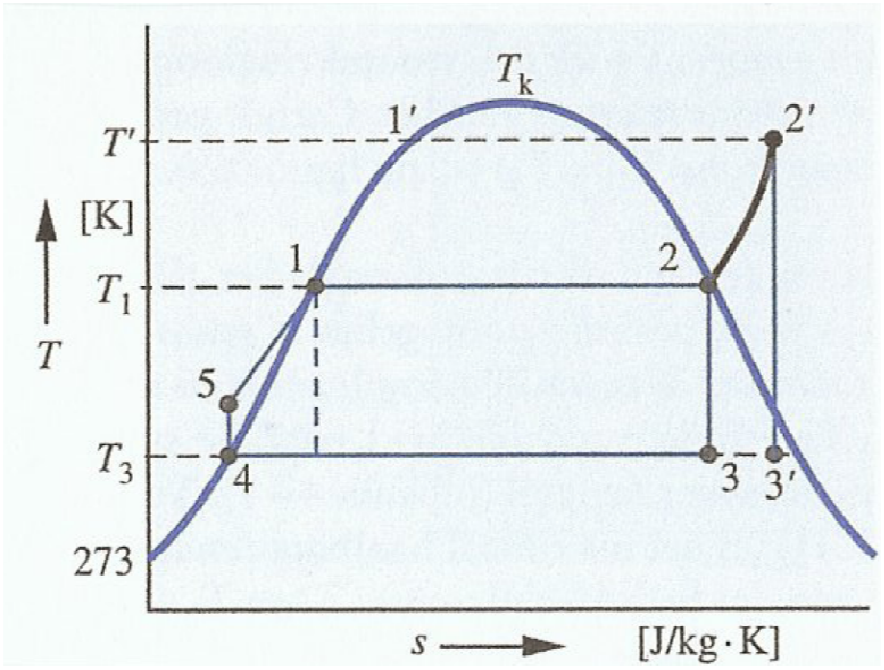



**Figure 5-10 Process of Rankine with super heater**

Having commented the most important part of the process, the delivery of exhaust heat and production of electricity in the steam turbine and generator part of the CHP plant, let us now come to the overall process scheme. This consists of:

- The biomass stock and supply
- The steam boiler
- The steam turbine and generator
- The economizer

In consultation with Kauno Energija, I have decided to take the option for the feasibility study of a CHP plant delivering 44 MWth and 16 MWel (MW total 70,6 MW based on fuel).

The idea is to get the plant operating at its full capacity during 7500 hours per year.

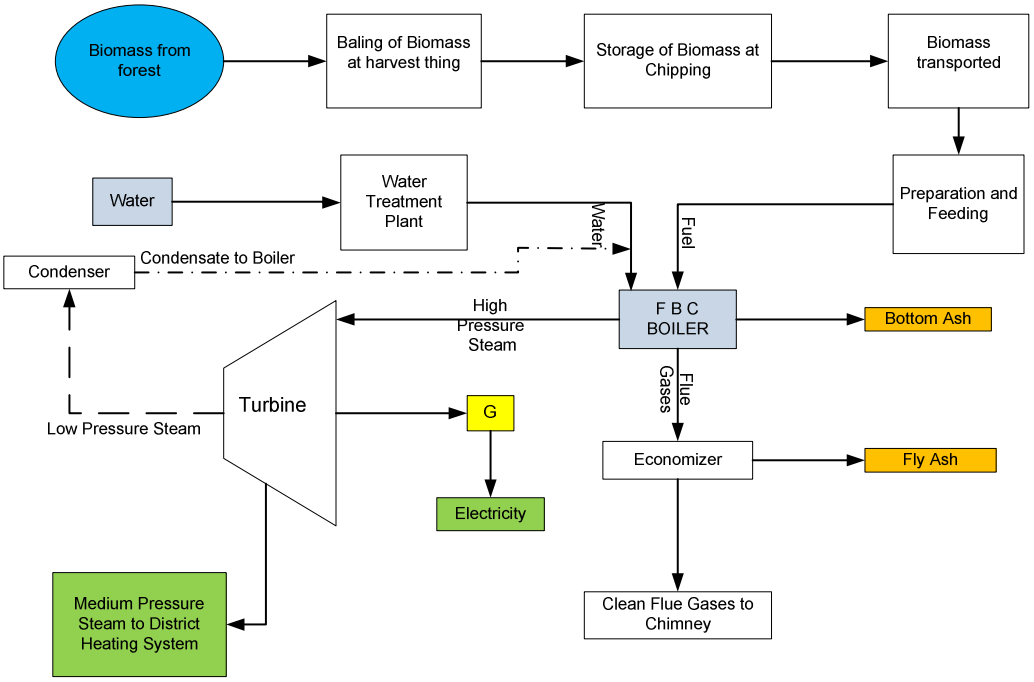



**Figure 5-11 Overall scheme of cogeneration plant**

- ***The biomass stock and supply***

  The woodchips can be stored in open air. Based on a minimum availability of 3 days and the fuel capacity of the boiler of 70,6 MW storage would be needed of 9.466 $m^3$

  The open storage will be located as near as possible to the boiler feeding point and will have a concrete floor. Maximum storage height should not exceed 15 m

  As a rule of thumb a storage space can be calculated as 12,5 $m^3$ per 10 MWh.

  Important fact to take in mind:

  - Bacteria and fungi may start decomposing stock pile rapidly and rising inside temperatures of the stock up to 66℃ – therefore pile heights should be limited to maximum 15 m and in case of bark with foliage it is recommended to limit the height to 8 m.
  - No stocks for longer than 4 weeks should be held.

- ***The steam boiler***

  After talking to different stakeholders and a work visit to the Dalkia new biomass cogeneration plant in Vilnius, I decided to take the option for a Circulating Fluidized bed boiler. In fluidized bed, high pressure air brings fuel particles in suspension. The fuel forms about 5% of the bed material and the remaining is inert material like sand and ashes. Average temperatures are between 850-950°C.

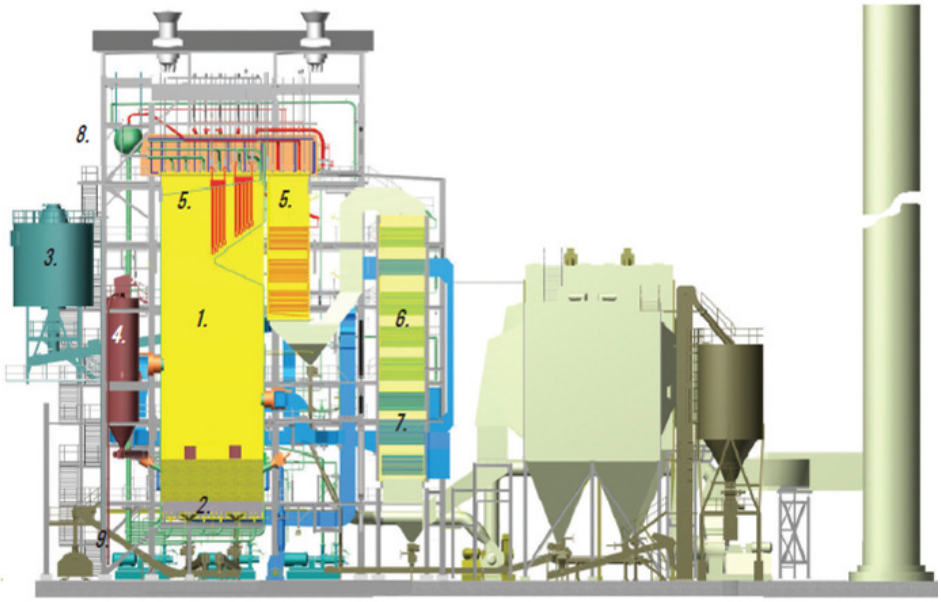



**Figure 5-12 Fluidized bed boiler**[83]

| | | |
|---|---|---|
| 1: Fluidized bed | 4: Bed material feeding | 7: Flue gas air preheater |
| 2: Grid with air entrance | 5: Super heater | 8: Drum |
| 3: Biomass feeding | 6: Economizer | 9. Bottom ash collecting system |

Two main types of fluidized bed boilers exist: the bubbling or stationary fluidized bed reactors (SFB) where particles do not leave the fluidized bed, and the circulating fluidized bed reactor (CFB) where speeds of particles are much higher. Here the particles can leave the bed and are returned by a cyclone.

I have taken the option for a Circulating fluidized bed boiler. This has many advantages I could understand, such as:

[83] Hulkonen, S. and Kauranen, T.: High Performance biomass boilers for green energy production. In: *Andritz Oy*

- High efficiency of about 85% (combustion efficiency of more than 95% because of ideal t°, residence time and turbulence.
- Reduction of boiler volume compared to traditional boiler systems.
- Flexibility in fuel including use of high-ash content fuels with low caloric value.
- Low melting ashes do not form a problem due to low combustion temperatures, the uniform temperature and the water cooled grid (example agriculture and wood waste). No volatilization of alkali components ashes, so no slagging. Continuous automated ash removal to an ash container is easy to do – less manpower needed!
- No danger for corrosion.
- Fast start up and turn-down possible by ignition burners on gas until t° reaches 650°C.
- Low maintenance.
- Due to higher CO2 in the flue gases, the boiler can function with less excess air. Even in the lower bed, sub-stoechometric conditions may exist and this minimizes the oxidation of nitrogen from the fuel. So 90% of fuel bound nitrogen is converted to $N^2$.
- Through the utilization of sorbents like limestone the formed $SO^2$ can be captured.
- High availability up to 8400 hours.

The circulating fluidized bed allows for steam temperatures of 470°C and maximum pressure of 65 bar.

The biomass fuel supply must be well designed and includes often the reception and stocking area, the transport to the separation and crushing point, magnetic separation, prepared fuel storage and a screw feeding system to the boiler.

In this feasibility study I will not explain the detailed functioning of the fluidized bed boiler (see general literature at the end of my thesis .

- ***The Economiser***

In my basic scenario I have not included an economizer in the design of the plant. However as an option, I have looked into the effect of including a flue gas economizer of 15 MW on the overall feasibility of the project.

The use of flue gas heat recovery is interesting because it will have no effect on the power generation. The investment is high in such system – but through a specific design the flue gas recovery unit also acts as a filter of exhaust air: so dust and other harming substances are removed from the exhaust gases and the final exhaust air will largely fall under the limits of the EU emission standards. During my visit to the Vilnius Dalkia CHP plant this was stressed as very important. Of course this means that the water sprayed into the exhaust ducts of the heat recovery will need to be treated.

The energy in flue gases is present in the form of sensible and latent heat. By removing the sensible heat from the flue gas ; its temperature will decrease linearly. Latent heat is only recovered once the heat t° reaches the dew point and the water vapour is condensed into water.

Removing sensible heat above dew point requires a flue gas economizer in the form of a gas to liquid heat exchanger. Under the dew point corrosion may happen at the tubes of the heat exchanger.

The water vapour saturation point of the flue gases, due to the moisture content of the flue gases, is around 50-65 °C, and the return temperature of district heating water is around 70°C. It therefore has no sense to recover the latent heat, so the option is to take the non condensing flue gas economizer producing additional heat for the district heating system.

## 5.3 Capital Cost & Operation & maintenance cost

The biomass CHP plant I have planned after consultation of Kauno Energija, has a capacity of 71 MW fuel (44 MWth, 16 MWel) and has a yield of 84% and a power to heat ratio of 36%.

I had many difficulties to find reliable figures for the investment in biomass CHP in Lithuania. Many of the figures were underestimated and gave abnormal high Returns on investments and Net Present Values.

In addition I have been searching in the ETSAP (Energy Technology Systems Analysis Program) from the International Energy Agency[84], but the format and reference values were not really usable for the purpose of my work. I had similar experience with the RETSCREEN program[85]. At the website www.carbontrust.co.uk, I could find a reference value of 345.000 EUR/MW for biomass boiler systems above 3 MW[86].

I was finally able to have access to data from the Danish Energy Agency. This Agency was established in 1976 and is an agency under the Ministry of Climate and Energy (www.ens.dk). The agency reworked a complete database of technologies and financial data for heat and power production technologies including RES. The database forms an impressive publication and came out in June 2010.

I have used the data under section 09 of this publication for my CHP feasibility study (Biomass CHP)[87]. These data apply for medium capacity installations between 10-100 MW.

Data here are mainly for district heating supply and due to high initial investments, the plant needs to be operated in base load.

From these data I took

- Capex for turn-key system including fuel treatment and feed-in system, high pressure steam boiler, steam turbine, generator and flue gas recovery boiler (hot water or steam):
    - EUR 1,5 million/MW output

[84] IEA: Biomass for heat and power. In: *Energy Technology Systems Analysis Program*, May 2010

[85] See : http://www.RETScreen.net from Natural Resources Canada – http://www.nrcan.gc.ca

[86] Carbon Trust : Biomass heating a practical guide for potential users, February 2009

[87] Danish Energy Agency: Technology Data for Energy Plants, June 2010

- Operation and maintenance fixed costs: EUR 23.000/MW per year
- Operation and maintenance variable costs: EUR 3,2 MWh produced

I realize that data, mainly in the field of operation and maintenance, are questionable. However for the purpose of my thesis, I have used the Danish data. These may need to be corrected based on local salaries, electricity and water prices, disposal fee for ashes, etc.

Some local figures from the Lithuanian market I could obtain are:

- electricity costs for the plant based on 12 kWh/MWh heat produced (at cost of 55 euro/MWh;
- ashes: 3,5% of weight of the fuel (fuel of 50% moisture content);
- disposal fee: 14,48 euro/ton;
- taxes on emission pollutants – I received here a figure of 3,4% of all fixed costs excluding depreciation. Much depend on the use for a flue gas condensing unit, because this unit can also have substantial cleaning effect on the effluent gases;
- all by all I think that the Danish overall O&M figures may work as the differences compared with the Lithuanian cost model may level out due to lower efficiency. Example much more labour force for same work.

The integration of an economizer is a large extra investment cost that is included in the data base of the Danish Energy Agency. I had a rough estimate for a 15 MW flue gas condensing unit at a price of EUR 380.000/MW = EUR 5.700.000. I have in alternative scenario subtracted this in the capex in order to see the difference in financial performance based on flue gas heat recovery at 85% yield of total 15 MW capacity.

## 5.4 Fuel availability and prices

I have made an assessment regarding the potential of Kaunas region and Lithuania to produce woody biomass in the next years and refer to chapter 4 of my thesis ”Biomass market potential Lithuania”.

Large competition in the Kaunas area exist from a chipboard factory UAB Girių Bizonas belonging to the IKEA Swedspan group. The company produces 460.000 $m^3$ of particle board per year and needs 900.000 $m^3$ of wood logs for this (corresponding with 155.000 toe of fuel).

Based on actual installed capacity of 46 MW bio fuel boiler houses in a 50 km range around Kaunas, a need of 16.553 t.o.e. of wood fuel and additional 1458 t.o.e. peat will be needed.

Analysing supply and demand from endogenous resources, the Kaunas Technological University in an internal report predicts a shortage of woodchips in the Kaunas area in the near future. At actual figures, demand would be 2,4 times the supply in 2010 and this trend could be extrapolated into 2020 where demand would still overthrow supply by 2,399.

This again stresses the need for serious reform and support in production of biomass from agriculture and forest resources.

Regarding prices and calculation of biomass woodchips, a few comments:

- According to the Lithuanian National Control Commission for Prices and Energy (NCCPE), the prices for bio fuel including transportation in January – June 2010 amounted 30 euro/ton excluding VAT.
- It is difficult to predict the future price evolution, as there is a steady growing market from Russia through cheap short sea shipping routes from the North–West of Russia, from Belarus. In addition, government of Lithuania seems to have serious ambition do develop endogenous production capacities.
- However in the short run there may be a shortage of woodchips in the market. This declares why major Lithuanian traders and producers of woodchips are not able to quote prices.
- One company, Klasmann-Deilmann, producer and trader of peat and chips, confirmed an interest during my visit for partnership formulas in the investment in a cogeneration plant. A long term contract for wood/peat would allow them to enlarge in production and processing equipment. I have done visits to the company Klasmann-Deilmann in august 2011. The company focuses on peat and wood operations in the Kaunas area with a company in

Ezerelis (30 km from Kaunas) and one in Igliauskas (60 km distance from Kaunas). The company quoted a price of EUR 17,30/MWh or EUR 34,60/ton based on moister content of 55% and based on lower heating value of 2,02 MWh/ton

- In a recent report from the project IEE "Policy development for improving RES-H/C penetration in European member states", prices for woodchips are quoted stable at EUR 20/MWH from 2010 up to 2030 in low price scenario and rising up to EUR 24 per MWh towards 2020 in a high price scenario[88].
- I have also asked some other prices for wood in the international Baltic market and received a few offers: 1 quoted FOB Klaipeda EUR 27/ton (560.000 ton/year – origin Russia), another offer of EUR 44/ton from a Lithuanian company.
- I would like to also refer to the EUBIONET (European bio energy networks, www.eubionet.net). The project has examined the part of transportation cost in logging residues and chip according to different cultivation and chipping practices.

In all my contacts with biomass producers in Lithuania, I have been quoted different references to prices, but very often prices were quoted in euro/$m^3$ – which is not reliable for use in CHP plant operations. The quoted price from Klasmann-Deilmann in EUR/MWh is more defendable from the view of the CHP investor.

A simplified formula for woodchips allows easy calculation of the lower heat value (LHV) from the higher heat value (HHV):

*LHV = 19,0 – (0,2144 x moisture content). For example = 7,3 GJ/ton (or 2,02 MWh/ton at moisture content of 55%.*

Once calculated after measuring moisture content from samples the price of one truck with 15 ton of chips can be determined: LHV in MWh/ton x ton = x MWh and by multiplying x in MWH by the agreed price in MWh.

[88] Gatautis, R. et al.: Assessment of the effectiveness and economic efficiency of selected options for Lithuania. In: *RES-H policy – IEE project*, February 2011

A final remark I want to make is the rise of the indices in the wood fuel prices. This will allow for extended supply contracts, for hedging, international pricing, taxation and value setting. Since 2009, the Nordic countries worked out the PIX Pellet Nordic CIF index and also forest bio indexes are worked out including global energy chips index. The trading house FOEX and the wood suppliers will join forces to establish the index for wood chips for energy production[89].

## 5.5 Heat price parameter and contractual partnership

As I have commented in chapter 3, legal analysis of my thesis, my project can only have a heat delivery contract with the district heating company from Kaunas, Kauno Energija. Even on the territories of the Free Economic Zone, the company has a monopoly to decide whether to extend the heat transmission and distribution network and to provide clients of the Free Economic Zone in the future with district heating. The territory boundaries were granted by decision of the National Control Commission for Prices and Energy (decision of 26 February 2004 and 12 September 2008).

From the perspective of bankability of the project one can ask what the creditworthiness means of the company Kauno Energija (code number 235014830). I add in annex a Coface (company credit risk) and a Dun Bradstreet country credit risk report. From these one concludes that Kauno Energija is a company with moderate risk (scale 7 Coface). Performance indicators 2010 for the company:

- Return on sales: 2,38%
- Operating Margin: 2,29%
- Negative Working capital: - 1.768.130 euro
- Equity ratio: 63,47%
- Debt to equity ratio: 0,51
- Leverage 0,63

Kauno Energija UAB had on 31 December 2010: 42.731.977 shares of a nominal value of EUR 1,73 that were completely paid for. All shares were completely paid by bringing some ”in kind” contributions, the district heating networks (collectors and

[89] Sihvonen, M.: Biomass trade. In: *EUBIONET III workshop*, 14 april 2011

tunnels belonging to city)and boiler house, at a value assessed by independent surveyor and by applying the method of replacement cost value. Shares were owned 92,82% by Kaunas City Municipality. So the paid in capital amounts to EUR **74,256,255.79**. The shares are traded at the additional list of the NASDAQ OMX Vilnius Stock Exchange. Since 2009 net profits are realized.

Kauno Energija has a subsidiary:"UAB Pastatų Priežiūros Paslaugas"specialized in maintenance of heating systems.

In relation to the feasibility of the cogeneration plant, the big question poses if any un-bundling between transmission, distribution and production of heat will take place in the near future. I have tried to clarify this issue in my talks with the Ministry of Energy, but no clear answer was given. The president of the Lithuanian District Heating Association Mr. Stasiūnas confirmed to me that the issue is on the table but that his association opposes very much. This attitude was also confirmed to me by Dalkia in Lithuania. Another and parallel question relates to the possibility of PPS-schemes, joint ventures or concession agreements in the future in relation to district heating in Kaunas.

Heat energy prices are approved by the National Control Commission for Prices and energy for DH sales above 5 GWh/year. In case of production less than 5 GWh, the Municipal Council is the regulatory body. The price caps are set for a 3 year period and specific tariffs are calculated every year abiding the methodologies approved by the commission. Prices are based on justified costs and allowed return on justified asset base (price cap regulation ), WACC level 5% (2006-2008).

The fuel costs are followed on monthly basis and can be changed by company decision when minimum criteria are met. Annual adjustments are possible according to the heat volumes, inflation and investment plans of the producer. The Regula office (National Control Commission for Prices and Energy) follows prices in 5 district heating benchmark groups.

Procedure for the tariff setting is as follows[90]:

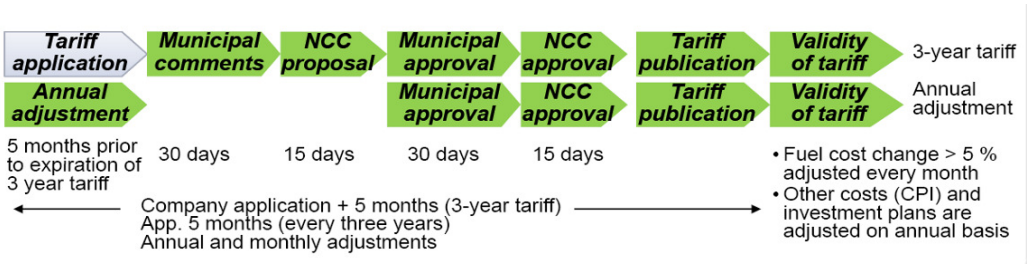



**Figure 5-13 Procedure for tariff setting**

Let us now focus on the end consumer prices per 01 July 2010.

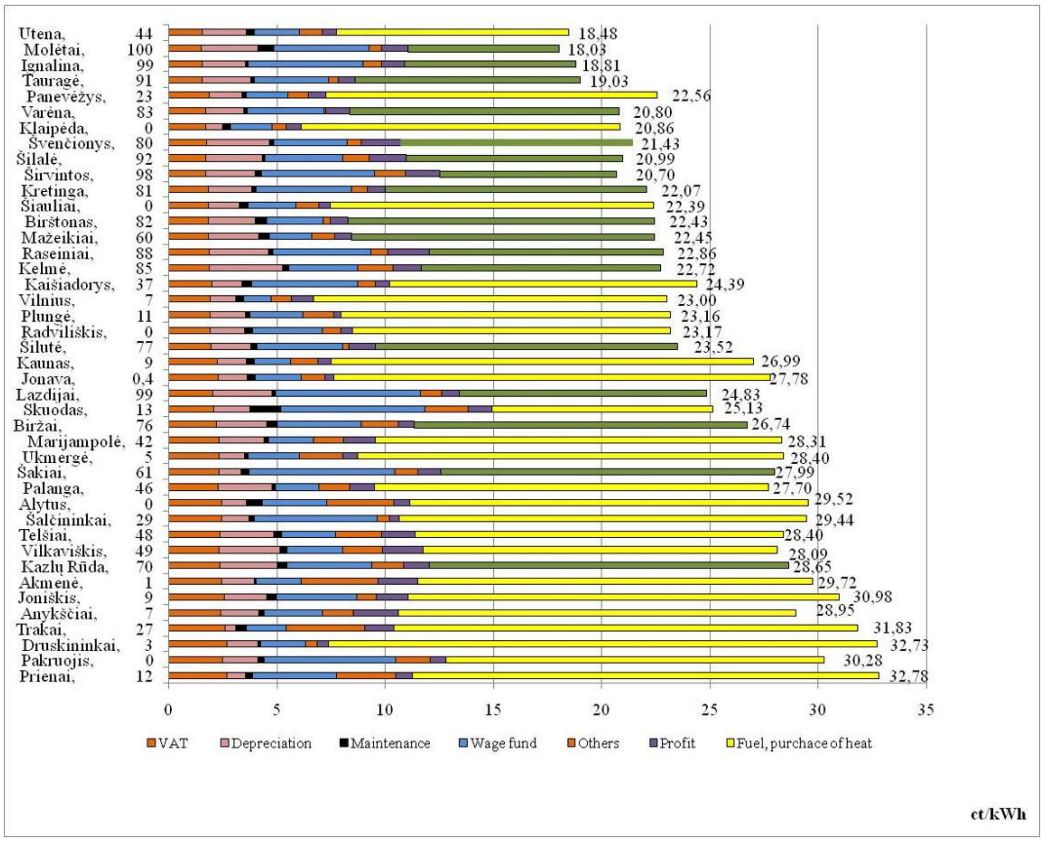



**Figure 5-14 National Control Commission for prices – www.regula.lt; the district heat prices and the constituent part, from the 1st of July, 2010 – prices**

[90] Energy Regulators Regional Association: Benchmarking District Heating In Hungary, Poland, Lithuania, Estonia and Finland. In: *St. Petersburg Conference*, 19 May 2011, Presentation 20 April 2011

The numbers next to each city and the green lines represent the percent of bio fuel, which is used to produce the heat. All the district heat prices presented in Lithuanian currency (ct/kWh). To convert in to EUR currency 1 LTL – EUR 0.29.

It is clear that biomass based boiler and CHP heat producers today can offer the best tariffs to consumers[91]. This is illustrated more in detail for specific boiler house heat producers:

[91] Janukonis, A.: Lithuanian heat sector: today based on imporated fuel, tomorrow – on local biofuel and wastes.

| No. | Heat supplier | The share of biofuel in the joint balance of fuel (%) | Prices of heat since 1 June 2010 (US $ct/kWh), VAT included |
|---|---|---|---|
| 1. | UAB "Ignalinos silumos tinklai" | 100.0 | 6.60 |
| 2. | UAB "Moletų siluma" | 98.6 | 6.52 |
| 3. | UAB "Sirvintu siluma" | 98.0 | 7.36[1]; 7.44[2] |
| 4. | UAB "Taurages silumos tinklai" | 87.0 | 6.68 |
| 5. | UAB "Litesko" Branch "Kelmes siluma" | 85.0 | 8.05[1]; 8.38[2] |
| 6. | UAB "Raseinių silumos tinklai" | 84.0 | 8.02[1]; 8.12[2] |
| 7. | UAB "Varenos siluma" | 80.5 | 7.30 |
| 8. | UAB "Silales silumos tinklai" | 80.6 | 7.36[1]; 7.56[2] |
| 9. | UAB "Fortum Svencioniu energija" | 77.8 | 7.43[1]; 7.56[2] |
| 10. | UAB "Birstono siluma" | 76.8 | 7.87 |
| 11. | UAB "Mazeikiu silumos tinklai" | 60.5 | 7.23 |
| 12. | UAB "Silutes silumos tinklai" | 54.4 | 8.25 |
| 13. | UAB "Utenos silumos tinklai" | 43.8 | 6.39[1]; 6.54[2] |

| No. | Heat supplier | The share of natural gas in the joint balance of fuel (%) | Prices of heat since 1 June 2010 (US $ct/kWh), VAT included |
|---|---|---|---|
| 1. | UAB "Akmenės energija" | 99.9 | 9.96 |
| 2. | AB "Jonavos silumos tinklai" | 99.5 | 9.22 |
| 3. | UAB "Pakruojo siluma" | 97.2 | 10.62 |
| 4. | UAB "Fortum Joniskio energija" | 90.0 | 10.28[1]; 10.69[2] |
| 5. | UAB "Anykscių siluma" | 82.5 | 10.16[1]; 10.51[2] |
| 6. | UAB "Prienu energija" | 80.0 | 10.84 |

**Explanations:**
[1]- heat points owned by dwellers;
[2]- heat points owned by heat suppliers.
1 US$=2.85 LT

**Figure 5-15 Retail district heat prices: comparison between natural gas and bio fuel dominated production sources – Lithuanian District heating Association**

We have made an important remark on the obligation that Kauno Energija has to buy in 80% of its annual heat needs from the Gazprom owned UAB Kauno Termoficacijos Elektrinė. This obligation will expire by the end of 2018.

The district heating company Kauno Energija sees only a possibility to buy our RES heat in the 5 years from the start our plant in 2014, if we are able to offer the heat at prices under the level of the Gazprom plant. This would mean that I sell heat at a tariff under the actual figure of EUR 48/MWh.

I have therefore used the tariff of EUR 43,44/MWh for the years up to 2018. From 2019 a tariff is used of EUR 31,86/MWh. This tariff is based on reference values and the overall expectation that prices will go down by the entrance of more RES in the heat markets.

## 5.6 Electricity price parameter

In chapter 3, I have explained in detail the new system of auctioning that may become operational in the near future. I have added a non-official translation of relevant articles in the law on renewable energy (see annex 3) and a non-official full translation of the auctioning system that was already adopted by the National Control Commission for Prices and Energy in July 2011 (see annex 2).

It is thus foreseeable that within the near future (probably from 2012) the new system will start. This means a market plus model, with a competition for the premium, will take place in well determined geographical areas. The model will replace the auctioning system that guaranteed the price until 2020.

As one has to start from a traded price for electricity above which a feed in premium to a fixed value is added or a premium (market plus premium) after auctioning, I have based parameters on the Baltpool traded electricity prices. BALTPOOL UAB is the electricity market operator of Lithuania. The main function of the company is to organize electricity trade (see: www.baltpool.lt). Based on the actual average trading price for electricity (2010 figure of EUR 40,60/MWh) and an annual growth of 2% the average price forecast 2021 would be EUR 50/MWh.

I have used, up to 2020, the feed in tariff of EUR 87,44/MWh and from 2021 the tariff of 40,55 lt. This may have to be revised once the first auction will have taken place.

## 5.7 Timing – project management of the project

I have made a phasing of the project preparatory stage based on legal, regulatory issues related to environmental assessment procedures and the building permit.

This gives the following overview:

| | Task Name | Duration | Start | Finish | Resource Nar |
|---|---|---|---|---|---|
| 1 | **Preaparation of the Detailed Plan** | **570 days** | **Mon 12.01.02** | **Fri 14.03.07** | |
| 2 | Agreement with the municipality concerning the transfer of authority | 5 days | Mon 12.01.02 | Fri 12.01.06 | |
| 3 | **An advertisement in a newspaper** | 1 day | Mon 12.01.09 | Mon 12.01.09 | Designer |
| 4 | Submission of an application | 4 days | Tue 12.01.10 | Fri 12.01.13 | |
| 5 | Design suggestions | 4 days | Mon 12.01.16 | Thu 12.01.19 | Senior archite |
| 6 | Technical conditions | 4 days | Mon 12.01.16 | Thu 12.01.19 | Senior archite |
| 7 | Main drawing | 5 days | Fri 12.01.20 | Thu 12.01.26 | Designer |
| 8 | **An advertisement in a newspaper** | 22 days | Fri 12.01.27 | Mon 12.02.27 | Designer |
| 9 | Public hearing | 1 day | Tue 12.02.28 | Tue 12.02.28 | Designer |
| 10 | Answers to the claims | 5 days | Wed 12.02.29 | Tue 12.03.06 | Designer |
| 11 | Drawing of engineering network | 5 days | Fri 12.01.20 | Thu 12.01.26 | Designer |
| 12 | Coordination of engineering networks | 20 days | Fri 12.01.27 | Thu 12.02.23 | Designer |
| 13 | Other coordination | 10 days | Mon 13.12.30 | Fri 14.01.10 | Designer |
| 14 | Coordination with the senior architect | 10 days | Mon 14.01.20 | Fri 14.01.31 | Senior archite |
| 15 | Coordination with construction committee | 10 days | Mon 14.02.03 | Fri 14.02.14 | Designer, con |
| 16 | Environmental impact assessment | 570 days | Mon 12.01.02 | Fri 14.03.07 | |
| 17 | **The approval of the detailed plan** | **29 days** | **Mon 14.01.13** | **Thu 14.02.20** | |
| 18 | Examination certificate | 10 days | Mon 14.01.13 | Fri 14.01.24 | County |
| 19 | Correction of the remarks | 7 days | Mon 14.01.27 | Tue 14.02.04 | Designer |
| 20 | A decision of the council | 4 days | Wed 14.02.05 | Mon 14.02.10 | Designer |
| 21 | Coordination with the planning department | 4 days | Tue 14.02.11 | Fri 14.02.14 | Designer |
| 22 | Coordination with the cadastre | 4 days | Mon 14.02.17 | Thu 14.02.20 | Designer |
| 23 | **Pre-designed stage** | **20 days** | **Fri 14.02.21** | **Thu 14.03.20** | |
| 25 | **TECHNICAL DESIGN** | **387 days** | **Fri 12.01.20** | **Mon 13.07.15** | |
| 46 | **Building permit** | **569 days** | **Mon 12.01.02** | **Thu 14.03.06** | |
| 52 | | | | | |
| 54 | | | | | |

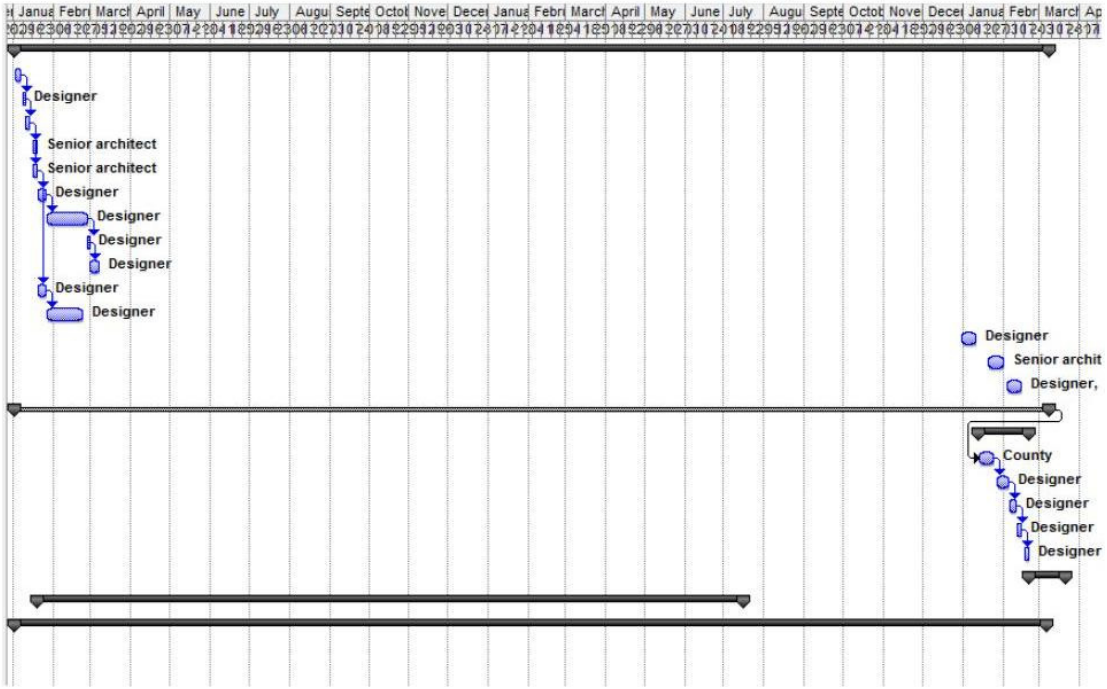



**Figure 5-16 Project management Overview**

## 5.8 Risk profile and bankability of the project

I have been analyzing the market for debt financing of CHP plants during my thesis work through interviews with senior people from 4 major banks:

- AB SEB: This is a leading Nordic financial services group owned 100% by Skandinavska Enskilda Banken AB. It is the major commercial bank in Lithuania. The bank financed the largest biomass CHP project in Lithuania.
- AB Swedbank is a bank belonging to Swedish investors and ranked as second commercial bank in Lithuania. They finance a biomass plant in Šiauliai EUR 29 million project – debt finance: EUR 11 million.
- AB DnB Nord is the third bank in Lithuania with strong financial background (Fitch rating ”A”).
- UAB Medicinos Bankas: Although this is a small bank with assets of EUR 240 million (1 Q 2011) – then bank is very open to financing small RES energy projects.

Let me now give common points in the Banks' attitudes towards financing of CHP-RES projects.

- Equity ratios of 20-60% are required. EU or other subsidies are treated as equity. Large regional heating companies and municipalities have better access to debt finance and enjoy lower equity requirements. Pure private developers need more equity (up to 50%) as the banks consider their status less strong in terms of monopolistic access to final consumer markets for heat and price revision mechanisms. Partnership formula with public district heating company may thus be very beneficial.
- Developer's requirement by the bank: a solid experience in energy projects is pre condition and also secured market to sell heat and electricity. Heat plant experience is important. In case of a new SPC, the bank will like to look at collateral income possibilities from other businesses of the borrower (preference in other sectors of the economy).
- Contractor of plant: Solid track record in mature and proven technologies is pre-condition and the developer should agree transparent contracting rules by including international procurement procedures. Enforceable completion guarantee may be required from sponsor (escrow bond or performance bond). Turn-key delivery, including damage compensation, preferred over

EPC. Guarantee price, timing and performance. O&M agreement by the technology owning company. Guarantee of use of specific technology by the plant (License) may be considered. Training of operator staff agreement is crucial.

- During construction phase: a deposit account is required by the banks in order to guarantee coverage of interests during the construction period. Also, the bank will ask pledge of the ”zero” project cycle assets (land, building, permits) until disbursement of the loan. Priority use of equity and subsidies before disbursement of loan.
- Heat contracts: as there is large involvement of Municipalities and State for price level and periodic revision of heat tariffs: banks require very proactive management of heat price revision procedures as a must. Bank will examine carefully heat contract and the status of the district heating company - buyer of the heat. Is there room for expansion and is the capacity of the network to take up the heat realistic. Market regulatory risks to be analyzed. Pledge of revenues to bank is standard. Contract lengths should minimum correspond to loan maturity terms.
- Electricity: more complex through liberalization of the market. Also pledge formula in favour of the bank.
- Maturity: 7-12 years (up to 10 years) is usual for such projects with debt recovery schemes of annuities until maturity (provided that cash flows are stable ). Covenants used: debt service coverage ratio (operational income over debt service requirements on annual base): not less than 1,20 – Loan to value ratio not less than 70% - Debt to EBITDA ratio not more then 4-5.
- Interests: in case of long maturity the developer may be required to hedge interest rate risk by acquiring an IRS (interest rate swap ). In case of very large projects it may be required to provide additional guarantees such as a comfort letter from the National Government. All extra VAT is required to cover the VAT bridge loan (which is usual in the project finance scheme )
- Fuel supply contracts: banks look at flexibility – possibility to use more than one fuel: security of supply ! Wood is treated as risky due to some shortages in wood for energy supply chains !!! No experience in peat operated plants by banks in Lithuania. Banks prefer therefore CHP on gas and oil.

## 5.9 Results of discounted cash flow analysis

Based on the parameters explained before, the result of my cashflow analysis can be summarized as follows:

**Table 5-1 Results Cashflow Analysis**

| *71 MW fuel ( 44MWth + 16 Mwel) economiser 15 MW* | | | |
|---|---|---|---|
| Capex in Euro | 92.315.000 | **NPV** | **203.112.306** |
| Operation and maintenance | | | |
| fixed O&M (Euro/MW) per year | 23.000 | **IRR** | **15%** |
| variable 0&M (Euro/MWh) per year | 3,2 | | |
| | | **Pay back** | **7,1 years** |
| Fuel price (Euro/ton) | 35,3 | | |
| | | | |
| Electricity price | | | |
| period 2014-2020 (Euro/MWh) | 87,57 | | |
| period 2021-2033 (Euro/Mwh) | 40,55 | | |
| | | | |
| Heat price | | | |
| period 2014-2018 ( Euro/MWh) | 43,44 | | |
| period 2019-2033 (Euro/MWh) | 31,68 | | |

I have done some sensitivity on the fuel parameters and this has the following result on the overall NPV of the project :

| **Fuel sensitivity analysis** | | | | |
|---|---|---|---|---|
| **Change, %** | **Biofuel price, EUR** | **NPV, EUR** | **Change, %** | **PBV** |
| -40% | 21.2 | 322,482,593 | 58.77% | 6.6 |
| -30% | 24.7 | 292,640,021 | 44.08% | 6.7 |
| -20% | 28.2 | 262,797,450 | 29.39% | 6.9 |
| -10% | 31.8 | 232,954,878 | 14.69% | 7.3 |
| 0% | 35.3 | 203,112,306 | 0.00% | 7.1 |
| 10% | 38.8 | 173,269,734 | -14.69% | 7.9 |
| 20% | 42.4 | 143,427,163 | -29.39% | 8.2 |
| 30% | 45.9 | 113,584,591 | -44.08% | 8.7 |
| 40% | 49.4 | 83,742,019 | -58.77% | 9.1 |

**Figure 5-17 Sensitivity of NPV and Payback time to changes in the biomass fuel price**

Regarding sensitivity to the electricity price, I examined the possibility that the feed tariff of EUR 87,57/MWh (until 2020) would not be obtained and that in addition the new auction system has not been put in place – it means that we trade all electricity

in normal non- subsidized scheme. Based on Baltpool's average trade tariff (ref. 01.10.2011), EUR 45,18/MWh, the new NPV is indicated in the next table together with a sensitivity .

| Category | Value |
|---|---|
| Tariff, EUR/MWh | 45.18072289 |
| NPV, EUR | 181,500,351 |
| Payback period, years | 8.6 |

| Electricity sensitivity analysis | | | | |
|---|---|---|---|---|
| Change, % | Tariff, EUR/MWh | NPV, EUR | Change, % | PB |
| -40% | 27.1 | 134,628,119 | 58.77% | 9.5 |
| -30% | 31.6 | 146,068,550 | 44.08% | 9.3 |
| -20% | 36.1 | 157,508,981 | 29.39% | 9.0 |
| -10% | 40.7 | 169,108,690 | 14.69% | 8.8 |
| 0% | 45.2 | 181,500,351 | 0.00% | 8.6 |
| 10% | 49.7 | 192,081,443 | -14.69% | 8.4 |
| 20% | 54.2 | 203,524,937 | -29.39% | 8.2 |
| 30% | 58.7 | 214,965,368 | -44.08% | 8.0 |
| 40% | 63.3 | 226,660,031 | -58.77% | 7.8 |

**Figure 5-18 Sensitivity of NPV and Payback time to changes in the electricity price**

As for the heat price: since I have used conservative "low value" based on the forecast of CHP produced heat by biomass: EUR 31,68/MW. That value was confirmed by Kauno Energija a realistic and conservative view.

## 5.10 Market consultation for "real business" proposition

I have been in contact with 3 companies in order to check real business proposals. One company MW Power (www.mwpower.fi) agreed in relation to my thesis to work out a non-binding preliminary proposal for a biomass CHP plant. They agree this proposal could be published as an annex to my thesis (see annex 5 ). MWPower is a joint venture of:

- Metso, a global supplier of sustainable technology and services for mining, construction, power generation, automation, recycling and the pulp and paper industries. They have about 28,500 employees in more than 50 countries (www.metso.com).
- Wärtsilä, a global leader in complete lifecycle power solutions for the marine and energy markets. By emphasising technological innovation and total efficiency, Wärtsilä maximises the environmental and economic performance

of the vessels and power plants of its customers. The company employs over 17,500 professionals in more than 70 countries (www.wartsila.com).

The company has a modular turn-key biomass CHP-product range for district heat and industrial applications. The proposed solution is a Bio power DH turnkey module of 32,3 MW fuel (20,5 MWth, 8,0 MWel)with additional flue gas condenser.

Based on heat demand averages over the year from Kauno Energija, the company esteemed it less risky to invest, not in a 71 MW fuel plant as I did in my feasibility study, but to start the operation smaller with one modular unit. One could get from the beginning all environmental and building permits for 2 units and consider the implementation of the second unit after the ”monopoly” position of Gazprom on the Kaunas district heating market comes to an end by 2018.

The unit works at its full capacity for 6.308 hours. Off service is done in summer months when the heat demand by Kauno Energija is very low.

Based on a capex of EUR 31,04 million, the heat price parameters of Gazprom (EUR 48/MWh), reference price of the actual feed in tariffs for electricity of EUR 86,88/MWh, fuel prices of EUR 35,3/ton (50% moisture), an economic cycle of 15 years and interest rate of 5%, the feasibility gives a net present value of the project of EUR 47,9 million and IRR of 23,5%. The payback time is 4,7 years.

In case the heat prices would be lower and equal to EUR 30/MWh thermal the payback time would amount 8,5 years with IRR of 12,0%.

It is clear that the high heat prices and the feed in tariffs are basic reason for the positive result.

More details can be found in annex 5.

# 6 Preliminary feasibility of heat distribution network in the free economic zone

## 6.1 Scope of the study

This part of my thesis is not focusing on the main question of the feasibility of a cogeneration plant, but on the subsidiary question: can the physical location of a cogeneration plant in the free economic zone also be used to provide companies in the industrial park with heat from a new distribution network to be installed.

In order to give a very accurate answer to that question one has to[92]:

- Make a detailed analysis on several economic growth models for this 500 ha green field development;
- Based on several growth scenario's and urban planning schemes, one could then proceed to make a detailed heat map for the whole area over the phased development stages;
- Static hydraulic studies for different pipe systems could clarify number and points for pressurization units and heat exchangers;
- Major challenge is to design the heat distribution network for future growth and expansion of the zone.

This is a large study and not within the scope of my thesis. I will rather seek for an indication if it would make sense to put the subject for further investigation on the agenda. Kauno Energija, the district heating company of Kaunas, has in its program to look for new extension areas for its district heating network and also wants to give special focus to industrial clients.

[92] Torkar, J. et al.: Economical management of district heating systems

## 6.2 District heating network – key facts

A district heating network mainly consists of 3 parts: the transmission network, the distribution network and the internal heating systems for the clients.

Amongst the most important factors that contribute to the pricing of a system, are the design temperatures and pressure, the length of the networks and the peak heat demands. The system mainly consists of a double pipe each for low temperature water transport: the heat flow (75-85°C) and the return pipe system (40-60°C). The flow t° - the return t° = ΔT. The larger the ΔT the better, and a minimum of 35°C is a requirement in order to reduce capital costs, to obtain a larger heat carrying capacity in the pipes and to reduce pumping costs. District heating systems are capital intensive and the distribution network may amount to 80% of the cost of the overall system.

The network can make use of 2 main different pipe systems: steel and plastic PEX flexible.
Steel pipes can operate under higher temperature (140°C), larger pressures (25 bar) and have heat losses of 23,6 W/m. They have a water diffusion barrier, leak detection possibility and pre-insulated valves. Expected life time is more than 50 years. Plastic pipes function under temperatures of 80-85°C, at pressures around 6 bar and have heat losses of 37-38 W/m. Life time goes up to 20 years. In the field of my thesis I have been searching for tools to dimension a district heating network.

Use of co-insulated pipe systems may result in 25% cost savings in the capital expenditure and also have 50% reduction of heat losses.

**Figure 6-1 Steel Pipes**

I have been in contact with the Danish company 7-Technologies (www.7t.dk) who distribute Termis, a complete district heating network design software including optimisation and the management of the network. The software is used in more than 500 cities worldwide. As a TU Wien student, I was able to have an educational license and this will allow me to deepen this study in a second phase with the help of other people.

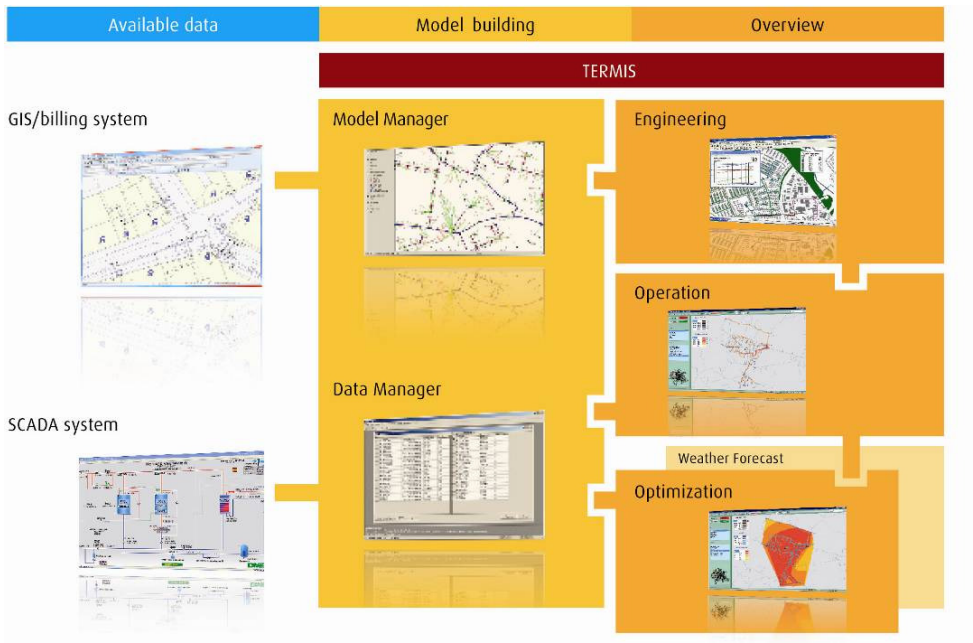



**Figure 6-2 print screen termis software modules**

## 6.3 Heat mapping

This is the very first and important step in order to make any preliminary feasibility. The basics for heat mapping are a true understanding of the heat calculation of a building and I will comment this first.

First we calculate the seasonal heat losses and the heat gains. Once this is known, it is possible to calculate the extra energy needed to balance the losses and the gains and to give a constant temperature.

The basic formula for this is:

| Fabric heat losses | | Ventilation heat losses | | Solar heat gains | | Casual heat gains | | Energy for heating or cooling |
|---|---|---|---|---|---|---|---|---|
| $P_{f=U\ A\ \Delta t}$ | + | $P_{v=0,33\ N\ V\ \Delta t}$ | = | g value x seasonal total heat gain x surface | + | People / Light Machinery | + | |

$P_f$= rate of fabric heat loss = heat energy lost/time

U= U-value of the element considered ( 〖W/m〗^2 K) is the measure of the overall rate of heat transfer under standard conditions, through a particular section of the construction and is measured as the rate of heat flow in watts through 1m^2 of structure when there is a temperature difference across the structure of 1 degree (K or ℃)

A= area of building

$\Delta t$ = difference between the temperatures assumed for the inside and outside environments

$P_v$= rate of ventilation heat loss (= heat energy / time (w) )

N= air infiltration rate of the room (the number of complete air changes per hour)

V = volume of the room in m^3

Casual heat gains may include:

- Heat emission person heavy work (20 ℃) = 190 W
- Desktop computer: 150 W

- Lighting: fluorescent system giving 400 lux: 20 W/m^2

Solar Heat Gain Co-efficient (SHGC) - also known as solar factor, or g-value, measures to what extent a window will absorb the heat from sunlight. It is a number between 0 and 1, where a lower SHGC means less heat gain.

Most solar heat gains are calculated through windows and direct radiation. Solar heat gains are complicated to calculate – as they are dependent on many factors like:

- Geographical location
- Orientation of the building
- Season of the year
- Nature of window glass
- Angles between sun and building surfaces

Degree days are essentially a simplified representation of outside air-temperature data. They are widely used in the energy industry for calculations relating to the effect of outside air temperature on building energy consumption.

"Heating degree days", or ”HDD", are a measure of how much (in degrees), and for how long (in days), outside air temperature was lower than a specific ”base temperature” (or ”balance point").

According to Recknagel[93]: energy consumption pro year can be derived from the formula: $E = f \times 24 \times Q \times HDD \times \Delta T$ where Q is the heat loss; HDD heat degree days and $\Delta T$ the difference between the outside t° and the inside design t°.
As one has the design t° for specific buildings – it is possible with software programs to calculate the heat demand for whole areas, including an industrial park. I have, with the assistance of a local design office Kita Kryptis, received overall figures that give a general idea of the heat demand of the free economic zone over its total development cycle.

[93] Recknagel et al.: Handbook on Heating and Air-conditioning Technology, Oldenbourg Wissensch.Vlg; issue 68 (1997/98)

A good example and background on what heat mapping means can be found at the website www.londonheatmap.org.uk. Here the heat map of London is searchable in interactive way.

In designing the heat map, an important notion is the linear heat density – it is the yearly heat demand divided by the length of the pipe network.

In our example, at the end of the development cycle of the zone, the yearly heat demand for the 500 ha area is 166.600 MWh and the length of the network would be 29,5 km. This is a linear heat density of 5,64 MWh/ m /year.

In some cases of low density area's, one includes the notion of effective width = Area of development divided length of the pipe line[94]. In addition the FAR as used in real estate, is also relevant in heat calculation and density assessments. The FAR (floor to area ratio) is the ratio of the building program: the floor area over the total area (including the non built parts).

## 6.4 Economic modelling

I carried out the analysis from the point of view of an independent heat distributor, who will buy heat from the Kaunas biomass CHP plant and sells the heat to the companies in FEZ. Two scenarios were evaluated:

- "Free Market" scenario, which assumes, that heat demand and heat sale price are interdependent and evolve according to a market equilibrium model;
- "Obligatory" scenario, which assumes that Kaunas FEZ customers are obliged to take the district heating. Such scenario may have negative effect on attracting companies (as this would be a restriction in any sale or lease contract with any candidate).

[94] Persson, U. and Werner, S.: Effective Width – the relative demand for district heating pipe lengths in city areas. In: *12th International Symposium on district heating and cooling*, 5 September 2010, Talinn

In practice, companies do not want at all to take heat from the district heating – as they face too high prices determined by the National Control Commission for prices and energy (www.regula.lt).

Input parameters are:

- Development cycle 3 phases starting years 1,10 and 15 with a total capital expenditure of 21 million euro for the 29,5 km district heat network for the 500 ha industrial park.
- The first stage can be covered by a 50% EU subsidy ;
- O&M is based on national and Kaunas experience determined at 29.000 euro/km/year of which 50% are fixed costs and 50% variable 1-100% over the development cycle.
- Heat losses (new network
- Linear depreciation over 30 years
- Discount rate: 5%

**Table 6-1 summary of results**

| | *Heat demand at end of development cycle in total GWh/year* | *Heat demand per Ha of industrial park at end of cycle MWh/Ha / year* | *Heat purchase price Euro/MWh* | *Heat sale price Euro/MWh* | *NPV Million Euro* | *IRR* |
|---|---|---|---|---|---|---|
| *Free Market scenario* | 166,6 | 333,2 | 40,5 | 47,8 | -10,60 | -9,03 |
| *Obligatory market scenario* | 133,3 | 266,6 | 40,5 | 75,3 | 9,95 | 9,50 |
| *In a free market scenario assumption is made that the network will be developed at 80% of the obligatory scenario.* | | | | | | |

The obligatory scenario may give a positive NPV – but this situation is based on actual very high industrial consumer heat prices.

It is clear that the feasibility cannot be done on such limited scenario. District heating networks are long term commitments. The feasibility should take more aspects into consideration:

- Avoided costs of energy through central use of CHP ;
- Reduced investment at the level of end-consumers and increased floor area (no boiler rooms );
- More energy efficiency
- Better use of exhaust gas heat through flue gas condensing units
- CO2 footprint
- Fuel flexibility

If one looks at the heat demand per ha per year then the project should be worth to examine more in detail. The heat density per meter pipe per year is a similar parameter: in Denmark more than 80% of district heating networks has a so called line density between 0,33 and 1,38 MWh/m per year[95]. As we may come up with densities from 4,51 to 5,64 MWh/meter pipe – it is for sure worth to explore more in detail the possibilities.

[95] Bruus, F. and Kristjansson, H.: Principal design of heat distribution. In: *News from DBDH*, 2/2004

# 7 Overall conclusions and proposed further actions

1. The official policy of Lithuania is to promote, in the near future, the development of RES based CHP within the well established district heating networks. This is a way to:
   - Ensure higher security of supply by creating less dependence from the import of Russian gas and oil;
   - To decentralize electricity production and to stimulate market liberalization;
   - To reduce $CO^2$ emissions and reach, by 2020, the mandatory target of 23% shares of RES in the gross final energy consumption. The national action plan has as its target towards 2020: a 50% RES share in the district heating systems and 21% RES in the gross national electricity consumption.
2. Although market assessment shows huge potential for cultivation of solid biomass in the agriculture and forestry sector, the biomass industry is rather poorly developed in comparison to neighbouring countries like Latvia, Finland and Sweden. The forest sector needs drastic reforms to raise productivity and serve RES overall policy of the country. Investments to promote RES based CHP should not just focus on the demand side of the biomass, but also stimulate production and processing of biomass.
3. Lithuania is part of the Baltic Sea area and may face large competition from foreign bio fuel markets, especially from North West Russia. Wood bio fuels including woodchips, can easily reach Lithuania in very cost competitive ways through Baltic Sea short shipping routes to the Klaipeda Port.
4. The biomass heat market in Kaunas faces severe competition from the chipboard industry at this moment. This may lead to shortages in the supply of wood biomass for the district heating sector. Co firing of woodchips with peat may be considered, but does not have wide public acceptance, as peat is not considered a renewable energy source. However the peat prices are

attractive and even by including $CO^2$ taxes, this fuel has very competitive pricing. Negative side is that feed in tariffs and priority rules for accepting RES heat may not apply, and therefore the author has not considered this as a real alternative.

5. The investment in a cogeneration plant is very capital intensive (reference 1,5 million/MW) and the debt recovery and pay-back of the sponsors, is only possible through long term secured cash flows from both the heat and the electricity sales. To secure the 3 main cash flow streams in a better way (wood fuel, heat and electricity), one could consider some possible strategic partnerships, in order of priority:
   - Biomass supply companies. Two international groups announced they may have an interest to start up such discussions.
   - Kauno Energija district heating company (although such partnership has the risks of political interference by the main shareholder, the city of Kaunas who may want to profile itself to the electorate with low heat prices.
6. The contractual arrangement of Kauno Energija, to buy not less than 80% of its needs in heat from the Gazprom owned company at the actual price of EUR 48/MWh, forms a serious obstacle for new private players who wants to enter the RES-CHP district heating market in Kaunas. At least until 2018, such market entrance barrier will continue to exist. It is known publicly that Gazprom wants to get out of its cogeneration plant in Kaunas, but recently the negotiations with the Fortum group has failed. So if the author plans to enter into the heat market in 2014, he will have to live during 5 years in a situation, where he can only deliver the full load 44 MWth capacity to the district heating network under the absolute condition that he sells at prices under the Gazprom price. This may require careful legal risk analysis, as Gazprom is not bounded by the regulatory heat framework in Lithuania but merely by a contractual relationship with Kauno Energija.
7. Another way to deal with the issue is to look into a possible partnership with the Gazprom Company – but the interest from their side is minimal as the author found out. In addition, this may involve certain political risks as the monopolist situation is a sensible one for the authorities. A broader consortium formula is however also a possibility and one could then also look at the plant in connection to a future biomass CHP plant.

8. The feasibility analysis for the 44 MWth – 16 MWel plant, working at full output design capacity and within the base-load of the Kaunas district network, gives a positive NPV of EUR 203 million and an IRR of 15% which means that project is feasible. However some parameters, like the electricity price within the future auction system, will require much attention. The author started with the expectation that the feed in tariff of electricity will stay in place until 2020. The author has however used quite conservative figures for the heat sale price after 2018 (EUR 31,86/MWh) and for the electricity price after the feed in tariff period, from 2021 onwards (EUR 40,55/MWh). Market premium with the new auctioning system were not introduced in his calculations. Fuel prices were taken at EUR 35,30/ton.
9. The sale of RES-e from next year on, is changed from the fixed feed in tariff valid until 2020, in the new market plus premium auction system for periods of 12 years. This will need careful monitoring. The system is innovative even in European context but also brings up questions like:
   - The risk of underbidding with consequence of a stop to future market developments;
   - Is there not a danger that a too low ceiling – threshold value will be fixed?
10. Market consultation with 3 international companies has shown a confirmation of the feasibility of the CHP project with an IRR of 12% (NPV EUR 16,3 million) in case of a heat price of EUR 30/MWh and an IRR of 23,5% - NPV EUR 47,9 million in case of a heat price of EUR 48 MWh.
11. The author has studied the investment in a heat distribution network in the 500 ha free economic zone of Kaunas. The outcome according to an obligatory and a free market connection scenario has given a negative NPV for the free market scenario and a positive value for the obligatory scenario. However the author was not able to study several detailed scenario's for optimizing a system of hydraulics for such heat distribution network. In addition he was not able to have a detailed market study for the development scenarios of the territories. Optimizing a phased development in relation to the gradual instalment of a distribution network, forms the key issue. Despite the negative outcome one can easily see from the yearly heat demand curves that a heat density of 5,49 MWh per year per meter length of network can be realized. Discussions with Kauno Energija district heating company seem appropriate to progress with the idea. It surely makes sense to attract

companies to the Free zone who need substantial heat and can be located near the CHP plant. If one considers our yearly heat production of the CHP plant at full capacity (330.000 MWh) even a fraction of the 500 ha heat map requirement (total after full development: 166.600 MWh/year) could give serious positive effect on the overall feasibility of the biomass CHP plant. And above all: a low carbon company park may be a trump card to attract international companies who include environment and sustainability standards into their location choice parameters.

12. The RES-CHP market will substantially develop in the coming years. A Government program for renovation and expansion is already in place untill 2020. Next round of EU structural funding will provide substantial funding possibilities. New market developments may also include: the un-bundling of transmission & distribution networks from the production of heat. In addition still a lot of municipal controlled heat operations may choose to enter into partnerships with the private sector in the form of PPP, concession agreements, or other partnership formulas in the very near future.

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# Annexes

**Annex 1:** COGENERATION DEVELOPMENT PLAN 2011-2020 (planned capacity expansion in renovation and new installations)(unofficial translation for the purpose of my thesis only )

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# Annex 1: Cogeneration development plan 2011-2020

| No | Municipality | Cogeneration technology /fuel (ST – Steam turbine/biofuel, MW – municipal waste, – CC - combined cycle/gas, ICE– internal combustion engine /biogas, gas, diesel) | CHP power capacity, MW | | | |
|---|---|---|---|---|---|---|
| | | | 2011–2015 | | 2016–2020 | |
| | | | From | to | from | To |
| 1. | Akmenė region | ICE | 3.76 | 5.38 | 0.07 | 0.12 |
| 2. | Alytus | ST | 2.41 | 2.50 | 2.60 | 2.76 |
| | | ICE | 5.04 | 5.04 | - | - |
| 3. | Alytus region | ICE | 0.84 | 1.04 | 0.05 | 0.05 |
| 4. | Anykščiai region | ICE | 6.30 | 6.46 | 0.14 | 0.16 |
| 5. | Birštonas | ICE | 1.22 | 1.44 | - | - |
| 6. | Biržai region | ICE | 3.30 | 4.92 | 0.06 | 0.07 |
| 7. | Druskininkai | ST | 0.91 | 1.50 | 1.15 | 1.73 |
| | | ICE | 6.82 | 6.84 | - | - |
| 8. | Elektrėnai | ICE | 5.52 | 5.52 | 0.01 | 0.02 |
| 9. | Ignalina region | ICE | 2.64 | 3.92 | 0.07 | 0.08 |
| 10. | Jonava region | ST | 2.00 | 2.00 | 3.00 | 3.00 |
| | | ICE | 10.68 | 10.68 | 0.15 | 0.20 |
| 11. | Joniškis region | ICE | 3.62 | 3.68 | 0.16 | 0.17 |
| 12. | Jurbarkas region | ICE | 3.62 | 5.02 | 0.15 | 0.17 |
| 13. | Kaišiadorys region | ICE | 6.08 | 7.28 | 0.19 | 0.40 |
| 14. | Kalvarija | ICE | 0.46 | 0.60 | 0.04 | 0.09 |
| 15. | Kaunas | ST | 2.61 | 12.66 | 2.61 | 18.16 |
| | | MW | 22.00 | 22.00 | 23.30 | 29.52 |
| | | ICE | 23.30 | 29.52 | - | - |
| | | ICE | 10.00 | 14.00 | - | - |
| 16. | Kaunas region | ICE | 9.96 | 10.48 | 0.04 | 0.09 |
| 17. | Kazlų Rūda | ICE | 5.12 | 5.12 | 0.01 | 0.01 |
| 18. | Kelmė region | ICE | 1.04 | 1.18 | 0.16 | 0.17 |
| 19. | Kėdainiai region | ICE | 4.86 | 5.16 | 0.35 | 0.54 |
| 20. | Klaipėda | ST | - | 0.52 | - | 0.52 |
| | | MW | 22.00 | 22.00 | - | - |
| | | CC | 12.74 | 20.77 | 12.74 | 20.77 |
| | | ICE | 10.00 | 10.00 | - | - |
| 21. | Klaipėda region | ICE | 6.58 | 7.40 | - | 0.02 |
| 22. | Kretinga region | ICE | 3.68 | 3.86 | - | - |
| 23. | Kupiškis region | ICE | 0.46 | 0.60 | 0.04 | 0.05 |
| 24. | Lazdijai region | ICE | 0.16 | 0.16 | 0.01 | 0.01 |
| 25. | Marijampolė | ST | 2.50 | 2.50 | 0.27 | 0.39 |
| | | ICE | 4.50 | 6.56 | 0.12 | 0.16 |
| 26. | Mažeikiai region | ST | 0.22 | 1.22 | 1.50 | 1.73 |
| | | ICE | 3.06 | 5.42 | - | - |
| 27. | Molėtai region | ICE | 0.30 | 0.34 | 0.02 | 0.03 |
| 28. | Pagėgiai | ICE | 0.52 | 0.54 | 0.06 | 0.06 |
| 29. | Pakruojis region | ICE | 3.16 | 3.64 | 0.34 | 0.35 |
| 30. | Palanga | ICE | 5.00 | 5.00 | - | - |
| 31. | Panevėžys | ST | - | 6.22 | - | 6.73 |
| | | CC | 34.90 | 34.90 | 2.10 | 2.10 |
| | | ICE | 0.31 | 0.47 | 0.36 | 0.56 |
| 32. | Panevėžys region | ICE | 5.44 | 7.60 | 0.48 | 0.50 |
| 33. | Pasvalys region | ICE | 7.30 | 7.34 | 0.34 | 0.46 |
| 34. | Plungė region | ICE | 8.40 | 8.66 | 0.11 | 0.11 |
| 35. | Prienai region | ICE | - | - | 0.04 | 0.10 |
| 36. | Radviliškis region | ICE | 7.02 | 7.14 | 0.38 | 0.38 |
| 37. | Raseiniai region | ICE | 1.12 | 1.34 | 0.16 | 0.20 |

| No | Municipality | Cogeneration technology /fuel (ST – Steam turbine/biofuel, MW – municipal waste, – CC - combined cycle/gas, ICE– internal combustion engine /biogas, gas, diesel) | CHP power capacity, MW | | | |
|---|---|---|---|---|---|---|
| | | | 2011–2015 | | 2016–2020 | |
| | | | From | to | from | To |
| 38. | Rietavas | ICE | 1.82 | 1.82 | 0.02 | 0.03 |
| 39. | Rokiškis region | ICE | 1.86 | 2.16 | 0.13 | 0.18 |
| 40. | Skuodas region | ICE | 0.68 | 0.74 | 0.06 | 0.09 |
| 41. | Šakiai region | ICE | 3.88 | 4.38 | 0.46 | 0.47 |
| 42. | Šalčininkai region | ICE | 4.84 | 5.60 | 0.03 | 0.03 |
| 43. | Šiauliai | ST | 0.13 | 5.50 | 0.13 | 6.23 |
| | | CC | 27.70 | 32.28 | 27.70 | 32.28 |
| | | ICE | 10.00 | 10.00 | - | - |
| 44. | Šiauliai region | ICE | 4.58 | 5.06 | 0.31 | 0.33 |
| 45. | Šilalė region | ICE | 0.02 | 0.02 | - | - |
| 46. | Šilutė region | ICE | 12.17 | 13.21 | 1.83 | 2.40 |
| 47. | Širvintos region | ICE | 2.16 | 3.18 | 0.02 | 0.02 |
| 48. | Švenčionys region | ICE | 3.52 | 3.80 | 0.01 | 0.02 |
| 49. | Tauragė region | ICE | 3.90 | 4.18 | 0.01 | 0.03 |
| 50. | Telšiai region | ICE | 6.08 | 6.40 | 0.10 | 0.13 |
| 51. | Trakai region | ICE | 5.74 | 5.74 | - | - |
| 52. | Ukmergė region | ICE | 5.66 | 5.66 | - | - |
| 53. | Utena region | ST | 0.58 | 1.05 | 1.62 | 1.71 |
| | | ICE | 10.86 | 11.10 | 0.11 | 0.14 |
| 54. | Varėna region | ICE | 0.46 | 0.48 | 0.03 | 0.05 |
| 55. | Vilkaviškis region | ICE | 3.26 | 4.34 | 0.21 | 0.22 |
| 56. | Vilnius | ST | 104.64 | 111.00 | 53.64 | 60.00 |
| | | MW | 22.00 | 22.00 | - | - |
| | | CC | 33.60 | 64.83 | 33.60 | 64.83 |
| | | ICE | 10.00 | 10.00 | - | - |
| 57. | Vilnius region | ST | 0.75 | 2.79 | 1.68 | 2.79 |
| 58. | Visaginas | ICE | 5.00 | 6.20 | - | - |
| 59. | Zarasai | ICE | 0.08 | 0.08 | 0.02 | - |
| | | **Total:** | 569.45 | 681.74 | 175.12 | 264.70 |

Source: Minister of Energy of the Republic of Lithuania: National Cogeneration Development Plan, Order No. 1-174, dated 22 June 2010, http://www.litlex.lt/scripts/sarasas2.dll?Tekstas=1&Id=138293

# Annex 2: National control commission for prices and energy resolution – approval

NATIONAL CONTROL COMMISSION FOR PRICES AND ENERGY RESOLUTION APPROVAL

## REGULATIONS FOR THE ALLOCATION OF INCENTIVE QUOTAS BY AUCTION

No O3-229 of 29 July 2011
Vilnius

( unofficial translation for the purpose of my thesis only )

NATIONAL CONTROL COMMISSION FOR PRICES AND ENERGY
R E S O L U T I O N

**APPROVAL OF REGULATIONS FOR THE ALLOCATION OF INCENTIVE QUOTAS BY AUCTION**

No O3-229 of 29 July 2011
Vilnius

Pursuant to Article 11(12) of the Law of the Republic of Lithuania on Renewable Energy (Official Gazette *Valstybės Žinios*, 2011, No. 62-2936), the National Control Commission for Prices and Energy hereby r e s o l v e s :

1. To approve the Regulations for the Allocation of Incentive Quotas by Auction (*enclosed*).

2. To establish that this resolution shall enter into force on 1 January 2012.

CHAIRWOMAN OF THE COMMISSION, DIANA KORSAKAITĖ

_____

APPROVED
by Resolution No O3-229 of 29 July 2011 of the National Control Commission for Prices and Energy

**REGULATIONS FOR THE ALLOCATION OF INCENTIVE QUOTAS BY AUCTION**

**I. GENERAL PROVISIONS**

1. Regulations for the allocation of incentive quotas by auction (hereinafter referred to as the Regulations) shall regulate the general principles and procedure of the announcement and the

organisation of an auction for the allocation of incentive quotas and the setting of fixed tariffs, and the selection of the successful bidder/bidders of that auction.

2. The Regulations have been developed pursuant to Article (11)(12) and (13) and Article 20(3) of the Law of the Republic of Lithuania on Renewable Energy (Official Gazette *Valstybės Žinios*, 2011, No 62-2936).

3. For the purpose of these Regulations:

***An auction*** shall be a way to get incentive quotas and a method to set fixed tariffs of electricity produced from renewable energy sources (hereinafter referred to as fixed tariffs) when the number of potential bidders in a certain group of producers of electricity from renewable energy sources is not limited, and the right to get an incentive quota is granted to a potential producer/producers offering the lowest desirable fixed tariff.

***A bidder*** shall be a producer entered into the auction register following the procedure established by these Regulations and seeking to obtain an incentive quota for the offered fixed tariff.

***A group of producers*** shall be at least two producers that operate electricity generators, use the same type or renewable sources, hold the appropriate permit to engage in such activities or intend to develop the production of electricity from renewable energy sources.

***An auction register*** shall be a document of each auction into which the auction secretary shall enter auction documents and bids for the fixed tariff submitted by a producer as well as other information that must be entered into this document following the procedure established by the Regulations.

For the purpose of these Regulations, other definitions shall be as defined by the Law of the Republic of Lithuania on Renewable Energy and other laws.

## II. GENERAL PRINCIPLES OF AUCTIONING

4. An auction shall be held within the deadlines set by the Commission; however, not later than within 180 calendar days after the date of the submission of the producer's request to hold an auction for a certain group of producers in the region indicated by the producer. An individual auction shall be held for each group of producers in each region. The commencement of the auction shall be the evaluation of documents at the meeting of the auction committee defined in paragraph 13 of the Regulations.

5. The ceiling of the fixed tariff shall be established for participating producers by the type of renewable energy sources for each calendar year according to the Methods of Setting Tariffs of Electricity Generated from Renewable Energy Sources (hereinafter referred to as the Methods).

6. Incentive quotas and auction regions shall be established and approved following the procedure set by the Government of the Republic of Lithuania.

7. An auction shall have the following stages:

7.1. Submission and registration of auction documents and initial bids regarding the fixed tariff;

7.2. Evaluation of the auction documents;

7.3. Making of a list of auction Bidders that meet the requirements established by the Regulations;

7.4. Making of a list and public announcement of the initial bids for the fixed tariff submitted to the auction by the Bidders;

7.5. Submission and registration of revised bids of the Bidders regarding the fixed tariff;

7.6. Selection and public announcement of the successful bidder of the auction.

8. The auction must have at least three Bidders. With due consideration to the specific character of each region and the share of allocated incentive quota, the commission shall have the right to establish a lower minimum number of Bidders in the description of the auction conditions.

9. Each Bidder can submit only one initial bid and one revised bid for the same auction. The number of bids for different auction regions shall not be limited. Auctions shall be held in each region until the entire incentive quota granted to that specific region is allocated.

10. The Bidders of the auction shall compete among themselves by bidding for the desired fixed tariff (ct/kWh) rounded to 0.5 cent. If the value of the desired fixed tariff proposed by the Bidder exceeds the ceiling set in line with the Methods, such bid shall be held null and void and shall not be considered while making a list of bids for the fixed tariff submitted by the Bidders. In the revised bid, the Bidder cannot offer a higher value of the fixed tariff than quoted in its initial bid. If the revised bid offers a higher value of the fixed tariff than quoted in the initial bid, the initial bid shall apply. If the Bidder fails to submit a revised bid by the set deadline and does not withdraw from the auction, the value quoted in the initial bid shall apply.

11. Once the auction Bidder wins the auction, it cannot change the connection point to the electricity network and the power plant capacity stated in the connection conditions issued by the electricity network operator.

12. The submission of documents and bids by auction Bidders and the participation in auctions shall be free of charge.

## III. AUCTION COMMITTEE

13. The auction committee (hereinafter referred to as the Committee) shall be a collegial body with at least five members, which shall examine and evaluate documents of persons registered for the participation in an auction as provided by the Regulations, submit proposals regarding the description of auction conditions, and deal with other issues stated in paragraph 16 of the Regulations and related with the allocation of incentive quotas and setting of fixed tariffs by auction.

14. The chairman of the Commission shall appoint members of the Committee from among the persons engaged in the Commission and, upon the recommendation of the administration of a respective authority, from persons employed at the Ministry of Energy of the Republic of Lithuania and at the State Energy Inspectorate under the Ministry of Energy. The chairman of the Commission shall appoint the chairman of the Committee (who shall be a person engaged in the Commission and who shall represent the Committee) and his deputy from among the members of the Committee. The chairman of the Commission shall appoint the auction secretary from among the persons engaged in the Commission; such person shall not be a member of the Committee.

15. Decisions of the Committee shall be adopted if more than half of the members of the Committee (including the chairman of the Committee or his deputy) are present, by a simple

majority of votes of the Committee members. In case of a tie vote, the chairman of the Commission shall have the casting vote. Minutes of the meetings of the Committee shall be kept. Decisions of the Committee shall be entered into the minutes, which in turn shall be signed by the auction secretary and by all members of the Committee present at the meeting.

16. The Committee must do the following actions on the impartial, objective and non-discriminatory basis and by the set deadlines:

16.1. To examine auction documents submitted by producers;

16.2. To make a list of Bidders eligible under paragraphs 56 and 57 of the Regulations and to present the list to the meeting of the Commission;

16.3. To make a list of initial bids for the fixed tariff submitted to the auction by Bidders and to present such list to the meeting of the Commission;

16.4. To make a list of revised bids for the fixed tariff submitted by Bidders;

16.5. With due consideration to the list specified in paragraph 16.4 of the Regulations, to select a Bidder/Bidders that is/are eligible under paragraphs 74, 75 and 76 of the Regulations and requirements of the description of auction conditions;

16.6. To recommend the Commission to recognise the Bidder/Bidders specified in paragraph 16.5 of the Regulations as the successful Bidder/Bidders of the auction;

17. A member of the Committee, the auction secretary shall exclude himself or must be excluded from participation in the activities of the Committee, if

17.1. He has legal relations with at least one person authorised by a Bidder; therefore, the outcome of the auction may influence his rights or obligations;

17.2. He is related to at least one person authorised by a Bidder, and such relation is family relation (ancestors and descendants, siblings and step-siblings, adoptive parents, adoptive children) or relation by marriage;

17.3. He is related to at least one person authorised by a Bidder by marital, guardianship or curatorship relations;

17.4. He and a Bidder has official relations prohibited under Article 20 of the Law of the Republic of Lithuania on the Adjustment of Public and Private Interests in the Civil Service (Official Gazette *Valstybės Žinios*, 1997, No 67-1659; 2000, No 18-431);

17.5. There are other circumstances causing reasonable doubt regarding his impartiality.

18. The definition of a spouse shall also include a person with whom the civil servant lives without contracting marriage, or to whom such civil servant is engaged (the marriage application has been filed), also the civil servant's ex-spouse. The definition of children and parents shall also include adoptive children and adoptive parents as well as former adopted children and former adoptive parents.

19. The decision regarding the exclusion of a member of the Committee, the auction secretary from participation in the activities of the Committee shall be adopted by the chairman of the Commission at his own initiative or with due consideration to the request of a member of the Committee, the auction secretary or a Bidder.

20. Members of the Commission, members of the Committee and the auction secretary can participate in the activities of the Committee only after they sign the confidentiality pledge annexed to these Regulations.

21. Members of the Committee, the auction secretary and members of the Commission must keep information that they got to know while performing their duties as members of the Committee, the auction secretary and members of the Commission confidential, and they

may disclose such information only for the purpose and according to the procedure provided by the laws and regulations of the Republic of Lithuania.

22. Members of the Committee, the auction secretary and members of the Commission shall have no right to disclose the following information for three years from the commencement of the examination of auction documents, unless the Bidder specifies a shorter period:

22.1. The content of documents and explanations submitted by each Bidder;

22.2. Information related to the examination and evaluation of auction documents submitted by Bidders, except for information about the results of the auction;

22.3. Other information related to performed auction procedures if the disclosure of such information conflicts with the law, violates legitimate commercial interests of the parties or prevents from ensuring fair competition.

23. Information described in paragraphs 21 and 22 of the Regulations shall not be considered confidential, if such information is entered into the resolution consolidating the results of the auction.

## IV. ANNOUNCEMENT OF THE AUCTION

24. Having received a producer's request to hold an auction, the Commission shall promptly announce information about the producer's request on the website of the Commission, stating the group of producers and the auction region to which the received request to hold an auction pertains.

25. Having received a producer's request to hold an auction, the Commission shall draft and approve the description of auction conditions within 30 calendar days from the date of the receipt of the request; the said description shall state:

25.1. Information about incentive quotas for the allocation of which the auction is being announced;

25.2. The auction region and the available free capacity in the zone where the successful Bidder will be entitled to use incentive quotas;

25.3. The period for the application of incentive quota;

25.4. The procedure for the registration of auction documents and bids for the fixed tariff;

25.5. The ceiling of the fixed tariff for the auction region and the group of producers;

25.6. Other information and conditions of importance for auctioning.

26. The Commission shall announce information about the auction, which will grant the right to get incentive quotas and set the fixed tariff, on the website of the Commission at least 15 calendar days prior to the registration of the Bidders.

27. The auction notice must state the following:

27.1. The title of the auction;

27.2. The region of the connection of power plants to the electricity network and the group of producers for which the quota allocation auction is announced;

27.3. Contact information of the auction secretary;

27.4. The period for the submission of documents;

27.5. Information where to find the description of auction conditions and where to register auction documents;

27.6. The time and venue of the first meeting of the Committee;

27.7. Other important information related to auctioning.

28. The Commission shall publish description of auction conditions stated in paragraph 25 of the Regulations on it's website.

29. The Commission shall respond to inquiries of potential Bidders within three working days from the date of the receipt of the inquiry. Depersonalised responses related to auctioning shall be announced on the website of the Commission.

30. Once the auction is announced, the Commission shall not provide any information about the Bidders until the announcement of the successful Bidder.

## V. REGISTRATION OF AUCTION DOCUMENTS AND INITIAL BIDS FOR THE FIXED TARIFF

31. The Commission shall commence the registration of auction documents and initial bids for the fixed tariff 15 calendar days before the commencement of the auction.

32. Wishing to participate in the auction, a producer must submit the following auction documents to the Commission:

32.1. An application to participate in the auction, stating the name, code and corporate address of the person;

32.2. Certification of the absence of circumstances described under paragraphs 57.3, 57.4, 57.5, 57.9 and 57.10;

32.3. Declaration about available or expected to be available facilities generating electricity from renewable energy sources, and the undertaking to use up the allocated incentive quota if the producer is selected as the successful Bidder;

32.4. Documents proving that the producer has not made use of the aid scheme stated in Chapter Eight of the Law of the Republic of Lithuania on Renewable Energy, viz. the national programme for the financing of the development of renewable energy sources and/or a municipal programme for the financing of the development of renewable energy sources;

32.5. Documents certifying the authorisation of the representative (if the application is submitted by the producer's representative);

32.6. The letter of intent, or a duly certified copy thereof, of the connection of electricity generators to the electricity network;

32.7. A document certifying the submission of the obligation performance security to the electricity network operator;

32.8. Producers listed in paragraph 33 of the Regulations must submit simplified connection conditions, or a duly certified copy thereof, issued by the electricity network operator;

32.9. Information of the State Tax Inspectorate under the Ministry of Finance about the discharging or the failure to discharge the producer's obligations related to the payment of taxes; such information must be released at least five working days prior to the date of submission of auction documents;

32.10. A certificate that the person is not in arrears to the State Social Insurance Fund issued by the State Social Insurance Fund Board under the Ministry of Social Security and Labour at least five working days prior to the date of submission of auction documents;

32.11. Equivalent documents issued in the country of registration (if the producer is registered in another Member State) certifying that the producer has discharged its obligations stated in paragraphs 32.9 and 32.10 of the Regulations in compliance with the requirements of the country of its registration or in compliance with the requirements of the Republic of Lithuania.

33. The following producers shall not be required to submit documents listed in paragraphs 32.6 and 32.7 of the Regulations: producers the installed power of whose power plants does not exceed 350 kW and does not exceed the present allowable power at the nearest connection point of the distribution network, except for biogas power plants under construction near cattle-breeding and poultry enterprises, landfills and wastewater treatment companies, as the power of such biogas power plans is not subject to restriction.

34. Wishing to participate in the auction, the producer shall concurrently submit auction documents and its initial bid for the fixed tariff placed in separate envelopes.

35. The auction secretary shall register envelopes containing auction documents and envelopes containing initial bids for the fixed tariff in the auction register no later than on the date of the receipt of the said envelopes. Envelopes containing auction documents and envelopes containing initial bids shall be registered only at the time of registration of these documents specified in the auction notice. Auction documents and bids for the fixed tariffs shall be considered as submitted on the date of their registration in the auction register.

36. The producer shall be considered as the Bidder as of the registration of the envelopes containing auction documents and initial bids for the fixed tariff in the auction register.

37. Auction documents shall submitted in a sealed enveloped, which shall be signed by the producer or its authorised representative so as to prevent the auction documents to be removed from the enveloped without breaking the envelope and the signature mark. The envelope shall state *Valstybinei kainų ir energetikos kontrolės komisijai* (Lith. *To the National Control Commission for Prices and Energy*) as well as the address of the Commission, the title of the auction, the producer's name/full name, code, address, telephone, e-mail, contact person's data and words *aukciono dokumentai* (Lith. *auction documents*).

38. The initial bid for the fixed tariff shall submitted in a sealed enveloped, which shall be signed by the producer or its authorised representative so as to prevent the initial bid for the fixed tariff to be removed from the enveloped without breaking the envelope and the signature mark. The envelope shall state *Valstybinei kainų ir energetikos kontrolės komisijai* (Lith. *To the National Control Commission for Prices and Energy*) as well as the address of the Commission, the title of the auction, the producer's name/full name, code, address, telephone, e-mail, contact person's data and words *pirminis pasiūlymas dėl fiksuoto tarifo* (Lith. *initial bid for the fixed tariff*).

39. All auction documents (incl. annexes) must be placed in a folder; all pages of these auction documents in a folder must be numbered and sewn or otherwise bound, as well as signed by the producer or the producer's authorised representative on the reverse side of the last sheet of auction documents, stating the position and the full name of the producer or the producer's authorised representative and the number of sheets sewn in the file. The first sheet shall contain the table of contents if the submitted auction documents and shall be signed by the producer or the producer's authorised representative. Auction documents must

be sewn or otherwise bound so as to prevent any removal, insertion or replacement of sheet of such auction documents without damaging the binding.

40. All envelopes, auction documents and bids for the fixed tariff must be submitted to the Commission in Lithuanian.

41. During the registration of envelopes containing auction documents and envelopes containing initial bids for the fixed tariff in the auction register, the auction secretary shall state that the envelopes have been received, and also state the date and time of their receipt, the title of the auction, the number provided to the Bidder, the full name of the auction secretary, and will sign the entry.

42. The auction register shall be kept in the custody of the auction secretary.

43. The auction secretary shall provide each Bidder with the number of the Bidder stated in paragraph 41 of the Regulations; such number shall be between 1 and 100, and shall be provided in random order. The provided number of the Bidder shall not be changed and shall remain valid during all stages of the auction.

44. During the registration of envelopes containing auction documents and envelopes containing initial bids for the fixed tariff in the auction register, the auction secretary shall issue a confirmation to the Bidder stating that the respective envelopes have been received, also stating the date and time of their receipt, the title of the auction, the number provided to the Bidder, the full name of the auction secretary, the contact telephone number and the signature. If auction documents and initial bids for the fixed tariff are sent by mail, the auction secretary shall send the confirmation by e-mail (indicated on envelopes defined in paragraphs 37 and 38 of the Regulations) not later than on the first working day following the date of the receipt of envelopes containing auction documents and initial bids for the fixed tariff.

45. The auction secretary shall have no right to register envelopes containing auction documents and envelopes containing bids for the fixed tariff, if:

45.1. Auction documents, bids for the fixed tariff are received by the Commission after the expiration of the deadline for the receipt of these documents;

45.2. Auction documents and/or bids for the fixed tariff are submitted in violation of the requirements of paragraphs 37, 38, 40 or 67 of the Regulations.

46. The Commission shall not be liable for any delays caused by the providers of post and/or delivery services resulting in the failure to receive auction documents and envelopes containing bids for the fixed tariff, or the receipt of the said auction documents and envelopes containing bids for the fixed tariff after the expiration of the deadline for the registration of the said documents. The Commission shall not open envelopes containing documents received after the expiration of the deadline for the registration, and the auction secretary shall return these documents to the Bidder within five working days from the date of the receipt of the documents.

## VI. RIGHTS AND OBLIGATIONS OF THE BIDDER

47. As of the date the sealed envelope containing auction documents and the sealed envelope containing initial bids for the fixed price are registered by the Commission as provided in the Regulations the Bidder shall acquire the following rights:

47.1. To submit a new envelope containing auction documents and/or a new envelope containing the initial bid for the fixed tariff in replacement of the earlier envelope/envelopes by the deadline of the registration of auction documents and initial bids for the fixed tariff. If the Bidder submits a new envelope containing auction documents and/or a new envelope containing the initial bid for the fixed tariff, he must also submit a request to the Commission to surrender the earlier envelope containing auction documents and/or the envelope containing the initial bid for the fixed tariff; such request must be supported by the certification stated in paragraph 44 of the Regulations and, if required, the power of attorney issued by the producer. The auction secretary must make an entry into the auction register stating that the earlier envelope containing auction documents and/or the envelope containing the initial bid for the fixed tariff has/have been withdrawn and a new envelope/envelopes has/have been submitted. The envelope/envelopes submitted earlier shall be returned to the Bidder. The auction secretary shall make an entry into the auction register stating when the envelope/envelopes was/were replaced. The Bidder shall confirm the submission of new documents by signing in the auction register. A new confirmation shall be issued to the Bidder who submits an envelope containing new auction documents and/or an envelope containing the initial bid for the fixed tariff;

47.2. To submit a new envelope containing a revised bid for the fixed tariff in replacement of the earlier envelope during the period from the commencement of the registration of revised bids for the fixed tariff until the end of the registration of revised bids for the fixed tariff. If the Bidder submits a new envelope containing a revised bid for the fixed tariff, he must also submit a request to the Commission to surrender the envelope containing the revised bid for the fixed tariff; such request must be supported by the certification stated in paragraph 44 of the Regulations and, if required, the power of attorney issued by the producer. The auction secretary must make an entry into the auction register stating that the earlier envelope containing a revised bid for the fixed tariff has been withdrawn and a new envelope has been submitted. The envelope/envelopes submitted earlier shall be returned to the Bidder. The auction secretary shall make an entry into the auction register stating when the envelopes were replaced. The Bidder shall confirm the submission of new documents by signing in the auction register. A new confirmation shall be issued to the Bidder who submits an envelope containing a new revised bid for the fixed tariff;

47.3. To withdraw from the auction by the deadline for the registration of revised bids for the fixed tariff. If the Bidder withdraws from the auction, he must submit a request to the Commission to surrender the envelope containing auction documents and/or the envelope containing the bid for the fixed tariff; such request must be supported by the certification stated in paragraph 44 of the Regulations and, if required, the power of attorney issued by the producer. The auction secretary must make an entry into the auction register stating that the Bidder withdraws from the auction, the date of withdrawal, and must sign the entry. The Bidder shall confirm his withdrawal from the auction by signing in the auction register. If the Bidder withdraws from the auction, auction documents and/or the envelope containing the bid for the fixed tariff shall be returned to such Bidder upon the expiration of the deadline for the registration of auction documents and/or envelopes containing bids. Once the Bidder withdraws from the auction, he shall not be eligible for submitting bids for the same auction.

48. A Bidder cannot delegate its rights of the Bidder to any other person.

## VII. EVALUATION OF AUCTION DOCUMENTS. MAKING A LIST OF BIDDERS

49. Once the Committee meets for its first meeting at the time set in the description of auction conditions, the chairman of the Committee shall announce the commencement of the auction and shall provide information specified in the description of the respective auction conditions. Bidders and other interested persons shall have the right to participate at the first meeting during which envelopes containing auction documents shall be opened. Other meetings of the Committee dealing with the evaluation of auction documents can only be attended by members of the Committee and by the auction secretary. Information about the first meeting of the Committee shall be provided on the website of the Commission at least three working days prior to the meeting of the Committee.

50. Submitted auction documents shall be examined and their compliance with the requirements of these Regulations shall be evaluated at the meetings of the Committee within 10 working days from the expiration of the deadline for the registration of auction documents. Upon a reasonable recommendation of the chairman of the Committee, the chairman of the Commission may extend this 10-day period by another 10 working days in the presence of circumstances listed under paragraphs 53 and/or 54 of the Regulations.

51. During the first meeting the members of the Committee shall open sealed envelopes containing auction documents and shall perform their initial examination whether they comply with the requirements of paragraph 56 of the Regulations. Auction documents that do not comply with any requirements of paragraph 56 of the Regulations shall be rejected and no longer examined. The auction secretary shall return rejected and not examined auction documents to the Bidder by mail within five working days from the date of the rejection of these auction documents. All information about rejected and not examined auction documents shall be entered into the minutes. The completed minutes shall be signed by all members of the Committee present at the meeting and by the auction secretary.

52. During other meetings of the Committee the members of the Committee shall evaluate the compliance of submitted auction documents with the requirements of paragraph 57 of the Regulations. Auction documents that do not comply with any requirements of paragraph 57 of the Regulations shall be rejected. All information about Bidders that fail to comply with the established requirements shall be entered into the minutes. The completed minutes shall be signed by all members of the Committee present at the meeting and by the auction secretary.

53. The Committee may propose to the Commission to request that Bidders provide additional information about auction documents and/or specification and explanation of initial and revised bids. Bidders must submit the required information to the Commission within three working days from the date of the receipt of such request of the Commission.

54. The Committee may propose to the Commission to contact respective Lithuanian or foreign authorities regarding the verification of data on the Bidders. The Commission and the Committee must use the received information in compliance with the confidentiality undertakings.

55. The Committee shall make a list the Bidders that comply with the established requirements and whose envelopes containing initial bids for the foxed tariff shall be further evaluated. All information about the Bidders shall be entered into the minutes of the

Committee, which shall be presented to the meeting of the Commission jointly with the minutes indicated in paragraphs 51 and 52 of the Regulations. The completed minutes shall be signed by all members of the Committee present at the meeting and by the auction secretary.

56. The Committee shall exclude the Bidder from further participation in the auction, if:

56.1. Any of the documents listed in paragraph 32 of the Regulation is not provided, or the provided documents fail to comply with the requirements of paragraphs 39 and/or 40 of the Regulations or the description of auction conditions;

56.2. Documents fail to provide all required data.

57. The Committee shall reject auction documents and/or bids for the fixed tariff prior to the expiration of the time-period of their examination, if it establishes the following:

57.1. Auction documents and/or bids for the fixed tariff do not comply with the conditions indicated at the time of the announcement of the auction;

57.2. Submitted auction documents and/or bids for the fixed tariff do not comply with the requirements of paragraphs 39 and/or 40 of the Regulations and/or the description of auction conditions, or the Bidder indicate additional conditions that are not in line with the Regulations of the auction;

57.3. Bankruptcy proceedings have been initiated against the Bidder or creditors are performing extrajudicial bankruptcy procedures of the legal entity;

57.4. Restructuring proceedings have been initiated against the Bidder;

57.5. A decision has been made by the court, creditors or members of the legal entity to liquidate the legal entity;

57.6. The producer fails to discharge his obligations related to the payment of taxes;

57.7. The producer is in arrears to the State Social Insurance Fund;

57.8. Information provided in auction documents or in the initial and/or revised bid is false and incorrect, which the Commission can prove by any legal means;

57.9. A conviction judgement against the producer became effective within the last 5 years in relation to criminal acts regarding property, property rights and property interests, intellectual or industrial property, economics or business procedure, financial system, civil service or public interests;

57.10. The manager of a producer (who is a legal entity) or a general partner/partners of a general partnership has unexpired and not repealed conviction, or in the course of the past 5 years a court judgement in respect of the producer has been passed and has come into effect for the participation in, organization or commanding of a criminal association, for a bribery, bribery or tampering of the producer's intermediary, fraud, the use of a credit, loan or an earmarked support not according to its purpose or the established procedure, credit fraud, failure to pay taxes, submission of false data on the income, profit or property, failure to submit a return, report or other document, the acquisition or disposal of a property that came into possession by virtue of criminal activities, or legalization of moneys or property acquired by way of criminal activities;

57.11. The presence of circumstances listed in paragraph 82 of the Regulations.

58. The Committee shall present the minutes stated in paragraph 55 to the meeting of the Commission. If the meeting fails to establish any factual circumstances as a result of which the list of Bidders provided by the Committee should not be approved, the meeting of the Commission shall resolve to approve the list of Bidders.

59. The Commission shall announce the list of Bidders on its website not later than on the first working day following the date of the resolution to sign the list of Bidders; numbers of the Bidders shall be indicated in random order, and the time and venue for the examination of initial bids for the fixed tariff shall be repeatedly announced.

## VIII. RANKING OF INITIAL BIDS FOR THE FIXED TARIFF SUBMITTED BY BIDDERS

60. The Committee shall meet for the evaluation of initial bids for the fixed tariff not later than within two working days from the date of the resolution stated in paragraph 58 of the Regulations. The chairman of the Committee shall open the meeting and shall provide information provided in the description of respective auction conditions. Bidders and other interested persons shall be entitled to attend the meeting of the Committee which opens envelopes containing initial bids for the fixed tariff submitted by eligible Bidders and announces the Bidder's number and the fixed tariff quoted by the Bidder. Information about the meeting of the Committee which opens envelopes containing initial bids shall be provided on the website of the Commission at least two working days prior to the meeting of the Committee.

61. Members of the Committee shall evaluate whether bids for the fixed tariff submitted by Bidders are in compliance with the requirements of paragraphs 57.1 and 57.2 of the Regulations. Bids for the fixed tariff that fail to comply with any requirement of paragraphs 57.1 and 57.2 of the Regulations shall be rejected. All information about bids for the fixed tariff submitted by Bidders that fail to comply with the established requirements shall be entered into the minutes.

62. The Committee shall rank initial bids for the fixed tariff that were submitted by the Bidders and that comply with the requirements of the Regulations. All information about initial bids submitted by Bidders and the ranking shall be entered into the minutes of the Committee. The completed minutes shall be signed by all members of the Committee present at the meeting and by the auction secretary.

63. The Committee shall present the minutes stated in paragraph 62 to the meeting of the Commission. If the meeting fails to establish any factual circumstances as a result of which the ranking of initial bids for the fixed tariff provided by the Committee should not be approved, the meeting of the Commission shall resolve to approve the ranking of initial bids for the fixed tariff submitted by the Bidders.

64. The Commission shall announce the ranking of initial bids for the fixed tariff on its website not later than on the first working day following the date of the resolution to sign the ranking of initial bids for the fixed tariff submitted by Bidders; numbers of the Bidders and their quoted fixed tariffs shall be indicated in ascending order, and the time and venue for the registration of revised bids for the fixed tariff shall be repeatedly announced.

## IX. REGISTRATION OF REVISED BIDS FOR THE FIXED TARIFF

65. Bidders shall submit revised bids for the fixed tariff to the Commission not later than within five working days following the announcement of the ranking of the initial bids for the fixed tariff on the website of the Commission.

66. The auction secretary shall register envelopes containing revised bids for the fixed tariff in the auction register. Envelopes containing revised bids shall be registered only at the time of registration of bids for the fixed tariff specified in the auction notice. Revised bids for the fixed tariff shall be considered as submitted on the date of their registration in the auction register.

67. The revised bid for the fixed tariff shall submitted in a sealed enveloped, which shall be signed by the producer so as to prevent the bid for the fixed tariff to be removed from the enveloped without breaking the envelope and the signature mark. The envelope shall state *Valstybinei kainų ir energetikos kontrolės komisijai* (Lith. *To the National Control Commission for Prices and Energy*) as well as the address of the Commission, the title of the auction, the producer's name/full name, code, address, telephone, e-mail, contact person's data and words *patikslintas pasiūlymas dėl fiksuoto tarifo* (Lith. *revised bid for the fixed tariff*).

68. During the registration of envelopes containing revised bids for the fixed tariff in the auction register, the auction secretary shall state that the envelopes have been received, and also state the date and time of their receipt, the title of the auction, the number provided to the Bidder, the full name of the auction secretary and the contact telephone number, and the auction secretary will sign the entry.

69. During the registration of envelopes containing revised bids for the fixed tariff in the auction register, the auction secretary shall issue a confirmation to the Bidder stating that the respective envelopes have been received, also stating the date and time of their receipt, the title of the auction, the number provided to the Bidder, the full name of the auction secretary and the signature. If the revised bid for the fixed tariff is sent by mail, the auction secretary shall send the confirmation by e-mail (indicated on the envelope defined in paragraph 67 of the Regulations) not later than on the first working day following the date of the receipt of the envelope containing the revised bid for the fixed tariff.

70. The auction secretary shall have no right to register envelopes containing revised bids for the fixed tariff in cases described in paragraph 45 of the Regulations.

## X. SELECTION OF SUCCESSFUL BIDDERS

71. The Committee shall meet for the evaluation of revised bids for the fixed tariff not later than within two working days from the expiration of the deadline for the registration of revised bids for the fixed tariff. Bidders and other interested persons shall be entitled to attend the meeting of the Committee which opens envelopes containing revised bids for the fixed tariff submitted by eligible Bidders and announces the Bidder's number and the fixed tariff quoted by the Bidder. Information about the meeting of the Committee which opens envelopes containing revised bids shall be provided on the website of the Commission at least two working days prior to the meeting of the Committee.

72. Members of the Committee shall evaluate the submitted revised bids according to the procedure established in paragraph 61 of the Regulations.

73. The Committee shall rank revised bids for the fixed tariff that were submitted by the Bidders and that comply with the requirements of the Regulations. Based on the ranking of revised bids for the fixed tariff, the Committee shall select the potential successful bidder/bidders according to the criteria provided in paragraphs 74 and 75 of the Regulations.

All information about revised bids submitted by Bidders and the ranking shall be entered into the minutes of the Committee. The completed minutes shall be signed by all members of the Committee present at the meeting and by the auction secretary.

74. With due consideration to the requirements of paragraph 75 of the Regulations, the Committee shall recognise the Bidder that does not exceed the amount of the incentive quota in the respective auction region and that quotes the lowest desirable fixed tariff as the potential successful Bidder.

75. If two or more Bidders quote the same desirable fixed tariff in their bids, the successful Bidder shall be the Bidder that proposed to construct more powerful energy generation devices, with due consideration to the fact that the maximum installed power of energy generation devices in one auction zone must not exceed 40% of the maximum power of energy generation sources allowed to be connected in the region. If the bids propose the same power of energy generation devices as well, the incentive quota in the respective connection point shall be allocated to such Bidders pro rata to their proposed power.

76. Where only one potential successful Bidder is selected as stated in paragraph 74 of the Regulations, the Bidders that are ranked second and third and that do not exceed the amount of the incentive quota in the respective auction region shall have the right to inform the Commission in writing within two working days after the date of the ranking of revised bids for the fixed tariff that they agree to be recognised as successful Bidders and be subject to the lowest fixed tariff quoted by the potential successful Bidder. No written consents received by the Commission upon the expiration of the two-working day period after the date of the ranking of revised bids for the fixed tariff shall be accepted.

77. The Committee shall present the minutes stated in paragraph 73 and the written consents stated in paragraph 76 of the Regulations to the meeting of the Commission. If the bids for the fixed tariff are in compliance with the requirements if the Regulations, the meeting of the Commission shall resolve to approve the potential successful Bidder/Bidders, viz. the Bidder/Bidders that meet the requirements of paragraphs 74, 75 and 76 of the Regulations, as the successful Bidder/Bidders.

78. The following must be stated in the resolution of the Commission:

78.1. The title of the auction;

78.2. The successful Bidder;

78.3. The lowest desirable tariff (ct/kWh)quoted by the successful Bidder;

78.4. The allocated incentive quota in MW;

78.5. The term of the incentive quota and the won fixed tariff.

79. The Commission shall dispatch a copy of the resolution regarding the results of the auction to all Bidders not later than on the first working day after the signature of the resolution.

80. The Commission shall have the right to amend its decision regarding the results of the auction within 30 working days after the date of the resolution stated in paragraph 77 of the Regulations, if it is established that the successful Bidder provided false information to the Commission or deliberately omitted them, or if any other material circumstances are identified that could have influenced the evaluation of auction documents and bids for the fixed tariff submitted by the Bidders.

81. The resolution of the Commission regarding the results of the auction shall be announced on the website of the Commission.

82. The successful Bidder/Bidders shall be liable for his/their failure to perform his/their undertakings under the Law of the Republic of Lithuania on Renewable Energy and implementing legislation in the manner provided by the law. In that case the Commission shall announce a new auction as provided in Chapter IV of the Regulations. In such case the successful Bidder/Bidders failing to perform his/their undertakings shall not be eligible to participate in the new auction mentioned in this paragraph.

## XI. FAILED AUCTION

83. The auction shall be considered as failed if envelopes containing auction documents and initial bids for the fixed tariff registered by the deadline for the acceptance of auction documents and initial bids for the fixed tariff stated on the website of the Commission are submitted by less than three persons, or if at least three persons that submitted auction documents and initial bids for the fixed tariff are not approved as Bidders.

84. The decision regarding the failed auction shall be passed as a resolution of the Commission.

## XII. FINAL PROVISIONS

85. Disputes related to the implementation, application and interpretation of the requirements of the Regulations shall be resolved as provided by the law of the Republic of Lithuania.

86. Actions or omissions of the Commission may be complained against following the procedure established by the law of the Republic of Lithuania.

_____

Annex to the Regulations for the Allocation of Incentive Quotas by Auction

_____

_
(Full name)

**CONFIDENTIALITY PLEDGE**

No _____ of _____ 201__

_____
(Place)

1. Being a member of the Commission or a member of the Committee, or the auction secretary[96], I hereby solemnly pledge:

1.1. To keep information that I get to know while performing my duties as a member of the Committee of the allocation auction of incentive quotas, the auction secretary, confidential, and to use such information only for the purpose and according to the procedure provided by the laws and regulations of the Republic of Lithuania;

1.2. To protect information entrusted to me so as to prevent the third party from getting any opportunity to learn and use such information.

2. I have been informed that confidential information shall be:

2.1. Qualification information of the Bidders;

2.2. The content of auction documents, the bid for the fixed tariff and explanations submitted by each Bidder;

2.3. Other information related to the examination and evaluation of documents submitted by Bidders, except for information regarding the results of the auction;

2.4. Information related to performed auction procedures if the disclosure of such information conflicts with the law, violates legitimate commercial interests of the parties or prevents from ensuring fair competition.

3. I have been warned that if I violate this pledge, I will have to pay damages sustained by the authority that announced the auction and by the Bidders.

| _____ | _____ | _____ |
|---|---|---|
| (Position) | (Signature) | (Full name) |

_____

[96] Please underline where applicable

# Annex 3: Law on renewable energy

**Partial translation of relevant issues in relation to my thesis**

**LAW ON RENEWABLE ENERGY**

**OF THE REPUBLIC OF LITHUANIA**

**12 May 2011 No XI-1375**

(unofficial partial translation of the purpose of my thesis only )

**Article 3. The promotion of energy from renewable energy sources**

1. Terms and conditions of the promotion of energy from renewable energy sources are regulated by this Law and other legal acts.
2. The promotion of energy from renewable energy sources is established by a support scheme, which consists of one or more incentives of the following:
   1) The fixed tariff;
   2) Buying – up of energy from renewable energy sources;
   3) Compensation of expenses of equipment which use renewable energy sources connection to an electricity network or system;
   4) The reservation of capacity and bandwidth and other technical parameters of energy networks or systems, in order to connect the equipment that access renewable energy sources;
   5) Transmission of energy from renewable energy sources with a priority right;
   6) Electricity producers are exempted from liability for the balancing of generated electricity and (or) reservation of the generation capacity during the promotion;
   7) Support for generation and procession of agricultural generation - biofuel, bio olive and generation of raw materials.
   8) Requirements of mandatory accession of renewable energy sources for energy generation and (or) mandatory consumption of energy from renewable energy sources, as well as special requirements for accession of biofuel;
   9) Support for investments in technologies that access renewable energy sources;
   10) Other incentives prescribed by this Law and other laws.
3. After the promotion period the Government of the Republic of Lithuania (hereinafter – the **Government**) makes a decision regarding electricity producer's exemption from liability for electricity balancing and (or) reservation of electricity generating capacities. The decision is made commonly for all the producers while using the existing infrastructure and facilities.

4. Unless this Law regulates the terms and conditions of the incentives, they shall be regulated by the Government of the Republic of Lithuania.
5. The Government may grant the status of the pilot project for the promotion of environmentally friendly technologies using renewable sources.

## CHAPTER THREE

## PROMOTING, PLANNING AND EXPANDING ELECTRICITY GENERATION FROM RENEWABLE ENERGY SOURCES

## THE CONNECTION OF POWER PLANTS TO ELECTRICITY NETWORKS

### Article 13. Expansion of use of renewable energy sources in electricity generation

1. The expansion of use of renewable energy sources in electricity generation is one of the purposes in country's electricity strategy.
2. Terms and conditions of the expansion of use of renewable energy sources in electricity generation are regulated by this Law and other legal acts.
3. The tasks for this Law in the electricity sector by the year 2020 are as follow:
   1) To increase the installed total capacity to 500 MW of wind power plants, which are connected to electricity networks, despite the small power plants with the installed total capacity no higher than 30 kW. When the total capacity of 500 MW of wind power plants is reached, the Government shall prepare and certify the procedure for future expansion of wind power plants, transmission and distribution networks, advanced networks and electricity storage infrastructure, taking into account the obligations of the Republic of Lithuania on the reduction of environmental pollution, also on the assurance of security and reliability in electricity supply and the protection of consumer rights;
   2) To increase the installed total capacity of solar energy power plants to 10 MW, which are connected to electricity networks, except the small power plants with installed total capacity no higher than 30 kW. When the total capacity of 10 MW of solar power plants is reached, the Government shall prepare and certify the procedure for future expansion of solar power plants;

3) To increase the installed total capacity of hydro power plants, which are connected to electricity networks to 141 MW;
4) To increase the installed total capacity of natural gas power plants, which are connected to electricity networks, to 355 MW.

4. When the installed total capacity of power plants exceeds the installed total capacity listed in Part 3 of this Article, the Government shall prepare and certify the procedure for future expansion of wind power plants, transmission and distribution networks, advanced networks and electricity storage infrastructure, taking into account the obligations of the Republic of Lithuania on the reduction of environmental pollution, also on the assurance of security and reliability in the supply of electricity and the protection of consumer rights. The description must be prepared no later than by 1 January, 2015.

**Article 14. The connection of power plants to electricity networks**

1. Grid operator must with a priority right connect the producer's power plant to the connection point of electricity networks, which is controlled by grid operator and matches the required voltage level and is the closest to the power plant of the producer if there are no other electricity networks, that would be more suitable in technological and economic point of view. This has to be done no later than by 18 months or by the period during which the producer undertakes to construct a power plant, if the period is longer than 18 months. The priority right in the connection to electricity networks is assured in respect of other electricity producers, who do not use renewable energy sources in the generation process. The period of connection to electricity networks shall be counted from the day when the contract between the producer and the grid operator is signed. The moment when the power plant shall be considered as connected to the electricity network is when the power plant is connected to begin technological testing in electricity networks (the beginning of harmonization works before the activation of a power plant). The grid operator, in accordance with the requirements of legal acts and the special requirements for separate groups of producers, shall prepare and publish standard conditions of the service contract of connection of a power plant to electricity networks. The terms, according to their un-discriminatory basis must be applicable equally to all of the producers.
2. Grid operator is also required to connect the producer's power plant to electricity networks even when the connection is possible only after a technological upgrade of electricity networks by optimizing and extending the networks, increasing the capacity of the networks or reconstructing them otherwise. In such cases, the power plant shall be connected to the electricity networks in a reasonable period agreed by Parties, after the evaluation of the

need for renovation or expansion, but only to the extent reasonably necessary for an upcoming connection.

3. The terms for the connection to the electricity networks, that are mentioned in Part 1 and Part 2 of this Article, may be extended in cases when the technological testing cannot be started in the electricity networks by grid operator because of the delay of other party or other reasons beyond the will of the operator. In each and every case the term for connection to the electricity networks cannot be extended any longer than for 6 months. The term is extended by a mutual agreement between the producer and the grid operator reached in accordance with the procedure of the connection agreement.
4. The connection point is selected and estimated in the connection terms by the grid operator, which is an owner of electricity networks where the power plant will be connected to. This is completed by an operator in accordance with the request of a producer and after the evaluation of technological and economic criteria that are presented in the procedure estimated in Use of electricity networks in Part 7 of this Article.
5. The producer has the right to select another connection point of the power plant, which is technologically and economically possible in accordance with the information concerning the level of capacity of electricity networks and the installed capacity of the power plant, provided by grid operator.
6. Grid operator has the right to select another connection point, regardless of the producer's selected connection point, as indicated in Part 5 of this Article. The additional costs shall be covered as regulated in Article 21(7) of this Law.
7. Grid operator has to prepare and publish the procedure of Use of electricity networks in accordance with the conditions provided by the National Control Commission for Prices and Energy and after the mutual agreement of the procedure with the Commission. The procedure of Use of electricity networks shall be based on objective, transparent and non-discriminatory principles. All the benefits and costs concerning the connection of power plants to electricity networks must be reviewed in accordance with these principles.
8. Grid operator, by no later than 30 calendar days from receiving the producer's request to provide preliminary conditions of the upcoming connection, must provide all the information concerning mandatory actions that must be accomplished by the producer in order to connect his power plant to electricity networks. The information must also include conditions that are estimated to extend the electricity networks and, if it is mandatory, to complete the actions provided in Article 18 of this Law before the beginning of the connection. In case of producer's request, grid operator must submit a detailed outlay of costs related with the upcoming connection, also a reasonable and precise schedule of the submission and consideration of requests for connection and a reasonable tentative schedule concerning the possible date of the connection. In all cases the necessary technical and other information for the connection shall be shared between the grid

operator and the producer. Pre-conditions of the connection must comply with the procedure of electricity use, which is presented in Part 7 of this Article. Pre – conditions can not include any other requirements except from the ones necessary to secure the safety, trustworthiness and a proper quality of the work of electricity equipment and electricity system. Pre - conditions shall be published on the website of the grid operator.

9. Producer has a legal right to make a complaint to the National Control Commission for Prices and Energy concerning the pre - conditions provided in Part 8 of this Article in compliance with a complaint submission procedure as regulated in Article 64 of this Law. If the National Control Commission for Prices and Energy decides that pre – conditions, according to the conclusion of The State Energy Inspectorate do not comply with the description of Use of electricity networks procedure provided in Part 7 of this Article, the grid operator must provide new pre – conditions during a period no longer than 30 calendar days.
10. Producer, who has received the pre - conditions and is planning to extend the electricity generating capacity from renewable energy sources, shall prepare and provide to the grid operator a request to sign the letter of intent, except the cases provided in Part 16 of this Article.
11. Grid operator, who has received the request of a producer who is planning to extend the electricity generating capacity from renewable energy sources as it is provided in Part 10 of this Article, must sign the Letter of intent with a producer in a period no longer that 30 calendar days after the provision of the request. The letter of intent must include:
    1) The capacity of a power plant and the type of renewable energy sources, provided by the producer;
    2) The term during which the producer commits to construct the power plant, to finish the works in his part of electricity networks related to the construction and to provide required documents to The State Energy Inspectorate under the Ministry of Energy in order to receive an act – certificate of an examination of technical condition of his electricity equipment;
    3) The producer's commitment during a period suggested by a producer himself to prepare and provide a technical project of the power plant's installation and connection to installed electricity networks (hereinafter – the technical project) to grid operator's harmonization, if one is necessary;
    4) The grid operator's commitment during a period no longer than 4 months after the date of harmonized technical project provision or a period no longer than 2 months since the day of the signing of the Letter of intent, to prepare the project of agreement of the power plant's connection to electricity networks, if no technical project is necessary;
    5) Producers' commitment during a period of one month, since the day of the provision of the project of agreement of power plant's connection to electricity networks, which complies with the harmonized technical project or, if the technical project is not necessary, the connection

conditions provided by grid operator, to sign the above mentioned agreement;

6) Producer's commitment during a period of one moth, since the day of the fulfillment of power plant's connection to electricity networks agreement, to pay the costs of power plant's connection according to the amount of costs provided in Article 21(3) of this Law;
7) The grid operator's commitment during a period no longer than those provided in Part 1 and Part 2 of this Article, to connect the power plant to electricity networks and to secure a reliable electricity transmission and distribution;
8) The extent of security of producer's obligations, conditions and procedure of its provision and use;
9) Documents that would confirm the validity of detailed plan, which allows constructing a power plant with a capacity and type as in the producer's request, if such document is necessary according to the procedure estimated in legal acts.

12. The exemplary form of Letter of intent is confirmed by the National Control Commission for Prices and Energy.
13. After signing of the Letter of intent, but in no later than 15 calendar days left until the auction estimated in Article 20(3) of this Law, the producer must provide security of his obligations to grid operator with an extent as estimated in 15(1) of this Law. Security of obligation guarantees the implementation of producer's obligation to install new or extend installed generating capacity from renewable energy sources.
14. Term, estimated in subparagraph 2 of Article 14(11) can be pro - longed in following cases:
    1) Regarding the Government actions, actions of third parties and in case of an extraordinary event that cannot be prevented in certain circumstances (*force majeure*);
    2) Regarding the producer's request after the provision of an additional security for his obligations, estimated in Article 15(1) of this Law;
    3) In other cases estimated in an agreement of power plant's connection to electricity network and in other legal acts.
15. When the Letter of intent is signed by the producer and he provides the security of his obligations as well as an authorization of promotion of electricity generating capacity from renewable energy sources, as estimated in the Letter of intent, the grid operator has to sign the agreement of a power plant's connection to electricity networks.
16. Power plants with installed capacity no higher than 350 kW and no higher than the one allowed in the connection point of distribution network, except ones near stock-raising, aviculture companies and natural gas power plants constructed next to dump and sewage cleaning companies, with installed unlimited capacity, are connected to electricity networks immediately after the producer fulfills the simplified version of conditions of the connection, provided by grid operator. These power plants are connected to electricity distribution network by installing the accounting of generation and

consumption. Compliance with the requirements estimated in Article 15 of this Law is not necessary for such producers in order to make a connection to electricity network.

17. Every month information concerning the in – hand projects of the construction of power plants and the accomplishment of conditions estimated in letters of intent has to be provided by the grid operator to the ministry of Energetic and the National Control Commission for Prices and Energy.
18. Terms and procedure of the connection of power plants which use renewable energy sources are estimated in this Law and other legal acts.

**Article 15. Producer's commitments**

1. The producer who is planning to extend the electricity generating capacity from renewable energy sources shall provide security of his obligations to the grid operator in order to guarantee his obligations to extend electricity generating capacity from renewable energy sources. The extent of the security of obligations is estimated by multiplying the size (kW) of a power plant's capacity with 50 LTL for each kW. In order to pro-long the term of validity of the authorization for the extension of the electricity generating capacity from renewable energy sources, as it is estimated in Article 16(8) of this Law, the security of producer's obligations has to be increased with the size equal to the multiplication of the power plant's capacity by 50 LTL for each kW and the period that is required to pro-long the validity of authorization, expressed in years.
2. If the producer does not win the auction, which is mentioned in Article 20(3) of this Law, or the power plant is announced to be suitable for use according to the procedure estimated in legal acts, grid operator shall refuse his rights to the security of producer's obligations and shall either return the security of obligations to a person who has granted it or inform the person who granted the security of obligations in writing. After the end of the construction of a power plant and the granting of authorization for electricity generation, the security of producer's obligations is returned according to the procedure estimated in legal acts.
3. If the commitments estimated in the letter of intent and (or) in an agreement of power plant's connection to electricity network are not accomplished or not entirely accomplished by the producer, the grid operator has the right to use the security of producer's obligations, except when the commitments are not accomplished or improperly accomplished by the producer because of the circumstances and their consequences impossible to control or rationally foresee and prevent by the producer at the moment of formation of the agreement of power plant's connection to the network or because of other circumstances appearing without a guilt of a producer and estimated in Laws.

**Article 16. Procedure for Granting Authorizations for Expansion of the Electricity Generating Capacities from renewable energy sources**

1. Expansion of the installed generating capacity from renewable energy sources and construction of new generating capacity from renewable energy sources shall be a subject to authorization.
2. The ministry of Electricity issues authorizations for expansion of the electricity generating capacities from renewable energy sources in observance with legal acts.
3. Authorization for expansion of the electricity generating capacities from solar energy in Kursiu Nerija and wind energy in territorial sea in the Republic of Lithuania and in exclusive economic zone in Baltic Sea are issued by a tender in a manner as established by the Government or a body assigned by it in accordance with the common requirements for expansion of the electricity generating capacities from renewable energy sources estimated in this Law and under the principles of objectivity and undiscrimination.
4. Authorizations for expansion of the electricity generating capacities from renewable energy sources for producers who are planning to expand a power plant, except affluent type hydro power plants with an installed capacity no higher than 350 kW and no higher than the capacity estimated in distribution networks' connection point and except natural gas power plants that are constructed next to stock-raising, aviculture or dump and sewage cleaning companies with an installed capacity no higher than 1,2 MW, shall be issued by a simplified procedure in a matter of the rules for granting authorizations for activities in the sector of electricity, approved by the Ministry of Electricity and under the principles of objectivity and indiscrimination.

5. Authorizations for expansion of the electricity generating capacities from renewable energy sources are granted to producer who is planning to expand the electricity generating capacities from renewable energy sources only after he submits the following documents:

1) An application to issue an authorization for expansion of the electricity generating capacities from renewable energy sources;
2) The letter of intent of the power plant's connection to the grid which is signed by the grid operator in a manner of a procedure estimated in Article 14(11) in case if the letter of intent is necessary according to this Law;
3) Documents of a land plot where the power plant will be constructed or the electricity generating capacities will be expanded, which would assure that a producer has a right to manage and use the land plot as an owner or in other ways established in the legal acts. If the land plot is managed as a common divided ownership or as another right which is not an ownership, the

producer shall also provide a consent of co - owners or the owner to construct and maintain a power plant in the land plot for no less than 20 years;

4) A screening's conclusion regarding environmental impact assesment of the proposed economic activity or a decision regarding environmental impact assesment of the proposed economic activity, if environmental impact assesment procedures are estimated as necessary in the Law on Environmental Impact Assesment Of The Proposed Activity;

5) A screening's conclusion regarding the effect of the proposed economic activity on public health (except if the capacity of a power plant is no higher than 250 kW);

6) a confirmation about a fixed tariff reached in an auction for a promotional quote for producers whose power plants‘ installed capacity exceeds 30 kW, except of the cases when the fixed tariff is not applicable to the power plants.

6. The Ministry of Energy must issue an authorization to the producer to expand the electricity generating capacities from renewable energy sources within 30 calendar days after the day when the request was received or to provide a motivated refusal to issue an authorization in writing. If not all of the required documents were submitted, a term for issuing shall start since the day of the submission of the full set of documents.

7. A refusal to issue an authorization to expand the electricity generating capacities from renewable energy sources can only be based on following reasons:

1) At least one of the documents estimated in Article 16(5) is not submitted by the producer or the submitted data is false;

2) The commitments concerning paying of taxes in accordance to requirements of a country, where the producer is registered as a tax - payer, are not fulfilled.

8. Authorization to expand the electricity generating capacities from renewable energy sources is valid until the begging of power plant's maintenance, which is estimated in the letter of intent of power plant’s connection to the grid, but no longer than 24 months. An authorization shall be prolonged for no longer than 6 months, if the design work is finished and development work is finished at least by 50 per cent and if an additional security of his obligations is provided by the producer as estimated in Article 15(1) of this Law. An authorization shall be additionally prolonged for no longer than 6 months, if the producer can provide proof that planned works are not accomplished because of Government's actions, third parties' actions or in case of an extraordinary event that cannot be prevented in certain

circumstances (*force majeure*), also in case of other circumstances that can not be controlled or managed by a producer.

**Article 17. Admission of electricity and transmission of electricity**

1. Grid operator shall in a priority right accept, transmit and (or) distribute in indiscriminative tariffs all amount of electricity generated from renewable energy sources and offered by a producer. This priority right of acceptation, transmission and distribution for a producer is secured in a respect of other producers who generate electricity from non-renewable energy sources.
2. If accepting grid operator is not a transmission system's operator himself, the commitment to accept and transmit electricity in a priority right, as estimated in Article 17(1), also implies to transmission system operator.
3. Transmission of electricity, generated from renewable energy sources, can be restricted or temporarily discontinued in case of failures or other technical reasons when the transmission capability is restricted according to indiscriminative basis. Producer's losses because of such restriction are not compensated except of the cases when circumstances that results the restriction, appears because of the guilt of grid operator or in other basis estimated in Laws.
4. If in cases, estimated in Article 17(3), grid operator takes measures which results in material restriciton of the use of renewable energy sources in order to secure the safety of state's electricity system and the reliability of electricity supplience, he immediately has to inform competent instituion about adequate measures, the level and reasons to take them and also he shall point what measures will be taken to prevent inproper restricitons.

**Article 18. Increase of the capacity of grid**

1. When the producer and the grid operator sign the agreement of power plant's connection to the grid, the grid operator shall immediately take all reasonably necessary measures according to technical condition of the grid, including electric installations and objects, to expand and (or) reconstruct and increase the grid's capacity in order to secure a reliable admission, transmission and distribution of energy generated from renewable energy sources.
2. If there are any data that would prove an assumption that the grid operator is not fulfilling his commitments according to this Chapter, producers have a right to require information from grid operator about the reasons and level in which the operator did not fulfilled his commitment to optimize and expand the electricity network system and to increase electricity networks' capacity.

**Article 19. Regulation of connection of power plants**

1. Works of power plant's connection in the part of electricity network which is managed by grid operator, including the installation of electricity energy meters, shall be accomplished by the grid operator or by another person assigned by operator according to the procedure estimated in legal acts.
2. Producer's electricity equipment that are connected to electricity network, connection work and equipment necessary for the security of electricity network must be in conformity with technical regulations and requirements estimated in other legal acts.
3. If grid operator requests, producers must provide the wind power plants with installed capacity higher than 350 kW and hydro power plants with installed capacity higher than 5 MW with technical and maintenance measures that would allow to decrease the generating capacity or increase generation of electricity to electricity networks, using the remote measures which would be accessible for grid's operator. These measures shall be considered as an inherent part of producer's power plant. Producer gain these measures and install them in conformity with technical regulations and (or) the requirements estimated by the grid operator.
4. Grid operator has a right to regulate the amount of electricity generated and supplied to electricity network by wind power plant with installed capacity higher than 350 kW and hydro power plant with installed capacity higher that 5 MW. Operator can also delay the connection to electricity network of mentioned power plants:
   1) If without the delay electricity networks, which accepts the generated electricity energy, would be overloaded;
   2) In cases of an extraordinary event that cannot be prevented in certain circumstances;
   3) In cases when the failure in electricity network or energy system needs to be prevented or an existing failure in energy system needs to be liquidated;
   4) In other cases estimated in Laws.
5. If improper maintenance, supervision, management and promotion of electricity network are estimated in case of guilt of grid operator and this is the reason to apply the regulation of power plant's connection to electricity network estimated in Article 19(4), the grid operator must cover direct losses and lost incomes.

**Article 20. Promoting electricity generation from renewable energy sources**

1. Electricity energy generation from renewable energy sources is a public service. Common principles, procedure and conditions of payments in fixed tariffs mentioned in this Law are estimated by the Government which certifies the procedure of public interests' obligations. Trade of electricity which is generated from renewable energy sources is accomplished in

accordance with the procedure and ways estimated in Electricity trading rules, except the trading of electricity energy which is generated in power plants with installed capacity no higher than 30 kW and electricity energy is bought in a fixed tariff according to the procedure and conditions estimated by the Government.

2. Generation of electricity energy from renewable energy sources is promoted by public service obligations supply procedure, estimated by the Government, by covering for the producer a diference between fixed tariff and the price of selled electricity energy according the procedure estimated in Electricity trading rules. The price must be no less than the last month's average price which is established in a procedure estimated by the National Control Commission for Prices and Energy. This part of Article is not applicable to power plant with and installed capacity no higher than 30 kW and whose generated electricity energy is bought in a fixed tariff according to the procedure estimated by the Government.
3. Fixed tariffs are estimated and promotion quotes, in compliance with tasks, estimated in Article 13(3), are distributed by auction. Promotion quotes and regions of auctions are estimated and certified by the Government in terms, estimated by the National Control Commission for Prices and Energy, which cannot be any longer than 180 calendar days after the submission of producer's request to organize an auction for a concrete group in an estimated region. Every producer, who has signed a letter of intent mentioned in Article 14(1) and who has submitted a security of his obligations, mentioned in Article 14(13), shall have the right to participate in an auction. The National Control Commission estimates highest possible fixed tariff for Prices and Energy for every calendar year. The winner of an auction is a participant who has indicated the lowest tariff. If two or more participants offer the same tariff, the winner is a participant who has offered to construct power plants' park with a higher capacity after evaluating the fact, that in a single auction zone the highest installed capacity of power plants' park can not exceed 40 per cent of maximum permitted capacity of generating sources. If the offers concerning the capacity of power plants' park also coincides, the promotion quote in a connection point is distributed in proportion with the offered capacity for each participant.
4. Fixed tariff for power plant with installed capacity no higher than 30kW and the highest size of a fixed tariff for participants in auction for every calendar year is estimated by the National Control Commission for Prices and Energy in a matter with fixed tariffs' estimation principles, mentioned in this Law.
5. The National Control Commission for Prices and Energy certifies the methodic of fixed tariffs for power plant with installed capacity no higher than 30 kW and the methodic of fixed tariffs for producers who are participating in auctions of highest fixed tariffs and estimates the tariffs for every group of producers. This is the reason why despite the other measurement estimated by the National Control Commission for Prices and Energy, there also must be evaluated:

1) Average comparative investments to the connection of power plants to electricity networks and installation of them;

2) Average comparative yearly amounts of electricity energy generated in power plants and supplied to electricity network per one unit of capacity installed in a power plant;

3) Physical period of validity of power plant;

4) Period of the beginning of power plant's maintenance and the distribution of investments during this period;

5) Prognosis of inconstant expenses of power plant's maintenance, the change of them during the physical period of validity of power plant and a fixed tariff estimated for a producer;

6) Period of applicability of fixed tariffs, estimated in this Law;

7) Average yearly capital expenses per one unit of capacity installed in power plant, that are counted according to the necessary investments per one unit of capacity installed in power plant and a discount rate;

8) Discount rate;

9) Ratio of project's owned and borrowed financing;

10) Producer's own financing change;

11) Interests for loans required by banks;

12) Prognosis of other benefits directly associated with the activity of power plant during the period of physical validity of power plant;

13) Ratio of installed electricity and heat for power plants, that uses hard natural gas;

14) Expenses to balance the generation of electricity if such expenses are estimated.

6. Fixed tariffs are estimated according to various technologies of electricity generation from renewable energy sources, data of meteorology and the location of power plant in the state's territory, in compliance with the transparent and non-discriminative principles.
7. Every year the National Control Commission for Prices and Energy evaluates the enlargement of electricity generation from various renewable energy sources, in accordance with the de facto amount of electricity generated in the last calendar year, total installed capacity of active power plant's and the total capacity planned to install in power plant that are still in construction. Fixed tariffs for power plant with installed capacity no higher than 30 kW are reviewed while taking into account the promotion of generation of electricity from renewable energy sources and the compliance of this promotion to the tasks and aims estimated in national renewable

energy action plan. Reviewed fixed tariffs are implied to producers whose power plant was authorized after the day of the change of these tariffs.

8. Permanent promotional measures estimated in this Article are applicable for a period of 12 moths since the day of authorization. If the authorization to expand the generation from renewable energy sources is issued until the day of the valuation of this Law, Article 20(3) is not applicable to the producer and the highest tariff estimated by the National Control Commission for Prices and Energy is applicable instead for a period of 12 years.
9. Fixed tariff is applicable to electricity energy generated from renewable energy sources that has a guarantee granted in a procedure estimated in legal acts.
10. Power plants, which use renewable energy sources and a promotion scheme or separate promotion measurements are not applicable to them, can be constructed in accordance with the common requirements estimated in legal acts. Height of installed capacities estimated in Article 13(3) and (or) highest electricity generation promotion quote do not restrict the construction and (or) maintenance of such power plant. Electricity, generated in power plant not applicable to promotional measurements, is traded in procedure and ways estimated in Trading electricity rules.
11. Electricity generated in power plant with installed capacity no higher than 30 kW and which use renewable energy sources and surplus generated electricity, which is left after the used electricity for own needs mandatory is bought - in in a fixed estimated tariff and in a procedure and conditions estimated by the Government.
12. The Government estimates procedure and conditions of the promotional measurements for use of renewable energy sources, mentioned in Article 3(2).
13. Grid operator who is aiming to evaluate total generated and consumed energy from renewable energy sources, shall manage the accounting of generated electricity and the accounting of electricity, which was generated and consumed by producers for their needs.
14. This Article is not applicable to producers who used the promotional scheme estimated in this chapter to gain equipment after the validation of this Law.

**Article 21. Power plant' connection to the grid costs' distribution**

1. Power plants’ connection to the grid is a public service obligation.
2. Costs, related with the power plants’ connection to the grid, are distributed between the producer and the grid operator in accordance with the margins of the ownership right of electricity network.
3. Except the power plants with installed capacity no higher than 30 kW, that are connected to the electricity network for free, producer shall pay the costs of power plants’ connection to the electricity network in a procedure estimated by the Government or its assigned institution:
   1) 40 per cent of connection costs of power plants with installed capacity higher than 350 kW;

2) 20 per cent of connection costs of power plants with installed capacity higher that 30 kW but no higher than 350 kW.

4. Connection price of a power plant is equal to price of performed work of contractor who won the public procurement concerning the connection announced by the grid operator.
5. Provisions of Article 21(3) are not applicable when the producer accomplishes the connection work by himself according to the procedure estimated in legal acts.
6. If the grid operator selects another technically and economically proper connection point according to Article 14(5) and this is the reason of the increase of connection expenses, they must be covered by the operator.
7. If the grid operator selects a connection point from several technologically equal alternatives as estimated in Article 14(6) and this connection point appears to be less economically favorable, the grid operator must cover all the reasonable expenses that appeared because of the selection.
8. The producer compensates no more than 10 per cent of grid operator's expenses concerning electricity network, including expenses of acquisition of equipment and objects necessary to maintain electricity network, expenses of optimization, expansion and (or) reconstruction of it in order to secure safe and reliable admission, transmission and distribution of electricity generated from renewable energy sources, as estimated in Article 18 of this Law. Coverage and division of expenses provided in this Article is estimated by the grid operator in coordination with the National Control Commission for Prices and Energy in the procedure of Accession of electricity network that is published publicly, as estimated in Article 14(7). Restriction of the expenses that are experienced by producer is not applicable when the promotion scheme or its separate measures are not used for a power plant's connection to the grid.
9. Additional expenses provided in Article 21(7) and expenses that are provided in Article 21(8) and that are experienced by grid operator during the optimization, expansion and (or) reconstruction of electricity network, are considered as public interest obligation in a part which is necessary for the security of promotion of renewable energy sources and is certified by the National Control Commission for Prices and Energy.

**Article 22. Generation of electricity from renewable energy sources in the territorial sea of the Republic of Lithuania, in exclusive economic zone in the Baltic Sea of the Republic of Lithuania and in the coast line of the Republic of Lithuania**

1. Government or its assigned institution certifies necessary legal acts regulating the construction of power plants and the maintenance of them in the territorial sea of the Republic of Lithuania, in exclusive economic zone in the Baltic Sea of the Republic of Lithuania and in the coast line.

2. Territorial sea of the Republic of Lithuania, exclusive economic zone in the Baltic Sea of the Republic of Lithuania and (or) the coast line shall be accessed for the construction or maintenance of power plants only with an authorization granted by Government or its assigned institution.
3. An authorization to access territorial sea of the Republic of Lithuania, exclusive economic zone in the Baltic Sea of the Republic of Lithuania and (or) the coast line for the construction or maintenance of power plants is granted in a tender. The tender can be initiated by any person who is consistent with the requirements of qualification estimated by the Government or its assigned institution by submitting an application to institution that grants authorizations. Tender must be organized by the Government or its assigned institution during the period of three months.
4. Tender, estimated in Part 3 of this Article is organized for the water area that has a prepared power plant's construction in territorial sea of the Republic of Lithuania, exclusive economic zone in the Baltic Sea of the Republic of Lithuania and (or) the coast line scheme and where has been accomplished an strategic impact assesment of the proposed economic activity for the water area and (or) for the water area to which the impact of power plant's evaluation was accomplished and in its technical documents of its parts is estimated the expansion of infrastructure.
5. The scheme provided in Part 4 of this Article has to be prepared and certified no later than until January 1, 2013 by the Government or its assigned institution. Strategic impact assesment of the proposed economic activity has to be performed according to the procedure estimated by the Government.
6. Regulations of the tender provided in Part 3 of this Article shall be prepared and the tender shall be organized by the Government or its assigned institution. The winner of a tender is estimated in correction with the principles of objectivity, clarity and nondiscrimination, in accordance with the reliability of the producer, his preparation to accomplish such a project and the commitments that a producer takes.
7. After the granting of authorization to access territorial sea of the Republic of Lithuania, exclusive economic zone in the Baltic Sea of the Republic of Lithuania and (or) the coast line for construction and maintenance of a power plant, a producer gains an exceptional right for a period no longer than 4 years to accomplish a research which is necessary to make a decision concerning the construction of a power plant. If an authorization is not granted during the estimated period in a procedure provided in legal acts or if a producer submits a report concerning his refusal to construct a power plant, the authorization to access territorial sea of the Republic of Lithuania, exclusive economic zone in the Baltic Sea of the Republic of Lithuania and (or) the coast line for construction or maintenance can be repealed. All the results and data of the research, accomplished by the producer, shall be published publicly.

**CHAPTER FOUR**

## PROMOTION, PLANNING, EXPANSION AND ACCESSION OF HEAT AND COOLNESS ENERGY GENERATION FROM RENEWABLE ENERGY SOURCES

### Article 23. Planning of the expansion of heat and coolness energy generating capacity from renewable energy sources

1. The expansion of heat and coolness energy generating from renewable energy sources is one of the country's strategic aims. The expansion of equipment of renewable energy sources' heat and coolness energy is promoted and supported according to the procedure estimated in this Law and other legal acts.
2. Heat energy supply is organized according to specialized plans of heat economy, that are prepared in compliance with national planned rates estimated in Article 55(2) and presumptions of promotion of heat and coolness energy generating capacity from renewable energy sources. Decisions regarding the expansion of heat and coolness energy generating capacity shall be made by municipality council in compliance with the regulations estimated in the specialized plan of heat economy.
3. Municipalities during the planning of towns' and (or) regions' infrastructure expansion, renewal (modernization) of buildings, heat or coolness energy supply to public and private objects, shall evaluate the opportunities to generate heat and coolness energy form renewable energy sources.

### Article 24. Connection of heat equipment of energy from renewable energy sources

1. Heat supplier must connect all the heat equipment of energy from renewable energy sources of independent heat producers to the heat transmission network, when the generated heat energy of connected equipment changes the heat energy generated from fossil fuel. Independent heat producer must secure that the heat energy, that he is supplying, complies with the requirements of quality, reliability of supply and environmental friendliness, estimated in legal acts. The conditions and procedure of renewable energy sources heat equipment's connection are estimated by an institution assigned by the Government.
2. Heat equipment of energy from renewable energy sources is connected to the heat transmission network in a connection point that is technically suitable and is the closest to the equipment, if there are no technologically more suitable connection points. Equipment's connection point is selected

by a supplier according to the request of an independent producer in compliance with the technological, economic and nondiscriminatory connection point's selection principles.

**Article 25. Buying up of heat energy generated from renewable energy sources**

1. Heat suppliers buy up with a priority right the heat from independent heat producers, that is generated from renewable energy sources in a procedure estimated in Law on Heat Sector of the Republic of Lithuania.
2. Heat supplier must buy up all the cheaper heat energy generated from renewable energy sources from independent heat producers whose heat generating facilities are connected to heat transfer networks except the cases when the amount of independent producers' generated heat exceeds the need of the consumers of heat system.
3. When, in a case mentioned in Part 2 of this Article, heat from renewable energy sources or residual energy are generated by several independent producers, the priority right goes to the producer who sells the heat energy in a lower price.
4. Heat energy, generated from renewable energy sources, shall be bought up and sold by the heat supplier from independent heat producers whose heat facilities are connected to heat transfer network, to all heat consumers.
5. Complaints because of the regulations of this Article and Article 24 between the heat supplier and an independent producer of heat energy from renewable energy sources are examined by the National Control Commission for Prices and Energy according to the pre – court complaint examination procedure.

**Article 26. Promotion of the use of heat pumps**

Investments to heat pumps according to the requirements estimated in Article 47(3) of this Law and investments necessary to install these pumps are promoted by the procedure estimated in the Chapter 8 of this Law. In a case of use of this kind of support, an opportunity to use the promotional measure, estimated in Article 11(3), is deprived.

**Article 27. Accession of industrial and municipal wastes that are suitable for generation of electricity**

1. Technological, environmental requirements and quality standards of industrial and municipal wastes' biologically separable parts suitable for use of electricity generation is estimated by Government or an institution assigned by the Government.
2. Planning, granting of authorizations, procedure of construction and maintenance of energetic objects that use the biologically separable parts of

industrial and municipal wastes suitable for electricity generation is estimated by the Government or its assigned institution under their competence and in accordance with common requirements concerning the granting of authorizations to act in energy sector, construction, territory planning, impact assesment of the proposed economic activity and environmental requirements as estimated in Law and other legal acts.

## CHAPTER NINE

## REQUIREMENTS APPLICABLE TO PRODUCERS OF ENERGY FROM RENEWABLE ENERGY SOURCES

### Article 44. Licensing, authorization and certification

1. Licenses, authorizations and certificates for activity of energy of renewable energy sources are estimated by this Law, Law on Energy, Law on Electricity, Law on Heat Sector, Natural Gas Law and other laws regulating the energy sector. The type of licensed activity, the granting of authorizations, the suspension of validity of an authorization, the cancelation of suspension and the cancelation of validity is estimated by other Energy, Electricity, Heat Sector, Natural Gas and other laws on energy sector. Some requirements of restrictions concerning legal form and (or) other restrictions concerning the freedom of establishment are applicable to persons aiming to get a license, an authorization or a certificate, that are estimated by Energy, Electricity, Heat Sector, Natural Gas and other laws on energy sector, but only if the restrictions are reasonable because of the public interest and is in compliance with the principles of necessity and proportionality. Granted licenses, authorizations and certificates can be changed by an initiative of the granting institution when the conditions of licensed activity estimated in Law on Energy, Law on Electricity, Law on Heat Sector, Natural Gas Law and other laws on energy sector change.
2. Activity of energy from renewable energy sources is forbidden without the license, authorization or a certificate if they are necessary. It is forbidden to precede the activity after the suspension of license's, authorization's or certification's validity.

# Annex 4: Discounted Cash Flow Analysis – summary of calculations

| Sensitivity analysis | | | |
|---|---|---|---|
| Change, % | Heat price | Electricity price | Biofuel price |
| -30% | 146.231.730 | 68.099.630 | 69.160.976 |
| -20% | 167.121.977 | 77.828.148 | 79.041.115 |
| -10% | 188.012.224 | 87.556.667 | 88.921.255 |
| 0% | 208.902.471 | 97.285.185 | 98.801.394 |
| 10% | 229.792.718 | 107.013.704 | 108.681.534 |
| 20% | 250.682.965 | 116.742.222 | 118.561.673 |
| 30% | 271.573.213 | 143.043.273 | 128.441.812 |

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Biofuel pricing index** | | | | | | | | | | | |
| Period | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| Biofuel price index | 1,00% | 1,02% | 1,04% | 1,06% | 1,08% | 1,10% | 1,13% | 1,15% | 1,17% | 1,20% | 1,22% |
| **Indexes for income and costs** | | | | | | | | | | | |
| Income index | 3,30% | 3,80% | 4,36% | 5,02% | 5,77% | 6,64% | 7,63% | 8,78% | 10,09% | 11,61% | 11,90% |
| Price recalculation index | 1,00 | 1,04 | 1,08 | 1,14 | 1,20 | 1,28 | 1,38 | 1,50 | 1,65 | 1,85 | 2,07 |
| Cost index | 2,00% | 2,40% | 2,88% | 3,17% | 3,80% | 4,18% | 5,02% | 5,52% | 6,62% | 7,29% | 7,47% |
| Cost recalculation index | 1,00 | 1,02 | 1,05 | 1,09 | 1,13 | 1,18 | 1,23 | 1,30 | 1,39 | 1,49 | 1,60 |

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Biofuel pricing index** | | | | | | | | | | | |
| Period | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** |
| Biofuel price index | 1,24% | 1,27% | 1,29% | 1,32% | 1,35% | 1,37% | 1,40% | 1,43% | 1,46% | 1,49% | 1,52% |
| **Indexes for income and costs** | | | | | | | | | | | |
| Income index | 12,20% | 12,51% | 12,83% | 13,16% | 13,50% | 13,84% | 14,19% | 14,55% | 14,93% | 15,31% | 15,70% |
| Price recalculation index | 2,32 | 2,61 | 2,94 | 3,33 | 3,78 | 4,30 | 4,91 | 5,63 | 6,47 | 7,46 | 8,63 |
| Cost index | 7,66% | 7,85% | 8,04% | 8,24% | 8,45% | 8,66% | 8,88% | 9,10% | 9,33% | 9,56% | 9,80% |
| Cost recalculation index | 1,72 | 1,86 | 2,01 | 2,17 | 2,36 | 2,56 | 2,79 | 3,04 | 3,33 | 3,65 | 4,00 |

TABLE 22b: Cash flow, EUR (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Net profit | 8.932.097 | 8.328.927 | 8.368.036 | 8.408.144 | 8.449.279 | 7.802.968 | 7.842.726 | 7.883.501 | 7.925.319 | 9.934.469 | 11.890.954 |
| Deprecation | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 2.250.000 | 0 |
| Working capital | -641 | -17.783 | -705 | -723 | -742 | -760 | -780 | -800 | -820 | -841 | -862 |
| **Cash flow from Company's activity** | **13.494.705** | **12.874.395** | **12.930.580** | **12.970.671** | **13.011.787** | **12.365.458** | **12.405.196** | **12.445.951** | **12.487.749** | **12.183.628** | **11.890.092** |
| **Cash flow from investment activity** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Δ Long-term receivables** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Δ Long-term liabilities** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Δ Capital** | | | | | | | | | | | |
| **Δ EU funding** | | | | | | | | | | | |
| **Net cash flow** | **13.494.705** | **12.874.395** | **12.930.580** | **12.970.671** | **13.011.787** | **12.365.458** | **12.405.196** | **12.445.951** | **12.487.749** | **12.183.628** | **11.890.092** |
| **Accumulated cash flow** | **150.578.097** | **163.452.492** | **176.383.072** | **189.353.743** | **202.365.530** | **214.730.988** | **227.136.184** | **239.582.136** | **252.069.885** | **264.253.513** | **276.143.605** |

TABLE 23b: Financial ratios (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Operating profit margin, % | 82,41% | 78,41% | 78,43% | 78,45% | 78,48% | 78,50% | 78,52% | 78,55% | 78,57% | 78,60% | 78,62% |
| Net profit margin, % | 51,76% | 48,13% | 48,22% | 48,32% | 48,41% | 44,57% | 44,66% | 44,75% | 44,84% | 56,02% | 66,83% |
| Current liquidity ratio | 1,16 | 1,31 | 1,45 | 1,60 | 1,75 | 1,88 | 2,02 | 2,16 | 2,30 | 2,44 | 2,57 |
| Quick liquidity ratio | 1,16 | 1,31 | 1,45 | 1,60 | 1,74 | 1,88 | 2,02 | 2,16 | 2,30 | 2,44 | 2,57 |
| ROA, % | 6,23% | 5,49% | 5,23% | 4,99% | 4,78% | 4,22% | 4,07% | 3,93% | 3,80% | 4,55% | 5,17% |
| ROE, % | 16,44% | 13,29% | 11,78% | 10,58% | 9,61% | 8,15% | 7,58% | 7,08% | 6,64% | 7,68% | 8,42% |
| Debt ratio | 0,621 | 0,587 | 0,556 | 0,528 | 0,503 | 0,482 | 0,462 | 0,444 | 0,427 | 0,408 | 0,387 |
| Debt service coverage ratio | | | | | | | | | | | |
| Shareholder Equity/Total Assets | 0,38 | 0,41 | 0,44 | 0,47 | 0,50 | 0,52 | 0,54 | 0,56 | 0,57 | 0,59 | 0,61 |
| Shareholder Equity/Total | 0,61 | 0,70 | 0,80 | 0,89 | 0,99 | 1,08 | 1,16 | 1,25 | 1,34 | 1,45 | 1,59 |

TABLE 24b: Discounted cash flow (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Period number | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Investments | | | | | | | | | | | |
| EBITDA | 14.219.571 | 13.567.496 | 13.609.775 | 13.653.136 | 13.697.605 | 13.743.213 | 13.789.987 | 13.837.957 | 13.887.155 | 13.937.611 | 13.989.357 |
| Discounted Cash flow | 13.542.448 | 12.921.425 | 12.961.690 | 13.002.986 | 13.045.338 | 13.088.774 | 13.133.321 | 13.179.007 | 13.225.861 | 13.273.915 | 13.323.197 |
| Accumulated Cash flow | 71.956.792 | 84.878.216 | 97.839.907 | 110.842.893 | 123.888.231 | 136.977.005 | 150.110.326 | 163.289.333 | 176.515.194 | 189.789.109 | 203.112.306 |

TABLE 22a: Cash flow, EUR (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Net profit | -47.313.250 | -52.794.275 | 15.490.360 | 15.914.606 | 16.366.989 | 16.868.736 | 16.099.394 | 12.806.021 | 7.605.110 | 8.137.584 | 8.525.184 |
| Deprecation | 2.313.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 | 4.563.250 |
| Working capital | 89.000.000 | 0 | -355.690 | -1.983 | -2.490 | -2.622 | -3.292 | 42.107 | 64.281 | -3.013 | -616 |
| **Cash flow from Company's activity** | **44.000.000** | **-48.231.025** | **19.697.920** | **20.475.873** | **20.927.749** | **21.429.364** | **20.659.352** | **17.411.378** | **12.232.642** | **12.697.821** | **13.087.818** |
| **Cash flow from investment activity** | **0** | **-45.000.000** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Δ Long-term receivables** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Δ Long-term liabilities** | **33.120.500** | **57.862.375** | **-36.894.507** | **-5.664.232** | **-5.947.444** | **-6.244.816** | **-6.557.057** | **-6.884.909** | **-7.229.155** | **-7.590.613** | **-7.970.143** |
| **Δ Capital** | **14.194.500** | **13.500.000** | | | | | | | | | |
| **Δ EU funding** | | | | | | | | | | | |
| **Net cash flow** | **91.315.000** | **-21.868.650** | **-17.196.587** | **14.811.641** | **14.980.305** | **15.184.548** | **14.102.295** | **10.526.469** | **5.003.487** | **5.107.209** | **5.117.675** |
| **Accumulated cash flow** | **91.315.000** | **69.446.350** | **52.249.763** | **67.061.404** | **82.041.710** | **97.226.258** | **111.328.553** | **121.855.022** | **126.858.509** | **131.965.717** | **137.083.392** |

TABLE 23a: Financial ratios (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Profitability ratios** | | | | | | | | | | | |
| Operating profit margin, % | n/a | n/a | 88,81% | 88,85% | 88,86% | 88,91% | 88,93% | 86,99% | 82,24% | 82,37% | 82,39% |
| Net profit margin, % | n/a | n/a | 59,74% | 61,00% | 62,28% | 63,67% | 60,20% | 56,00% | 44,92% | 47,41% | 49,54% |
| **Liquidity ratios** | | | | | | | | | | | |
| Current liquidity ratio | n/a | n/a | 0,06 | 0,23 | 0,39 | 0,56 | 0,72 | 0,84 | 0,90 | 0,95 | 1,01 |
| Quick liquidity ratio | n/a | n/a | 0,06 | 0,23 | 0,39 | 0,56 | 0,72 | 0,84 | 0,90 | 0,95 | 1,01 |
| **Return ratios** | | | | | | | | | | | |
| ROA, % | n/a | n/a | 17,98% | 16,51% | 15,32% | 14,36% | 12,68% | 9,63% | 5,71% | 6,08% | 6,34% |
| ROE, % | n/a | n/a | -27,21% | -38,81% | -66,42% | -217,04% | 193,34% | 60,60% | 26,46% | 22,07% | 18,78% |
| **Financial leverage ratios** | | | | | | | | | | | |
| Debt ratio | n/a | n/a | 1,661 | 1,425 | 1,231 | 1,066 | 0,934 | 0,841 | 0,784 | 0,724 | 0,662 |
| Debt service coverage ratio | n/a | n/a | 14.754 | 16.559 | 17.361 | 18.258 | 19.251 | 16.852 | 12.372 | | |
| Shareholder Equity/Total Assets | n/a | n/a | -0,66 | -0,43 | -0,23 | -0,07 | 0,07 | 0,16 | 0,22 | 0,28 | 0,34 |
| Shareholder Equity/Total | n/a | n/a | -0,40 | -0,30 | -0,19 | -0,06 | 0,07 | 0,19 | 0,27 | 0,38 | 0,51 |

TABLE 24a: Discounted cash flow (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Period number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Investments | | -14.194.500 | -13.500.000 | | | | | | | | |
| EBITDA | -45.000.000 | -45.000.000 | 23.027.753 | 23.182.274 | 23.351.446 | 23.555.820 | 23.779.594 | 19.891.338 | 13.924.486 | 14.138.676 | 14.178.172 |
| Discounted Cash flow | -42.857.143 | -56.375.714 | 9.074.051 | 22.078.357 | 22.239.472 | 22.434.115 | 22.647.233 | 18.944.131 | 13.261.416 | 13.465.405 | 13.503.021 |
| Accumulated Cash flow | -42.857.143 | -99.232.857 | -90.158.806 | -68.080.450 | -45.840.977 | -23.406.863 | -759.630 | 18.184.501 | 31.445.917 | 44.911.322 | 58.414.343 |

TABLE 25: Project's ratios (2012-2033)

| Project's ratios | |
|---|---|
| NPV, EUR | **203.112.306** |
| IRR, % | **15%** |
| Payback period, years | **7,1** |

TABLE 20b: P&L, EUR (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sales** | **17.255.446** | **17.303.300** | **17.352.374** | **17.402.700** | **17.454.309** | **17.507.234** | **17.561.508** | **17.617.167** | **17.674.245** | **17.732.778** | **17.792.804** |
| Heat | 11.796.096 | 11.828.810 | 11.862.358 | 11.896.761 | 11.932.042 | 11.968.222 | 12.005.325 | 12.043.374 | 12.082.393 | 12.122.407 | 12.163.442 |
| Electricity | 5.459.350 | 5.474.490 | 5.490.017 | 5.505.939 | 5.522.267 | 5.539.012 | 5.556.183 | 5.573.793 | 5.591.851 | 5.610.370 | 5.629.362 |
| **COGS** | **3.035.876** | **3.735.804** | **3.742.599** | **3.749.564** | **3.756.704** | **3.764.021** | **3.771.522** | **3.779.210** | **3.787.090** | **3.795.167** | **3.803.446** |
| Fixed production costs | 1.485.641 | 2.182.814 | 2.186.784 | 2.190.854 | 2.195.025 | 2.199.301 | 2.203.684 | 2.208.176 | 2.212.780 | 2.217.500 | 2.222.337 |
| Variable costs | 1.550.234 | 1.552.990 | 1.555.815 | 1.558.710 | 1.561.678 | 1.564.720 | 1.567.838 | 1.571.034 | 1.574.310 | 1.577.668 | 1.581.109 |
| Variable costs | 7.929.571 | 7.931.519 | 7.933.505 | 7.935.532 | 7.937.598 | 7.939.707 | 7.941.857 | 7.944.050 | 7.946.288 | 7.948.570 | 7.950.897 |
| **General profit** | **14.219.571** | **13.567.496** | **13.609.775** | **13.653.136** | **13.697.605** | **13.743.213** | **13.789.987** | **13.837.957** | **13.887.155** | **13.937.611** | **13.989.357** |
| **Operating costs** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **EBITDA** | **14.219.571** | **13.567.496** | **13.609.775** | **13.653.136** | **13.697.605** | **13.743.213** | **13.789.987** | **13.837.957** | **13.887.155** | **13.937.611** | **13.989.357** |
| **Deprecation** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **2.250.000** | **0** |
| **EBIT** | **9.656.321** | **9.004.246** | **9.046.525** | **9.089.886** | **9.134.355** | **9.179.963** | **9.226.737** | **9.274.707** | **9.323.905** | **11.687.611** | **13.989.357** |
| **Financial and investment activity** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Interest costs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **EBT** | **9.656.321** | **9.004.246** | **9.046.525** | **9.089.886** | **9.134.355** | **9.179.963** | **9.226.737** | **9.274.707** | **9.323.905** | **11.687.611** | **13.989.357** |
| **Corporate Tax (FEZ assumptions)** | **724.224** | **675.318** | **678.489** | **681.741** | **685.077** | **1.376.994** | **1.384.010** | **1.391.206** | **1.398.586** | **1.753.142** | **2.098.404** |
| **Net profit** | **8.932.097** | **8.328.927** | **8.368.036** | **8.408.144** | **8.449.279** | **7.802.968** | **7.842.726** | **7.883.501** | **7.925.319** | **9.934.469** | **11.890.954** |

TABLE 21b: Balance sheet, EUR (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash and liquid assets | 103.263.097 | 116.137.492 | 129.068.072 | 142.038.743 | 155.050.530 | 167.415.988 | 179.821.184 | 192.267.136 | 204.754.885 | 216.938.513 | 228.828.605 |
| Inventories | 74.857 | 92.116 | 92.283 | 92.455 | 92.631 | 92.811 | 92.996 | 93.186 | 93.380 | 93.579 | 93.784 |
| Receivables | 189.101 | 189.625 | 190.163 | 190.715 | 191.280 | 191.860 | 192.455 | 193.065 | 193.690 | 194.332 | 194.990 |
| **Current assets** | **103.527.055** | **116.419.233** | **129.350.518** | **142.321.913** | **155.334.441** | **167.700.659** | **180.106.635** | **192.553.386** | **205.041.955** | **217.226.424** | **229.117.378** |
| Value of fixed assets | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 |
| New fixed assets | | | | | | | | | | | |
| Accumulated depreaction | 52.509.000 | 57.072.250 | 61.635.500 | 66.198.750 | 70.762.000 | 75.325.250 | 79.888.500 | 84.451.750 | 89.015.000 | 91.265.000 | 91.265.000 |
| **Residual value of fixed assets** | **39.806.000** | **35.242.750** | **30.679.500** | **26.116.250** | **21.553.000** | **16.989.750** | **12.426.500** | **7.863.250** | **3.300.000** | **1.050.000** | **1.050.000** |
| **Receivables** | | | | | | | | | | | |
| **Total assets** | **143.333.055** | **151.661.983** | **160.030.018** | **168.438.163** | **176.887.441** | **184.690.409** | **192.533.135** | **200.416.636** | **208.341.955** | **218.276.424** | **230.167.378** |
| Shareholder equity and reserves | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 |
| Current period profit (losses) | 26.638.555 | 34.967.483 | 43.335.518 | 51.743.663 | 60.192.941 | 67.995.909 | 75.838.635 | 83.722.136 | 91.647.455 | 101.581.924 | 113.472.878 |
| **Total shareholder equity** | **54.333.055** | **62.661.983** | **71.030.018** | **79.438.163** | **87.887.441** | **95.690.409** | **103.533.135** | **111.416.636** | **119.341.955** | **129.276.424** | **141.167.378** |
| **Subsidies** | | | | | | | | | | | |
| **Long-term liabilities** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Short-term liabilities** | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 |
| **Total equity and liabilities** | **143.333.055** | **151.661.983** | **160.030.018** | **168.438.163** | **176.887.441** | **184.690.409** | **192.533.135** | **200.416.636** | **208.341.955** | **218.276.424** | **230.167.378** |
| **Control** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

TABLE 20a: P&L, EUR (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sales** | **0** | **0** | **25.928.969** | **26.091.612** | **26.278.651** | **26.493.746** | **26.741.105** | **22.867.000** | **16.931.281** | **17.164.149** | **17.208.782** |
| Heat | 0 | 0 | 14.961.858 | 15.055.708 | 15.163.636 | 15.287.753 | 15.430.487 | 11.436.063 | 11.574.491 | 11.733.684 | 11.764.196 |
| Electricity | 0 | 0 | 10.967.111 | 11.035.904 | 11.115.015 | 11.205.993 | 11.310.618 | 11.430.937 | 5.356.789 | 5.430.465 | 5.444.587 |
| **COGS** | **0** | **0** | **2.901.216** | **2.909.338** | **2.927.205** | **2.937.926** | **2.961.511** | **2.975.662** | **3.006.794** | **3.025.474** | **3.030.610** |
| Fixed production costs | 0 | 0 | 1.419.744 | 1.423.718 | 1.432.462 | 1.437.708 | 1.449.250 | 1.456.175 | 1.471.410 | 1.480.551 | 1.483.065 |
| Variable costs | 0 | 0 | 1.481.472 | 1.485.619 | 1.494.743 | 1.500.217 | 1.512.261 | 1.519.487 | 1.535.384 | 1.544.923 | 1.547.546 |
| Biofuel costs, EUR | 0 | 0 | 7.913.674 | 7.915.303 | 7.916.966 | 7.918.661 | 7.920.391 | 7.922.155 | 7.923.954 | 7.925.789 | 7.927.661 |
| **General profit** | **0** | **0** | **23.027.753** | **23.182.274** | **23.351.446** | **23.555.820** | **23.779.594** | **19.891.338** | **13.924.486** | **14.138.676** | **14.178.172** |
| **Operating costs** | **45.000.000** | **45.000.000** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **EBITDA** | **-45.000.000** | **-45.000.000** | **23.027.753** | **23.182.274** | **23.351.446** | **23.555.820** | **23.779.594** | **19.891.338** | **13.924.486** | **14.138.676** | **14.178.172** |
| **Deprecation** | **2.313.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** |
| **EBIT** | **-47.313.250** | **-49.563.250** | **18.464.503** | **18.619.024** | **18.788.196** | **18.992.570** | **19.216.344** | **15.328.088** | **9.361.236** | **9.575.426** | **9.614.922** |
| **Financial and investment activity** | **0** | **3.231.025** | **2.974.144** | **2.704.418** | **2.421.207** | **2.123.835** | **1.811.594** | **1.483.741** | **1.139.496** | **778.038** | **398.507** |
| Interest costs | 0 | 3.231.025 | 2.974.144 | 2.704.418 | 2.421.207 | 2.123.835 | 1.811.594 | 1.483.741 | 1.139.496 | 778.038 | 398.507 |
| **EBT** | **-47.313.250** | **-52.794.275** | **15.490.360** | **15.914.606** | **16.366.989** | **16.868.736** | **17.404.750** | **13.844.347** | **8.221.741** | **8.797.388** | **9.216.415** |
| **Corporate Tax (FEZ assumptions)** | **0** | **0** | **0** | **0** | **0** | **0** | **1.305.356** | **1.038.326** | **616.631** | **659.804** | **691.231** |
| **Net profit** | **-47.313.250** | **-52.794.275** | **15.490.360** | **15.914.606** | **16.366.989** | **16.868.736** | **16.099.394** | **12.806.021** | **7.605.110** | **8.137.584** | **8.525.184** |

TABLE 21a: Balance sheet, EUR (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash and liquid assets | 44.000.000 | 22.131.350 | 4.934.763 | 19.746.404 | 34.726.710 | 49.911.258 | 64.013.553 | 74.540.022 | 79.543.509 | 84.650.717 | 89.768.392 |
| Inventories | 0 | 0 | 71.537 | 71.737 | 72.178 | 72.442 | 73.024 | 73.372 | 74.140 | 74.601 | 74.727 |
| Receivables | 0 | 0 | 284.153 | 285.935 | 287.985 | 290.342 | 293.053 | 250.597 | 185.548 | 188.100 | 188.589 |
| **Current assets** | **44.000.000** | **22.131.350** | **5.290.453** | **20.104.077** | **35.086.872** | **50.274.042** | **64.379.630** | **74.863.992** | **79.803.197** | **84.913.418** | **90.031.709** |
| Value of fixed assets | 47.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 |
| New fixed assets | 47.315.000 | 45.000.000 | | | | | | | | | |
| Accumulated depreaction | 2.313.250 | 6.876.500 | 11.439.750 | 16.003.000 | 20.566.250 | 25.129.500 | 29.692.750 | 34.256.000 | 38.819.250 | 43.382.500 | 47.945.750 |
| **Residual value of fixed assets** | **45.001.750** | **85.438.500** | **80.875.250** | **76.312.000** | **71.748.750** | **67.185.500** | **62.622.250** | **58.059.000** | **53.495.750** | **48.932.500** | **44.369.250** |
| **Receivables** | | | | | | | | | | | |
| **Total assets** | **89.001.750** | **107.569.850** | **86.165.703** | **96.416.077** | **106.835.622** | **117.459.542** | **127.001.880** | **132.922.992** | **133.298.947** | **133.845.918** | **134.400.959** |
| Shareholder equity and reserves | 14.194.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 | 27.694.500 |
| Current period profit (losses) | -47.313.250 | -100.107.525 | -84.617.165 | -68.702.559 | -52.335.570 | -35.466.834 | -19.367.440 | -6.561.419 | 1.043.691 | 9.181.275 | 17.706.459 |
| **Total shareholder equity** | **-33.118.750** | **-72.413.025** | **-56.922.665** | **-41.008.059** | **-24.641.070** | **-7.772.334** | **8.327.060** | **21.133.081** | **28.738.191** | **36.875.775** | **45.400.959** |
| **Subsidies** | | | | | | | | | | | |
| **Long-term liabilities** | 33.120.500 | 90.982.875 | 54.088.368 | 48.424.136 | 42.476.692 | 36.231.877 | 29.674.820 | 22.789.911 | 15.560.756 | 7.970.143 | 0 |
| **Short-term liabilities** | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 | 89.000.000 |
| **Total equity and liabilities** | **89.001.750** | **107.569.850** | **86.165.703** | **96.416.077** | **106.835.622** | **117.459.542** | **127.001.880** | **132.922.992** | **133.298.947** | **133.845.918** | **134.400.959** |
| Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 18a: BIOFUEL COSTS (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel capacity, MW | 0 | 0 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 |
| Operating hours | 0 | 0 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 |
| Load factor CHP | 0 | 0 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Calculated fuel capacity, MWh | 0 | 0 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 |
| NCV, MWh/ton | 0 | 0 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 |
| Biomass needed, ton | 0 | 0 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 |
| Fuel price, EUR/t | 0 | 0 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 |
| Biofuel costs, EUR | 0 | 0 | 7.913.674 | 7.915.303 | 7.916.966 | 7.918.661 | 7.920.391 | 7.922.155 | 7.923.954 | 7.925.789 | 7.927.661 |
| NPV, EUR | 0 | 0 | 7.536.832 | 7.538.384 | 7.539.967 | 7.541.582 | 7.543.229 | 7.544.909 | 7.546.623 | 7.548.371 | 7.550.154 |

TABLE 18b: BIOFUEL COSTS (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel capacity, MW | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 |
| Operating hours | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 |
| Load factor CHP | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Calculated fuel capacity, MWh | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 | 532.500 |
| NCV, MWh/ton | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 | 2,4 |
| Biomass needed, ton | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 | 221.875 |
| Fuel price, EUR/t | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 | 35,3 |
| Biofuel costs, EUR | 7.929.571 | 7.931.519 | 7.933.505 | 7.935.532 | 7.937.598 | 7.939.707 | 7.941.857 | 7.944.050 | 7.946.288 | 7.948.570 | 7.950.897 |
| NPV, EUR | 7.551.972 | 7.553.827 | 7.555.719 | 7.557.649 | 7.559.618 | 7.561.625 | 7.563.673 | 7.565.762 | 7.567.893 | 7.570.066 | 7.572.283 |

TABLE 19: NPV (2012-2033)

| NPV, (2012-2033) | Value |
|---|---|
| NPV (Total), EUR | 98.801.394 |

TABLE 13: INVESTMENTS BY CATEGORY (2012-2013)

| Investment split by year, EUR | 2012 | 2013 | Total |
|---|---|---|---|
| Land | 1.050.000 | | 1.050.000 |
| Buildings | 1.265.000 | | 1.265.000 |
| Turn key project | 45.000.000 | 45.000.000 | 90.000.000 |
| Total | 47.315.000 | 45.000.000 | 92.315.000 |

TABLE 14: FUNDING STRUCTURE, % (2012-2013)

| Split by funding source, % | 2012 | 2013 |
|---|---|---|
| Equity | 30% | 30% |
| Bank loan | 70% | 70% |

TABLE 15: FUNDING STRUCTURE, EUR(2012-2013)

| Split by funding source, EUR | 2012 | 2013 | Total |
|---|---|---|---|
| Equity | 14.194.500 | 13.500.000 | 27.694.500 |
| Bank loan | 33.120.500 | 31.500.000 | 64.620.500 |
| Total | 47.315.000 | 45.000.000 | 92.315.000 |

TABLE 16: REPAYMENT CALCULATIONS

| Loan | |
|---|---|
| Loan, EUR | 64.620.500 |
| Term, years | 10 |
| Annual interest rate, % | 5,00% |
| $a_{n;i}$ | 7,72 |
| Annual payment, EUR | 8.368.650 |

TABLE 17: INTEREST COSTS CALCULATIONS (2013-2022)

| Loan | Total | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual payment, EUR | 58.580.553 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 | 8.368.650 |
| Interests, EUR | 16.749.963 | 3.231.025 | 2.974.144 | 2.704.418 | 2.421.207 | 2.123.835 | 1.811.594 | 1.483.741 | 1.139.496 | 778.038 | 398.507 |
| Repayment, EUR | 41.830.589 | 5.137.625 | 5.394.507 | 5.664.232 | 5.947.444 | 6.244.816 | 6.557.057 | 6.884.909 | 7.229.155 | 7.590.613 | 7.970.143 |
| Residual value, EUR | | 59.482.875 | 54.088.368 | 48.424.136 | 42.476.692 | 36.231.877 | 29.674.820 | 22.789.911 | 15.560.756 | 7.970.143 | 0 |

TABLE 11a: OPERATION AND MAINTENANCE COSTS (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fixed production costs** | | | | | | | | | | | |
| Value of fixed costs/MW/EUR | 0 | 0 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 |
| Capacity, MW | 0 | 0 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Fixed production costs, EUR | 0 | 0 | 1.419.744 | 1.423.718 | 1.432.462 | 1.437.708 | 1.449.250 | 1.456.175 | 1.471.410 | 1.480.551 | 1.483.065 |
| **Variable production costs** | | | | | | | | | | | |
| Value of variable costs/MWh/EUR | 0 | 0 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 |
| Operating hours | 0 | 0 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 |
| Capacity, MW | 0 | 0 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Variable costs, EUR | 0 | 0 | 1.481.472 | 1.485.619 | 1.494.743 | 1.500.217 | 1.512.261 | 1.519.487 | 1.535.384 | 1.544.923 | 1.547.546 |
| **Total production costs** | | | | | | | | | | | |
| Total costs, EUR | 0 | 0 | 2.901.216 | 2.909.338 | 2.927.205 | 2.937.926 | 2.961.511 | 2.975.662 | 3.006.794 | 3.025.474 | 3.030.610 |
| NPV (Annual), EUR | 0 | 0 | 1.410.926 | 1.414.875 | 1.423.565 | 1.428.778 | 1.440.248 | 1.447.130 | 1.462.271 | 1.471.355 | 1.473.853 |

TABLE 11b: OPERATION AND MAINTENANCE COSTS (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fixed production costs** | | | | | | | | | | | |
| Value of fixed costs/MW/EUR | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 | 23.000 |
| Capacity, MW | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| **Fixed production costs, EUR** | **1.485.641** | **2.182.814** | **2.186.784** | **2.190.854** | **2.195.025** | **2.199.301** | **2.203.684** | **2.208.176** | **2.212.780** | **2.217.500** | **2.222.337** |
| **Variable production costs** | | | | | | | | | | | |
| Value of variable costs/MWh/EUR | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 |
| Operating hours | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 | 7.500 |
| Capacity, MW | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| **Variable costs, EUR** | **1.550.234** | **1.552.990** | **1.555.815** | **1.558.710** | **1.561.678** | **1.564.720** | **1.567.838** | **1.571.034** | **1.574.310** | **1.577.668** | **1.581.109** |
| **Total production costs** | | | | | | | | | | | |
| Total costs, EUR | 3.035.876 | 3.743.368 | 3.750.163 | 3.757.128 | 3.764.267 | 3.771.584 | 3.779.085 | 3.786.773 | 3.794.653 | 3.802.730 | 3.811.010 |
| NPV (Annual), EUR | 1.476.414 | 1.479.038 | 1.481.729 | 1.484.486 | 1.487.313 | 1.490.210 | 1.493.179 | 1.496.223 | 1.499.343 | 1.502.541 | 1.505.818 |

TABLE 12: NPV (2012-2033)

| NPV, (2012-2033) | Value |
|---|---|
| NPV (Total), EUR | 40.776.594 |

TABLE 10a: TOTAL SALES OF HEAT AND ELECTRICITY (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total, EUR | 0 | 0 | 30.264.508 | 30.454.346 | 30.672.659 | 30.923.720 | 31.212.439 | 26.180.859 | 20.285.253 | 20.564.251 | 20.617.726 |
| **NPV (Annual), EUR** | **0** | **0** | **28.823.341** | **29.004.139** | **29.212.056** | **29.451.162** | **29.726.133** | **24.934.151** | **19.319.288** | **19.585.001** | **19.635.929** |

TABLE 10b: TOTAL SALES OF HEATING AND ELECTRICITY (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total, EUR** | 20.673.633 | 20.730.967 | 20.789.762 | 20.850.057 | 20.911.889 | 20.975.298 | 21.040.324 | 21.107.008 | 21.175.393 | 21.245.521 | 21.317.437 |
| **NPV (Annual), EUR** | **19.689.175** | **19.743.778** | **19.799.774** | **19.857.197** | **19.916.085** | **19.976.474** | **20.038.404** | **20.101.912** | **20.167.040** | **20.233.829** | **20.302.321** |

TABLE 7a: SALES OF HEAT WITHOUT ECONOMIZER (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 0 | 0 | 43,44 | 43,44 | 43,44 | 43,44 | 43,44 | 31,86 | 31,86 | 31,86 | 31,86 |
| Volume, MWh | 0 | 0 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 |
| Sales, EUR | 0 | 0 | 14.961.858 | 15.055.708 | 15.163.636 | 15.287.753 | 15.430.487 | 11.436.063 | 11.574.491 | 11.733.684 | 11.764.196 |
| NPV, EUR | 0 | 0 | 14.249.389 | 14.338.770 | 14.441.558 | 14.559.764 | 14.695.702 | 10.891.488 | 11.023.325 | 11.174.937 | 11.203.996 |

TABLE 7b: SALES OF HEAT WITHOUT ECONOMIZER (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 |
| Volume, MWh | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 | 330.000 |
| Sales, EUR | 11.796.096 | 11.828.810 | 11.862.358 | 11.896.761 | 11.932.042 | 11.968.222 | 12.005.325 | 12.043.374 | 12.082.393 | 12.122.407 | 12.163.442 |
| NPV, EUR | 11.234.377 | 11.265.533 | 11.297.484 | 11.330.249 | 11.363.849 | 11.398.307 | 11.433.643 | 11.469.880 | 11.507.041 | 11.545.150 | 11.584.230 |

TABLE 8a: SALES OF HEAT PRODUCED BY USING ECONOMIZER (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 0 | 0 | 43 | 43 | 43 | 43 | 43 | 32 | 32 | 32 | 32 |
| Volume, MWh | 0 | 0 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 |
| Sales, EUR | 0 | 0 | 4.335.538 | 4.362.734 | 4.394.008 | 4.429.974 | 4.471.334 | 3.313.859 | 3.353.972 | 3.400.102 | 3.408.943 |
| NPV, EUR | 0 | 0 | 4.129.084 | 4.154.984 | 4.184.770 | 4.219.023 | 4.258.414 | 3.156.056 | 3.194.259 | 3.238.192 | 3.246.613 |

TABLE 8b: SALES OF HEAT PRODUCED BY USING ECONOMIZER (2023-20233)

| Year | 31,86 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 |
| Volume, MWh | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 | 95.625 |
| Sales, EUR | 3.418.187 | 3.427.666 | 3.437.388 | 3.447.357 | 3.457.580 | 3.468.064 | 3.478.816 | 3.489.841 | 3.501.148 | 3.512.743 | 3.524.634 |
| NPV, EUR | 3.255.416 | 3.264.444 | 3.273.703 | 3.283.197 | 3.292.934 | 3.302.918 | 3.313.158 | 3.323.658 | 3.334.427 | 3.345.470 | 3.356.794 |

TABLE 9a: SALES OF ELECTRICITY (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 0 | 0 | 87,57 | 87,57 | 87,57 | 87,57 | 87,57 | 87,57 | 40,55 | 40,55 | 40,55 |
| Volume, MWh | 0 | 0 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 |
| Sales, EUR | 0 | 0 | 10.967.111 | 11.035.904 | 11.115.015 | 11.205.993 | 11.310.618 | 11.430.937 | 5.356.789 | 5.430.465 | 5.444.587 |
| NPV, EUR | 0 | 0 | 10.444.868 | 10.510.385 | 10.585.729 | 10.672.375 | 10.772.017 | 10.886.607 | 5.101.704 | 5.171.872 | 5.185.321 |

TABLE 9b: SALES OF ELECTRICITY (2023-2024)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tariff, EUR/MWh | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 | 40,55 |
| Volume, MWh | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 | 120.000 |
| Sales, EUR | 5.459.350 | 5.474.490 | 5.490.017 | 5.505.939 | 5.522.267 | 5.539.012 | 5.556.183 | 5.573.793 | 5.591.851 | 5.610.370 | 5.629.362 |
| NPV, EUR | 5.199.381 | 5.213.800 | 5.228.587 | 5.243.751 | 5.259.302 | 5.275.249 | 5.291.603 | 5.308.374 | 5.325.573 | 5.343.210 | 5.361.297 |

TABLE 6a: FIXED ASSET VALUE (SPLIT BY CATEGORY) (2010-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buildings and constructions | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 |
| Land | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 |
| Plant | 45.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 |
| **Total** | **47.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** |

TABLE 6b: FIXED ASSET VALUE (SPLIT BY CATEGORY) (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buildings and constructions | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 | 1.265.000 |
| Transport | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 | 1.050.000 |
| Plant | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 | 90.000.000 |
| **Total** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** | **92.315.000** |

TABLE 2: DEPRECATION QUOTA

| Fixed asset group | Deprecation term |
|---|---|
| Buildings and constructions | 20 |
| Plant | 20 |

TABLE 3: FIXED ASSETS PURCHASE (2012-2022)

| Year | 2012 | 2013 |
|---|---|---|
| Buildings and constructions | 1.265.000 | 0 |
| Plant | 45.000.000 | 45.000.000 |
| Land | 1.050.000 | 0 |
| **Total** | **47.315.000** | **45.000.000** |

TABLE 4a: FIXED ASSETS: VALUE, ACCUMULATED DEPRECATION AND RESIDUAL VALUE (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Value of fixed assets, EUR | 47.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 |
| Accumulated deprecation, EUR | 2.313.250 | 6.876.500 | 11.439.750 | 16.003.000 | 20.566.250 | 25.129.500 | 29.692.750 | 34.256.000 | 38.819.250 | 43.382.500 | 47.945.750 |
| Residual values of fixed assets, EUR | 45.001.750 | 85.438.500 | 80.875.250 | 76.312.000 | 71.748.750 | 67.185.500 | 62.622.250 | 58.059.000 | 53.495.750 | 48.932.500 | 44.369.250 |

TABLE 4b: FIXED ASSETS: VALUE, ACCUMULATED DEPRECATION AND RESIDUAL VALUE (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Value of fixed assets, EUR | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 | 92.315.000 |
| Accumulated deprecation, EUR | 52.509.000 | 57.072.250 | 61.635.500 | 66.198.750 | 70.762.000 | 75.325.250 | 79.888.500 | 84.451.750 | 89.015.000 | 91.265.000 | 91.265.000 |
| Residual values of fixed assets, EUR | 39.806.000 | 35.242.750 | 30.679.500 | 26.116.250 | 21.553.000 | 16.989.750 | 12.426.500 | 7.863.250 | 3.300.000 | 1.050.000 | 1.050.000 |

TABLE 5a: ANNUAL DEPRECATION VALUE (2012-2022)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buildings and constructions | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 |
| Plant | 2.250.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 |
| **Total** | **2.313.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** |

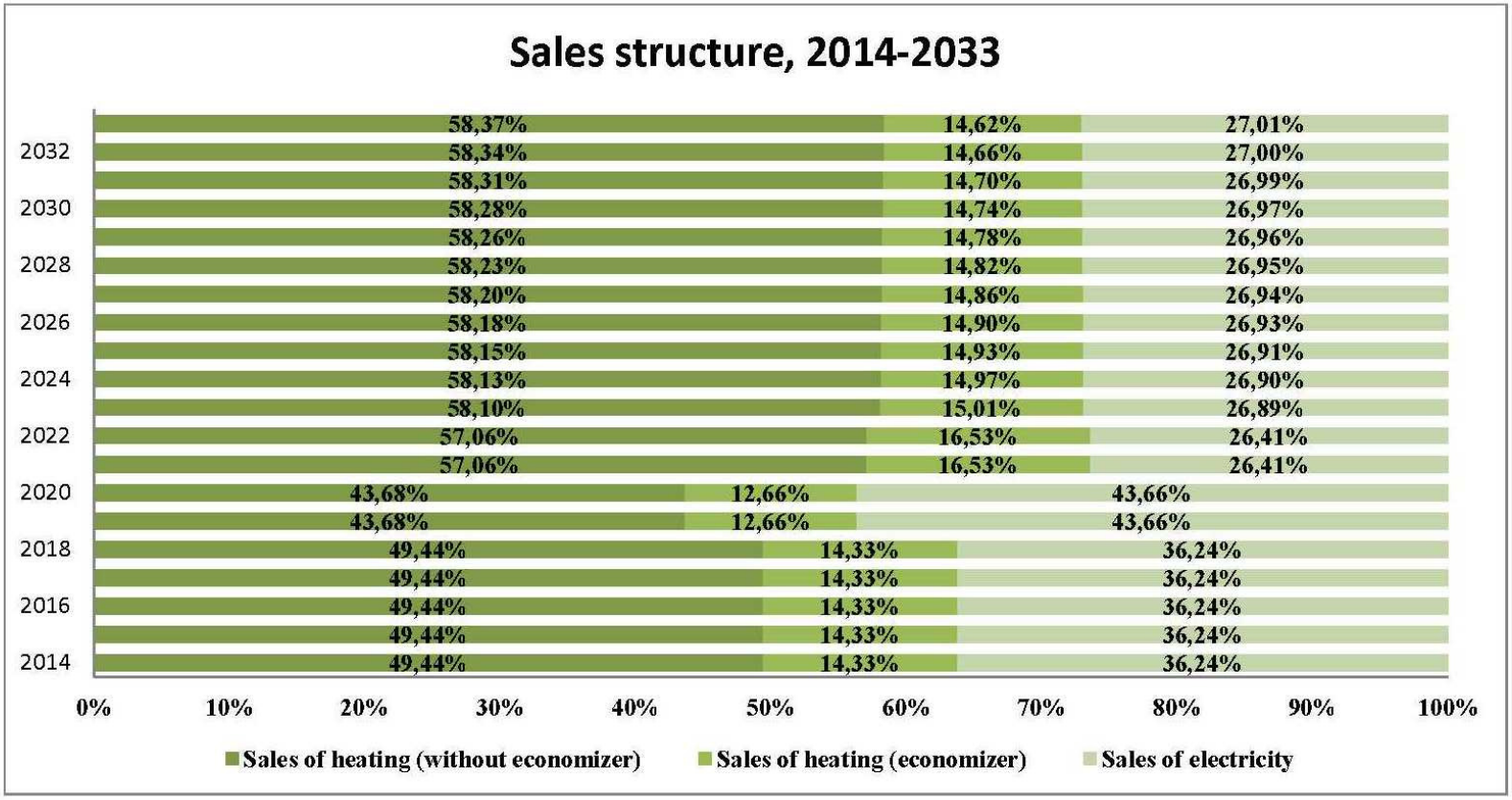
TABLE 5b: ANNUAL DEPRECATION VALUE (2023-2033)

| Year | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buildings and constructions | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 63.250 | 0 | 0 |
| Plant | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 4.500.000 | 2.250.000 | 0 |
| **Total** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **4.563.250** | **2.250.000** | **0** |

TABLE 1: CAPITAL EXPENDITURES (2012-2013)

| Category | Unit | Volume | Price per unit, EUR | Total price, EUR |
|---|---|---|---|---|
| Land | $m^2$ | 30.000 | 35 | 1.050.000 |
| Buildings | | | | 1.265.000 |
| Turn key project | | | | 90.000.000 |
| **Total** | | | | **92.315.000** |
| NPV, EUR | | **87.919.048** | | |

| Project's ratios (No EU Subsidies) | |
|---|---|
| NPV, EUR | 203.112.306 |
| IRR, % | 15% |
| Payback period, years | 7,1 |



| Funding structure, % / EUR | | |
|---|---|---|
| Year | 2012 | 2013 |
| Equity | 30% / 20 284 500 | 30% / 13 500 000 |
| Bank loan | 70% / 47 330 500 | 70% / 31 500 000 |

| Loan | |
|---|---|
| Loan, EUR | 64.620.500 |
| Term, years | 10 |
| Annual interest rate, % | 5,00% |
| Annual payment, EUR | 8.368.650 |

| Annual production , MWh | |
|---|---|
| Heat | 330.000 |
| Heat (from the economizer) | 95.625 |
| Electricity | 120.000 |

| Tariffs, EUR/MWh | | |
|---|---|---|
| Category | Value and periods | Value and periods |
| Heating | 43,44 (2014-2018) | 31,68 (2019-2033) |
| Electricity | 87,57 (2014-2020) | 40,55 (2020-2033) |

| NPV structure (2012-2033 period) | | |
|---|---|---|
| Category | Value, EUR | % from the project's NPV |
| Capital expenditures | 87.919.048 | 16,47% |
| Sales of heat | 208.902.471 | 39,14% |
| Sales of electricity | 97.285.185 | 18,23% |
| Biofuel costs | 98.801.394 | 18,51% |
| Fixed and variable costs | 40.776.594 | 7,64% |

| Taxes | Tariffs |
|---|---|
| Valued added tax (VAT) | 21% |

| FEZ incentive | Tariffs | Comments |
|---|---|---|
| Corporation Income Tax (CIT) | 0% | First 6 reporting periods |
| | 7,5% | Another 10 years |
| Real Estate Tax | 0% | |
| Dividend taxation | 0% | |

| Project's summary | |
|---|---|
| Project | Technical-financial model for CHP |
| Location | Lithuania |
| Description | Electricity and heating is generated by biomass-fired boiler and steam turbine. |
| Type of fuel | Wood chips |

| Project's life cycle | |
|---|---|
| Life cycle, years | 20 |
| Project period | 2012-2033 |
| CHP construction period | 2012-2013 |
| CHP operation period | 2014-2033 |

| CHP capacity information | |
|---|---|
| Fuel capacity, MW | 71 |
| Heating. MW | 44 |
| Electricity, MW | 16 |
| Economizer capacity, MW | 15 |
| Load factor CHP | 100% |
| Yield economizer | 85% |
| Operating hours | 7.500 |

| Biofuel information | |
|---|---|
| Fuel name | Wood chips |
| NCV, MWh/ton | 2,4 |
| Fuel price, EUR/t | 35,30 |

| Investments split by year, EUR | | | |
|---|---|---|---|
| Year | 2012 | 2013 | Total |
| Land | 1.050.000 | 0 | **1.050.000** |
| Buildings | 1.265.000 | 0 | **1.265.000** |
| Turn key project | 45.000.000 | 45.000.000 | **90.000.000** |
| Total | 47.315.000 | 45.000.000 | **92.315.000** |

| Annual deprecation and quota | | |
|---|---|---|
| Category | Annual value, EUR | Quota, years |
| Buildings and constructions | 1.265.000 | 20 |
| Plant | 45.000.000 | 30 |

# Annex 5: Industry assessment example of feasibility for a cogeneration plant in the Free economic zone of Kaunas

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**Feasibility calculation, input data and summary**
Kaunas, Lithuania PLE NV
8.9.2011 MKa

**Plant:** **BioPower 8 DH + Flue gas condenser (FGC)**

Average district heating network temperature assumed 90/50 °C.

| Indicative operation parameters | Load point 1 | Load point 2 | |
|---|---|---|---|
| Fuel effect | 32,3 | 12,8 | $MW_f$ |
| Boiler load | 100 | 40 | % MCR |
| Generator electrical output | 8,4 | 1,5 | $MW_e$ |
| Own consumption | 1200 | 500 | $kW_e$ |
| Heat output (to DH-net) | 25,6* | 8,2 | $MW_{th}$ |

*Estimated FGC heat output ~6MW. Actual value depends on fuel moisture and DH-network conditions.
The highest heat recovery in the FGC is achieved when the DH inlet temperature is low and the fuel moisture is high.

**Calculation data:**

Fuel price 35,3 € / ton wood chips (122LT/solid $m^3$. Solid $m^3$ ~1 ton)
*(30,7 € / ton peat)*
The plant is capable to combust both wood chips and peat, but in this calculation 100% wood combustion is considered due to the assumption that peat is not an eligible RES-fuel

Electricity price (RES-E FIT) 86,88 € / $MWh_e$ (guaranteed until 2020)
Heat price 48 € / $MWh_{th}$ (AB Kauno Energija purchase price from Gasprom)
Calculation rate (interest rate) 5 %

| Heat demand | Month 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | sum | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Independent prod. | 34 621 | 31 113 | 25 877 | 14 030 | 7 981 | 5 391 | 0 | 6 263 | 6 543 | 17 638 | 30 899 | 18 186 | 198 542 | $MWh_{th}$ |
| AB Kauno energija | 10 873 | 12 199 | 10 277 | 4 867 | 2 815 | 3 974 | 11 182 | 2 573 | 2 493 | 4 282 | 3 793 | 3 749 | 73 077 | $MWh_{th}$ |
| **Total annual** | **45 494** | **43 312** | **36 154** | **18 897** | **10 796** | **9 365** | **11 182** | **8 836** | **9 036** | **21 920** | **34 692** | **21 935** | **271 619** | $MWh_{th}$ |

**Estimated investment costs**

| | | |
|---|---|---|
| BioPower 8 DH | 23 M€ | Process-EPC (excluding building foundations) |
| Foundation works | 1,5 M€ | |
| Process connections | 1 M€ | DH-, raw water- and sewage piping connections, electrical network connection |
| Other costs | 3,5 M€ | Flue gas condenser investment(~2M€), excavations and earth works site, permits and fees... |
| Land | 0,8 M€ | |
| Interest during construction | 1,24 M€ | 5% interest rate |
| Total investment | 31,04 M€ | |

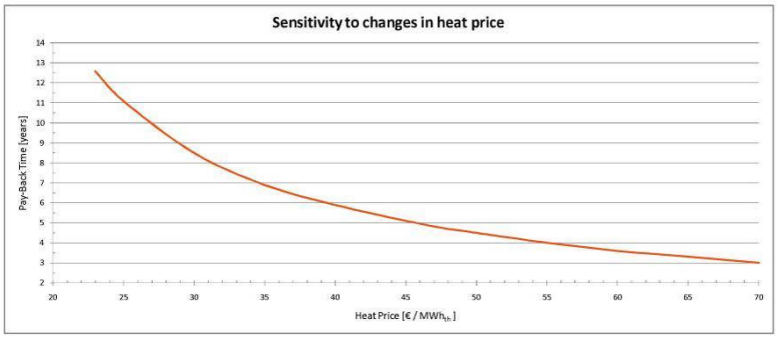
**Feasibility summary**

| | | |
|---|---|---|
| Pay-Back Time | 4,7 | years |
| Internal Rate Of Return | 23,5 | % |
| Net present value | 47,9 | M€ |

**Sensitivity to changes in heat price**

Heat price 30 € / $MWh_{th}$ (Other data as above)

| | | |
|---|---|---|
| Pay-Back Time | 8,5 | years |
| Internal Rate Of Return | 12,0 | % |
| Net present value | 16,3 | M€ |



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# Kaunas

## Feasibility Evaluation

| | Project name and number | | Customer name and country | | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|---|---|
| **Power Plants** | Kaunas | BP8DH+FGC | | Lithuania | Electricity | 31 Mill. EUR | 4,7 years | 08.09.2011 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Investment** | | | **Energy prices** | | | **Plant** | BioPower 8 DH | | |
| Currency | | EUR | Electricity | EUR/MWhel | 86,88 | **Maintenance** | % of investment | % of investment | |
| Turn-Key Price | Mill. EUR | 23,00 | Station power | EUR/MWhel | 86,88 | | 1,50 | 1,00 | |
| Foundation | Mill. EUR | 1,50 | Heat | EUR/MWhth | 48,00 | **Consumption** | mg/MJ fu | g/kWh el | |
| Process connections | Mill. EUR | 1,00 | **Other prices** | | | Lube oil | | | |
| Other costs | Mill. EUR | 3,50 | Raw water | EUR/m3 | 2,00 | DeNOx, Ammonium urea | | | |
| Land | Mill. EUR | 0,80 | Lube oil | EUR/liter | | DeSOx, Reagent | | | |
| Fees | Mill. EUR | | DeNOx, Ammonium urea | EUR/kg | | **Fuel handling** | EUR/ton fu | EUR/ton fu | |
| Interest during construction | Mill. EUR | 1,24 | DeSOx, Reagent | EUR/kg | | | | | |
| Reserves | Mill. EUR | | NOx charge | EUR/ton | | **Cat. maintenance** | EUR/MWh el | EUR/MWh el | |
| Investment total | Mill. EUR | 29,80 | Bottom Ash, wet | EUR/ton | 10,00 | | | | |
| Subsidies | % | | Fly Ash, dry | EUR/ton | 20,00 | **NOx emission** | mg/MJ fu | mg/MJ fu | |
| Investment, net | Mill. EUR | 31,04 | **Annual costs** | | | | | | |
| | | | Operation | Mill. /year | 0,50 | **Boilers** | Gas boilers | | |
| **Economical parameters** | | | Back-up fuel | Mill. /year | | Efficiency, design poi | 85 | % | |
| Calculation rate | % | 5,00 | **Fuel specification** | | **Fuel 1** | **Fuel 2** | **Fuel 3** | **Fuel 4** | |
| Development fee | % | | Type | | Wood chips | Peat | | Gas | |
| Financial fee | % | | Density | kg/m3 | 250 | 300 | | 1 | |
| Other fees | % | | Moisture | m-% | 50,00 | 45,00 | | | |
| Fuel storage, reserve | days | | Ash content | m-%, dry | 5,00 | 5,20 | | | |
| Debt service, reserve | days | | **Fuel heat value, LHV** | | | | | | |
| Working capital, reserve | days | | Unit | | kJ/kg | kJ/kg | kJ/kg | kJ/m3(n) | |
| Construction time | months | 20 | Value | bio dry, others wet | 19000 | 20200 | | 36000 | |
| Calculation period | years | 15 | LHV, wet | kJ/kg, wet | 8278 | 10010 | | 35964 | |
| Zero Year | | 2012 | **Fuel cost** | | | | | | |
| **Certificates** | | | Unit | | EUR/ton | EUR/ton | EUR/MWh | EUR/1000 m3(n) | |
| | EUR/MWhel | | Value | wet | 35,30 | 30,70 | | 160,00 | |
| | EUR/MWhel | | **Fuel consumption** | | **Wood chips** | **Peat** | | **Gas** | |
| CO2 credit (el) | EUR/MWhel | | BioPower 8 DH | m-% | 100 | | | | |
| CO2 credit (heat) | EUR/MWhth | | | m-% | | | | | |
| | | | Boilers | m-% | | | | | |

Units : el = electricity, th = thermal, fu = fuel, ash = ash

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# Kaunas

## Feasibility Evaluation

| Power Plants | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 4,7 years | 8.9.2011 |

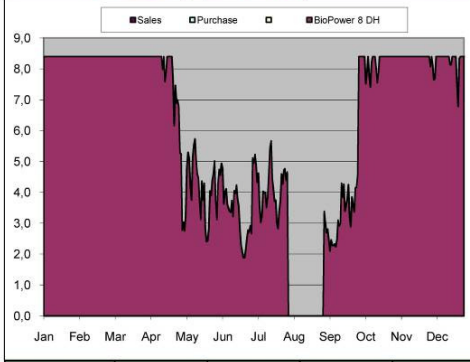
BioPower 8 DH

| Power balance | BioPower 8 DH | | | |
|---|---|---|---|---|
| | Point 1 | Point 2 | Point 1 | Point 2 |
| Gen. power MW | 8,40 | 1,50 | | |
| Station power kW | 1200 | 500 | | |
| Heat MW | 25,60 | 8,20 | | |
| Fuel MW | 32,30 | 12,80 | | |
| Water kg/h | 1500 | 1500 | | |

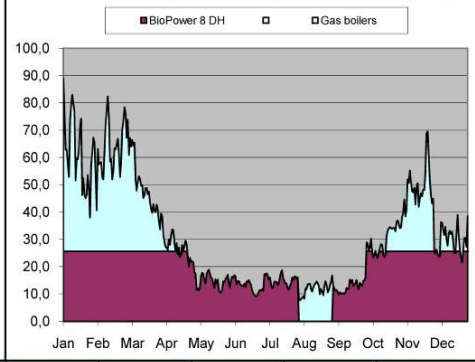
| Energy balance | BioPower 8 DH | | | | | |
|---|---|---|---|---|---|---|
| | Calculated | Corrected | Selected | Calculated | Corrected | Selected |
| Electricity MWh | 52986 | | 52986 | | | |
| Heat MWh | 169030 | | 169030 | | | |
| Fuel MWh | 218329 | | 218329 | | | |

| Energy Consumption | January | February | March | April | May | June | July | August | September | October | November | December | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity MWh | | | | | | | | | | | | | |
| Heat MWh | 45494 | 43312 | 36154 | 18897 | 10796 | 9365 | 11182 | 8836 | 9036 | 21920 | 34692 | 21935 | 271619 |

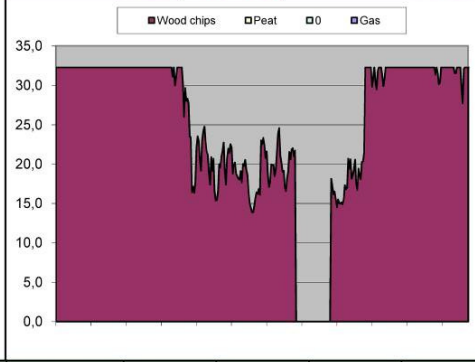
**Electricity (MW/MWh)** #DIV/0!




**Heat (MW/MWh)** max 89,2




**Fuel (MW/MWh)** max 32,3




| BioPower 8 DH | | Purchase | Sales | Consumption | BioPower 8 DH | | Gas boilers | | Consumption | Wood chips | Peat | | Gas | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52986 | | #DIV/0! | #DIV/0! | #DIV/0! | 169030 | | 102589 | | 271619 | 218329 | | | | 218329 |

Units : el = electricity, th = thermal, fu = fuel, ash = ash

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## PLANT PERFORMANCE

| **Performance** | | BioPower 8 DH | 330 | Total |
|---|---|---|---|---|
| Electricity | kW | 8400 | | 8400 |
| Station power | kW | 1200 | | 1200 |
| Heat | kW | 25600 | | 25600 |
| Fuel | kW | 32300 | | 32300 |

| **Efficiency, design point** | | BioPower 8 DH | | Total |
|---|---|---|---|---|
| Electricity | % | 26,0 | | 26,0 |
| Heat | % | 79,3 | | 79,3 |
| Total | % | 105,3 | | 105,3 |

| **Annual energy** | | BioPower 8 DH | Purchase | Sales | Boilers | Total |
|---|---|---|---|---|---|---|
| Electricity | MWh | 52986 | #DIV/0! | #DIV/0! | | #DIV/0! |
| Station power | MWh | 8162 | | | | 8162 |
| Heat | MWh | 169030 | | | 102589 | 271619 |
| Fuel | MWh | 218329 | | | 120693 | 339022 |
| Water | m3/year | 12024 | | | | 12024 |

| **Annual efficiency** | | BioPower 8 DH | | |
|---|---|---|---|---|
| Electricity | 2009 | 24,3 | | |
| Heat | % | 77,4 | | |
| Total | | 101,7 | | |

| **Annual Production** | | BioPower 8 DH & |
|---|---|---|
| Electrical | MWh | 52986 |
| Heat | MWh | 169030 |
| Total | MWh | 222016 |

| **Full Power Hours** | | BioPower 8 DH |
|---|---|---|
| Electricity | h | 6308 |
| Heat | h | 6603 |
| Running hours | | 8016 |

## PROFITABILITY

| **Investment and profitability** | | |
|---|---|---|
| **Total Investment** | **31,0** | **Mill. EUR** |
| **Pay-Back Time** | **4,7** | **years** |
| **Internal Rate Of Return** | **23,5** | **%** |
| **Net present value** | **47,9** | **Mill. EUR** |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## Fuels, Ash, NOx

| **Share of fuel consumed** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| BioPower 8 DH | m-% | 100 | | | | 100 |
| | m-% | | | | | |
| Boilers | m-% | | | | | |

| **Fuel concumption** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| BioPower 8 DH | MWh | 218329 | | | | 218329 |
| | MWh | | | | | |
| Boilers | MWh | | | | | 120693 |
| Total | MWh | 218329 | | | | 339022 |

| **Fuel property and price** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| Density | kg/m3 | 250,00 | 300,00 | | 1,00 | |
| Moisture content | m-% | 50,00 | 45,00 | | | |
| Ash content | m-% | 5 | 5,2 | | | |
| Heat value | | 19000 | 20200 | | 36000 | |
| | | kJ/kg | kJ/kg | kJ/kg | kJ/m3(n) | |
| | MWh/ton | 2,30 | 2,78 | | 9,99 | |
| Consumption | ton/year | 94954 | | #DIV/0! | | |
| Fuel price | | 35,3 | 30,7 | | 160,0 | |
| | EUR | /ton | /ton | /MWh | /1000 m3(n) | |
| | EUR/MWh | 15,35 | 11,04 | | 16,02 | |
| Fuel costs | Mill. EUR | 3,35 | | | | 3,4 |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## REVENUES AND COSTS

### Revenues

| | | | | |
|---|---|---|---|---|
| **Energy** | | | | |
| Electricity | 4,60 | Mill. EUR | 86,9 | EUR/MWh |
| Heat | 8,11 | Mill. EUR | 48,0 | EUR/MWh |
| **Certificates** | | | | |
| | | Mill. EUR | | EUR/MWhel |
| | | Mill. EUR | | EUR/MWhel |
| CO2 credit (el) | | Mill. EUR | | EUR/MWhel |
| CO2 credit (heat) | | Mill. EUR | | EUR/MWhth |
| **Total** | 12,72 | Mill. EUR | | |

### Costs

| | | | | |
|---|---|---|---|---|
| **Operating costs** | | | | |
| Fuel | 3,35 | Mill. EUR | | |
| Fuel handling | | Mill. EUR | | |
| Station power | 0,71 | Mill. EUR | 86,9 | EUR/MWh |
| Fixed Operating Costs | 0,50 | Mill. EUR | | |
| Maintenance | 0,47 | Mill. EUR | | |
| Cat. maintenance | | Mill. EUR | | |
| Raw water | 0,02 | Mill. EUR | 2,00 | EUR/m3 |
| Lube oil | | Mill. EUR | 0 | ton/year |
| DeNOx, Ammonium urea | | Mill. EUR | 0 | ton/year |
| DeSOx, Reagent | | Mill. EUR | 0 | ton/year |
| NOx charge | | Mill. EUR | 0 | ton/year |
| Bottom ash handling | 0,03 | Mill. EUR | 3391 | ton/year |
| Fly ash handling | 0,03 | Mill. EUR | 1396 | ton/year |
| **Total** | 5,11 | Mill. EUR | | |

### Summary

| | | | | |
|---|---|---|---|---|
| **Financial analysis** | | | | |
| Revenues | 12,72 | Mill. EUR /year | | |
| Operating costs | -5,11 | Mill. EUR /year | | |
| Operating profit | 7,60 | Mill. EUR /year | | |
| Capital Costs | -2,99 | Mill. EUR /year | | |
| Net cash flow | 4,61 | Mill. EUR /year | | |
| **Generating costs** | | | | |
| Fuel | 3,35 | Mill. EUR /year | | |
| Heat Credit | -8,11 | Mill. EUR /year | | |
| Fuel (Net) | -4,76 | Mill. EUR /year | -89,87 | EUR/MWh |
| Operation and maintenance | 1,76 | Mill. EUR /year | 33,23 | EUR/MWh |
| Capital | 2,99 | Mill. EUR /year | 56,44 | EUR/MWh |
| Total | -0,01 | Mill. EUR /year | -0,19 | EUR/MWh |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## INVESTMENT

### Investment

**Investment parameters**

| | | |
|---|---|---|
| Calculation rate | 5 | % |
| Calculation period | 15 | years |
| Annuity | 9,6 | % |
| Time of construction | 20 | months |

**Working Capital**

| | | | | |
|---|---|---|---|---|
| Annual Running Costs / hours | 5,11 | Mill. EUR | 6308 | h |
| Working Capital | | Mill. EUR | | days |

**Investment**

| | | | | |
|---|---|---|---|---|
| Turn-Key Price | 23,00 | Mill. EUR | | |
| Foundation | 1,50 | Mill. EUR | | |
| Process connections | 1,00 | Mill. EUR | | |
| Other costs | 3,50 | Mill. EUR | | |
| Land | 0,80 | Mill. EUR | | |
| Construction costs | 29,80 | Mill. EUR | | |
| Subsidies | | Mill. EUR | | % |
| Development Fee | | Mill. EUR | | % |
| Financing Fee | | Mill. EUR | | % |
| Other Fees | | Mill. EUR | | % |
| Interest during construction | 1,24 | Mill. EUR | | |
| Working Capital | | Mill. EUR | | |
| Fuel reserves | | Mill. EUR | | days |
| Costs w/o debt service reserve | 31,04 | Mill. EUR | | |
| Debt service reserve | | Mill. EUR | | days |
| **Total investment cost** | 31,04 | Mill. EUR | 3548 | EUR/kWel |
| Annual Capital Costs | 2,99 | Mill. EUR | | |

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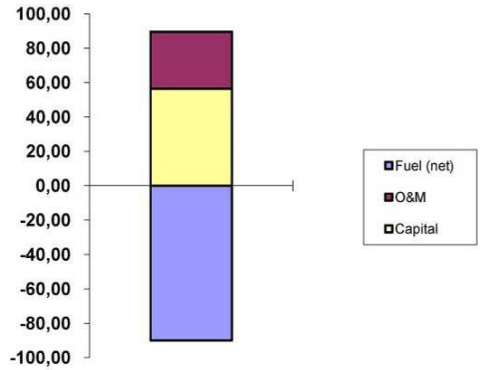
# Kaunas

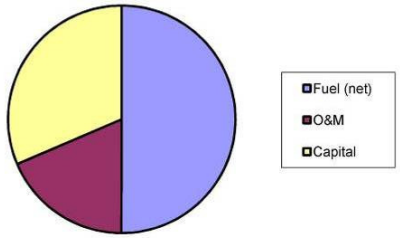
## Feasibility Evaluation

| | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| **Power Plants** | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 4,7 years | 8.9.2011 |

## Generating costs — EUR/MWh

| | |
|---|---|
| Fuel (net) | -89,87 |
| O&M | 33,23 |
| Capital | 56,44 |
| Total | -0,19 |



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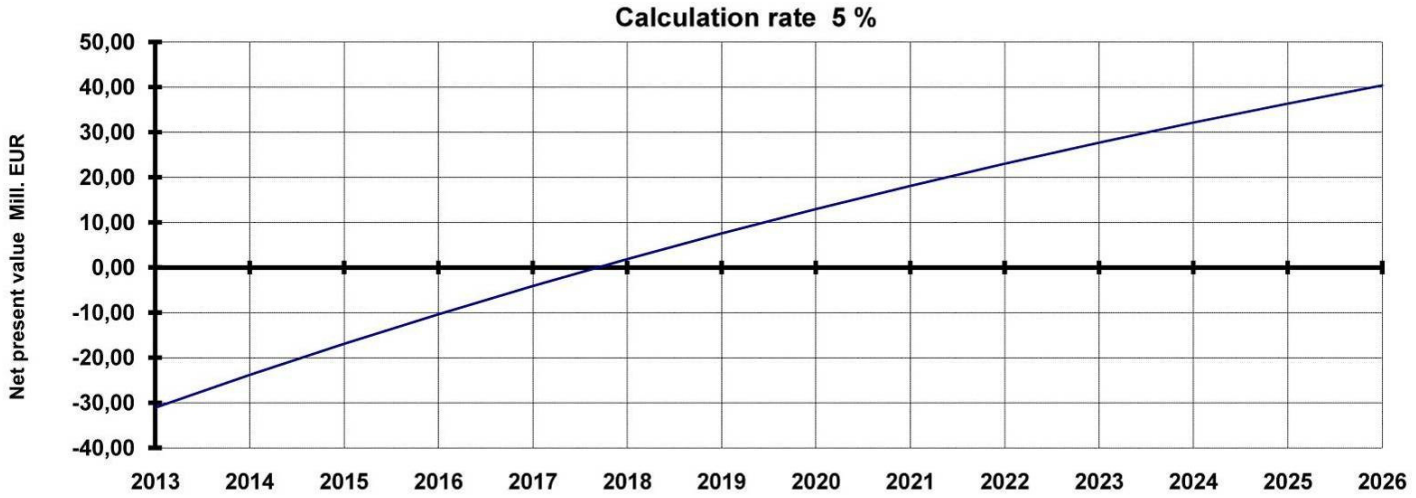
# Kaunas
## Feasibility Evaluation

| | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| **Power Plants** | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 4,7 years | 8.9.2011 |

## Net present value — Mill. EUR



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# Kaunas

## Feasibility Evaluation

| | Project name and number | | Customer name and country | | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|---|---|
| **Power Plants** | Kaunas | BP8DH+FGC | | Lithuania | Electricity | 31 Mill. EUR | 8,5 years | 08.09.2011 |

| **Investment** | | | **Energy prices** | | | **Plant** | BioPower 8 DH | |
|---|---|---|---|---|---|---|---|---|
| Currency | | EUR | Electricity | EUR/MWhel | 86,88 | **Maintenance** | % of investment | % of investment |
| Turn-Key Price | Mill. EUR | 23,00 | Station power | EUR/MWhel | 86,88 | | 1,50 | 1,00 |
| Foundation | Mill. EUR | 1,50 | Heat | EUR/MWhth | 30,00 | **Consumption** | mg/MJ fu | g/kWh el |
| Process connections | Mill. EUR | 1,00 | **Other prices** | | | Lube oil | | |
| Other costs | Mill. EUR | 3,50 | Raw water | EUR/m3 | 2,00 | DeNOx, Ammonium urea | | |
| Land | Mill. EUR | 0,80 | Lube oil | EUR/liter | | DeSOx, Reagent | | |
| Fees | Mill. EUR | | DeNOx, Ammonium urea | EUR/kg | | **Fuel handling** | EUR/ton fu | EUR/ton fu |
| Interest during construction | Mill. EUR | 1,24 | DeSOx, Reagent | EUR/kg | | | | |
| Reserves | Mill. EUR | | NOx charge | EUR/ton | | **Cat. maintenance** | EUR/MWh el | EUR/MWh el |
| Investment total | Mill. EUR | 29,80 | Bottom Ash, wet | EUR/ton | 10,00 | | | |
| Subsidies | % | | Fly Ash, dry | EUR/ton | 20,00 | **NOx emission** | mg/MJ fu | mg/MJ fu |
| Investment, net | Mill. EUR | 31,04 | **Annual costs** | | | | | |
| | | | Operation | Mill. /year | 0,50 | **Boilers** | Gas boilers | |
| **Economical parameters** | | | Back-up fuel | Mill. /year | | Efficiency, design poi | 85 | **%** |
| Calculation rate | % | 5,00 | **Fuel specification** | | **Fuel 1** | **Fuel 2** | **Fuel 3** | **Fuel 4** |
| Development fee | % | | Type | | Wood chips | Peat | | Gas |
| Financial fee | % | | Density | kg/m3 | 250 | 300 | | 1 |
| Other fees | % | | Moisture | m-% | 50,00 | 45,00 | | |
| Fuel storage, reserve | days | | Ash content | m-%, dry | 5,00 | 5,20 | | |
| Debt service, reserve | days | | **Fuel heat value, LHV** | | | | | |
| Working capital, reserve | days | | Unit | | kJ/kg | kJ/kg | kJ/kg | kJ/m3(n) |
| Construction time | months | 20 | Value | bio dry, others wet | 19000 | 20200 | | 36000 |
| Calculation period | years | 15 | LHV, wet | kJ/kg, wet | 8278 | 10010 | | 35964 |
| Zero Year | | 2012 | **Fuel cost** | | | | | |
| **Certificates** | | | Unit | | EUR/ton | EUR/ton | EUR/MWh | EUR/1000 m3(n) |
| | EUR/MWhel | | Value | wet | 35,30 | 30,70 | | 160,00 |
| | EUR/MWhel | | **Fuel consumption** | | **Wood chips** | **Peat** | | **Gas** |
| CO2 credit (el) | EUR/MWhel | | BioPower 8 DH | m-% | 100 | | | |
| CO2 credit (heat) | EUR/MWhth | | | m-% | | | | |
| | | | Boilers | m-% | | | | |

Units : el = electricity, th = thermal, fu = fuel, ash = ash

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# Kaunas

## Feasibility Evaluation

| Power Plants | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 8,5 years | 8.9.2011 |

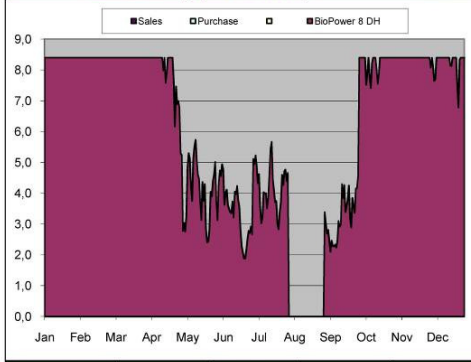
BioPower 8 DH

| Power balance | | BioPower 8 DH | | | |
|---|---|---|---|---|---|
| | | Point 1 | Point 2 | Point 1 | Point 2 |
| Gen. power | MW | 8,40 | 1,50 | | |
| Station power | kW | 1200 | 500 | | |
| Heat | MW | 25,60 | 8,20 | | |
| Fuel | MW | 32,30 | 12,80 | | |
| Water | kg/h | 1500 | 1500 | | |

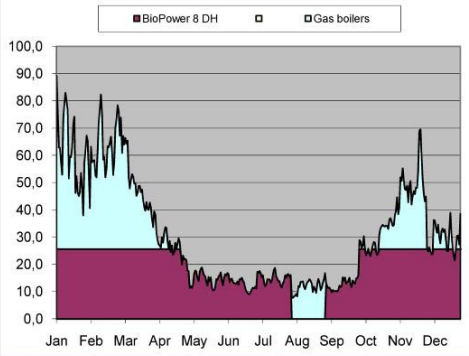
| Energy balance | | BioPower 8 DH | | | | | |
|---|---|---|---|---|---|---|---|
| | | Calculated | Corrected | Selected | Calculated | Corrected | Selected |
| | | 52986 | | 52986 | | | |
| Heat | MWh | 169030 | | 169030 | | | |
| Fuel | MWh | 218329 | | 218329 | | | |

| Energy Consumption | | January | February | March | April | May | June | July | August | September | October | November | December | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity | MWh | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | |
| Heat | MWh | 45494 | 43312 | 36154 | 18897 | 10796 | 9365 | 11182 | 8836 | 9036 | 21920 | 34692 | 21935 | 271619 |

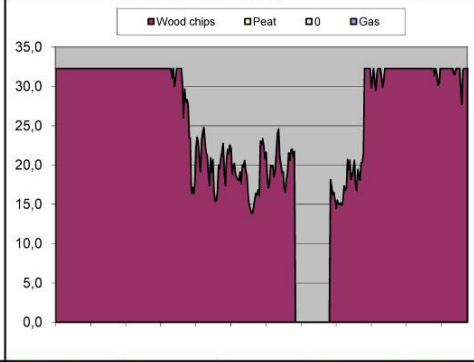
**Electricity (MW/MWh)** #DIV/0!




**Heat (MW/MWh)** max 89,2




**Fuel (MW/MWh)** max 32,3




| BioPower 8 DH | | Purchase | Sales | Consumption | BioPower 8 DH | | Gas boilers | | Consumption | Wood chips | Peat | | Gas | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52986 | | #DIV/0! | #DIV/0! | #DIV/0! | 169030 | | 102589 | | 271619 | 218329 | | | | 218329 |

Units : el = electricity, th = thermal, fu = fuel, ash = ash

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## PLANT PERFORMANCE

| **Performance** | | BioPower 8 DH | 330 | Total |
|---|---|---|---|---|
| Electricity | kW | 8400 | | 8400 |
| Station power | kW | 1200 | | 1200 |
| Heat | kW | 25600 | | 25600 |
| Fuel | kW | 32300 | | 32300 |

| **Efficiency, design point** | | BioPower 8 DH | | Total |
|---|---|---|---|---|
| Electricity | % | 26,0 | | 26,0 |
| Heat | % | 79,3 | | 79,3 |
| Total | % | 105,3 | | 105,3 |

| **Annual energy** | | BioPower 8 DH | Purchase | Sales | Boilers | Total |
|---|---|---|---|---|---|---|
| Electricity | MWh | 52986 | #DIV/0! | #DIV/0! | | #DIV/0! |
| Station power | MWh | 8162 | | | | 8162 |
| Heat | MWh | 169030 | | | 102589 | 271619 |
| Fuel | MWh | 218329 | | | 120693 | 339022 |
| Water | m3/year | 12024 | | | | 12024 |

| **Annual efficiency** | | BioPower 8 DH | | |
|---|---|---|---|---|
| Electricity | 2009 | 24,3 | | |
| Heat | % | 77,4 | | |
| Total | | 101,7 | | |

| **Annual Production** | | BioPower 8 DH & |
|---|---|---|
| Electrical | MWh | 52986 |
| Heat | MWh | 169030 |
| Total | MWh | 222016 |

| **Full Power Hours** | | BioPower 8 DH |
|---|---|---|
| Electricity | h | 6308 |
| Heat | h | 6603 |
| Running hours | | 8016 |

## PROFITABILITY

| **Investment and profitability** | | |
|---|---|---|
| **Total Investment** | **31,0** | **Mill. EUR** |
| **Pay-Back Time** | **8,5** | **years** |
| **Internal Rate Of Return** | **12,0** | **%** |
| **Net present value** | **16,3** | **Mill. EUR** |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## Fuels, Ash, NOx

| **Share of fuel consumed** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| BioPower 8 DH | m-% | 100 | | | | 100 |
| | m-% | | | | | |
| Boilers | m-% | | | | | |

| **Fuel concumption** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| BioPower 8 DH | MWh | 218329 | | | | 218329 |
| | MWh | | | | | |
| Boilers | MWh | | | | | 120693 |
| Total | MWh | 218329 | | | | 339022 |

| **Fuel property and price** | | Wood chips | Peat | Gas | | Total |
|---|---|---|---|---|---|---|
| Density | kg/m3 | 250,00 | 300,00 | | 1,00 | |
| Moisture content | m-% | 50,00 | 45,00 | | | |
| Ash content | m-% | 5 | 5,2 | | | |
| Heat value | | 19000 | 20200 | | 36000 | |
| | | kJ/kg | kJ/kg | kJ/kg | kJ/m3(n) | |
| | MWh/ton | 2,30 | 2,78 | | 9,99 | |
| Consumption | ton/year | 94954 | | #DIV/0! | | |
| Fuel price | | 35,3 | 30,7 | | 160,0 | |
| | EUR | /ton | /ton | /MWh | /1000 m3(n) | |
| | EUR/MWh | 15,35 | 11,04 | | 16,02 | |
| Fuel costs | Mill. EUR | 3,35 | | | | 3,4 |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## REVENUES AND COSTS

### Revenues

| | | | | |
|---|---|---|---|---|
| **Energy** | | | | |
| Electricity | 4,60 | Mill. EUR | 86,9 | EUR/MWh |
| Heat | 5,07 | Mill. EUR | 30,0 | EUR/MWh |
| **Certificates** | | | | |
| | | Mill. EUR | | EUR/MWhel |
| | | Mill. EUR | | EUR/MWhel |
| CO2 credit (el) | | Mill. EUR | | EUR/MWhel |
| CO2 credit (heat) | | Mill. EUR | | EUR/MWhth |
| **Total** | 9,67 | Mill. EUR | | |

### Costs

| | | | | |
|---|---|---|---|---|
| **Operating costs** | | | | |
| Fuel | 3,35 | Mill. EUR | | |
| Fuel handling | | Mill. EUR | | |
| Station power | 0,71 | Mill. EUR | 86,9 | EUR/MWh |
| Fixed Operating Costs | 0,50 | Mill. EUR | | |
| Maintenance | 0,47 | Mill. EUR | | |
| Cat. maintenance | | Mill. EUR | | |
| Raw water | 0,02 | Mill. EUR | 2,00 | EUR/m3 |
| Lube oil | | Mill. EUR | 0 | ton/year |
| DeNOx, Ammonium urea | | Mill. EUR | 0 | ton/year |
| DeSOx, Reagent | | Mill. EUR | 0 | ton/year |
| NOx charge | | Mill. EUR | 0 | ton/year |
| Bottom ash handling | 0,03 | Mill. EUR | 3391 | ton/year |
| Fly ash handling | 0,03 | Mill. EUR | 1396 | ton/year |
| **Total** | 5,11 | Mill. EUR | | |

### Summary

| | | | | |
|---|---|---|---|---|
| **Financial analysis** | | | | |
| Revenues | 9,67 | Mill. EUR /year | | |
| Operating costs | -5,11 | Mill. EUR /year | | |
| Operating profit | 4,56 | Mill. EUR /year | | |
| Capital Costs | -2,99 | Mill. EUR /year | | |
| Net cash flow | 1,57 | Mill. EUR /year | | |
| **Generating costs** | | | | |
| Fuel | 3,35 | Mill. EUR /year | | |
| Heat Credit | -5,07 | Mill. EUR /year | | |
| Fuel (Net) | -1,72 | Mill. EUR /year | -32,44 | EUR/MWh |
| Operation and maintenance | 1,76 | Mill. EUR /year | 33,23 | EUR/MWh |
| Capital | 2,99 | Mill. EUR /year | 56,44 | EUR/MWh |
| Total | 3,03 | Mill. EUR /year | 57,23 | EUR/MWh |

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# BioPower
## Feasibility Evaluation

| | Project name and number | Customer name and country | Print Date |
|---|---|---|---|
| **Power Plants** | Kaunas, BP8DH+FGC | , Lithuania | 8.9.2011 |

## INVESTMENT

### Investment

**Investment parameters**

| | | |
|---|---|---|
| Calculation rate | 5 | % |
| Calculation period | 15 | years |
| Annuity | 9,6 | % |
| Time of construction | 20 | months |

**Working Capital**

| | | | | |
|---|---|---|---|---|
| Annual Running Costs / hours | 5,11 | Mill. EUR | 6308 | h |
| Working Capital | | Mill. EUR | | days |

**Investment**

| | | | | |
|---|---|---|---|---|
| Turn-Key Price | 23,00 | Mill. EUR | | |
| Foundation | 1,50 | Mill. EUR | | |
| Process connections | 1,00 | Mill. EUR | | |
| Other costs | 3,50 | Mill. EUR | | |
| Land | 0,80 | Mill. EUR | | |
| Construction costs | 29,80 | Mill. EUR | | |
| Subsidies | | Mill. EUR | | % |
| Development Fee | | Mill. EUR | | % |
| Financing Fee | | Mill. EUR | | % |
| Other Fees | | Mill. EUR | | % |
| Interest during construction | 1,24 | Mill. EUR | | |
| Working Capital | | Mill. EUR | | |
| Fuel reserves | | Mill. EUR | | days |
| Costs w/o debt service reserve | 31,04 | Mill. EUR | | |
| Debt service reserve | | Mill. EUR | | days |
| **Total investment cost** | 31,04 | Mill. EUR | 3548 | EUR/kWel |
| Annual Capital Costs | 2,99 | Mill. EUR | | |

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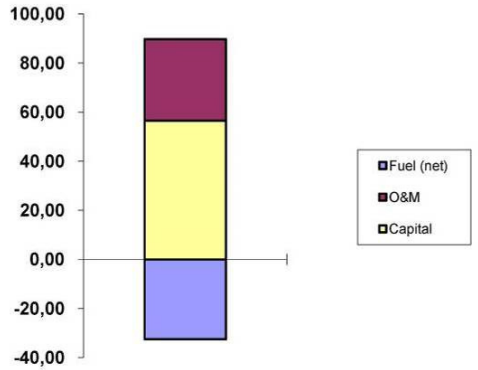
# Kaunas

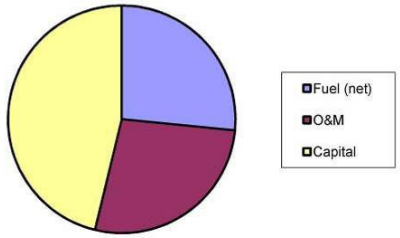
## Feasibility Evaluation

| | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| **Power Plants** | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 8,5 years | 8.9.2011 |

## Generating costs — EUR/MWh

| | |
|---|---|
| Fuel (net) | -32,44 |
| O&M | 33,23 |
| Capital | 56,44 |
| Total | 57,23 |



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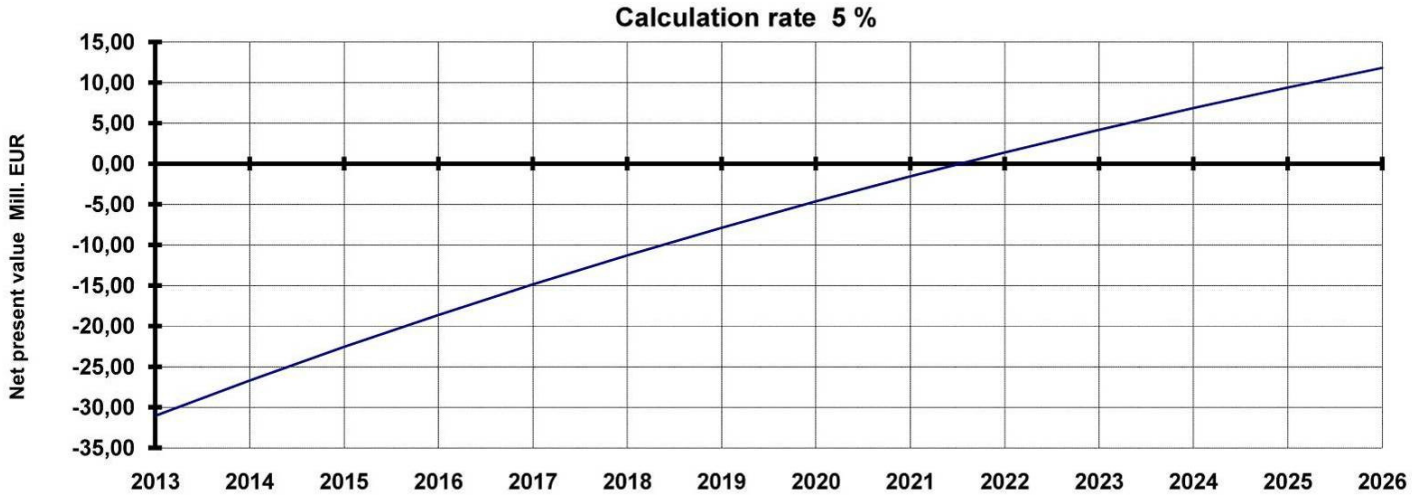
# Kaunas

## Feasibility Evaluation

| | Project name and number | Customer name and country | Calculation mode | Investment, net | Feasibility | Print Date |
|---|---|---|---|---|---|---|
| **Power Plants** | BP8DH+FGC Kaunas | Lithuania | Electricity | 31 Mill. EUR | 8,5 years | 8.9.2011 |

## Net present value — Mill. EUR



# Annex 6: Discounted Cash Flow Analysis – preliminary analysis for installing a heat distribution network in the Free Economic Zone of Kaunas.

## "Free Market" scenario

| | Mill. euro | Km |
|---|---|---|
| Construction of heating supply network. Stage 1 | 7,9 | 11,10 |
| Construction of heating supply network. Stage 2 | 6,4 | 8,99 |
| Construction of heating supply network. Stage 3 | 2,5 | 3,47 |
| Total | 16,8 | 23,6 |

| | Without VAT | With VAT |
|---|---|---|
| Heat buying price, euro/MWh | 37,2 | 40,5 |
| Heat selling price, euro/kWh | 43,8 | 47,8 |
| **Average annual operation and maintenance cost, thous. euro/km** | **29,0** | |
| Heta demand of the total | 80% | |

| Activities | The length of supply lines, km | Relative length of supply lines, km | **Heat selling, GWh/year** | **Heat buying, GWh/year** |
|---|---|---|---|---|
| Construction of heating supply network. Stage 1 | | | | |
| | 11,10 | 6,04 | 4,8 | 5,4 |
| | 11,10 | 6,59 | 10,2 | 11,5 |
| | 11,10 | 7,15 | 15,7 | 17,5 |
| | 11,10 | 7,93 | 23,3 | 26,1 |
| | 11,10 | 8,52 | 29,1 | 32,6 |
| | 11,10 | 9,26 | 36,4 | 40,7 |
| | 11,10 | 9,96 | 43,3 | 48,5 |
| | 11,10 | 10,57 | 49,3 | 55,2 |
| Construction of heating supply network. Stage 2 | 11,10 | 11,10 | 54,4 | 61,0 |
| | 20,09 | 16,15 | 60,7 | 68,0 |
| | 20,09 | 17,42 | 75,2 | 84,2 |
| | 20,09 | 18,59 | 88,5 | 99,2 |
| | 20,09 | 19,35 | 97,1 | 108,8 |
| Construction of heating supply network. Stage 3 | 20,09 | 20,09 | 105,6 | 118,2 |
| | 23,56 | 22,38 | 114,3 | 128,1 |
| | 23,56 | 22,73 | 120,1 | 134,5 |
| | 23,56 | 23,01 | 124,5 | 139,5 |
| | 23,56 | 23,22 | 127,8 | 143,1 |
| | 23,56 | 23,39 | 130,5 | 146,2 |
| | 23,56 | 23,56 | 133,3 | 149,3 |
| | 23,56 | 23,56 | 133,3 | 149,3 |
| | 23,56 | 23,56 | 133,3 | 149,3 |
| | 23,56 | 23,56 | 133,3 | 149,3 |
| | 23,56 | 23,56 | 133,3 | 149,3 |

| Year | Costs, mill. euro | | | | | Benefits, mill. euro. | | | | Cash flow, mill. euro | | Discount factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction | Heat buying cost | Operation and maintenance cost | Totel | | Heat selling revenues (turnover) | Residual value | Total | | | | |
| | Non-discounted | | | | Discounted | Non-discounted | | | Discounted | Non-discounted | Discounted | |
| 0 | 3,953 | | | 3,953 | 3,765 | | | | 0,000 | -3,953 | -3,765 | 0,9524 |
| 1 | | 0,201 | 0,175 | 0,376 | 0,341 | 0,211 | | 0,211 | 0,192 | -0,165 | -0,149 | 0,9070 |
| 2 | | 0,426 | 0,191 | 0,617 | 0,533 | 0,449 | | 0,449 | 0,388 | -0,169 | -0,146 | 0,8638 |
| 3 | | 0,652 | 0,207 | 0,859 | 0,707 | 0,686 | | 0,686 | 0,565 | -0,173 | -0,142 | 0,8227 |
| 4 | | 0,971 | 0,230 | 1,201 | 0,941 | 1,022 | | 1,022 | 0,801 | -0,179 | -0,140 | 0,7835 |
| 5 | | 1,214 | 0,247 | 1,461 | 1,090 | 1,277 | | 1,277 | 0,953 | -0,183 | -0,137 | 0,7462 |
| 6 | | 1,515 | 0,268 | 1,784 | 1,268 | 1,595 | | 1,595 | 1,133 | -0,189 | -0,134 | 0,7107 |
| 7 | | 1,803 | 0,289 | 2,092 | 1,416 | 1,898 | | 1,898 | 1,284 | -0,194 | -0,131 | 0,6768 |
| 8 | | 2,052 | 0,306 | 2,359 | 1,520 | 2,160 | | 2,160 | 1,392 | -0,199 | -0,128 | 0,6446 |
| 9 | 6,402 | 2,268 | 0,322 | 8,992 | 5,520 | 2,387 | | 2,387 | 1,465 | -6,605 | -4,055 | 0,6139 |
| 10 | | 2,529 | 0,468 | 2,997 | 1,752 | 2,862 | | 2,862 | 1,556 | -0,335 | -0,196 | 0,5847 |
| 11 | | 3,133 | 0,505 | 3,637 | 2,025 | 3,297 | | 3,297 | 1,836 | -0,341 | -0,190 | 0,5568 |
| 12 | | 3,689 | 0,539 | 4,228 | 2,242 | 3,882 | | 3,882 | 2,059 | -0,346 | -0,183 | 0,5303 |
| 13 | | 4,046 | 0,560 | 4,606 | 2,326 | 4,257 | | 4,257 | 2,150 | -0,349 | -0,176 | 0,5051 |
| 14 | 2,470 | 4,399 | 0,582 | 7,451 | 3,584 | 4,629 | | 4,629 | 2,227 | -2,822 | -1,357 | 0,4810 |
| 15 | | 4,764 | 0,648 | 5,412 | 2,479 | 5,013 | | 5,013 | 2,297 | -0,399 | -0,183 | 0,4581 |
| 16 | | 5,003 | 0,658 | 5,661 | 2,470 | 5,265 | | 5,265 | 2,297 | -0,397 | -0,173 | 0,4363 |
| 17 | | 5,189 | 0,667 | 5,856 | 2,433 | 5,460 | | 5,460 | 2,269 | -0,395 | -0,164 | 0,4155 |
| 18 | | 5,323 | 0,672 | 5,995 | 2,372 | 5,601 | | 5,601 | 2,217 | -0,394 | -0,156 | 0,3957 |
| 19 | | 5,437 | 0,677 | 6,115 | 2,305 | 5,722 | | 5,722 | 2,156 | -0,393 | -0,148 | 0,3769 |
| 20 | | 5,552 | 0,682 | 6,234 | 2,238 | 5,842 | | 5,842 | 2,097 | -0,392 | -0,141 | 0,3589 |
| 21 | | 5,552 | 0,682 | 6,234 | 2,131 | 5,842 | | 5,842 | 1,997 | -0,392 | -0,134 | 0,3418 |
| 22 | | 5,552 | 0,682 | 6,234 | 2,030 | 5,842 | | 5,842 | 1,902 | -0,392 | -0,128 | 0,3256 |
| 23 | | 5,552 | 0,682 | 6,234 | 1,933 | 5,842 | | 5,842 | 1,812 | -0,392 | -0,122 | 0,3101 |
| 24 | | 5,552 | 0,682 | 6,234 | 1,841 | 5,842 | 6,429 | 12,271 | 3,624 | 6,037 | 1,783 | 0,2953 |
| Iš viso | 12,825 | 82,376 | 11,621 | **106,822** | **51,263** | 86,684 | 6,429 | 93,112 | 40,667 | -13,710 | **-10,596** | |

| | |
|---|---|
| Present value of costs (PVC), mill.euro | 51,26 |
| Present value of benefits (PVB), mill.euro | 40,67 |
| Net present value (NPV), mill. euro | -10,60 |
| Benefit and cost ratio B/C (PVB/PVC) | **0,79** |
| Internal rate of return (IRR), % | -9,03% |
| Discount rate | 5,00% |

## "Obligatory" scenario

| | Mill. euro | Km |
|---|---|---|
| Construction of heating supply network. Stage 1 | 9,9 | 13,9 |
| Construction of heating supply network. Stage 2 | 8,0 | 11,2 |
| Construction of heating supply network. Stage 3 | 3,1 | 4,3 |
| Total | 21,0 | 29,5 |

| | Without VAT | With VAT |
|---|---|---|
| Heat buying price, euro/MWh | 37,2 | 40,5 |
| Heat selling price, euro/kWh | 69,1 | 75,3 |
| **Average annual operation and maintenance cost, thous. euro/km** | **29,0** | |
| Heta demand of the total | 100% | |

| Activities | The length of supply lines, km | Relative length of supply lines, km | Heat selling, GWh/year | Heat buying, GWh/year |
|---|---|---|---|---|
| | | | 100% | 1,12 |
| Construction of heating supply network. Stage 1 | | | | |
| | 13,88 | 7,55 | 6,0 | 6,7 |
| | 13,88 | 8,24 | 12,8 | 14,3 |
| | 13,88 | 8,93 | 19,6 | 21,9 |
| | 13,88 | 9,91 | 29,1 | 32,6 |
| | 13,88 | 10,65 | 36,4 | 40,8 |
| | 13,88 | 11,57 | 45,5 | 50,9 |
| | 13,88 | 12,46 | 54,1 | 60,6 |
| | 13,88 | 13,22 | 61,6 | 69,0 |
| Construction of heating supply network. Stage 2 | 13,88 | 13,88 | 68,1 | 76,2 |
| | 25,11 | 20,18 | 75,9 | 85,0 |
| | 25,11 | 21,78 | 94,0 | 105,3 |
| | 25,11 | 23,24 | 110,7 | 124,0 |
| | 25,11 | 24,18 | 121,4 | 135,9 |
| Construction of heating supply network. Stage 3 | 25,11 | 25,11 | 132,0 | 147,8 |
| | 29,45 | 27,97 | 142,9 | 160,1 |
| | 29,45 | 28,42 | 150,1 | 168,1 |
| | 29,45 | 28,77 | 155,7 | 174,4 |
| | 29,45 | 29,02 | 159,7 | 178,9 |
| | 29,45 | 29,23 | 163,1 | 182,7 |
| | 29,45 | 29,45 | 166,6 | 186,6 |
| | 29,45 | 29,45 | 166,6 | 186,6 |
| | 29,45 | 29,45 | 166,6 | 186,6 |
| | 29,45 | 29,45 | 166,6 | 186,6 |
| | 29,45 | 29,45 | 166,6 | 186,6 |

| Year | Costs, mill. euro | | | | | Benefits, mill. euro. | | | | Cash flow, mill. euro | | Discount factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction | Heat buying cost | Operation and maintenance cost | Totel | | Heat selling revenues (turnover) | Residual value | Total | | | | |
| | Non-discounted | | | | Discounted | Non-discounted | | | Discounted | Non-discount. | Discounted | |
| 0 | 9,883 | | | 9,883 | 9,412 | | | | 0,000 | -9,883 | -9,412 | 0,9524 |
| 1 | | 0,251 | 0,219 | 0,470 | 0,426 | 0,416 | | 0,416 | 0,378 | -0,054 | -0,049 | 0,9070 |
| 2 | | 0,533 | 0,239 | 0,772 | 0,667 | 0,884 | | 0,884 | 0,764 | 0,112 | 0,097 | 0,8638 |
| 3 | | 0,815 | 0,259 | 1,074 | 0,883 | 1,352 | | 1,352 | 1,112 | 0,278 | 0,229 | 0,8227 |
| 4 | | 1,214 | 0,287 | 1,501 | 1,176 | 2,013 | | 2,013 | 1,577 | 0,512 | 0,401 | 0,7835 |
| 5 | | 1,517 | 0,308 | 1,826 | 1,362 | 2,516 | | 2,516 | 1,877 | 0,690 | 0,515 | 0,7462 |
| 6 | | 1,894 | 0,335 | 2,230 | 1,584 | 3,141 | | 3,141 | 2,232 | 0,912 | 0,648 | 0,7107 |
| 7 | | 2,254 | 0,361 | 2,615 | 1,770 | 3,738 | | 3,738 | 2,530 | 1,123 | 0,760 | 0,6768 |
| 8 | | 2,565 | 0,383 | 2,948 | 1,900 | 4,254 | | 4,254 | 2,742 | 1,306 | 0,842 | 0,6446 |
| 9 | 8,002 | 2,835 | 0,402 | 11,240 | 6,900 | 4,702 | | 4,702 | 2,886 | -6,538 | -4,014 | 0,6139 |
| 10 | | 3,162 | 0,585 | 3,746 | 2,190 | 5,243 | | 5,243 | 3,065 | 1,496 | 0,875 | 0,5847 |
| 11 | | 3,916 | 0,631 | 4,547 | 2,532 | 6,493 | | 6,493 | 3,616 | 1,947 | 1,084 | 0,5568 |
| 12 | | 4,611 | 0,673 | 5,285 | 2,803 | 7,647 | | 7,647 | 4,055 | 2,362 | 1,253 | 0,5303 |
| 13 | | 5,057 | 0,700 | 5,758 | 2,908 | 8,386 | | 8,386 | 4,235 | 2,628 | 1,327 | 0,5051 |
| 14 | 3,087 | 5,498 | 0,727 | 9,313 | 4,480 | 9,117 | | 9,117 | 4,386 | -0,196 | -0,094 | 0,4810 |
| 15 | | 5,955 | 0,810 | 6,765 | 3,099 | 9,875 | | 9,875 | 4,524 | 3,109 | 1,424 | 0,4581 |
| 16 | | 6,254 | 0,823 | 7,077 | 3,088 | 10,370 | | 10,370 | 4,524 | 3,293 | 1,437 | 0,4363 |
| 17 | | 6,486 | 0,833 | 7,320 | 3,041 | 10,755 | | 10,755 | 4,469 | 3,436 | 1,428 | 0,4155 |
| 18 | | 6,653 | 0,840 | 7,494 | 2,966 | 11,032 | | 11,032 | 4,366 | 3,539 | 1,400 | 0,3957 |
| 19 | | 6,797 | 0,847 | 7,643 | 2,881 | 11,270 | | 11,270 | 4,248 | 3,627 | 1,367 | 0,3769 |
| 20 | | 6,940 | 0,853 | 7,793 | 2,797 | 11,508 | | 11,508 | 4,131 | 3,715 | 1,333 | 0,3589 |
| 21 | | 6,940 | 0,853 | 7,793 | 2,664 | 11,508 | | 11,508 | 3,934 | 3,715 | 1,270 | 0,3418 |
| 22 | | 6,940 | 0,853 | 7,793 | 2,537 | 11,508 | | 11,508 | 3,747 | 3,715 | 1,209 | 0,3256 |
| 23 | | 6,940 | 0,853 | 7,793 | 2,416 | 11,508 | | 11,508 | 3,568 | 3,715 | 1,152 | 0,3101 |
| 24 | | 6,940 | 0,853 | 7,793 | 2,301 | 11,508 | 8,036 | 19,544 | 5,771 | 11,751 | 3,470 | 0,2953 |
| Iš viso | 20,973 | 102,970 | 14,527 | **138,469** | **68,785** | 170,741 | 8,036 | 178,777 | 78,736 | 40,307 | **9,951** | |

| | |
|---|---|
| Present value of costs (PVC), mill.euro | 68,79 |
| Present value of benefits (PVB), mill.euro | 78,74 |
| Net present value (NPV), mill. euro | 9,95 |
| Benefit and cost ratio B/C (PVB/PVC) | **1,14** |
| Internal rate of return (IRR), % | 9,50% |
| Discount rate | 5,00% |

## CBA analysis of "Obligatory" scenario

| Year | Costs, mill. euro | | | | | Benefits, mill. euro | | | | Cash flow, mill. euro | | Discount factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction costs | Heat buying costs | Operation and maintenance cost | Total Costs | | Heat selling revenues (turnover) | Residual value | Total Benefits | | | | |
| | Non-discounted | | | | Discounted | Non-discounted | | | Discounted | Non-disc. | Discounted | |
| 0 | 9,883 | | | 9,883 | 9,412 | | | | 0,000 | -9,883 | -9,412 | 0.9524 |
| 1 | | 0,251 | 0,219 | 0,470 | 0,426 | 0,416 | | 0,416 | 0,378 | -0,054 | -0,049 | 0.9070 |
| 2 | | 0,533 | 0,239 | 0,772 | 0,667 | 0,884 | | 0,884 | 0,764 | 0,112 | 0,097 | 0.8638 |
| 3 | | 0,815 | 0,259 | 1,074 | 0,883 | 1,352 | | 1,352 | 1,112 | 0,278 | 0,229 | 0.8227 |
| 4 | | 1,214 | 0,287 | 1,501 | 1,176 | 2,013 | | 2,013 | 1,577 | 0,512 | 0,401 | 0.7835 |
| 5 | | 1,517 | 0,308 | 1,826 | 1,362 | 2,516 | | 2,516 | 1,877 | 0,690 | 0,515 | 0.7462 |
| 6 | | 1,894 | 0,335 | 2,230 | 1,584 | 3,141 | | 3,141 | 2,232 | 0,912 | 0,648 | 0.7107 |
| 7 | | 2,254 | 0,361 | 2,615 | 1,770 | 3,738 | | 3,738 | 2,530 | 1,123 | 0,760 | 0.6768 |
| 8 | | 2,565 | 0,383 | 2,948 | 1,900 | 4,254 | | 4,254 | 2,742 | 1,306 | 0,842 | 0.6446 |
| 9 | 8,002 | 2,835 | 0,402 | 11,240 | 6,900 | 4,702 | | 4,702 | 2,886 | -6,538 | -4,014 | 0.6139 |
| 10 | | 3,162 | 0,585 | 3,746 | 2,190 | 5,243 | | 5,243 | 3,065 | 1,496 | 0,875 | 0.5847 |
| 11 | | 3,916 | 0,631 | 4,547 | 2,532 | 6,493 | | 6,493 | 3,616 | 1,947 | 1,084 | 0.5568 |
| 12 | | 4,611 | 0,673 | 5,285 | 2,803 | 7,647 | | 7,647 | 4,055 | 2,362 | 1,253 | 0.5303 |
| 13 | | 5,057 | 0,700 | 5,758 | 2,908 | 8,386 | | 8,386 | 4,235 | 2,628 | 1,327 | 0.5051 |
| 14 | 3,087 | 5,498 | 0,727 | 9,313 | 4,480 | 9,117 | | 9,117 | 4,386 | -0,196 | -0,094 | 0.4810 |
| 15 | | 5,955 | 0,810 | 6,765 | 3,099 | 9,875 | | 9,875 | 4,524 | 3,109 | 1,424 | 0.4581 |
| 16 | | 6,254 | 0,823 | 7,077 | 3,088 | 10,370 | | 10,370 | 4,524 | 3,293 | 1,437 | 0.4363 |
| 17 | | 6,486 | 0,833 | 7,320 | 3,041 | 10,755 | | 10,755 | 4,469 | 3,436 | 1,428 | 0.4155 |
| 18 | | 6,653 | 0,840 | 7,494 | 2,966 | 11,032 | | 11,032 | 4,366 | 3,539 | 1,400 | 0.3957 |
| 19 | | 6,797 | 0,847 | 7,643 | 2,881 | 11,270 | | 11,270 | 4,248 | 3,627 | 1,367 | 0.3769 |
| 20 | | 6,940 | 0,853 | 7,793 | 2,797 | 11,508 | | 11,508 | 4,131 | 3,715 | 1,333 | 0.3589 |
| 21 | | 6,940 | 0,853 | 7,793 | 2,664 | 11,508 | | 11,508 | 3,934 | 3,715 | 1,270 | 0.3418 |
| 22 | | 6,940 | 0,853 | 7,793 | 2,537 | 11,508 | | 11,508 | 3,747 | 3,715 | 1,209 | 0.3256 |
| 23 | | 6,940 | 0,853 | 7,793 | 2,416 | 11,508 | | 11,508 | 3,568 | 3,715 | 1,152 | 0.3101 |
| 24 | | 6,940 | 0,853 | 7,793 | 2,301 | 11,508 | 8,036 | 19,544 | 5,771 | 11,751 | 3,470 | 0.2953 |
| **Total** | 20,973 | 102,970 | 14,527 | **138,469** | **68,785** | 170,741 | 8,036 | **178,777** | **78,736** | **40,307** | **9,951** | |

| | |
|---|---|
| Present value of costs (PVC), mill. euro | 68,79 |
| Present value of benefits (PVB), mill. euro | 78,74 |
| **Net present value (NPV), mill. euro** | **9,95** |
| **Benefit and cost ratio B/C (PVB/PVC)** | **1,14** |
| **Internal rate of return (IRR)** | **9,50%** |
| Discount rate | 5,00% |

## Annex 6 Discounted cash flow analysis : CBA analysis of "Free Market" scenario

| Year | Costs, mill. euro | | | | | Benefits, mill. euro | | | | Cash flow, mill. euro | | Discount factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction costs | Heat buying costs | Operation and maintenance cost | Total Costs | | Heat selling revenues (turnover) | Residual value | Total Benefits | | | | |
| | Non-discounted | | | | Discounted | Non-discounted | | | Discounted | Non-disc. | Discounted | |
| 0 | 3,953 | | | 3,953 | 3,765 | | | | 0,000 | -3,953 | -3,765 | 0.9524 |
| 1 | | 0,201 | 0,175 | 0,376 | 0,341 | 0,211 | | 0,211 | 0,192 | -0,165 | -0,149 | 0.9070 |
| 2 | | 0,426 | 0,191 | 0,617 | 0,533 | 0,449 | | 0,449 | 0,388 | -0,169 | -0,146 | 0.8638 |
| 3 | | 0,652 | 0,207 | 0,859 | 0,707 | 0,686 | | 0,686 | 0,565 | -0,173 | -0,142 | 0.8227 |
| 4 | | 0,971 | 0,230 | 1,201 | 0,941 | 1,022 | | 1,022 | 0,801 | -0,179 | -0,140 | 0.7835 |
| 5 | | 1,214 | 0,247 | 1,461 | 1,090 | 1,277 | | 1,277 | 0,953 | -0,183 | -0,137 | 0.7462 |
| 6 | | 1,515 | 0,268 | 1,784 | 1,268 | 1,595 | | 1,595 | 1,133 | -0,189 | -0,134 | 0.7107 |
| 7 | | 1,803 | 0,289 | 2,092 | 1,416 | 1,898 | | 1,898 | 1,284 | -0,194 | -0,131 | 0.6768 |
| 8 | | 2,052 | 0,306 | 2,359 | 1,520 | 2,160 | | 2,160 | 1,392 | -0,199 | -0,128 | 0.6446 |
| 9 | 6,402 | 2,268 | 0,322 | 8,992 | 5,520 | 2,387 | | 2,387 | 1,465 | -6,605 | -4,055 | 0.6139 |
| 10 | | 2,529 | 0,468 | 2,997 | 1,752 | 2,662 | | 2,662 | 1,556 | -0,335 | -0,196 | 0.5847 |
| 11 | | 3,133 | 0,505 | 3,637 | 2,025 | 3,297 | | 3,297 | 1,836 | -0,341 | -0,190 | 0.5568 |
| 12 | | 3,689 | 0,539 | 4,228 | 2,242 | 3,882 | | 3,882 | 2,059 | -0,346 | -0,183 | 0.5303 |
| 13 | | 4,046 | 0,560 | 4,606 | 2,326 | 4,257 | | 4,257 | 2,150 | -0,349 | -0,176 | 0.5051 |
| 14 | 2,470 | 4,399 | 0,582 | 7,451 | 3,584 | 4,629 | | 4,629 | 2,227 | -2,822 | -1,357 | 0.4810 |
| 15 | | 4,764 | 0,648 | 5,412 | 2,479 | 5,013 | | 5,013 | 2,297 | -0,399 | -0,183 | 0.4581 |
| 16 | | 5,003 | 0,658 | 5,661 | 2,470 | 5,265 | | 5,265 | 2,297 | -0,397 | -0,173 | 0.4363 |
| 17 | | 5,189 | 0,667 | 5,856 | 2,433 | 5,460 | | 5,460 | 2,269 | -0,395 | -0,164 | 0.4155 |
| 18 | | 5,323 | 0,672 | 5,995 | 2,372 | 5,601 | | 5,601 | 2,217 | -0,394 | -0,156 | 0.3957 |
| 19 | | 5,437 | 0,677 | 6,115 | 2,305 | 5,722 | | 5,722 | 2,156 | -0,393 | -0,148 | 0.3769 |
| 20 | | 5,552 | 0,682 | 6,234 | 2,238 | 5,842 | | 5,842 | 2,097 | -0,392 | -0,141 | 0.3589 |
| 21 | | 5,552 | 0,682 | 6,234 | 2,131 | 5,842 | | 5,842 | 1,997 | -0,392 | -0,134 | 0.3418 |
| 22 | | 5,552 | 0,682 | 6,234 | 2,030 | 5,842 | | 5,842 | 1,902 | -0,392 | -0,128 | 0.3256 |
| 23 | | 5,552 | 0,682 | 6,234 | 1,933 | 5,842 | | 5,842 | 1,812 | -0,392 | -0,122 | 0.3101 |
| 24 | | 5,552 | 0,682 | 6,234 | 1,841 | 5,842 | 6,429 | 12,271 | 3,624 | 6,037 | 1,783 | 0.2953 |
| **Total** | 12,825 | 82,376 | 11,621 | **106,822** | **51,263** | 86,684 | 6,429 | **93,112** | **40,667** | **-13,710** | **-10,596** | |

| | |
|---|---|
| Present value of costs (PVC), mill. euro | 51,26 |
| Present value of benefits (PVB), mill. euro | 40,67 |
| **Net present value (NPV), mill. euro** | **-10,60** |
| **Benefit and cost ratio B/C (PVB/PVC)** | **0,79** |
| **Internal rate of return (IRR)** | **-9,03%** |
| Discount rate | 5,00% |

# Annex 7: Credit report on the company Kauno Energija (source Coface)and Dun & Bradstreet: country credit report on Lithuania

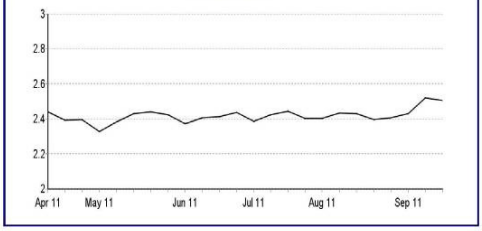
## Currency Information

**Exchange Rates**
(London, 19 Sep 11)

| | |
|---|---|
| EUR | 3.4528 |
| GBP | 3.9562 |
| JPY* | 3.2583 |
| USD | 2.5048 |

*(x 100)

**Local Currency**
(Litas [LTL]: USD)




**Local Currency**
(Litas [LTL]: USD)

| | Apr 11 | May 11 | Jun 11 | Jul 11 | Aug 11 | Sep 11 |
|---|---|---|---|---|---|---|
| Week 1 | 2.441 | 2.327 | 2.370 | 2.384 | 2.403 | 2.430 |
| Week 2 | 2.392 | 2.380 | 2.405 | 2.422 | 2.433 | 2.518 |
| Week 3 | 2.395 | 2.431 | 2.413 | 2.445 | 2.429 | 2.505 |
| Week 4 | | 2.440 | 2.438 | 2.404 | 2.395 | |
| Week 5 | | 2.421 | | | 2.405 | |

| FX/Bank Delays: | 0-2 months |
|---|---|

The average time between the placement of payment by the importer in the local banking system and the receipt of funds by the exporter. Such delays may be dependent on FX controls, FX availability and the efficiency of the local banking system.

**Trade & Commercial Environment**

Business risk in Lithuania continued to moderate in Q2. Even so, payment delays and delinquencies will be a concern into 2012. The availability of credit for companies and households is still relatively poor; in the first seven months of this year loans to non-financial corporations and households were down by an average of 8.0% and 4.2% year on year, respectively. The ratio of non-performing loans eased slightly (it stood at 19.1% in Q1 2011 and decreased to 18.4% in Q2 2011) but remained uncomfortably high. External liquidity could tighten in the months ahead, challenging some firms' ability to pay their liabilities in FX. We continue to recommend LC terms with Lithuania-based customers.

## Export Credit Agencies

| | |
|---|---|
| **US Eximbank** | Full cover available |
| **Atradius** | Full cover available |
| **ECGD** | Full cover available |
| **Euler Hermes UK** | Restrictions will apply |

## Economic Indicators

| | 2008 | 2009 | 2010e | 2011f | 2012f |
|---|---|---|---|---|---|
| **Real GDP growth, %** | 2.9 | -14.7 | 1.3 | 5.5 | 4.5 |
| **Inflation, annual ave, %** | 11.1 | 4.2 | 1.2 | 3.8 | 2.9 |
| **Govt balance, % GDP** | -3.3 | -9.5 | -7.1 | -5.3 | -3.5 |
| **Unemployment, %** | 5.8 | 13.7 | 17.8 | 16.5 | 14.5 |
| **C/A balance, % GDP** | -13.4 | 4.5 | 1.8 | 1.3 | 0.6 |

Inflation and unemployment are based on EU-harmonised data.

## Key Facts

| | |
|---|---|
| **Population**: | 3.4m |
| **Surface area (sq km)**: | 65,300 |
| **Capital**: | Vilnius |
| **Timezone**: | GMT +02:00 |
| **Official language**: | Lithuanian |
| **Head of government**: | Prime Minister Andrius KUBILIUS |
| **GDP (USD)**: | 37.0bn |
| **GDP per capita (USD)**: | 11,058 |
| **Life expectancy (years)**: | 71 |
| **Literacy (% of adult pop.)**: | 99.9 |

**Country Overview**:

Lithuania is located on the Baltic coast in Eastern Europe, bordering Latvia, Belarus, Poland and the Russian exclave around Kaliningrad. Since gaining independence in 1991, the small former Soviet republic has swapped communist rule for a market economy and democratic political institutions. However, a stable party system has yet to emerge, and fractious, multi-party coalition governments are the norm. A foreign-policy reorientation towards the West has been part of Lithuania's transition process, culminating in NATO and EU accession in 2004.

The country's overarching economic policy goal is to catch up with Western European living standards. Liberalised investment laws and progress in law enforcement have encouraged investment, which has helped to build up export-oriented manufacturing industries (including textiles, intermediate goods production and oil refining), along with financial services and transport companies. However, economic progress has so far bypassed many rural regions, resulting in rising internal income disparities and prompting emigration. Meanwhile, current economic slowdown have temporarily stopped the country's convergence with the Western Europe.

## Trade & Commercial Environment

### Trade Terms

| | |
|---|---|
| **Minimum Terms:** | SD |

The minimum form of documentation or trading method that D&B advises its customers to consider when pursuing export trade with the stated country.

| | |
|---|---|
| **Recommended Terms:** | LC |

D&B's recommended means of payment. The use of recommended terms, which are generally more stringent than minimum terms, is appropriate when a customer's payment performance cannot be easily assessed or when an exporter may wish to limit the risk associated with a transaction made on minimum terms.

| | |
|---|---|
| **Usual Terms:** | 15-30 days |

Normal period of credit associated with transactions with companies in the stated country.

### Transfer Situation

| | |
|---|---|
| **Local Delays:** | 0-2 months |

The time taken beyond agreed terms for a customer to deposit money in their local bank as payment for imports.

Decide with Confidence

D&B Country RiskLine Report

# LITHUANIA

**Region : Eastern Europe**
**Edition : September 2011**

## D&B Country Risk Indicator

**DB3c**

DB7 — DB1

**This "DB" Rating Indicates:**

**Slight risk**

Enough uncertainty over expected returns to warrant close monitoring of country risk. Customers should actively manage their risk exposures.

**Trend**

**Stable**

The country's overall risk profile has not changed appreciably, even though some minor changes to its political, commercial, economic and/or external risk environment may have occurred

The 'DB' risk indicator provides a comparative, cross-border assessment of the risk of doing business in a country and encapsulates the risk that country-wide factors pose to the predictability of export payments and investment returns over a two year time horizon. The 'DB' risk indicator is a composite index of four over-arching country risk categories:

*Political risk* - internal and external security situation, policy competency and consistency, and other such factors that determine whether a country fosters an enabling business environment;

*Commercial risk* - the sanctity of contract, judicial competence, regulatory transparency, degree of systemic corruption, and other such factors that determine whether the business environment facilitates the conduct of commercial transactions;

*External risk* - the current account balance, capital flows, FX reserves, size of external debt and all such factors that determine whether a country can generate enough FX to meet its trade and foreign investment liabilities;

*Macroeconomic risk* - the inflation rate, government balance, money supply growth and all such macroeconomic factors that determine whether a country is able to deliver sustainable economic growth to provide further expansion in business opportunities.

The DB risk indicator is divided into seven bands, ranging from DB1 through DB7. Each band is subdivided into quartiles (a-d), with an 'a' designation representing slightly less risk than a 'b' designation and so on. Only the DB7 indicator is not divided into quartiles.

detailed matter dealt with in compiling the information and the fact that some of the data are supplied from sources not controlled by D&B which cannot always be verified, including information provided direct from the subject of enquiry as well as the possibility of negligence and mistake, D&B does not guarantee the correctness or the effective delivery of the information and will not be held responsible for any errors therein or omissions therefrom.



Part of the balance of payments that records a nation's exports and imports of goods and services, and income and transfer payments.

DSR (debt service ratio), %:

Annual interest and principal payments on a country's external debts as a percentage of exports of goods and services.

Govt balance, % GDP:

The balance of government expenditure and receipts.

Real GDP growth, %:

GDP adjusted for inflation.

Inflation, %:

The increase in prices over a given period.

**GLOSSARY**

| | |
|---|---|
| CiA | Cash in Advance |
| CLC | Confirmed Letter of Credit |
| CWP | Claims Waiting Period |
| FX | Foreign Exchange |
| LC | Letter of Credit |
| LT | Long term |
| MT | Medium term |
| OA | Open Account |
| SD | Sight Draft |
| ST | Short term |

## Customer Service & Support



**D&B Country Risk Services**
For information relating to D&B's Country Risk Services.

UK
Telephone: 01628 492700
Fax: 01628 492929
Email: CountryRisk@dnb.com

USA Inquiry
Telephone: 1-800 234-3867 option 1, 1 and then 2
Email: CountryRiskServices@dnb.com

Rest of World
Telephone: +44 1628 492700
Email: CountryRisk@dnb.com

**D&B Customer Services**
For all other information or queries relating to D&B products and services.

UK
Telephone: 0870 243 2344 (UK) / 1 890 923296 (IR)
Email: CustomerHelp@dnb.com

USA
Telephone: 1-800 234-3867 option 1, 1 and then 2
Email: CustomerService@dnb.com

Rest of World
You can contact your local D&B Customer Services departments by clicking here.

Whilst D&B attempts to ensure that the information provided is accurate and complete, by reason of the immense quantity of

## Risk Factor

After an economically very impressive first half, when the economy expanded by an average real growth rate of 6.6% year on year (y/y), the second half of 2011 is set to put an end to positive economic surprises: the first signs of a gradual slowdown have already been spotted in the data. Thus, July's industrial production figures came in at their lowest level in 2011, which dragged the three-month moving average growth rate down to 10.4% y/y (it stood at 16.4% y/y at the beginning of the year); while exports and imports registered growth rates of 26.4% and 15.0% y/y respectively in July, down significantly from their January 2011 values of 59.5% and 61.1% y/y respectively. August's set of economic sentiment indicator values do not give any reason to expect July's comparatively weak data to be a singular phenomenon: the industrial confidence indicator dipped into negative territory in August (-4.8 points from July's 5.3) and the consumer confidence indicator continued on its downwards path (-17.1 points after July's -15.3) despite the further easing of inflationary pressure (4.4% y/y in August after 4.6% y/y in July).

The global, and more particularly the European economic backdrop (i.e. the euro-zone debt crisis and the economic slowdown amongst the core EU member states), poses a number of important risks to the Lithuanian economy which need to be watched carefully in the coming months. Among these risks are two which are particularly critical: exports are likely to weaken (exports represented nearly 70% of total GDP in 2010) and FDI may decrease (in Q1 2011 FDI from European countries stood at 86.6% of total FDI to Lithuania). A fall in FDI was already seen in July and may well continue over the coming months. The risks associated with decreasing external inflows are not negligible given Lithuania's high external debt levels. So far, there is no problem for the country to meet its recent FX-denominated debt payments, but the value of credit default swaps, used to insure against a possible default of Lithuania, remained high over the past weeks (in mid-September it stood at 260 basis points, up from 200 in early July).

Meanwhile, fiscal consolidation is under way; according to the latest data and news flow the full year 2011 budget deficit is expected to come in at 5.3% to GDP. This represents the worst performance of the three Baltic countries in 2011, but is still an improvement compared with the deficit of 7.1% in 2010. Next year should see a further improvement in the budget deficit to GDP ratio (we pencil in a deficit of 3.5% for 2012); the intended measures by the government will be supported by a decrease in the expenditures on social benefits (these represented 43% of the total budget revenues in Q2 2010 to Q1 2011) driven by a decline in the unemployment rate.

## Glossary & Definitions

**DEFINITIONS**

Minimum Terms:

The minimum form of documentation or trading method that D&B advises its customers to consider when pursuing export trade with the stated country.

Recommended Terms:

D&B's recommended means of payment. The use of recommended terms, which are generally more stringent than minimum terms, is appropriate when a customer's payment performance cannot be easily assessed or when an exporter may wish to limit the risk associated with a transaction made on minimum terms.

Usual Terms:

Normal period of credit associated with transactions with companies in the stated country.

Local Delays:

The time taken beyond agreed terms for a customer to deposit money in their local bank as payment for imports.

F/X Bank Delays:

The average time between the placement of payment by the importer in the local banking system and the receipt of funds by the exporter. Such delays may be dependent on FX controls, FX availability and the efficiency of the local banking system.

C/A (current account) balance, % GDP:

## Industrial Production Growth


| Data Table | | | | | | |
|---|---|---|---|---|---|---|
| Jan 11 | Feb 11 | Mar 11 | Apr 11 | May 11 | Jun 11 | Jul 11 |
| 8.7 | 9.9 | 11.0 | 11.45 | 11.8 | 12.0 | 12.2 |

legal actions occur. - Payments stopped.

**Coface Sector Rating**

| | |
|---|---|
| A+, A, A- | In a good sector economic environment with robust corporate financial health, payment behaviour has been satisfactory. Corporate default probability is low on average. |
| B+, B, B- | The essentially good economic environment in the sector could experience short-term deterioration with negative consequences on corporate financial health. Payment behaviour has been generally satisfactory and default probability acceptable. |
| C+, C, C- | In a very uncertain economic environment with vulnerable corporate financial health, payment behaviour is relatively poor. Default probability is high enough to cause concern. |
| D | With a very poor economic environment prevailing in the sector, weakened corporate financial health gives rise to generally bad payment behaviour. Default probability is high. |

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The information and/or data provided are subject to the general terms and conditions or individual contract terms and may be used only for the purpose they have been requested for.

Thank you for using our services.
In case of any additional questions please contact our Credit Information and Analysis Department:
Coface Credit Management Services UAB
Vilniaus g. 23-3
01402 Vilnius
Tel.: + 370 (5) 263 99 79
Fax : +370 (5) 263 99 76
E-mail: reports@coface.lt

*** End of document ***

| | |
|---|---|
| **Contact With Company:** | 06.09.2011: Information was received from all the sources available. |
| **Additional information:** | Hypotec fact registered as at 30.08.2011 |
| **Registered Court Cases:** | 24.08.2011 416 record(-s) about the civil cases sessions where this company has participated as a defendant or plaintiff are registered in the official sources. The date above is the date of the latest record. |

## CODES AND DEFINITIONS

**Credit Rating**

| | |
|---|---|
| 10 | Excellent risk |
| 9 | Very low risk |
| 8 | Low risk |
| 7 | Moderate risk |
| 6 | Acceptable risk |
| 5 | Medium high risk |
| 4 | Significant risk |
| 3 | High risk |
| 2 | Very high risk of insolvency |
| 1 | Extremely high risk of insolvency |
| 0 | Insolvency/preliminary/debt regulation proceedings |

**Payment Practices**

Payments are made very correctly. - According to our experiences payments are made regularly. - Payments are made mostly according to terms - Payments are made irregularly. - Payments are made slowly. - Payments are made very slowly. - Payments are extremely slow, constantly

SWEDBANK AB
09308 Vilnius, Konstitucijos rd. 20A

**Ratios:**

| | 2010 | 2009 | 2008 | 2007 |
|---|---|---|---|---|
| **Return on sales ( ROS ), in%** *(Profit after tax / Sales)*100* | 2,38 | 2,88 | -2,31 | -6,19 |
| **Operating margin, in %** *Operating result / Sales* | 2,29 | 3,71 | -1,09 | -5,82 |
| **Return on equity (ROE), in %** *(Profit after tax / Equity capital)*100* | 1,43 | 2,38 | -3,72 | -7,20 |
| **Current assets turnover** *Sales income / Current assets* | 3,51 | 3,86 | 2,82 | 3,20 |
| **Working capital** *Current assets - Current amounts payable and liabilities* | -6.105.000 | 2.839.000 | -7.409.000 | -9.545.000 |
| **Leverage** *Long Term Liabilities / Total Equity* | 0,63 | 0,68 | 0,48 | 0,55 |
| **Current ratio** *(Short-term assets / Short term liabilities)* | 0,93 | 1,04 | 0,91 | 0,85 |
| **Quick ratio** *[(Short-term assets - Inventory) / Short-term liabilities]* | 0,87 | 0,96 | 0,83 | 0,74 |
| **Debt-to-equity ratio** *Amounts payable and liabilities / Equity* | 0,51 | 0,48 | 1,10 | 0,83 |
| **Equity ratio, in %** *(Equity / Total Assets)* 100* | 63,47 | 67,58 | 47,65 | 54,64 |

**ADDITIONAL INFORMATION**

| | | | | | |
|---|---|---|---|---|---|
| | **ACTIVITIES** | | | | |
| 1. | Income | 2.024.000,00 | | | |
| 2. | Expenses | 2.897.000,00 | | | |
| **VIII.** | **PROFIT (LOSS) FROM NORMAL ACTIVITIES** | **7.258.000,00** | **8.071.000,00** | **-4.779.000,00** | **-10.492.000,00** |
| **IX.** | **PROFIT (LOSS) BEFORE TAX** | **7.258.000,00** | **8.071.000,00** | **-4.779.000,00** | **-10.492.000,00** |
| X. | PROFIT TAX | 3.521.000,00 | 1.895.000,00 | 436.000,00 | 1.871.000,00 |
| **XI.** | **NET PROFIT (LOSS)** | **3.737.000,00** | **6.176.000,00** | **-4.343.000,00** | **-8.621.000,00** |

**Approximate Exchange Rates:**
2009: 3,4528 LTL = 1 EUR
2008: 3,4528 LTL = 1 EUR
2007: 3,4528 LTL = 1 EUR
2006: 3,4528 LTL = 1 EUR
2007: 2,523 LTL = 1 USD
2006: 2,7513 LTL = 1 USD

**Financial data source:**
2010: Financials obtained from an official source
2009: Financials obtained from an official source
2008: Financials obtained from an official source
2007: Financials obtained from an official source

**Bankers:**
SEB BANKAS AB
01103 Vilnius, Gedimino ave. 12

| | | | | | |
|---|---|---|---|---|---|
| 3. | Trade amounts payable | 60.977.000,00 | | | |
| 4. | Amounts received in advance | 571.000,00 | | | |
| 5. | Liabilities related with labour relations | 1.712.000,00 | | | |
| 6. | Provisions | 237.000,00 | | | |
| 7. | Other amounts payable and current liabilities | 909.000,00 | | | |
| | **TOTAL EQUITY AND LIABILITIES:** | **410.541.000,00** | **383.252.000,00** | **244.782.000,00** | **219.198.000,00** |
| | **PROFIT AND LOSS** | | | | |
| **I.** | **SALES INCOME** | **305.441.000,00** | **280.712.000,00** | **206.555.000,00** | **169.373.000,00** |
| **II.** | **COST OF SALES** | **298.437.000,00** | **270.296.000,00** | **208.815.000,00** | **179.226.000,00** |
| III. | GROSS PROFIT (LOSS) | 7.004.000,00 | 10.416.000,00 | -2.260.000,00 | -9.853.000,00 |
| IV. | OPERATING COSTS | 0,00 | | | |
| **V.** | **OPERATING PROFIT (LOSS)** | **7.004.000,00** | **10.416.000,00** | **-2.260.000,00** | **-9.853.000,00** |
| VI. | OTHER ACTIVITIES | 1.127.000,00 | | | |
| 1. | Income | 1.935.000,00 | | | |
| 2. | Expenses | 808.000,00 | | | |
| **VII.** | **FINANCING AND INVESTING** | **-873.000,00** | **-2.345.000,00** | **-2.519.000,00** | **-639.000,00** |

| | | | | | |
|---|---|---|---|---|---|
| | **LIABILITIES** | | | | |
| **I.** | **NON-CURRENT AMOUNTS PAYABLE AND LIABILITIES** | **40.034.000,00** | **54.284.000,00** | **47.415.000,00** | **37.036.000,00** |
| 1. | Financial debts | 31.811.000,00 | | | |
| a) | Liabilities to credit institutions | 31.811.000,00 | | | |
| 2. | Trade amounts payable | 3.000,00 | | | |
| 3. | Amounts received in advance | 407.000,00 | | | |
| 4. | Provisions | 1.593.000,00 | | | |
| a) | Provisions for pensions and similar obligations | 1.593.000,00 | | | |
| 5. | Deferred tax liabilities | 6.220.000,00 | | | |
| **II.** | **CURRENT AMOUNTS PAYABLE AND LIABILITIES** | **93.132.000,00** | **69.965.000,00** | **80.740.000,00** | **62.392.000,00** |
| 1. | Current portion of non-current debts | 13.703.000,00 | | | |
| 2. | Financial debts | 15.023.000,00 | | | |
| a) | Liabilities to credit institutions | 15.023.000,00 | | | |
| b) | Other debts | 0,00 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | subsidiaries and associates | | | | |
| 3. | Other amounts receivable | 5.596.000,00 | | | |
| **III.** | **OTHER CURRENT ASSETS** | **0,00** | | | |
| **IV.** | **CASH AND CASH EQUIVALENTS** | **3.524.000,00** | **3.095.000,00** | **3.604.000,00** | **4.864.000,00** |
| | **TOTAL ASSETS:** | **410.541.000,00** | **383.252.000,00** | **244.782.000,00** | **219.198.000,00** |
| | **EQUITY AND LIABILITIES** | | | | |
| **A.** | **EQUITY** | **260.585.000,00** | **259.003.000,00** | **116.627.000,00** | **119.770.000,00** |
| I. | CAPITAL | 256.392.000,00 | 255.710.000,00 | 119.510.000,00 | 118.310.000,00 |
| 1. | Authorised (subscribed) capital | 256.392.000,00 | 255.710.000,00 | 119.510.000,00 | 118.310.000,00 |
| II. | RESERVES | 448.000,00 | | 2.808.000,00 | 11.323.000,00 |
| 1. | Legal reserve | 448.000,00 | | | |
| III. | RETAINED EARNINGS (LOSSES) | 3.745.000,00 | 3.293.000,00 | -5.691.000,00 | -9.863.000,00 |
| 1. | Profit (loss) of the reporting year | 3.737.000,00 | | | |
| 2. | Profit (loss) of the previous year | 8.000,00 | | | |
| B. | GRANTS AND SUBSIDIES | 16.790.000,00 | | | |
| **C.** | **AMOUNTS PAYABLE AND** | **133.166.000,00** | **124.249.000,00** | **128.155.000,00** | **99.428.000,00** |

| | | | | | |
|---|---|---|---|---|---|
| | assets | | | | |
| **III.** | **FINANCIAL ASSETS** | **5.856.000,00** | **6.278.000,00** | **6.551.000,00** | **7.068.000,00** |
| 1. | Investments in subsidiaries and associates | 5.558.000,00 | | | |
| 2. | Amounts receivable after one year | 61.000,00 | | | |
| 3. | Other financial assets | 237.000,00 | | | |
| IV. | OTHER NON-CURRENT ASSETS | 0,00 | | | |
| **B.** | **CURRENT ASSETS** | **87.027.000,00** | **72.804.000,00** | **73.331.000,00** | **52.847.000,00** |
| **I.** | **INVENTORIES, PREPAYMENTS AND CONTRACTS IN PROGRESS** | **5.742.000,00** | **5.548.000,00** | **6.040.000,00** | **6.810.000,00** |
| 1. | Inventories | 5.144.000,00 | | | |
| a) | Raw materials and components | 5.144.000,00 | | | |
| 2. | Prepayments | 598.000,00 | | | |
| **II.** | **AMOUNTS RECEIVABLE WITHIN ONE YEAR** | **77.761.000,00** | **64.160.000,00** | **63.687.000,00** | **41.173.000,00** |
| 1. | Trade amounts receivable | 71.944.000,00 | | | |
| 2. | Receivables from | 221.000,00 | | | |

Type of premises: Premises
Type of ownership: unkown

**FINANCIAL INFORMATION**

**Financials:**

| | Amounts shown in Lithuanian Lit (LTL) | 2010 | 2009 | 2008 | 2007 |
|---|---|---|---|---|---|
| | **BALANCE SHEET** | | | | |
| | **ASSETS** | | | | |
| **A.** | **NON-CURRENT ASSETS** | **323.514.000,00** | **310.448.000,00** | **171.451.000,00** | **166.351.000,00** |
| **I.** | **INTANGIBLE ASSETS** | **614.000,00** | **1.172.000,00** | **1.683.000,00** | **2.448.000,00** |
| 1. | Other intangible assets | 614.000,00 | | | |
| **II.** | **TANGIBLE ASSETS** | **317.044.000,00** | **302.998.000,00** | **163.217.000,00** | **156.835.000,00** |
| 1. | Buildings and constructions | 258.309.000,00 | | | |
| 2. | Plant and equipment | 42.694.000,00 | | | |
| 3. | Vehicles | 404.000,00 | | | |
| 4. | Other property, plant and equipment | 5.456.000,00 | | | |
| 5. | Construction in progress | 10.181.000,00 | | | |
| 6. | Investment | 0,00 | | | |

| | | | | |
|---|---|---|---|---|
| Operating result - loss | 0 | 0 | 2.260.000 | 9.853.000 |

**Workforce:**

| | 2011 | 2010 | 2009 | 2008 |
|---|---|---|---|---|
| Total workforce | 551 - 570 | 510 | 510 - 540 | 540 - 570 |

**Motor Vehicles:**

| | 2011 | 2010 | 2009 |
|---|---|---|---|
| Number of motor vehicles | owned: 79 | | |
| Number of cars | | partly owned / partly rented: 84 | unkown: 80 |
| Total number of vehicles | 79 | 84 | 80 |

**Real Estate:**

Office
Address:
Raudondvario ave. 84
3021 Kaunas
Lithuania

Type of ownership: owned

Production premises
Address:
Raudondvario ave. 84
3021 Kaunas
Lithuania

Type of ownership: owned

**Premises:**

Address:
Raudondvario ave. 84
3021 Kaunas
Lithuania

**Subject of Operation:** NACE
main activity:
4291 Construction of water projects

3600 Water collection, treatment and supply
3530 Steam and air conditioning supply

Heat and electricity production and supply, heat and hot water systems maintenance.
NACE codes given are based on the most recent NACE Revision 2.

The company is active in the Coface sector 'Construction'.

Note: the Coface Sector Rating for this industry in the emerging markets of CEE is 'B+' (Last rating: 'B+')

Comment to Production: This sector is currently experiencing a strong decrease.
Comment to Consultancy: This sector is currently experiencing a strong decrease.
Comment to Service: This sector is currently experiencing a strong decrease.

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**Key Data:**

Amounts shown in Lithuanian Lit (LTL)

| | 2010 | 2009 | 2008 | 2007 |
|---|---|---|---|---|
| Turnover | 305.441.000 | 280.712.000 | 206.555.000 | 169.373.000 |
| NON-CURRENT ASSETS | 323.514.000 | 310.448.000 | 171.451.000 | 166.351.000 |
| EQUITY | 260.585.000 | 259.003.000 | 116.627.000 | 119.770.000 |
| Liabilities | 133.166.000 | 124.249.000 | 128.155.000 | 99.428.000 |
| Profit after taxation | 3.737.000 | 6.176.000 | 0 | 0 |
| Loss after taxation | 0 | 0 | 4.343.000 | 8.621.000 |
| Operating result - profit | 7.004.000 | 10.416.000 | 0 | 0 |

| Other known functions of **ZALAGENAITE Zita** | |
|---|---|
| Member of the executive board | DOBILAS SIUVIMO AB (LT)<br>National ID: 133248253 |

| Other known functions of **Simkus Mindaugas** | |
|---|---|
| Director | MAXIMA UAB (LT)<br>National ID: 132477256 |

| Other known functions of **Gatautis Ramunas** | |
|---|---|
| Member of the executive board | BUSTO VALDA UAB (LT)<br>National ID: 132125543 |

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**Related Companies:**

Branch
AKCINES BENDROVES "KAUNO ENERGIJA" FILIALAS KAUNO ELEKTRINE , Lithuania , National ID: 132285793

Branch
AKCINES BENDROVES "KAUNO ENERGIJA" FILIALAS "KAUNO SILUMOS TINKLAI" , Lithuania , National ID: 132751216

Branch
AKCINES BENDROVES "KAUNO ENERGIJA" FILIALAS "KAUNO ENERGIJOS" PASLAUGOS , Lithuania , National ID: 135187774

Branch
JURBARKO SILUMOS TINKLAI, AB KAUNO ENERGIJA filialas , Lithuania , National ID: 158244227

Branch
NAUJASODZIO ENERGIJA AB KAUNO ENERGIJA FILIALAS , Lithuania , National ID: 135050537

Branch
UAB "NAUJASODZIO ENERGIJOS PASLAUGOS" DARBUOTOJU PROFESINE SAJUNGA , Lithuania , National ID: 260445640

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**KEY DATA ON OPERATIONS**

| | | | |
|---|---|---|---|
| Registration: Lithuania | | Kaunas<br>Lithuania | |
| Jurbarko rajono savivaldybes administracija<br>Registration: Lithuania | Shareholder | Darius and Girenas str. 96<br>Jurbarkas<br>Lithuania | 1,51% |

**Management:**

| Full Name | Function | Address |
|---|---|---|
| AUGONIS Arvydas | Chairman of the executive board | |
| BAKAS Rimantas<br>Nationality: LT | Member of the executive board | |
| CIZIKAS Gintaras | Member of the executive board | |
| GATAUTIS Ramunas<br>Nationality: LT | Member of the executive board | |
| SIMKUS Mindaugas<br>Nationality: LT | Member of the executive board | |
| STANKEVICIUS Andrius | Member of the executive board | |
| ZALAGENAITE Zita<br>Nationality: LT | Member of the executive board | |
| BAKAS Rimantas<br>Nationality: LT | General director | |

**Former Management:**

| Full Name | Function | Address |
|---|---|---|
| SLEZAS Antanas<br>Nationality: LT | Former Managing director (signature right) | |

**Person functions in other companies:**

| Function | Company |
|---|---|

| | |
|---|---|
| **Payment Practices:** | Payments are made mostly according to terms |
| **Debt Collection:** | There is no record of any debt collection action by Coface Credit Management Services UAB against this company exceeding a single case volume of EUR 500. |

## COMPANY DETAILS

| | |
|---|---|
| **Established:** | 22.08.1997 |
| **Registration:** | No. 235014830<br>01.07.2004<br>Kaunas State Register, Lithuania |
| **Legal Form:** | 22.08.1997<br>Private Joint-Stock Company |
| **Capital:** | **Nominal capital:** **LTL 256.392.000,00**<br>**Changed from:** LTL 255.710.000,00 since |

**Shareholders:**

| Full Name | Function | Address | Equity capital |
|---|---|---|---|
| KAUNO MIESTO SAVIVALDYBES ADMINISTRACIJA<br>Registration: No. 188764867, Lithuania | Shareholder | Laisves ave. 96<br>44251 Kaunas<br>Lithuania | 93,00% |
| Kauno rajono savivaldybes taryba | Shareholder | Savanoriai pr. 371 | 3,77% |

| | |
|---|---|
| | **ICON number:** 80943550<br>**National ID:** 235014830<br>VAT number: LT350148314 |
| | Registration status: 01.07.2004 - registered company<br>Activity status: 01.07.2004 - active company |
| **Date of Last Research:** | 06.09.2011 |

## CREDIT INFORMATION SUMMARY

**Insolvency Information:** According to available information sources the company is not in a insolvency/preliminary/debt regulation proceeding.

**Maximum Credit:** EUR 2.500.000,00

Coface Central Europe Group defined a Maximum Credit of EUR 2.500.000 as the general upper limit for a suppliers' credit. The Maximum Credit computed for the company in question would exceed this upper limit.

Maximum Credit is to be understood as the highest possible engagement for a supplier delivering goods or rendering services on open terms with an average respite of 60 days. (It is assumed that, on the average, the company in question has 5 suppliers, who deliver goods or render services at the same time.)

**Credit Rating:** 7 - Moderate risk

| Insolvency / preliminary / debt regulation proceedings | Very High Risk | | | Medium High Risk | | Low Risk | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | | | | | | ▲ | | | |

**Annex 7 :**

**Credit report on the company Kauno Energija (source Coface ) and Dun Bradstreet country credit report on Lithuania.**


email: infoline@coface.lt
28.09.2011 13:23

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**Order Details:** Customer: Credit Card Payment

Order number: 260098
Delivery speed: Immediate
Language: English

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**COMPANY REPORTED**

**International Name: KAUNO ENERGIJA JSC**
**KAUNO ENERGIJA AB**

**Principal Address:**
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**47179 Kaunas**
**Lithuania**
**Telephone: +370-37-305650, +370-37-305800**
**Fax: +370-37-305622**
**Email: info@kaunoenergija.lt**
**Web: www.kaunoenergija.lt**

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