Univerzita Karlova v Praze

Fakulta sociálních věd

Institut ekonomických studií

Diplomová práce

2010 **Prokop Tošovský**

Univerzita Karlova v Praze
Fakulta sociálních věd

Institut ekonomických studií

DIPLOMOVÁ PRÁCE

Renewable Energy Sources and Project Evaluation

Vypracoval: Prokop Tošovský
Vedoucí: Doc. Ing. Oldřich Dědek, CSc.
Akademický rok: 2009/2010

Prohlášení

Prohlašuji, že jsem diplomovou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu.

V Praze dne

PODĚKOVÁNÍ

Na tomto místě bych rád poděkoval doc. Ing. Oldřichu Dědkovi, CSc., vedoucímu této práce, za konzultace a cenné připomínky. Dále děkuji všem svým blízkým za podporu a trpělivost.

Abstract

Firstly, this paper describes the European and particularly the Czech energy policy that aims to foster projects using renewable energy sources. The different European systems for supporting production of electricity from renewable energy sources are specifically discussed. These systems can be grouped into price-based and market-based systems and the specific rules usually differ from country to country. The Czech Republic uses the price-based system based on feed-in tariffs (green bonuses). The laws which support the production of electricity from renewable energy sources (particularly combined heat and power plants) are mentioned, focusing mainly on the description of the feed-in tariff system currently applied in the Czech Republic. An evaluation of a concrete project, combined heat and power plant using renewable sources of energy (biomass) as fuel, is carried out in the second part of the paper. This practical section uses the theoretical background and information given in the first part of the paper.

Abstrakt

Práce popisuje evropskou a českou energetickou politiku, která se zaměřuje na podporu projektů využívajících obnovitelné zdroje energie. Zejména jsou diskutovány různé systémy na podporu výroby elektřiny z obnovitelných zdrojů energie, které jsou uplatněny v Evropské unii. Tyto systémy mohou být rozděleny do skupin podle podpory založené na systému výkupních cen a na systému kvót, přičemž platí, že specifická pravidla podpory se obvykle liší stát od státu. Česká republika využívá systém podpory založený na pevně stanovených výkupních cenách, resp. zelených bonusech. V práci jsou diskutovány zákony vztahující se k podpoře výroby elektřiny z obnovitelných zdrojů energie (zejména podpora kombinované výroby elektřiny a tepla) s důrazem na popis systému pevných výkupních cen uplatňovaný v současné době v ČR. Hodnocení konkrétního projektu, zařízení na kombinovanou výrobu tepla a energie, který využívá obnovitelný zdroj energie (biomasu) jako palivo je provedeno v druhé části práce. Praktická část využívá teoretických východisek a informací uvedených v první části práce.

Abbreviations

CF	Cash Flow
CHP	Combined Heat and Power
DCF	Discounted Cash Flow
ERO	Energy Regulatory Office
EU	European Union
FCFE	Free Cash Flow to Equity
FCFF	Free Cash Flow to Firm
GWh	Gigawatt Hour
$kW_{el.}$	Kilowatt Electrical
$kW_{th.}$	Kilowatt Thermal
MC	Marginal Costs
$MW_{el.}$	Megawatt Electrical
$MW_{th.}$	Megawatt Thermal
NPV	Net Present Value
RES	Renewable Energy Sources
RES-E	Electricity from Renewable Energy Sources
UNFCCC	United Nations Framework Convention on Climate Change
WACC	Weighted Average Cost of Capital

1 Introduction

The aim of this thesis is to evaluate a project – the combined heat and power plant that uses renewable sources of energy (biomass) as a fuel. In the paper, I will analyze the project and give my results to the investor, Zemcheba s.r.o., addressing the question of whether the project (as described in detail in chapter 4) should be accepted or rejected. The projects that use renewable energy sources are usually supported by the green policy and this support is one of the most important factors for investors to enter into the renewable energy business and to launch similar projects. The world, European and Czech energy policies that lead to fostering projects that use renewable energy sources are described in the first part of the paper.

The world green policy is usually aimed at minimalizing the negative impact of the climate change on the world. The current climate change is a real issue that challenges many political leaders all over the world. The politicians and governments have realized that the support of the green policy is crucial for future sustainable, economic and environmental development therefore, they try to specify the concrete goals that should be achieved. Chapter 2 outlines the arguments that justify the support of renewable energy sources and provides binding documents focused on achieving the realistic goals in the green policy which have already been agreed upon.

An active role in fighting the climate change has also been incorporated into different European policies and support for the use of renewable sources in power generation has now become the aim of the European Union. It is one of the key factors in energy policy. To achieve this goal, the European Commission and similarly all Member States, have adopted ambitious targets regarding the use of renewable energy sources. These goals can be achieved by establishing support systems that can help to eliminate the primary disadvantages of renewable energy sources. These systems can be grouped into price-based and market-based systems and the specific rules applied in both approaches usually differ from country to country. These different systems and their advantages and disadvantages are described in chapter 2.3.

The concrete support that an investor may receive, while building and operating a combined heat and power plant from biomass in the Czech Republic, is described in chapter 2.4. The trends in production of electricity from renewable energy sources are also mentioned. There is emphasis on legislative support for combined heat and power plants, with a detailed description of the feed-in tariff system currently used in the Czech Republic.

An investment must be evaluated in accordance to certain criteria and these specific criteria are briefly described in chapter 3 and are used in the project evaluation of this paper.

Chapter 4 of this thesis is the evaluation of the actual project itself. The theoretical background, valid Acts and numbers described in chapters 1-3 are then applied to the calculation and the results are discussed in detail.

The final section states the conclusions derived from the information and evidence provided in the first part of this work. The question of whether or not Zemcheba s.r.o. should invest in a combined heat and power plant is answered and possible disadvantages of the project are addressed.

2 General views of using renewable sources of energy

Nowadays, there is a big discussion about the supporting of renewable energy sources (RES) going on and the crucial question for governments usually arise, whether there are any theoretical grounds that can justify the state supporting of renewable sources. These questions have been broadly discussed by different authors, we may mentioned for example Kloz et al. (2007) and Kramer et al. (2005), Menanteau (2003), Fouquet and Johansson (2008) and others.

The following arguments are usually mentioned for fostering of renewable energy sources:

- If the power is produced from RES it leads to less damage to environment than conventional sources electricity production (RES produce little or no waste products such as additional carbon dioxide or other chemical pollutants, and therefore have minimal impact on the environment). It means that the RES contribute to preservation of clean air and world climate stability. However, since environmental is a public good and non-excludable, the private persons are usually not willing to invest in something which can everybody use free of charge. This may be seen also in the Czech Republic where the additional optional fee (0,10 CZK/kWh) for supporting "Green energy" offered by company ČEZ a.s. was paid by approximately two thousand customers from total amount of 3.7 million customers in 2009. Taking this into account, the distribution of electricity from renewable energy sources (RES-E) should be regulated and thus it should be ensured that the positive public good will be spread in the market and there will be no free-riders.

- The great deal of electricity is produced by burning the fossil fuels. However, these resources are limited and there is general consensus that will be exploited in several decades, which will inevitably lead to usage of the RES earlier or later. Contrarily, RES are long-term sustainable and therefore will never run out.

- The growing dependence of economies and societies on access to abundant and currently cheap energy from abroad means that the state (society) is energetically dependent on the external sources. It means that securing enough electricity for inhabitants is generally accepted as a commitment that states should fulfil. We may see from the history that global energy markets can be easily distorted by distrust, rivalry and power maneuvering (consider the OPEC oil embargo in 1973, the gas crisis in Europe in 2008). Since the electricity produced from RES is usually dispread near the place of its production it strengthens the energetic safety of the region and the state. Moreover, it brings economic benefits to different regional areas, as most projects are located away from large urban centres and suburbs of the capital cities.

Speaking about the using renewable energy sources namely biomass as fuel we may add several other advantages (positive public goods):

- Burning wooden chips, straw, sawdust or biological or municipal waste enables to use all this kind of material and transform it into the power and heat. Thus, also the possible bad smell is diminished and the protection of surface and ground water is ensured. However, the burning has to be done according to precisely specified rules ensuring that the emissions do not influence the living standard of the people having their homes near the power plants.
- Using the land for a production of biomass also means utilizing the sources of nature that would be otherwise left without any usage: the land in the country is practically used and allows agriculture companies to reasonably utilize their resources not only for food production but also to produce energy crops (willow, poplar, grasses such as Miscanthus, or the main field-crops) suitable for energy production. Hence, the diversification of the field production can be achieved.

However, several technical problems arise in connection with using technology for production of RES-E:

- Relatively quite high investment cost of the production units. These high investment costs are set because the technology for production of RES-E is generally not used for such a long time as the technology for conventional sources. The production of these units is usually also quite complicated.
- Low concentration of sources leads to less efficiency. Nowadays, the conventional sources of energy may produce reasonably more $kW_{el.}$ per 1 m^2 comparing to plants producing RES-E.
- The problem of inequality of production – the consumption of energy is systematic and changing over the time, so we cannot be totally dependent on RES-E (especially solar energy or wind energy), because production of energy from these sources derives from the current climatic conditions.

The governments all over the world discussed the above mentioned arguments and decided to support the RES (the world policy is described in chapter 2.1) by different tools. The governments usually take into consideration that the conventional energy production has benefited from the quite a long time of mass production; on the other hand the renewable energy technology is relatively young and still in process of development. Hence, if the technological progress can be achieved in the renewable technologies, they could compete with the non-renewable sources (fossil fuel, gas, nuclear fuel) later on.

Probably the most efficient solution for achieving the fair competition would be to impose the environmental tax on the non-renewable sources. However, this solution is not socially and politically acceptable and it also does not have to lead automatically to the sufficient progress in renewable technologies. The problem is also how exactly is possible to measure the cost of the public damage resulting from burning of fossil fuels and/or the value of the public goods preserved resulting from using the RES, in terms of an air quality or the climate change. The measurement and valuation of the negative externalities such as pollutions, climate change, energy dependency etc. is difficult to carry out and thus computing the appropriate energy tax is uneasy and quite problematic.

Even if we consider an appropriate support to RES that equalize the social costs it will still not guarantee the dynamic process of creating the sufficient development and diffusion of renewable technologies, because the technologies are quite new and have to compete with already developed and proved traditional technologies and thus the renewable technologies remain in the unfavourable position. These RES technologies do not represent the optimal reliability and costs structure, when they enter the market, due to the lack of experience with them. The optimum result of such technologies may be achieved by producing renewable energy in the long-term and on a mass scale. It may be the case that the reason for not adopting the new technology is that the technology is inefficient, however once technology is adopted it becomes efficient.

As a consequence, the different incentives for electricity producers to adopt the new renewable energy technologies are given by the state green policy.

These incentives can be generally divided into two systems: systems based on price approach, where the operators are forced to purchase electricity produced from renewable energy sources on the guaranteed price (feed-in tariffs) and systems based on quantity-approach where the public authorities gives an objective of the electricity amount from renewable sources to be reached and organize the market for the players to be able to achieve this goal. The different methods of supporting will be discussed in chapter 2.2.

2.1 World policy

The most important scientific intergovernmental body that significantly influences the global (national) responses to climatic change is the Intergovernmental Panel on Climate Change[1]. This international panel has warned political elites against the high cost of the global change and estimates it as high as $1.9 trillion annually (in today's dollars prices) by 2100[2]. There was quite a long discussion about the report and mainly because of the warning mentioned in the document the world political leaders finally came into conclusion that some steps regarding the green policy should be taken.

2.1.1 International treaties and measures

One of the first steps in the world fight against climatic changes was taken in June 1992, when United Nations Conference on Environment and Development was held in Rio de Janeiro in Brazil. The common attitude towards this problem was found after a heated debate and all the parties agreed on the document The United Nations Framework Convention on Climate Change (UNFCCC). This agreement came into force in 1994 and it has been ratified by 192 countries of the world.

UNFCCC was the very first international treaty that called for regulation of greenhouse gases production and therefore serves as a basic framework for the international community to cooperate on the issue of climate change.

However, the treaty itself does not set any mandatory limits on greenhouse gas emissions for countries that signed the contract and also do not contain any enforcement mechanisms. From this point of view, the treaty cannot be forced and thus is considered legally non-binding.

Because of this lack of legally binding commitments the states signed the Kyoto Protocol where 37 industrialized countries commit themselves to specific aims in a reduction of greenhouse gases. This protocol was signed by the Czech Republic as well (at that time by Czechoslovakia) where the specific aim was given to reduce the amount of gas to 92 % of the values from 1990 by 2008-12, calculated as an average over these five years. The aim of the whole European Union is also the reduction of greenhouse gases by 8 %.

The given aims should be reached primary on the national level, but Kyoto Protocol also enables the usage of other international approaches such

[1] Further information on http://www.ipcc.ch/

[2] Further information and the dividing of the cost into segments can be found on http://www.nrdc.org/globalwarming/cost/contents.asp

as emissions trading, the clean development mechanism – encourages investments in ventures that reduce emissions in the developing countries and joint implementation to Annex I allows countries to meet their limitations of greenhouse gas emission by purchasing emission reductions credits from elsewhere.

The last (2009) United Nations Climate Change Conference was held in Copenhagen, Denmark. The final agreement was recognized, but not agreed upon, so it is not legally binding and does not contain any legally binding commitments for reducing CO_2 emissions. The document states that climate change is one of the greatest challenges of the present and adequate actions should be taken to keep any temperature increases below 2℃.

The meeting meant an important step forward in efforts to protect the Earth from climate change. However, it failed to reach specific agreements on funds and technology transfer the developed countries should be obliged to provide.

2.1.2 Controversial views

There are also authors such as Lomborg (2001), Klaus (2007), etc., who are sceptical about the fact that the global warming is caused by human activities and therefore they generally refuse any support for ecological projects by state policy as it is accepted as the mainstream European policy and treated in the following text. These authors doubt the global warning exists, dispute it is caused by human beings, and generally are sceptical to believe that the word politics, people or ecological organizations can do anything about it. They have broadly discussed the method of setting correct discount rate of future shortfalls and thus the right comparison of future values of potential losses caused by global warming and climatic changes to the present values of costs for environmental policy.

The above mentioned authors conclude that the discount rate should be set about 3-6% and thus they calculate present value of the future costs for the losses caused by global warming and ecological changes dramatically lower than estimated by Intergovernmental Panel on Climate Change.

2.2 Renewable energies in energy policy of the European Union

The European Commission launched the European Climate Change Program that was created to implement the Kyoto Protocol in June 2000. The goal of the European Climate Change Program is to identify and develop all the necessary elements of an EU strategy so that the duties arising from Kyoto Protocol would be fulfilled.

In order to promote RES, The European Commission proposed binding legislation to meet required climate and energy targets by 2020. These targets were specified as follows:

- to cut its greenhouse gas emissions by 20% by 2020 compared to level in 1990;
- to improve energy efficiency to save 20% of the EU's energy consumption compared to forecasts for 2020;
- to raise the share of renewable energy to 20% of EU overall energy consumption by 2020.

This “climate and energy package” was adopted by the EU Parliament on December 17th 2008.

The aim of the Directive is to ensure that the EU will reach the 20% of renewable energy on the total consumption of EU in year 2020. In order to achieve this European goal, different targets for all individual Member States have been set by the EU commission with consideration of the 2005 share of the RES and two other elements, a base-line same for all Member States and GDP per capita, thus taking into account the economic situation of the Member States.

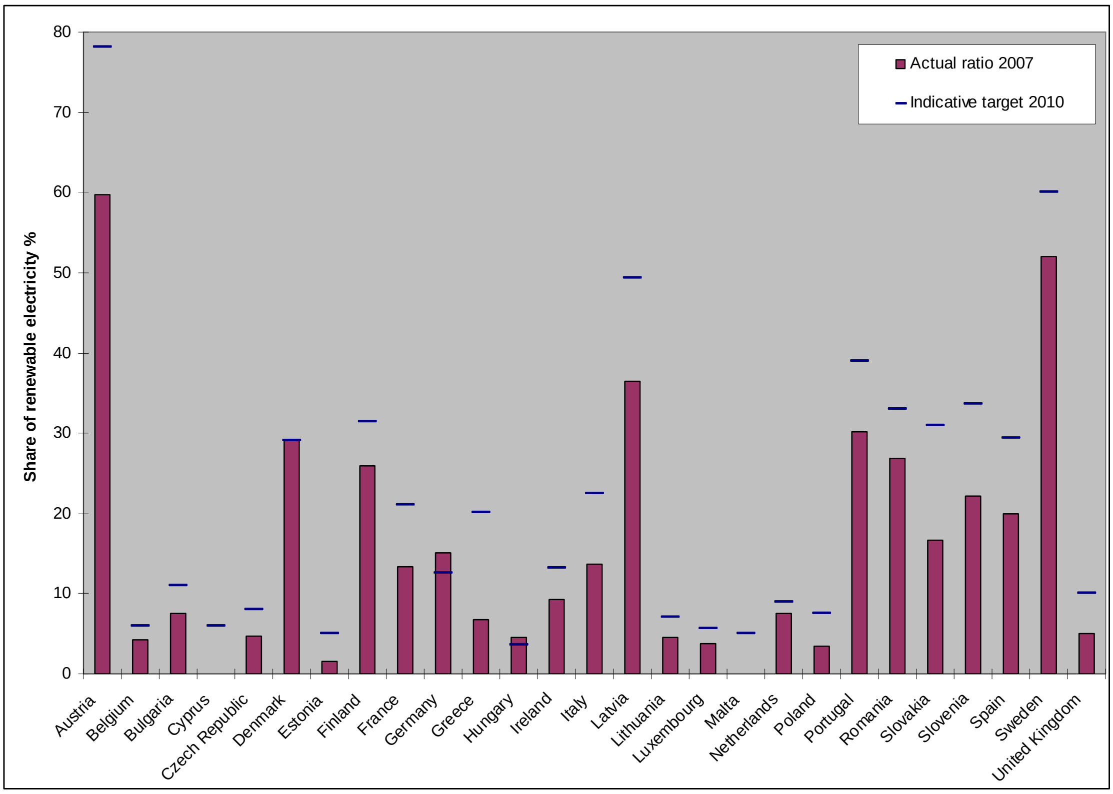
In 2001, a European Directive (Directive 2001/77/EC) was adopted to foster electricity from renewable energy sources. The aim was formulated to cover 21% of the electricity consumption by renewable energy sources by 2010[3].

The overall goal (indicative target for year 2010) was further transformed into the different indicative targets for Member States of the EU that were set also with respect to the economic situation of Member States and their base-level according to local and national conditions; for instance Austria like all Alpine countries has been highly specialized in using hydropower, so the indicative target is set quite high. Similarly, Germany, Denmark and other Scandinavian countries have used wind energy for

[3] The initial target was defined as 22.1% for the EU-15 and was changed to 21% for the EU-25.

decades etc. (Ringel 2005). The targets for year 2010 and ratios of this indicator (year 2007) may be seen in Fig. 1.

Fig. 1. Progress of EU 27 Member States (share of electricity generated from renewable sources in gross electrical consumption) achieved in 2007 towards their 2010 indicative renewable energy target.



Source: Eurostat

We may see in the Fig. 1 that the indicative target for year 2010 was already fulfilled in Denmark, Germany and Hungary in year 2007. The other states will have to make an effort to increase the shares according to their commitments. Some of them will not probably meet the indicative target (for example Cyprus, Italy, the Czech Republic). Accordingly, even the European Commission reported in 2004 that the given target would probably not be achieved.

2.3 Different ways of RES support in the European Union

There are different approaches to support the production from renewable sources to stimulate the investors to invest into green sources in different states. This support thus protects the investors from severe and direct competition done by producers of energy from conventional sources.

First method that is used by Member States is the supporting of research and development programs for RES. According to the European Commission (2004) more than half of the renewable energy research is done by the public sector, one quarter of the public expenses comes directly from the EU budget, one third of the EU-15 Government research spending and half of the personnel working on research for renewables were from Germany in 2004.

Apart from research and development support the governments enhance RES-E by price-based approach (feed-in tariffs) or quantity based approach (bidding process or tradable green certificates).

2.3.1 Feed-in tariffs

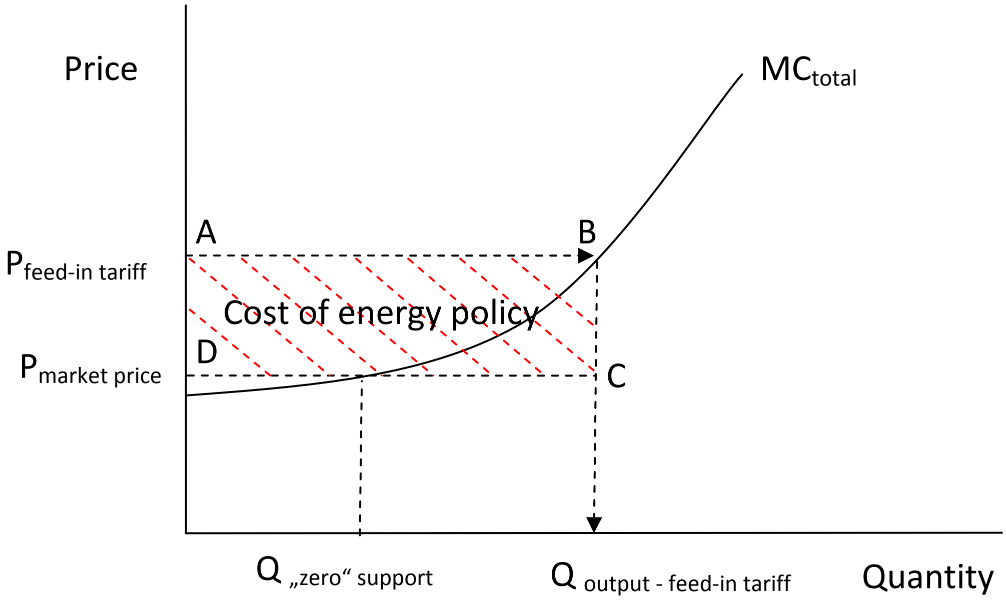
The majority of the Member States (for example Austria, Germany, Hungary, Spain, Italy, Estonia) established the system that is usually called "feed-in tariffs system". This system is based on the obligation of the operators (utilities) involved in the purchase of electricity to buy the electricity produced from the renewable energy producers at a tariff (so called feed-in tariff) determined by the state authorities (also guaranteed for given period of time).

The Czech Republic established a similar system (so called dual pricing system) offering a choice for the investor into green energy to decide either for fixed feed-in tariffs or green bonus under the strictly defined conditions (described in detail in chapter 2.4).

The guaranteed price set for the producers is described as $P_{\text{feed-in tariff}}$ in the Fig. 2. This price is usually defined differently for the various types of renewable energy sources. So, the producer of energy from hydro-power plants, biomass, wind or photovoltaic energy receives the different price for each kWh produced. The guaranteed price is usually the key factor further generating the total output for the different type of electricity $Q_{\text{feed-in tariff}}$. If the price is set too low (bellow the market price), there may be almost no production of electricity from given renewable sources ($Q_{\text{“zero” support}}$). In case of zero support, the total amount of electricity produced depends on the intersection of marginal cost curve with the market price.

However, if the feed-in tariff is set too high there may be abnormal boom of number of producers and RES-E produced.

Fig. 2. Quantity of electricity produced – Feed-in tariffs



The marginal cost curve of the energy production is usually not known and all projects benefit from the given tariff $P_{feed\text{-}in\ tariff}$ including those, whose marginal production costs are lower than the feed-in tariff. The cost of such energetic policy is given by the rectangular area ABCD. The cost of subsidizing producers is covered differently in different states, for example in the Czech Republic, Energy Regulatory Office impose a fee on electricity consumers for covering costs connecting with support of electricity from renewable energy sources, cogeneration and secondary sources. In year 2010, the price is set to 199.61 CZK/MWh (including VAT) and is paid by the final electricity consumers.

The right setting of $P_{feed\text{-}in\ tariff}$ is broadly discussed and examined by economists and politics, for instance in Germany and the Czech Republic due to the high prices of electricity generated by solar photovoltaic. M. Fondel et al. (2008) argue that "solar photovoltaic stipulated in Germany's Renewable Energy Act currently provides the largest demand for PV modules in the world, thereby leading to high prices for solar cells and shortages in high-quality silicon used for their production". They argue that the positive economic effects (for instance employment, growth of GDP, etc.) are insignificant.

In the Czech Republic, a peculiar situation was caused due to acceptance of the Act No. 180/2005, where the maximum decrease by 5% of the guaranteed 15-year feed-in tariffs was set from year to year. This maximum decrease should give the investor the security in the long-term investment planning. However, the price of solar panel dropped dramatically (in case of total photovoltaic energy industry shifting MC_{total} to the right during the years), therefore the whole photovoltaic business has started to be extremely profitable for investors. The number of producers preparing to step into the photovoltaic business this year has been enormous and leads the state authorities to the maximum reduction of the $P_{feed\text{-}in\ tariff}$ and thus to try to reduce the total electricity production.

CZ Biom[4] and Energy Regulatory Office warn the public that due to the enormous increase of photovoltaic electricity plants with the abnormal increase of power production and due to the high price of the feed-in tariff for photovoltaic, there is almost no space on the market for supporting the other producers of RES-E and that only the cost of supporting of photovoltaic will be about 30% of the total RES-E support, while solar energy will produced only 3% of RES-E. The wrong setting of feed-in tariffs regarding to solar energy in the Czech Republic is quite famous and in the articles is sometimes called as "Czech Solar Klondike", Niedermayer (2009).

The specific tariffs (green bonuses), other support and valid legislation that are currently set in the system of the Czech Republic will be described in detail in chapter 3.4.

2.3.2 Tender-based (bidding) system

One of the used systems that is based on market approach is tendering system. The tendering system was used in Ireland, in the United Kingdom and partly existed in France for some time. The principle of the system is that the state usually issues a series of invitations to tender in the competitive bidding processes for the supply of renewable energy sources, which will be sold at market price. The producers of RES-E place their offer during the bidding process and the proposals are sort according to the offered price per kWh until the specified amount Q total output is reached. Those who succeeded in the bidding system are rewarded by long term contract to supply electricity at bid price[5]. It means that to the marginal project the marginal price P_{out} is paid. Menanteau (2003). If all producers know ex-ante their MC and are willing to set the bidding price according to it, the overall cost of energetic policy (reaching the Q_{1out}) will be under the MC curve (area ABC). We may see that the overall cost of policy is smaller than in the feed-in tariff system, since each producer is paid the bid-price (not the same margin P_{out} price).

However, the producers, especially those whose MC are under or near the market price $P_{market\text{-}price}$, will probably find out that for them it has the benefit to offer a higher price than is their real MC. There may also be speculators who will bid lower than their marginal costs (but reasonably higher than market price and speculating that meanwhile they will be able to

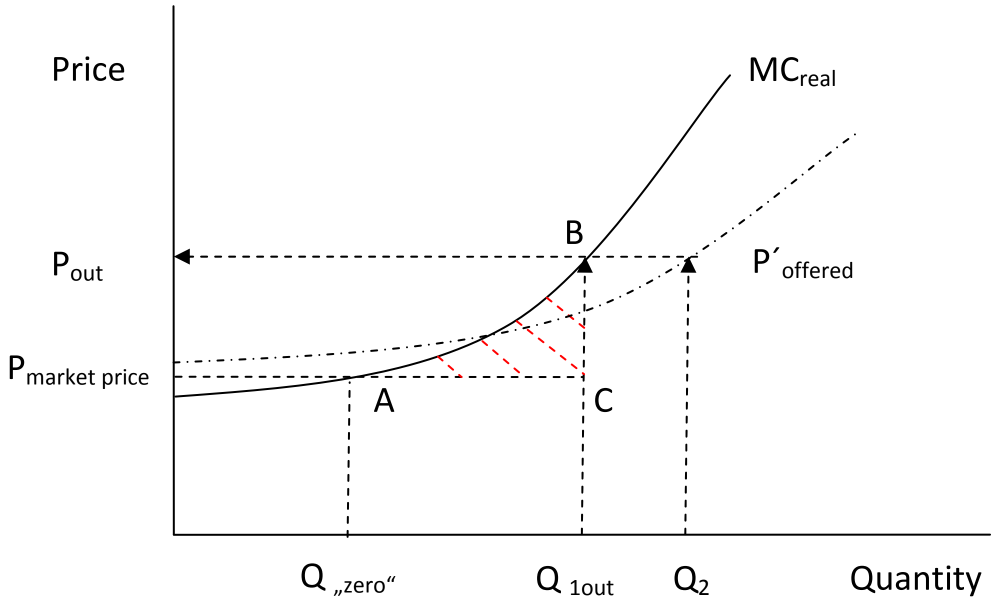
[4] http://biom.cz/FVE/otevreny_dopis_predsedovi_vlady.pdf

[5] Another approach is that the producers are paid by the price offered by the marginal project.

get new technology for producing RES-E cheaper) in order to be chosen, but finally they will not put the power plant into operation. So, there is also slight danger, that the aim given by public authorities Q_2 will not be precisely achieved.

We may see that marginal cost of the producers (in the Fig. 3) may differ from the price offered. In this case, the policy maker may hardly discover the marginal production costs of producers really involved in the system (ex-post). Hence, the cost of the policy may also differ from the cost given by the area ABC.

Fig. 3. Tender-based (bidding) system



2.3.3 Green certificate system

The third system used in Europe, the green certificate system[6], is currently in force in Sweden, the United Kingdom, Italy, Belgium and Poland. It usually consists in the process in which the RES-E is put on the market and sold at the standard "conventional" market price. The necessary support for producers of the renewable energy sources is secured by consumers (operators) that are obliged to buy (sell) a certain number of green certificates from producers according to a fixed percentage (quota - q) of their total electricity consumption. Madlener and Stagl (2000).

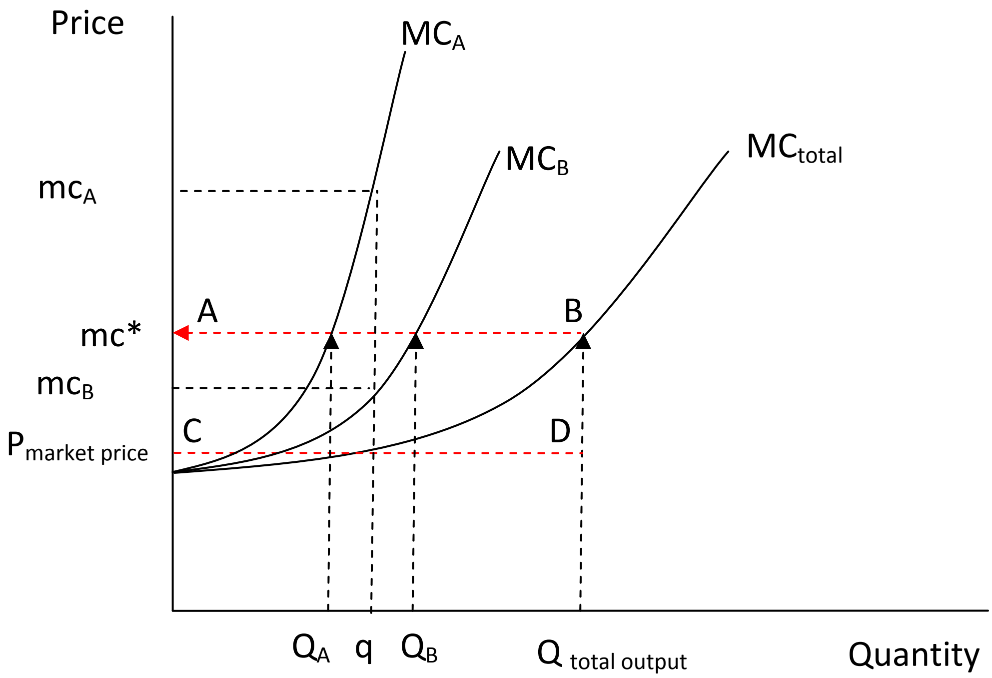
Certificates are issued by renewable energy producers and sold on the green certificates market. The producers do not have the same marginal

[6] further information on http://europa.eu/legislation_summaries/energy/renewable_energy/l24452_en.htm

production cost curves, thus by exchanging on the market, green certificates enables quotas to be allocated in an efficient way.

The system is described in Fig 4. Let us consider the producer A and producer B that have the production objective q. Let us suppose that the producer A has poorer quality resources which leads to the higher marginal production costs MC_A. The producer B may use resources with smaller costs and thus have lower marginal production costs MC_B. Without the green market system, the producer A would have to produce the quantity q on the market cost MC_A. Since the green certificate market is established, the A producer may buy the total amount of green certificates (in Fig. 4 seen as q-Q_A) from the producer B at the price mc*. Thus the producer A fulfils its obligation in receiving the q certificates. And the whole system leads to better efficiency. Menanteau (2003). The total cost of this policy can be considered as the rectangular area ABCD.

Fig. 4. Green certificate system



The same result could be achieved by setting different objectives on producers of electricity. The problem usually arises in connection with the fact that the public authority does not have enough information (ex ante and usually not even ex post) about the marginal cost curves of the different producers. The green certificate system enables producers to minimalize the overall cost of production by reaching the production target due to equalizing the marginal production costs. Menanteau (2003).

Each state also sets the different tax incentives and support the RES-E producers and/or investors.

The Commission Staff Working Document SEC(2008) 57 "The support of electricity from renewable energy sources"[7] compares the different approaches to the support of RES in the Member States. One of the conclusions of this document is that "feed-in tariff regimes are generally the most efficient and effective support schemes for promoting renewable electricity".

One of the usually mentioned disadvantages of the market-base systems is the lack of perfect market competition in the energy market, so buyers or sellers have enough market share and can significantly influence the prices on the market. The difference in the cost-effectivity of various systems were discussed by Toke (2006). He concludes that the British system based on green electricity certificates "does not deliver renewable energy any more cheaply than a feed-in tariff that works in Germany". On the contrary, he found out that the German feed-in tariff system is more cost-effective than the British system. However, he concludes that the system based on perfectly competitive market can work effectively. He also discussed the situation of implementing the market-base system in the whole EU market. He estimates, according to the economic theory, that the investment should be probably allocated into the more cost-effective areas (states). On the other hand, he supposes that this may significantly diminish the total amount of financial resources invested into renewable energy, since the investors (farmers, local people, etc.) are regularly more interested in investing in their areas than in other countries usually thousands kilometres away.

The second usually mentioned problem of green certificate system is that there is no long-term certainty for the investor of the prices in the future. Menanteau (2003) concludes that "in terms of installed capacity price-based approaches have given far better results, than quantity-based approaches. In theory, there should be no such difference, since bidding prices established at the same level as feed-in tariffs should logically give rise to comparable installed capacities. The difference can be explained by the attraction of fixed prices, which project developers see as ensuring a safe investment with better predictability and a stable incentives framework, as well as by the lower transaction costs for each project."

However, the decision on the state policy for supporting different renewable technologies should be based also on the competitiveness of the given technologies. M. Frondel et. al. (2008) together with Lesser and Su (2008) conclude that: "Technologies that are theoretically promising, but unlikely to be competitive for many years, may be best addressed under other

[7] Document available on
http://ec.europa.eu/energy/climate_actions/doc/2008_res_working_document_en.pdf

policies, such as publicly funded research and development." Therefore not only the market creation (demand-pull) policy, but also the fostering of the technology research and development (supply-push) is necessary to make RES-E economically competitive with traditional forms of generation, since in the emerging competitive electricity market, the private sector has little incentive to invest in the development of the technology for production of RES-E.

2.4 Green policy of the Czech Republic

2.4.1 Support for renewable energy sources

The Czech Republic made a commitment to fulfil the indicative target utilizing 8%[8] share of electricity generated from renewable sources in gross electrical consumption by 2010. Hence, it tries to create such legislative and market conditions to maintain the trust of the investors who would be willing to invest into plants utilizing RES.

The above mentioned goal (defined by the Accession Treaty) was implemented to the Czech legislation by the Act No. 180/2005 on the promotion of electricity produced from renewable energy sources. The Directive does not define the precise tools for receiving such goal and gives each Member State to set the appropriate tools to achieve the indicative target.

Therefore, it was necessary to create the sophisticated system of support for the investors to create energy from the renewable sources. On the other hand, the precise rules (laws) had to be passed, so the system would be clear and not-exploitable.

The Act No. 180/2005 on the promotion of electricity produced from renewable energy sources entered into effect on 1 August 2005. Even though supporting renewable sources of energy started in the Czech Republic before the Act No. 180/2005 came into effect; this Act was the real break-point. The decisive statements of this Act are:

a) **Preferential connection to the grid**. There is an obligation for operators of the regional grid systems and the transmission system operator to purchase all electricity from renewable sources. However, these obligations for operators are somehow weak (Niedermayer, 2009) and sometimes create hard obstructions for investor. The investor has to ask the operator after receiving capacity and the operator may decide after analysis that he has not enough capacity to connect the proposed power plant into the grid. Since the blockage of the capacity is done free of charge, there were found many speculators who reserved the capacity for enormous amount of $MW_{el.}$ (it is true especially about the photovoltaic, where the considerable part of capacity has been speculatively blocked). If the capacity is blocked by the speculators, the operator cannot connect the other real potential investors. Consequently, if the investor wants to continue with the project, he has the only chance - ask the speculator to purchase him the permission. The speculator usually sells him the capacity for the enormous amount of money and thus the investor pays additional costs even before the project actually starts.

[8] This commitment will not be probably reached, see http://www.mpo.cz/dokument42645.html

b) **The guarantee of revenue** per each $MW_{el.}$ produced over period of time (15 years, 20 years, 30 years – depends on the kind of renewable sources of energy and also on the date when the plant is put into operation). The investor has the possibility of choosing between two supporting systems.

The first one is the minimum feed-in tariffs – all the electricity produced can be sold to the relevant distribution system operator. This option is quite easy for the investor, since he does not have to care about the prices for electricity. The only issue that he has to care about is to deliver as much $MW_{el.}$ as he is allowed according to the contract.

The Energy Regulatory Office[9] determines the value of the feed-in tariffs and the green bonuses each year in advance[10]. The feed-in tariffs are guaranteed by Energy Regulatory Office for the given period of years (usually 15-30 years depending on the type of production renewable sources of energy; in case of energy received from burning biomass the duration is 20 years) and the price for $MW_{el.}$ is set as a minimum price.

The investor may also choose to receive green bonuses[11] (premium pay to the market price of electricity) – thus RES-E can be placed on the single electricity market. In this system the producer receives the agreed price from the customer and he also obtains the additional green bonuses for every $MW_{el.}$ produced. The system of green bonuses is more in compliance with the idea of free market. The market price of electricity produced by investor of renewable sources of energy is usually lower than from conventional producer of electricity, because it includes the non-stability of production and delivery. Therefore, it is usually different for the various types of RES-E. However, the investor cannot combine the green bonuses and the feed-in tariffs within one plant generating electricity.

The Act No 180/2005 (§ 6) determines, that the prices set by Energy Regulatory Office stipulated in the following year may not be lower than 95%[12] of the value of the year before. This principle should have ensured that the investors are able to make long term investment plans. However, the Act No. 180/2005 (§ 6) was amended by Novelty that was approved by

[9] See http://www.eru.cz

[10] For some economists the activities of ERO are disputable. For example, Mach (2009) criticizes the activity of ERO and claims that the office is useless.

[11] Definition of "green bonus" according to Act No. 180/2005, §2, paragraph (2), letter d) shall mean the financial amount increasing the market price of electricity that is paid by the operator of the regional grid system or the operator of the transmission system to the producer of electricity from renewable sources, taking account of reduced damage to the environment resulting from use of a renewable source compared to combustion of fossil fuels, of the type and size of the production plant and of the quality of electricity supplied.

[12] „The purchase prices set by the Office for the subsequent calendar year may not be lower than 95 % of the value of the purchase prices valid in the year during which a decision is made on their new values. This provision shall apply for the first time to the prices stipulated in 2007."

Parliament in 2010. The Novelty sets that the feed-in tariff of RES-E can be lowered more than 5%, if the payback period fell under 11 years. The feed-in tariffs will be determined according to the novelty from year 2011.

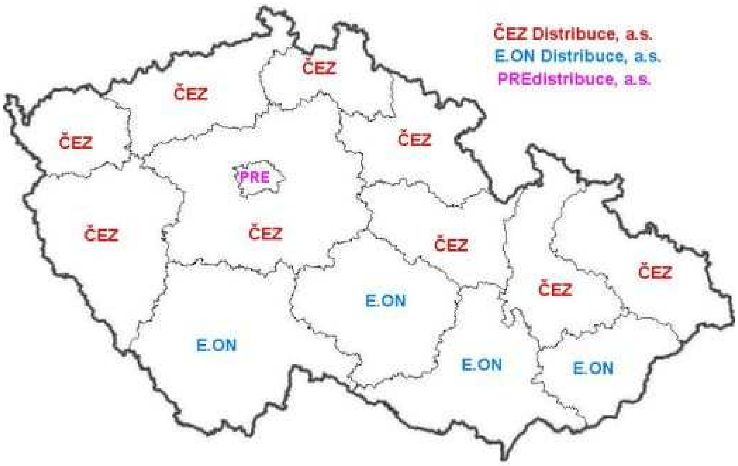
Prices and green bonuses are set by Energy Regulatory Office on the following assumptions:

- Return on investment should be 15 years and it should include the profit.
- Prices are differentiated according to the source of energy, it means the price depends on the type of source from which is the electricity produced.
- Prices are differentiated by the year of commissioning.

The company ČEPS, a.s.[13] is responsible for the operation of transmission system facilities and the dispatch of generation within the Czech Republic, as well as for parallel operation with the power systems of neighbouring countries via cross-border tie-lines under specific rules. ČEPS, a.s. is a licensed Czech transmission system operator according to the provisions of Act No. 458/2000 Coll. The Company provides safe and reliable electricity transmission for users of the Czech transmission system within European interconnected power systems.

There are three distribution companies in the Czech Republic which operate in the areas that can be seen in following Fig. 5.

Fig. 5. Distribution companies in the Czech Republic



Source: http://www.centralenergy.cz/

ČEZ Distribuce a.s., holds a license for power distribution and operator distributive system for nine territories. E.ON Distribuce a.s., is another company involved in distribution networks. This company is located in the

[13] Further information about the company on http://www.ceps.cz/

southern part of the Czech Republic and operates in four territories. The PRE Distribuce a.s. is the company that is responsible for providing electricity for the capital of the Czech Republic, Prague.

A producer of renewable energy sources needs to know the corresponding distribution company where he can ask for connection to the electricity grid. So, for example if the producer is from south of the Czech Republic he should ask for connection in the E.ON Distribution a.s. The connection is usually done in the nearest supply network, as to the cost related to connection would be the smallest.

2.4.2 Production of electricity from renewable sources of energy in year 2008

The Act No. 180/2005, in § 7 imposes the duty of the Energy Regulation Office, the Ministry of Industry and Trade and the Ministry of the Environment to publish in the Energy Regulatory Bulletin the values of the share of electricity produced from renewable sources from the gross consumption of electricity for the previous calendar years and the calculation of the projected effects of promotion on the overall price of electricity for final consumers in the following calendar year.

The Ministry of Industry and Trade published in September 2009 the "Report about renewable energy sources in the Czech Republic in 2008"[14]. According to this Report the share of electricity generation from renewables in domestic gross electricity consumption amounted to 5.2% in 2008. However, the national indicative target share for the Czech Republic was set to 8% by year 2010.

The gross electricity production from renewable energy sources has increased and amounted to 3 731 GWh in 2008, in year 2007 it was 3 412 GWh, that means the increase by 319 GWh. The gross electricity production using biomass increased to 1 171 GWh in 2008, in year 2007 it was 968 GWh. The total rise was caused mainly by growth of electricity production from biomass (202 GWh) and wind energy production (120 GWh).

However, as it was mentioned in previous lines, the Czech Republic has committed itself to fulfil the indicative target and thus needs to achieve the indicative target of an 8% share of RES-E in gross domestic consumption. We may do a rough estimation from the last data and from expert opinions and estimate that the gross domestic consumption will be approximately 68 000 GWh, it means that to achieve the indicative target, the electricity produced from RES still would need to achieve 5500 GWh (the expected development of the market is described in chapter 4.1).

[14] The whole report is available for download on http://www.mpo.cz/zprava64928.html

The data set bellow are the latest data available published by Ministry of Industry and Trade in September 2009. Official data set for year 2009 will be likely accessible on the web pages of Ministry in September 2010.

Table 1. Electricity gross generation from RES in 2008

	Grid / net generation	Share on consumption	Share on total generation
MWh	MWh	%	%
Hydro power plants total	2 024 335,0	54,26%	2,81%
Biomass total	1 170 527,4	31,37%	1,62%
Chips, bark, waste wood	603 047,9	16,16%	0,84%
Black liquor	458 468,7	12,29%	0,64%
Non-agglomerated energy plants	23 085,2	0,62%	0,03%
Briquettes and pellets	84 535,6	2,27%	0,12%
Other biomass	1 390,0	0,04%	0,00%
Biogas total	266 868,3	7,15%	0,37%
Municipal solid bio-degradable wastes	11 684,3	0,31%	0,02%
Wind energy	244 661,0	6,56%	0,34%
Photovoltaics	12 937,0	0,35%	0,02%
Biofuels	0,0	0,00%	0,00%
Total	3 731 013,0	100,00%	5,18%

Data source: Ministry of Industry and Trade; Energy Regulatory Office

2.4.3 Legislation in the Czech Republic

The investor must be aware of the legislation that he should follow. In the following paragraphs I will describe the most important Acts, Directives and Notices that are necessary for the producers and investors to be familiar with. The legal framework is very important for every investor in general; in case of the investment into the renewable sources of energy it is crucial.

2.4.3.1 a) Act No. 458/2000 Coll. on Business Conditions and Public Administration in the Energy Sectors and on the Amendment to Other Laws (Energy Act) [15]

This Act sets conditions of business issues in energetic sectors, such as electricity, gas industry and heating industry in accordance to European community law. It also mentions the discretions and duties of natural and legal entities connected with doing business in such industry.

[15] The Czech Acts and Notices can be found on http://portal.gov.cz/wps/portal/_s.155/701

The aim of the Act is to increase power efficiency in producing, distributing and consumption of energy. This law also deals with storage of gas and an energetic demand factor of buildings.

The § 31 defines the renewable sources of energy and sets the right for the investor to preferential connection of source of electricity to distribution grid system and thus the duty of the operator of the regional grid system to connect the sources of RES into its distribution grid system.

2.4.3.2 b) Act No. 180/2005 of 31 March 2005 promotion of electricity production from renewable energy sources and amending certain acts (Act on Promotion of Use of Renewable Sources) [16]

By this Act the Directive 2001/77/EC was implemented in the Czech legislation. The aim of this Act is the stabilization of the business environment in the area of renewable energy sources, increasing the attraction of investing into the technologies of RES and creating the conditions for sustainable development of RES in the Czech Republic.

Title I. – General Provisions – exactly defines what are renewable sources in the Czech Republic, what is the subject of support according to this Act and also defines the basic terms. The very important statements are given in § 1, paragraph (2), letters a)-d) where the purposes of the Act are stated.

These are:

(a) To promote the use of renewable energy sources;

(b) To ensure constant increase of the share of renewable sources in consumption of primary energy sources;

(c) To contribute to economical use of natural resources and sustainable development of society;

(d) To create conditions to fulfil the indicative target for the share of electricity from renewable sources in the gross consumption of electricity in the Czech Republic amounting to 8 % in 2010, and for further increase of this share after 2010.

Article 3 (Subject of support) defines among others that promotion shall apply only to production of electricity from renewable sources produced in plants in the Czech Republic. Paragraph (2) highlights that promotion is stipulated differently according to the type of renewable sources and the magnitude of the install capacity of the production plant and in case of

[16] Compare to http://www.czrea.org/files/pdf_en/zakony/RES_act_english.pdf

electricity produced from biomass also according to the parameters of the biomass laid down in an implementing regulation.

Title II, Article 4 (Rights and obligations of the entities on the market with electricity from renewable sources) contains very important provisions that are crucial for producer of RES-E and their rights to be connected to the transmission system or to the grid systems.

Especially paragraph (1) states the obligation of operator of the transmission system or the operators of the grid systems to **preferentially connect** to the transmission system or to the grid systems plants for the purpose of transmitting or distributing electricity from renewable sources, provided that the producer of electricity from renewable sources it requests and that the producer meets the criteria for connection and electricity transport laid down in a special regulation.

Paragraph (3) defines the right of the producer of RES to choose whether to offer his electricity for purchase or whether to request a green bonus for this electricity. This choice must not be changed for a period of one year. Change in the choice shall always be performed on the 1 of January of the subsequent calendar year.

Paragraph (4) states the obligation of the operators of the regional grid systems and the operator of the transmission to purchase **all electricity** from renewable sources eligible for promotion, if a producer offered this electricity.

Paragraph (7) sets the obligation of the operator of the regional grid systems and the operator of the transmission to pay the producer of the electricity a green bonus expressed in CZK/MWh in case the producer did not offer the electricity for mandatory purchase.

Paragraph (16) also states the obligation of the operator of the regional grid systems and the operator of the transmission to pay green bonus to producers producing electricity from renewable sources for their own consumption.

Article 6 determines the prices for electricity from renewable sources and green bonuses

Paragraph (1) states that the Energy Regulatory Office determines the purchase prices for electricity from renewable sources for the subsequent calendar year in advance, separately for the individual types of renewable sources and green bonuses,

Paragraph (4) states that the purchase prices determined by the Energy Regulatory Office for the subsequent calendar year may not be lower than 95 % of the value of the purchase prices valid in the year during which a decision is made on their new values. This statement gives the assurance to the investors regarding the purchase price in following years. It may happen that the investor plans to put into operation new plant in subsequent year and he is sure that the purchase price will be lowered by 5% on maximum. This Article was amended by Novelty that was approved by Parliament in 2010 (see chapter 2.4.1).

2.4.3.3 Notice No. 475/2005 Sb. as amended by Notice No. 364/2007 and Notice No. 409/2009

This Notice implement certain provisions of the law on support for the use of renewable sources (Act. No. 180/2005)

The object of the Notice is defined in the Article 1. The public notice determines the time limits and other details for selecting a method of support for electricity generated from renewable sources, time limits for notifying plans to offer electricity generated from renewable sources for mandatory purchase, and some technical and economic parameters.

It means that the Notice gives us the information from which technical and economical parameters of the value of different kind of electricity should be calculated.

Article 2 sets the definition, among others also of WACC in letter e): Weighted average cost of capital [WACC]: weighted average of the expected interest rate on lending for investment in projects designed for using renewable sources for electricity generation and the expected return on equity of an investor in a project designed for using renewable sources for electricity generation.

Very important part of the Notice is defined in Section 4 (Technical and economic parameters for support of electricity generated from renewable sources by way of purchase prices) especially the paragraph (2) “indicative values of the technical and economic parameters, separately for the various supported categories of renewable sources and selected technologies that make it possible to meet the required economic criteria under paragraph (1) in electricity generation from renewable sources, are listed in Appendix 3 hereto.”

Appendix 3 to the Act has been changed several times in the past due to the different development of costs. Regarding to biomass energy, the following is mentioned in the Notice.

Energy from biomass:

1. Expected life of the new plant: 20 years.

2. Required efficiency of using the primary energy content: Rational use of waste heat is expected for plants that burn biomass in electricity generation.

3. Unit capital expenditure and annual utilization of the plant's installed capacity:

Table 2. Unit capital expenditure

Plant description	Total unit capital expenditure [CZK/kWe]	Annual utilization of installed capacity [kWh/kWe]
Dedicated biomass-fired plant	< 75,000	> 5,000
Plant firing (separately) gas produced by solid biomass gasification	< 75,000	> 5,000

Source: Notice No. 475/2005 Coll.

2.4.3.4 Notice No. 150/2007 Coll., on the method of price regulation in the energy industry and on the procedures of price regulation

This Notice has been in effect since 1 July 2007.

Under public notice no. 150/2007, feed-in tariffs and green premiums are applied throughout the service life of electricity generating plants (Notice No. 475/2005 Sb. as amended, Appendix 3 - see the previous article). Over the service life of an electricity generating plant included in the respective category by the type of the renewable source used and the date of commissioning, feed-in tariffs are annually increased with regard to the producers price index, by at least 2% but no more than 4%, **with the exception of generating electricity from plants that fire biomass and biogas.**

The time of guaranteed feed-in tariffs for the various types of renewable electricity capacities newly commissioned after 1 January 2008 is listed in the Table 3.

Table 3. Guaranteed feed-in tariffs

Type of renewable resource	Guaranteed feed-in tariffs (years)
Small hydroelectric power stations	30
Biomass	20
Biogas	20
Landfill gas, sewage/sludge gas, drained gas	15
Wind power plants	20

Geothermal plants	20
Photovoltaic plants	20

Source: Notice No. 150/2007 Coll.

2.4.3.5 The Energy Regulatory Office's Price Decision No. 5/2009 of 3 November 2009 Laying down support for electricity generation from renewable energy sources, combined heat and power, and secondary energy sources[17]

The Energy Regulatory Office sets each year the purchase prices (feed-in tariffs) and green premiums for different types of renewable sources. This due is set under Section 6 of Act No. 180/2005 on Support for Electricity Generation from Renewable Energy Resources and on Changes to Certain Laws. Price Decision No. 5/2009 is valid for year 2010. The prices specified in the Decision do not include value added tax pursuant to separate law regulation[18]. We will mention the parts regarding burning biomass. In the following table you can see the purchase prices and green premiums for electricity generation from biomass (paragraph (1.5) of the Price Decision):

Table 4. Purchase prices and green premiums for electricity generation from biomass

Date of commissioning	Purchase prices of electricity supplied to the network (CZK/MWh)	Green premiums (CZK/MWh)
Electricity generation by firing O1 category biomass only in new electricity generating plants or generating units from 1 January 2008 to 31 December 2010	4 580	3 610
Electricity generation by firing O2 category biomass only in new electricity generating plants or generating units from 1 January 2008 to 31. December 2010	3 530	2 560
Electricity generation by firing O3 category biomass only in new electricity generating plants or	2 630	1 660

[17] Compare with Price Decision No. 8/2008, available on: http://www.eru.cz/user_data/files/english/Price%20decision/CR8_2008en.pdf

[18] Act. No. 234/2004 on Value Added Tax, as amended.

generating units from 1 January 2008 to 31. December 2010		

Source: Energy Regulatory Office's Price Decision No. 5/2009

The paragraph (2) includes additional contributions to electricity prices applied to electricity from combined heat and power plants having a total installed electricity generating capacity of up to 1 $MW_{el.}$, inclusive:

"(2.2.) An electricity generator from combined heat & power with a total installed capacity of up to 1 $MW_{el.}$ per generating plant, inclusive, will charge the regional distribution system operator serving the respective area, or the transmission system operator if it is connected to the transmission system, a contribution to electricity price of 470 CZK/MWh for each reported MWh of electricity generated under a separate legal regulation 7).

(2.3.) If the electricity generator supplies electricity to an electricity trader or eligible customer, or if the electricity generator itself consumes this electricity at the time of high rate applicability for a total of eight hours a day, the electricity generator will charge the respective system operator a contribution to electricity price of 1 800 CZK/MWh for each reported MWh of electricity generated at the time of high rate applicability under a separate legal regulation. This electricity trader or eligible customer, or directly the electricity generator, shall define the high rate band. The electricity generator shall determine the high rate band solely if it consumes all the electricity it generates. In the case of applying the contribution in the high rate band there is no entitlement to a contribution under (2.2) and (2.4).

(2.4.) If the electricity generator supplies electricity to an electricity trader or eligible customer, or if the electricity generator itself consumes this electricity at the time of high rate applicability for a total of twelve hours a day, the electricity generator will charge the respective system operator a contribution to electricity price of 1320 CZK/MWh for each reported MWh of electricity generated at the time of high rate applicability under a separate legal regulation. This electricity trader or eligible customer, or directly the electricity generator, shall define the high rate band. The electricity generator shall determine the high rate band solely if it consumes all the electricity it generates. In the case of applying the contribution in the high rate band there is no entitlement to a contribution under (2.2) and (2.3)."

The paragraph (6) includes additional contributions to electricity generated by firing secondary energy resources, so this payment can be added to every MWh produced by CHP producer.

“(6.2.) An electricity generator that fires secondary energy resources, with the exception of drained gas, will charge the regional distribution system operator serving the respective area, or the transmission system operator if it is connected to the transmission system, a contribution to electricity price of 45 CZK/MWh for each reported MWh of electricity generated under a separate legal regulation. In this case the generator may at the same time apply support under points (2), (3) or (4).”

2.4.3.6 Act no. 586/1992 Coll., on income tax, as amended

Act No. 586/1992 Coll. is also quite important for the investor and especially the § 4 (release of tax duty), paragraph (1), letter e) for natural persons and § 19 (release of tax duty), paragraph (1), letter d). Pursuant to above mentioned paragraphs the following income shall be released from income tax: income from the operation of small hydropower plants with an output of up to 1 MW, wind power plants, heat pumps, solar equipment, equipment for the generation and energy use of biogas and wood gas, **equipment for electricity or heat generation from biomass**, equipment for the generation of biodegradable substances stipulated by special regulations and equipment for the utilization of geothermal energy; the **income shall be exempt from tax in the calendar year in which the above have been put into operation as well as in the following five years**.

The above mentioned Act No. 586/1992 means that if we put the plant into operation in year 2010, we will not have to pay any tax from year 2010 up to the year 2015. That is very important for calculating cash flow, WACC and other deciding economic values of the investment.

2.4.3.7 Notice No. 51/2006 Coll., conditions for connection to grids

This Notice determines among others the conditions of connection of producer of electricity to the distribution grid. The application according to § 4 has to be submitted before connection or before the capacity increases (at least 30 days). It also states the precise technical requirements.

2.4.3.8 Notice No. 363/2007 Coll., amending Notice No. 426/2005 Coll., on details of granting licenses for the enterprise in energy industry branches

Every investor that wants to enter the business in the energetic sector (for example to produce energy) has to receive the license. The license is granted by Energetic Regulatory Office. Holding the license for producing electricity and signing a contract with distribution operator are necessary conditions which enable the company to deliver electricity to national grid.

2.4.4 Subvention

Ministry of Agriculture determines the rules of conditions for support of Program of the Rural Development Programme for years 2007-2013. The European Agricultural Fund allocated EUR 2.8 billion for the Czech Republic for the whole programme period of 2007-2013 and together with the finances from the state budget the total amount achieves approx. EUR 3.6 billion. This seven-year programme consists of 4 basic parts, each of them meant to meet specific goals, for example in part III it is supported the diversification of economic activities in agricultural companies.

The diversification of the economic activities in part III also means the construction and modernization of boiler plant and district heating plant including the support of combined heat and power plants. The maximum subvention is generally CZK 50 millions per project and in the south-west region the maximal percent support is set as 56% for the small companies, 46% for the middle companies and 36% for the big ones in 2010. To receive the support the investor must fulfil the criteria given in the program and must follow the planned project that he describes in the project proposal.

3 Investment

The New Palgrave Dictionary of Economics (2008) defines the investment as present sacrifice for future benefits. Individuals, firms and governments are regularly in the position of deciding whether or not to invest, and how to choose among the available options. It means that every economic unit, the government, a company or an individual should use some investment decision criteria for choosing rationally in situations that involve the trade-off between present or future consumption.

We usually think about the company investment in the sense of capital budgeting in the corporate governance. Thus, the capital budgeting is considered as one of the fundamental and basic decisions of business management. The investment (capital budgeting) is usually divided into physical (such as land, buildings, machinery, equipment), intangible (such as software, goodwill, patents, breeders right, etc.) or financial (stocks, bonds, etc.). All these assets are supposed to produce streams of expected revenues. The usual situation is that the revenue in the future is connected with the particular costs or outflows. Therefore, the firm's management regular task is to decide, whether the investment has "benefits" and whether it produces the positive value for the shareholders of the company.

However, the process of the investment (an allocation of the capital) is usually more complex than just deciding how to allocate the capital. The company usually faces the broader issues like whether it should launch a new product or services, whether it should enter a new market or try to dominate the market already operated. These types of decisions determine the nature of the firm business (products, services) for many years, because the fixed asset investments are long-lived and the company cannot easily transform them.

It means that the core issue of the business is the decision about the product and services that the company will produce in the future. To be able to answer these types of questions, the company is obliged to allocate its scare resources (capital) to certain types of assets. This process is in the literature usually called strategic asset allocation (Ross et al. 2008). This allocation issue is probably the most important question for the managers from corporate finance. There are several other questions, for instance how to manage its short-term operating activities, the capital structure question, etc. but the investment issues determine the core of the business of the company for a long time period.

There are many possible investments of all kind and managers (investors) have to decide which ones to accept and which should be refused.

Hence, they have to choose the best ones according to some rules (techniques, criteria) that help them to decide which investment opportunity increase most the value of the firm. These techniques will be described further on in the chapter 3.1.

We may understand the capital company value as a present value of all projects that are and will be carried out in the future. Hence, maximizing the shareholders wealth is equivalent to maximizing the discounted cash flow provided by investment projects, so searching for best investment projects is crucial for all managers of the capital company. The evaluation techniques of the projects should best fulfil the criteria defined by the investor. The aim that the investors are usually looking for is maximizing their wealth. The techniques for choosing the best investment opportunity should have following properties according to Copeland et. al (2005):

a) All cash flow should be considered.

b) The cash flows should be discounted at the opportunity cost of funds.

c) The techniques should select from a set of mutually exclusive projects the one that maximizes shareholders´ wealth. We may distinguish the independent projects that are those that can be done one or all of them and so called contingent projects – they can be carried out all of them or none of them.

d) Managers should be able to consider one project independently from all others. It means that it is possible to sum the value of the projects.

I will theoretically discuss the most often used techniques (criteria) that help managers (investors) to decide rationally whether or not to invest, and how to choose among the options available in the chapter 3.1. These criteria will be further applied in the practical part – in chapter 4. Further discussion about theoretical background can be found for example in Damodaran (2001), Brealey et al. (2008), Ross et al. (2008) or Synek et al. (2001).

3.1 Methods of evaluation

(1) The payback period

The payback period is the time it takes to return all initial investments. The investment is considered as suitable according to this rule if its calculated payback period is shorter than some previously decided period of time. Hence, this method strictly takes into account only the period of time up to the payment of initial investment. This is the method that investors usually take into account when they want to receive invested money back as soon as possible.

However, the crucial problem of this method is not considering all the incomes during the investment period. It may be the case that the project has the negative cash flows after is considered as paid, so finally the funds that were invested in the project may not be returned at all. The second very important problem of this evaluation method is not taking into account the time value of the money.

(2) The discounted payback period

We may define the discounted payback period as the time until the discounted cash flows equals its cost. The investment is suitable according to this rule if its calculated discounted payback period is shorter than some previously decided period of time. The method tries to solve the shortcoming of the payback period by discounting the future cash flow.

However, this method has the same problem as the payback period rule; it simply omits the cash flows that emerge after the project is considered as paid.

Despite the problems mentioned before, the method of the payback period and discounted payback period is often used by companies when carrying out the relatively simple decision, because the cost of the more sophisticated analysis would exceed the possible loss from the incorrect decision.

The second reason for using these methods is the endeavour of the management to be involved in the project that secures the liquidity for the firm, since these methods tend to favour investments that will return cash invested quickly. It can be important especially for the small and medium enterprises. The third idea hidden in these methods is that the cash flow occurring later in the project´s life is more uncertain. That is why they tend to favour the cash flow that is more secure and ignore the unsecure ones.

(3) The Average Accounting Return (AAR)

This method is based on setting the demanded value of AAR and then comparing with the previously target value. The AAR value (in many economic textbooks defined slightly differently – compare Brealey et al. (2008) and Ross et al. (2008)) is set as:

$$AAR = ANI/ABV \qquad (1)$$

Where

ANI …… average net income during the life of the whole investment

ABV …. average book value during the life of the whole investment

The investment will be acceptable for the investor if the AAR is higher than the average accounting return set as target value.

There are several serious disadvantages that make this method not so precise. The first one is that the method is not a rate of return in the straight economic sense; it is just the ratio of two accounting numbers. The second one is that it does not take into account the value of money in a certain time. The third drawback of this method is that it does not take into account the correct and suitable variables. It concentrates on the income and book value, but it omits the cash flow.

(4) The Net Present Value (NPV)

The basic idea of this method is straightforward. The investment should be accepted if it creates the positive value for the investors, it means if the present value of cash flow is bigger than the present value of costs of the project. Hence, according to NPV method projects that have the net present value greater than zero are accepted. The idea of this criterion is relatively simple; still there are two challenging issues for the investor to be sold. The first one is to estimate correctly the free cash flow during the time of investment and the second one is to estimate correctly the *k* in time t.

The NPV assumes that the company can reinvest their money on the company cost of capital. However, every investor should have in mind that the value of NPV is just estimation, depending mainly on the reliability of figures that were brought into calculation. The formula for calculating NPV:

$$\mathbf{NPV} = C_0 + \sum_{t=1}^{n} \frac{\mathbf{FCF}_t}{[(1+\mathbf{k}]_t)^t} \qquad (2)$$

Where

C_0 ……. the initial cash flow (in normal investment situation negative)

FCF_t …. free cash flow in time t

k_t ….. cost of capital in time t

The calculation of FCF is done by following formula:

The FCF to firm = EBIT (1-t) + depreciation and amortization – change in noncash working capital – capital expenditures

The investor usually estimates pro forma financial statements[19] and project cash flows. All relevant financial information about the project is thus included in these predicted accounting statements.

Setting the right discount rate (*k*) to discount future cash flows to their present values is a very important issue of evaluation of the investment project. The firm (and also the projects) is usually financed by equity and liabilities. So, the discount rate *k* has to include the demand for return of equity by investor (r_e) and similarly cost of debt (r_d). The most often common method for setting *k* is calculating the project's weighted average cost of capital that is computed from r_e and r_d. Setting of the previously mentioned values (r_e and r_d) are done by several methods.

Cost of equity and equity risk for projects

Damodoran (2001) considers several sources of risks that may influence the cost of equity and have to be taken into consideration. These risks may be gathered into following groups:

a) Project risk – this risk is based on the wrongly estimated assumptions of the future cash flow in the individual project (cash flow may be higher or lower than expected).

b) Competitive risk – the reaction of the competitors is usually expected in the analyses, however the actual actions taken by competitors may differ from these expectations.

c) Industry risk reflects the specific area in which the investor operates. Industry risk is usually divided into:

[19] All these statements will be calculated in practical part.

a. Technology risk is connected with the changes in the technology different from those expected when project was analyzed.

b. Legal risk reflects the changes in laws and regulations. It may include the prices guaranteed by state, the taxes, etc.

c. Commodity risk – there can be shifts in resources used within the production which may change the price of these sources (commodities or services).

d) International risk refers to the situation, when the project is carried out in another country. It may include the exchange rate risk, political risk, etc.

e) Market risk refers to the macroeconomic factors that have an influence on all companies and projects. It may include the changes of discount rates, inflation, economic grow, the risk profile of the investors, etc.

The risks mentioned in a) – d) may be diversified by the firm or by the investor. Usually the company may diversify more expensively than the investor, since creating a diversified portfolio costs far less than creating diversified firms. Hence, to specify exactly the risk of the investment the investors in the firm should be described.

There are three basic model situations of the difference in the cost of equity for a project and cost of equity of the whole firm.

The first situation is that a project has the same risk profile as the company's existing business activities and the investor may use the overall cost of equity[20] as the cost of equity for the projects, since the risks are the same. The advantage of this situation is that the firm does not have to consider risk estimation for each situation and can use the same hurdle rates for all projects.

However, if the project is riskier than business activity, the cost of capital of the project should be higher. On the other hand, if the project is not as risky as the usual companies activities, the cost of capital should be lowered.

If the company operates in more than one field, it has several risk profiles regarding to different projects. Using just one cost of equity for the projects from different business areas would lead into incorrect decisions, since each activity has its own risk. Damodaran (2001) states the different methods of setting correct beta as bottom-up estimates or regression

[20] Recent studies of utilizing the methods of evaluation of the cost of equity are included in Kolouchová (2008)

accounting data for a specific business activity. The most common is the bottom-up approach which includes the following steps:

(i) To identify the business activity.

(ii) To find the companies that conduct the business primarily and are publicly traded.

(iii) To estimate of the market risk parameters for these companies (the estimations are usually published for different sectors).

(iv) To correct market risk parameters regarding the differences in financial leverage between the firms and the project.

(v) To use the corrected market risk parameters.

The company may follow the above mentioned steps even if it wants to invest in the totally different area with a different risk profile than are its everyday activities. The following formula is usually used calculating the r_e.

$$r_e = r_f + beta \times (r_m - r_f) \quad (3)$$

Where

r_e ……. Cost of equity

r_f …. Risk free rate

beta ….. Coefficient that measures systematic risk

r_m-r_f .....Risk premium

Coefficient beta is usually further amended by the expert opinion due to different risk of the project and the different estimation of the market risky parameters of the companies working in the same business, if some aspects of the project are different from the general projects. Hence, the beta of the project might be amended due to the relative magnitude of the project, diversification of the activities of the investor, guarantee of the prices etc.

Cost of debt

There are three ways how to calculate the cost of debt for a project. The first approach is claiming that money is borrowed by the firm and thus the cost of debt should be the same as the cost of debt for the whole firm. This is generally true if the project is relatively small and thus has only a small impact on firm´s default risk.

The second approach makes sense if the project is large in the terms of capital needs and has different cash flow volatility than other firm investments. In this case the best way is to consider the other firms that did similar projects and use the cost of debts of these firms.

The third way is applied when the project is extremely large and borrows its own funds, so in case of project default the debtor will probably also lose all his money. In this case the debtor usually calculates the project revenues relative to project defaults and sets the appropriate discount rate.

Cost of Capital for Projects

Receiving the cost of equity and cost of debt we may calculate the cost of capital by weighting each by their relative proportions. However, we should consider the different situation. If the project is small and does not influence the firm´s ratio of the company, we may suppose that the project does not influence the capital structure of the firm. If the project is considerably large (stand-alone projects), the financing weights should vary from project to project (as the cost of debt differs during the time).

We may then calculate cost of capital for projects using equation (4). Such computed cost of capital will serve for discounting the free cash flow in equation (2).

$$\text{Cost of capital} = D/C * r_d * (1-t) + E/C * r_e \qquad (4)$$

(5) The internal rate of return (IRR)

This method tries to find internal rate of return in the sense that it depends only on the cash flow of the investment, not on the other rates given from the external surroundings.

We may define the internal rate of return as a rate which equals the net present value to zero. So, this is the rate of return of the capital that was invested that exactly equals the discounted FCF of the company.

$$0 = \mathbf{NPV} = C_0 + \sum_{t=1}^{n} \frac{\mathbf{FCF_t}}{(1 + \mathbf{IRR})^t} \qquad (5)$$

Where

C_0 ……. the initial cash flow (in normal situation negative)

FCF_t …. free cash flow in time t

IRR….. cost of capital in time t

The investment is acceptable according to this rule, if the IRR exceeds the previously given required return by the investor.

We may consider the IRR as the opportunity cost of capital. The difference between the NPV rule and the IRR method is that both make the different assumption about the reinvestment rate. The IRR method assumes that the cash flows invested (received) in the project has opportunity costs equal to the IRR.

The first problematic issue of IRR is that we may find multiple rates of return. It happens when the investment has the non-conventional time-frame. By the conventional time-frame is meant the investment when the money is invested on the beginning and then the cash-flow is received during the time of the investment. The maximum number of IRRs is equal to the number of times when the cash flow change sign from positive to negative and/or vice versa. If the multiple of IRRs occur there emerges a problem how to interpret them. The second problem with IRR method is when we compare the mutually exclusive investments (it means that we cannot take both of them). We cannot rank them according to the criteria of IRR, because it is misleading. However, we should evaluate them according to NPV rule, since the investor is primary interested in the increase of the value for him, not in the rate of return.

However, this method is broadly used by financial analysts because the rates of return seem clearer than the NPV. The second advantage of this method can be observed when the investor does not have any clue about required return on investment.

Several ways have been broadly discussed how to amend IRR method to eliminate the multiple IRR problems and receive just one value, so called modified internal rate of return (MIRR). The following methods are usually mentioned:

(a) The discounting approach – the idea is to discount the negative cash flows to the present value and then add it to the initial cash flow in period 0. Thus we receive only one value of MIRR.

(b) The Reinvestment Approach – the idea is to reinvest all the cash flow (except the first one) until the end of the project and then compute the MIRR rate.

(c) The Combination Approach – usually the negative cash flows are discounted back to the present, and positive cash flows are compounded to the end of the project.

However, such modified internal rate of return is quite controversial. Interpretation of MIRR is problematic and calculating MIRR requires using the discount rate. However, if we know (suppose) the given hurdle rate, it is possible to calculate the NPV and thus have the results immediately.

(6) The Profitability Index

We may define the profitability index as a ratio between benefit and cost, so the ratio between present value of the future cash flows divided by the initial investment. The interpretation of the index is straightforward and it represents the value created per one invested dollar. It makes sense to compare the projects by this method when there are scarce resources.

PI = PV of future CF / PV of initial investment (6)

As it was mentioned above, for a theoretically best method is usually considered NPV. However, other methods can help the investor to decide if there are no hidden drawbacks in the investment. Let us assume that NPV is positive, payback is short and AAR is quite high. Then the investor may feel more secure about the investment. On the other hand, let us suppose that NPV is positive, but the payback period is long and AAR is quite low. Then the investor should be more careful before taking the final decision and consider the given numbers once again.

In the previous text we mentioned the cash flow, but we should specify what this cash flow means. The cash flow means any change in the company's cash flow connected with working on the project. In this sense, the sunk costs cannot be incorporated into the cash flow. On the other hand the opportunity costs should be considered in the cash flow. The investor should be aware that he has to consider the cash flow when it actually occurs.

4 Project

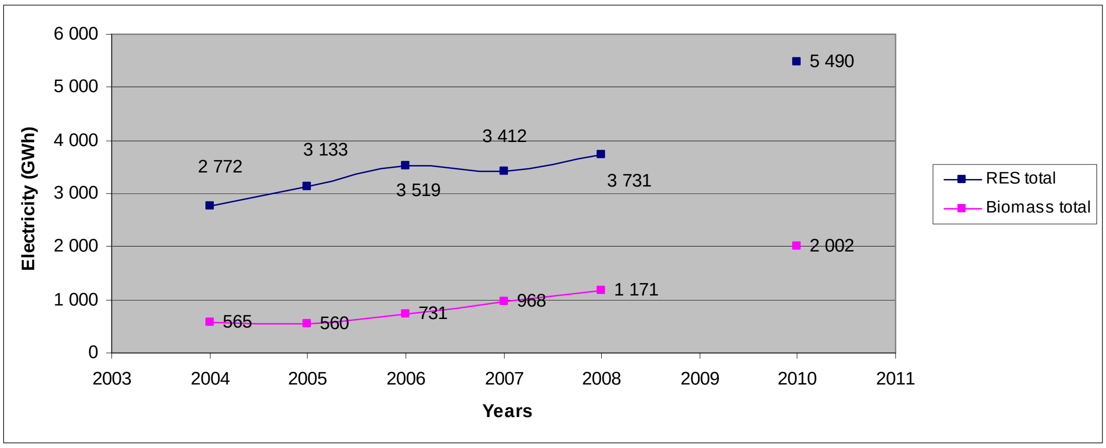
4.1 Business plan

The production of the power from biomass has been continuously growing in the last years and there was produced nearly 1 200 GWh in the Czech Republic in 2008. However, there still exists quite a huge potential for the increase of electricity produced from combined heat and power plants. In order to achieve the indicative target given to the Czech Republic (8% share of electricity generated from renewable sources in gross electrical consumption) in year 2010, it would be necessary to produce about 5 500 GWh from RES.

Taking into consideration the technical limits of other sources of energy (for example potential of hydroelectric energy has been almost exhausted, complicated negotiations relating to the location of the wind power plants, technical problems of photovoltaic energy) leads us into conclusion that the majority - about 70% (1 230 GWh) of the necessary growth (1 760 GWh) should be produced in plants using biomass or biogas.

According to the progress and perspective, it is expected an increase of production in biogas plants by 400 GWh. Thus, it would be necessary produce additional 830 GWh from biomass to achieve the indicative target. It means either to build additional biomass power plants or to start burning biomass in the current plants with power output 100-120 MW_{el} (Akční plán pro biomasu pro ČR (2009) - calculation amended according to the power consumption development in the Czech Republic).

Fig. 6. Electricity produced from biomass and total RES



Source: MPO, ERO, own calculation

The growth of the market for the RES-E should be quite huge. Hence, potential investors especially those who operate in the agricultural or forest area or have an access to the cheap biomass are looking for suitable projects that would diversify their business activities and bring an additional value to their existing products.

In the practical part of the paper, I will analyse and evaluate the possible investment that is planned by the Czech investor – Zemcheba s.r.o. Generally, the largest problem for the investors considering the investment into new combined small-scaled heat and power plant with the energy output about 1 $MW_{el.}$ using burning biomass as a fuel is a limited experience with the production technology, a lack of such technology available in the Czech market for small plants and relatively high investment costs. This is caused mainly due to the fact that the technologies have not still reached the technical and commercial maturity.

4.2 Information about investor

Company Zemcheba s.r.o. is an agricultural company that operates in the south of the Czech Republic and has its headquarters in a village called Chelčice[21]. The company was founded in 1998 with the starting equity of 180 000,- CZK. The equity was increased to 40 000 000,- CZK in 2004. The company was established according to the Czech law and thus Czech Acts are essential for the whole business activity and all processes in the company. All business activities are carried out primarily according to Czech Commercial Law (Act No. 513/1991 Coll. as amended), Act No. 586/1992 Coll., on income tax as amended and other Czech Acts.

4.2.1 The main company activities

The company core subject of business lies in the agricultural area. Zemcheba s.r.o. is engaged in different activities[22] such as:

a) Fruit production – the company produces fruit on approximately 400 ha of orchards. The main fruit products are apples, pears, sweet cherries, sour cherries, currants, plums. The fruit trees have to be pruned every year (usually twice per year – summer pruning and winter pruning), so this wood material can be cut and transformed into the wooden chips and then used in the cogeneration unit as a fuel, if the price of the wooden chips from the forest industry suddenly and significantly increases. It means that the wood material (pruned branches) from fruit orchards partly reduces the price risk of the wooden-chips that will be bought from forest companies.

[21] More information on http://www.chelcice.cz/
[22] More information on http://www.zemcheba.cz/

b) Fruit processing – the company produces fruit concentrates, fruit juices, fruit purée. The capacity of the fruit processing is about 10 000 tons of fruit per year. The necessary steam for the production is received from burning gas in the classical boiler. The company burns gas for receiving necessary heat to keep this going process. The heat that will be created by the plant will thus reduce the costs paid to the supplier of the gas and therefore it is calculated as revenue of the project.

c) Producing different products for protection of the plants against pest animals in the different plantation areas (forests, fruit orchards, etc.).

d) Crop production – the company operates on 2 100 ha of arable land with the main production of wheat, barley, rapeseed. The production of the straw can be used in the cogeneration unit as a fuel too in case of the unfavourable price change of wooden chips – this way the price risk of increasing cost of wooden-chips is lowered.

e) Animal production – the company produces cows for milk production (about 300 cows) and different kinds of meat – beef, pork and chicken.

f) The production of dried products – dried bone broth and bone powder. The heat power that will be produced in cogeneration unit might be potentially used in the process of drying products and thus safe costs for gas bought for the heating.

g) Fishery – the company manages 11 ha of ponds. The year production is approximately 8 t of fish every year.

h) Agrotourism – pension is located in Chelčice – the waste heat from the cogeneration unit can also be used for district heating of the pension (intention – not calculated in the project evaluation).

4.2.2 Economic situation

In Table 5, there are shortly summarized the basic economic figures from balance sheet and P/L statement from year 2007 and 2008. The whole Annual report 2008 can be found on the websites of Ministry of Justice[23].

Table 5. Basic economic figures

	Year 2008 (thousand CZK)	Year 2007 (thousand CZK)
Total assets	121 483	114 081

23 http://www.justice.cz/xqw/xervlet/insl/index?sysinf.@typ=sbirka&sysinf.@strana=documentList&vypisListin.@cEkSub=309659

Fixed assets	36 591	34 010
Inventory	48 885	39 307
Short-term receivables	30 643	34 714
Short-term financial assets	4 382	5 034
Registered capital	40 000	40 000
Equity	22 216	21 184
Short-term payables	53 938	40 460
Bank loans	21 961	30 542
Average No. of employees	96	100
Total revenues	161 897	163 336
Total expenses	161 885	145 781
Net income	32	17 555
Average wage	20.5	19.0

Source: www.justice.cz and internal documents

4.3 Summary of the business plan

The purpose of the business plan is to build one combined heat and power (CHP) plant that will be used for producing heat and electricity in the district of investor Chelčice, on the cadastral unit area[24] 558/1, 558/2, 563/8, cadastral area Chelčice. The total energy input in fuel is 6.7 MW, thermal energy output from the cogeneration unit is 6.3 MW and production of power received from thermal energy is 0.996 $MW_{el.}$. The plant will also produce process steam with 8 bar (abs), saturated pressure that will be available for 8 working hours per day for technological purpose (producing of fruit concentrates, fruit juices, fruit purée). Out of working hours, the procedure of creating process steam is reduced or switched off.

4.3.1 Technical description of combined heat and power plant

The main technological parts of the unit are[25]: building, storage of the fuel, fuels handling system, combustion unit, steam boilers, and steam engines with asynchrony generators, exhaust steam condenser.

a) Building has to be build to protect the technological parts of the delivery against external environment, thieves, etc.

b) Storage compartment should have at least 300 m^3 to provide enough fuel for the combustion all the time (24 hours per day, 365 days in the year).

[24] More information about cadastral maps on http://nahlizenidokn.cuzk.cz/
[25] According to the information from the suppliers

c) Fuels handling system ensures that the fuel is safely transfer from the storage to the combustion unit. It consists of 13 horizontal hydraulically driven scrapers and 1 conveyer.

d) The burning in the combustion unit is based on the technique of two-levelled combustion. The primary combustion is managed in the first zone and the secondary combustion is done in the following zone, where the secondary air is mixed to reach constant temperature (1050 ℃) of outgoing gas. There are installed thre e fans to ensure that the combustion is managed in optimal conditions.

e) The steam boilers provide enough energy for running steam engines and also generate the steam to the process steam where the steam is used for drying food and food processing.

f) The steam engines – two steam engines that together generate 0,996 MWel.

g) Electric generators – electric generators are of synchronus type, 1000 rpm, 0.4 kV, 550 kVA. These generators will connect the plant to the EON national grid.

h) Pumps – there are several pumps that can feed the boiler with the full capacity. One pump is always set as a spare.

i) Exhaust steam condenser ensures that the steam is pressure is lowered to 1 bar when only electricity is produced and to 8 bar when the electricity and production steam are produced.

4.3.2 Function of the plant

4.3.2.1 Description of the combustion system

The combustion system receives fuel (wooden chips/agro-waste) from a fuel storage, which is integrated into the main building. Trucks deliver fuel to the fuel storage; either from back tipping or side tipping. A fully automatic mechanical system will feed the fuel into the combustion unit.

The combustion unit is designed for the needed thermal power. It has a movable grate system; all grates are water cooled in order to prevent as much as possible melting ash to create slag.

In order to keep the proper temperature in accordance with the fuel used, the flue gas around 200 deg C is also induced in the combustion chamber.

In order to reduce the amount of dust created from the combustion unit the heat load of the grate per square meter is kept low and the volume of the whole combustion unit is kept big, so that the gas shall be able to finalise its combustion – keeping the amount of dust leaving the combustion unit at its minimum; so that a minimum of soot will be left on the boiler tubes, and also as little soot particles as possible will be collected in the dust filter proceeding the chimney.

After the ash combustion section of the grate an automatic ash removal system is installed. It is built up by an extremely sturdy screw, which has its centre properly water cooled. Also the casing of the screw is water cooled in order to prevent ash melting into slag. The ash is removed automatically by means of an automatic system into an ash container.

4.3.2.2 Description of the power generation system

The electric power generation system is built up by two identical reciprocating steam engines.

The engines receive the high pressure steam from the steam boiler (30 barg/500 deg C). Expansion takes place to the 1 bar atm. level. These engines produce together 0,996 $MW_{el.}$ measured on the generator terminals.

Generally, the generators can be either synchronised with the national E.ON grid, or they can run isolated only for the domestic plant. In the case of the project the generators will be synchronised to the national grid and will supply E.ON. with as much energy as it can for the set feed-in tariffs. The rest will be consumed by Zemcheba s.r.o. or will be sold to the other subject.

4.3.2.3 Process Steam Supply

The plant uses process steam with 8 bar (abs), saturated pressure. This corresponds to about 170 deg C. The amount of steam used for this purpose is set to four tons per hour, which in turn corresponds to about 3 MW thermal power. However, past the working hours, this process steam is reduced or switched off.

When running at using process steam, the steam engine output condenser pressure is increased to 8 bar also. When running this way, the efficiency of the steam engine alone will go down, since the steam will not fully expand to the low pressure of 1 bar, but instead only expand to 8 bar. The electric power will be reduced accordingly when running in process steam mode.

Process steam will also be added from a separate heat exchanger, supplying heat directly from the main steam boiler.

4.3.2.4 Changing steam engine between condensing running and process steam running

The steam engine is prepared for running both ways. At process steam, the condenser pressure is increased to 8 bar; at condensing pressure the condenser has 1 bar. The adjustment is done inside the steam engine, and it is also necessary to change the cooling water temperature/amount in the condenser.

4.4 Production opportunity

The intention of the project is production of non-commodity product – it means the production of electricity power and production of process steam for technological purposes.

4.4.1 Development of the market

The Czech Republic has accepted the commitment as one of the Member States of the EU to utilize 8% share of electricity generated from renewable sources in gross electrical consumption by 2010. Hence, the valid Acts guarantee the producers the price (feed-in tariff) for each $MWh_{el.}$ produced and also ensure that they will be able to sell all the electricity contracted.

The aim of this business plan is to produce the green electricity (using biomass burned in the cogeneration unit) and also the production of the process steam for technological purposes. Simanov (2002) estimates that another 14 million cubic meters of woody material could be used potentially as an energy source in the Czech Republic. The price of the electricity is given in advance for the next 20 years. It is also necessary to take into consideration the tax release in the calendar year in which the plant is put into operation as well as in the following five years.

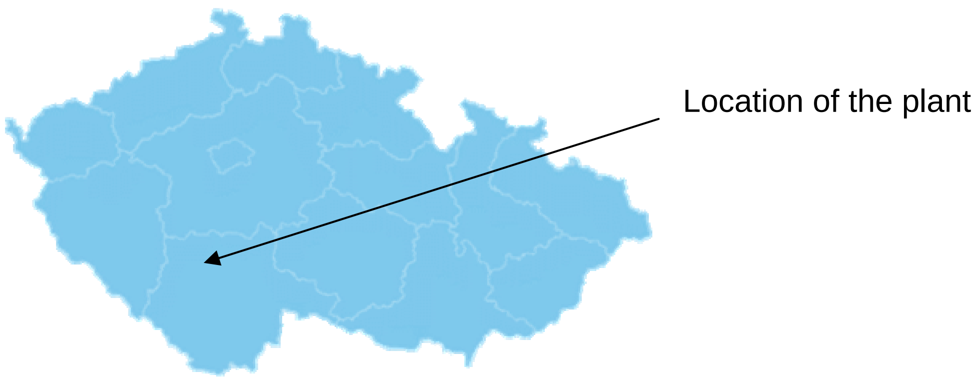
There is also opportunity for signing a contract with the buyer of the electricity and selling power directly to the consumer with receiving the green bonus and thus achieving the higher price for the electricity in total than the guarantee price (feed-in tariff) is. However, in the calculation we will calculate merely the sale of electricity for the given feed-in tariff.

It may happen that in case the grid capacity is over-load in the area, the distribution company is not obliged to buy the electricity power from the producer of renewable sources of energy. Hence, it is absolutely necessary to receive positive statement from distribution company E.ON before starting the project (construction phase). This statement has been already received.

4.4.2 Location

The project is placed in village Chelčice, cca 3 km from town Vodňany. Vodňany has around 7,000 inhabitants. The distance between the project area and the near more populated town is quite important, since there have been several warnings of the worse air quality and the project will become one of the biggest local air polluters in the Vodňany area.

Fig. 7. Location of the plant on the map of the Czech Republic



There may be problems with fulfilling pollution limits according to Czech legislation (Act No. 86/2002 on Clean Air Protection as amended) and the company must be very careful in choosing the technology and concluding a precise and careful agreement with the supplier of the technology about the emission produced from the burning process.

South Bohemian Regional Authority, Department of the Environment, Agriculture and Forestry has already given the Binding Statement where preliminary agrees with building of construction stationary source of pollution "CHP plant Chelčice". However, the Regional Authority set severe conditions that must be fulfilled by the investor to be able to put the plant into operation phase. These conditions mainly refer to emissions and noise limits. Therefore, it is absolutely necessary to avoid incomplete combustion caused by a high content of water in the fuel in order to reduce emissions of pollutants. The incomplete combustion may also occur due to the lack of control over the combustion process leading to pollution in the flue gases.

4.4.3 Prediction of electricity volume, process steam, delivery and prices

According to valid legislation (Act. No. 180/2005 Coll. as amended) the operator of the regional grid system and the transmission system operator are obliged to purchase all electricity from renewable sources from the producer, with whom he already concluded an agreement about the delivery.

The price of the electricity is determined in Price Decision No. 5/2009 by the “Energy Regulatory Office”. The price is therefore determined as 4 045 CZK/MWh in case the plant will be put into operation in year 2010 (the detailed calculation is done in Table 10).

Instead of the feed-in tariff, the power producer may receive the green bonus in case he finds a customer to whom he sells the electricity. However, the green bonuses and the given prices guaranteed by the Price decision cannot be used in the same year and the producer has to decide which support he wants to use.

The price of process steam is evaluated as a savings of the gas that is consumed on average in the previous years. According to expert predictions, the consumption is increased by 5% every year of the project, due to the fact that the price of the gas increases in the long term.

The expected operating time is set to 8000 hours per year (two or three weeks overhaul may take place during the summer), it means that the total production of energy is 7 968 MWh per year.

The agreement with E.ON company was already signed that E.ON would purchase the electric output of 810 $kW_{el.}$ and the rest 186 $kW_{el.}$ can be sold to other consumers or it will be consumed directly in the operation processes in the company.

4.4.4 Investment costs and costs connected with running the plant

The total costs of the project are expected to be CZK 81 million. After putting plant into operation in December 2010, the electricity produced by CHP plant will be purchased by the distribution company and Zemcheba s.r.o. will receive the corresponding financial amounts every month according to the amount of electricity delivered.

The investment costs of the different parts and the corresponding proportion of the total investment is computed in the Table 6.

Table 6. The total investment cost and the corresponding proportion

Item	Cost in CZK (thousands)	% of the total investment cost
Building and land area	17 000	20.99%
Technology	62 000	76.54%
Others	2 000	2.47%
Total investment costs	81 000	100.00%

We may see that the technology part creates the highest fraction of the total amount invested into the plant (more then 76% of the total investment cost). For this reason, the purchasing the optimal and well-working technology is crucial and the correct decision will influence the success of the whole project.

We may compare the calculation of the investment costs with the indicative values set in the Appendix 3 to the Notice No. 475/2005 Coll., as amended.

Table 7. Unit capital expenditure and annual utilization of the plants installed capacity

Plant description	Total unit capital expenditure [CZK/kWel]	Annual utilization of installed capacity [kWh/kWel]
Dedicated biomass-fired plant	< 75 000	> 5 000
Project – Zemcheba s.r.o.	81 000	8 000
Fulfilling the criteria	No	Yes

Source: Notice No. 475/2005 Coll., own calculation

We may see from the Table 7 that the values of the Notice No. 475/2005 Coll., as amended are fulfilled in terms of annual utilization of installed capacity, but slightly exceeds the recommended values regarding to total unit of capital expenditure.

Since the project is considerable large regarding to other business activities, operates in the different part of the business area and has different business strategy, objectives and competitors, we will suppose that the company evaluates the project as a special unit and thus can create special financial statements for the project.

4.4.4.1 Structure of financing

The total investment of the plant will be financed by equity (20%) and by debt (80%) – bank loan; it means that the total investment costs of 81 million CZK will be financed at the beginning of the project by CZK 16.2 million of equity and CZK 64.8 million of a bank loan.

According to previous experience with the similar projects and with the preliminary inquiry, the bank loan should be received, since the investment is relatively save due to the fact that purchase prices (feed-in tariffs) are guaranteed by the state (European) green policy and corresponding Acts, so the banks are relatively prepared to finance these kinds of projects. For example, Czech commercial bank Česká spořitelna a.s. prepared the Top Energy Program that is aimed at financing renewable energy projects. This program is intended not only for the big investors but for the small and medium companies as well[26]. We will suppose further on that the bank will grant a loan with 8% yearly interest that will be granted for 15 years. We also presume that the first loan repayment of interest and principal will be deferred and so, the investor will reimburse the first payment in the year 2011. The every-year payment to the bank will be done in the same total amount, including interest and principal.

The total distribution and payment of the interest and principle over time may be seen in Table 8.

Table 8. Payment of Interest and Principal

Year	Interest	Principal	Total payment	Principal remaining
2011	5 184 000.00	2 386 554.51	7 570 554.51	62 413 445.49
2012	4 993 075.64	2 577 478.87	7 570 554.51	59 835 966.62
2013	4 786 877.33	2 783 677.18	7 570 554.51	57 052 289.43
2014	4 564 183.15	3 006 371.36	7 570 554.51	54 045 918.08
2015	4 323 673.45	3 246 881.07	7 570 554.51	50 799 037.01
2016	4 063 922.96	3 506 631.55	7 570 554.51	47 292 405.46
2017	3 783 392.44	3 787 162.08	7 570 554.51	43 505 243.38
2018	3 480 419.47	4 090 135.04	7 570 554.51	39 415 108.34
2019	3 153 208.67	4 417 345.84	7 570 554.51	34 997 762.50
2020	2 799 821.00	4 770 733.51	7 570 554.51	30 227 028.99
2021	2 418 162.32	5 152 392.19	7 570 554.51	25 074 636.79
2022	2 005 970.94	5 564 583.57	7 570 554.51	19 510 053.22
2023	1 560 804.26	6 009 750.25	7 570 554.51	13 500 302.97
2024	1 080 024.24	6 490 530.27	7 570 554.51	7 009 772.70
2025	560 781.82	7 009 772.70	7 570 554.51	0.00

4.4.4.2 Working capital

The influence of working capital can be neglected in our project. The reasons for this are that there will not be inventories generated during the project, because the product (electricity) is immediately sold out to the customer or consumed (process steam). Invoices will be addressed mainly to one company (more than 90%) – E.ON. Distribuce, a.s. and the due date of the invoices will be 20 days. So, accounts receivable become due in short term. Similarly, the accounts payable will be paid within 20 days to the suppliers of biomass, so there will not be time-lag between the payments.

[26] More information on http://www.csas.cz/banka/menu/cs/firmy/nav00000_firmy_nds_255_prod_1439#10

E.ON. Distribuce a.s. is a company that is regulated by state authorities (for example State energy inspection[27], Energy Regulatory Office, Ministry of Industry and Trade), so the risk of non-payment of the invoices is reduced to a minimum.

4.4.4.3 Supplier

A careful selection of supplier of the technology is essential part of the whole project. The highest risk of the entire project is the technology part of the process, so to choose the reliable and right partner who will deliver the well-function technology is a key issue.

There will be carried out selection procedure during which the producers of the technology (at least 3) will be allowed to place their offers. The terms will be set in the project documentation with the criteria 50% price and 50% guarantee on the functionality. The selection procedure will be public and the call with the given conditions and terms will be published on the internet, so any producer of CHP technology can place his offer. Moreover, the following producers of CHP have been already found to be suitable due to their previous experience and will be directly addressed to take part in the competition. They are:

a) Swedish company Energiprojekt AB[28], producer of biomass power plants. The company has 25-year-experience in the cogeneration business and has built and delivered several power plants in the different countries. The company mainly focuses on the small-medium plants with the electric output up to 3MW and production of heat power up to 10 MW.

b) The Belgium company Vyncke expert N.V.[29] a producer that makes solutions for burning biomass that has almost 100-year-experience in the business and has built more then 2500 combustion units. The solution range of technologies range from 2 MWth to 100 MWth and up to 10 MWel.

c) The Dutch company Kara Energy Systems B.V.[30] a producer of equipment that converts fuels into energy. The company has over 100-year-experience with producing heating systems and in recent years it has started to produce cogeneration units as well.

[27] Further information on http://www.cr-sei.cz/
[28] Further information on http://www.energiprojekt.com/
[29] Further information on http://www.vyncke.be/
[30] Further information on http://www.kara.nl/

The fundamental condition of the delivery is a contract between the supplier and investor. Supplier will have to set in advance the guaranteed period for the plant for at least 5 years. The contract is usually agreed according to General Conditions for the supply of mechanical, electrical and electronic products that were determined by Orgalime[31] and are primarily intended for use in international contracts for delivery of engineering industry products in general. However, some conditions in these General Conditions need to be amended, for example there is set the liability to defects which appear within a period of one year from delivery. This period should be extended and set as 5 years minimum. The other article of Orgalime that is usually changed is the article No. 18 setting that one third of the payment should be paid in the time of signing the contract, the other third when the essential part is ready for delivery and final third is paid when the product is delivered.

4.5 Marketing and communication strategy

4.5.1 External communication

There is almost no problem for the power producer from the renewable energy sources to sell his production to the customer, since the purchase quantity and price are guaranteed by Acts and contracts that are signed at the beginning of the project (in case of Zemcheba s.r.o. – the most important customer is E.ON. Distribuce a.s.)

However, a well done public presentation of the project should not be neglected regarding all stakeholders of the firm, especially the people living in the village Chelčice and surrounding (the Vodňany area). These people may feel that the plant could influence their lives in negative sense, i.e. it may worse the air characteristic due to the emissions that leave the chimney or people may be worried about the esthetical impact of the plant in nature. Hence, it is necessary to communicate with the citizens and explain them that the plant will not affect their health in any way and that the heat produced by the plant may possibly also help to create the positive effects in the village in the future (for example: district heating of several houses and a school).

There will be created three new job opportunities in the company (two full-time technicians and one part-time watchman) and also there will start direct positive effects on the companies producing the wood-chips and other biomass material, since the company will have to consider buying the agriculture raw material from firms in its surroundings because the transport of the material is too costly and also environmentally non friendly if delivered

[31] Further information on http://www.orgalime.org/publications/conditions.htm

from the long distance. Preliminary dealing has been already done by the company with the wood-chips producer about the future deliveries and prices of biomass.

4.5.2 Operation process - Chelčice

The complete power plant system will work according to the EU-Directives for unmanned operation. All running data from the operation will be put on the web site in the actual time, so the technician who is responsible for the correct operation of the plant will be able to check the right operation of the system 24 hours a day after log-in into the system (log-in name and password will be necessary).

It is calculated that the plant will consume 16 thousand tons of wooden chips per year; it means nearly 50 tons per day (not included the 14 days of technological brake plus the time necessary for cooling down the cogeneration unit – all together 30 days). It means that on average approximately 2 camions of wooden chips per day will arrive and download the material for burning to the storage near the plant.

4.6 Time-frame

The investor estimates to put plant into operation (test phase) in December 2010. The full operation phase shall follow, starting at the beginning of 2011. The total durability of the plant is estimated for 20 years (including test phase).

Preliminary phase of the project:

- Zoning decision – already confirmed;
- State building approval – already confirmed;
- Statement of the E.ON Distribuce a.s. – distribution organization (reservation of capacity of 810 kW) – already received;
- Searching for funding of the project – preliminarily confirmed;
- Selection procedure.

4.6.1 Investment period

The proposed time frame for the investment can be seen in the following Table 9. After the construction of the building part, there may follow the construction of the mechanical part. It is estimated that the whole time necessary for building the plant will be 5 months and will take place from July till November 2010. Since the initial investment is expected to be paid on 1st July 2010, the estimated values and calculations are related to that date.

Table 9. Time frame for the investment

2010	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
January	preliminary phase																														
February									the whole project submitted to the Ministry of Agriculture																						
March									preparation of the selection procedure																						
April	selection procedure + making the final decision about investment																														
May																															
June																															
July	construction of building part																														
August																															
September	construction of mechanical part																														
October																															
November																															
December	test phase																														

4.6.2 Operation period

The plant should be put into operation in December 2010 in trial phase. The trial period will last according to the experience two months according to the agreement with the distribution company. When the operation period is successfully over the normal period will start.

The technology is defined as for unmanned, however it is planned that one person (technician) will be responsible for the right process of the plant. He will be obliged to ensure there is enough biomass for burning; control the everyday smooth process of the plant and repair the invalid parts of the technology. During the technological brake, he will be responsible for checking the right function of all parts and deciding which parts need to be changed for the spare parts.

4.6.3 SWOT analysis

SWOT analysis can be defined as strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project. This method specifies the objective(s) of the project and identifies the internal and external factors that are favourable and unfavourable to achieve these objectives during the durability of the project.

4.6.3.1 Strengths

Almost no-risk investment after successfully putting the plant into operation thanks to governmental support of renewable sources of energy that are precisely specified in the current legislation.

The risk of non-paying invoices for the electricity is very low thanks to the delivery of the energy to the company that is regulated by legislation.

The purchase price of the electricity is guaranteed for the following 20 years for the expected durability of the plant.

The demand for labour force is quite low. It is estimated that only three persons will be involved in the project, so the total wage expenditures will be relatively low compared to the whole investment.

4.6.3.2 Weaknesses

The start of the project will be financed by the debt financing, it means that in case of the lack of cash flow in the beginning of the project there will be pressure from the bank on the company and therefore the firm will have to use its own financial resources.

The technology and the building part will be probably provided by two different subcontractors. There may be risk of misunderstanding and not fitting the technology with the construction company.

The difference between revenues and costs will mainly depend on the price of the biomass (wooden-chips, straw, etc.). In case of increasing the price of the wooden-chips the rentability of the project may be changed.

The pollution effect caused by the CHP plant (burning biomass) in the Vodňany region is relatively high. The plant will become one of the ten biggest air-polluters in the region.

The current insufficient experience of the managers (members of board) with this type of economic activity. Especially before the whole project is finally approved, it should be described in details to all members of the board, explaining them the financial and technical details, so they would deeply understand it.

4.6.3.3 Opportunities

No competition in the market. All the “green energy” already contracted with the distribution company will have to be purchased during the whole life of the project.

After the successful start-up of this project and receiving all necessary practical knowledge there may be a possibility of establishing a completely independent unit (for example daughter organization) that will implement such types of projects in the similar agricultural companies that would be interested in it.

Using of the resources (biomass – straw, hay, wooden-chips) from the company sources and thus eliminating the fluctuation on the market with raw biomass.

4.6.3.4 Threads

Pre-operation phase – problems with putting the technology in the operation, it may mean not only the problems with technology itself, but there can be problems with technical documentations and final state approval of the plant.

Operation problems – not enough biomass for burning and/or the price of biomass increases significantly, insufficient efficiency of the CHP plant.

Not finding the suitable employees (technicians) for the operation process or their high fluctuation.

Changes in legislation – it may happen that the guaranteed support from the government will be changed, which can mean the reduction of obligation of the distribution company to buy all the electricity produced for set price.

No possibility of receiving the financial resources (not enough equity and not receiving the bank loan).

4.7 Environmental influence

The power production from CHP plant should be environmentally friendly, it means that the use of biomass as a fuel does not cause net increase in carbon dioxide emissions to the atmosphere, since the trees and plants grow and remove carbon from the atmosphere through photosynthesis. So, the total amount of bio energy is carbon dioxide "neutral." It implies that the use of biomass for energy does not increase carbon dioxide emissions and does not contribute to the risk of global climate change. Additionally, the burning of biomass may destroy the waste materials that would otherwise create environmental risks.

4.8 Evaluation of the project

The revenues of the project are predictable relatively easily, since we estimate that the main part of electricity will be sold for the prices that are guaranteed by government.

We consider the investment to be in operation for 20 years from the putting plant into the test phase (predicted life-time of the plant), it means for the period when the electricity prices are guaranteed by Acts. We suppose that after this period the investment machines can be sold and the building used for other purposes, which will exactly cover the liquidation costs.

4.8.1 Profit and loss statement

The P/L statement is calculated according to the assumptions mentioned bellow. We will not consider the VAT payment, since this tax has no influence on the final profit.

4.8.1.1 Revenues

In year 2010, we calculate revenues as 8% of the total revenues of the following year, since we estimate putting the plant into operation at the end of November 2010, so the plant will be in operation only 1/12 of the year. We suppose that the energy will be sold to E.ON Distibution a.s. from year 2011 for stable price 4.045 CZK/kWh, so the revenue from this sale is unchanged. We know that the rest of electricity (power output 186 kW) will be consumed by the producer or sold on the free market and we carefully estimate that the free market price will be 1.1 CZK/kWh in year 2011 and there will be 3% increase in the free market price. The P/L statement also includes revenues (savings) of the process steam that is used in the operation process. The financial amount for the steam is set to 9 800 000 CZK (information from the investor) and we estimate that there will be 5% increase in the price of the process steam.

The estimated calculation of price per kWh and the total revenue from the electricity production for year 2011 may be seen in Table 10. The calculation of the total revenues of the project during the years is published in pro forma income statement in the Appendix No. 1.

Table 10. The revenues from the electricity production for year 2011

				Price according to "Price Decision No. 5/2009"				
	Electric Power (kW)	Operation time (hours)	Energy production (kWh)	§ 1.5. (CZK/kWh)	§ 2.2. (CZK/kWh)	§ 6.2. (CZK/kWh)	Total price CZK/kWh	CZK
Electricity (E.ON.)	810	8000	6 480 000	3.53	0.47	0.045	4.045	26 211 600
Electricity (free market)	186	8000	1 488 000				1.1	1 636 800
Total								27 848 400

4.8.1.2 Costs

Wooden chips

The price of the wooden chips is preliminary agreed with the nearest producer and is determined to 1.1 CZK/kg. The approximate 17 744 tons of wooden chips per year will have to be burned. It is estimated that the price of wooden chips will increase by 5% every year.

Personal costs

While calculating the personal costs we suppose that the two full-time jobs (technicians) and one part-time job (watchman) will be created during the plant project. The salary is set to 25 000 CZK per month for the technicians and 15 000 CZK for the watchman. We should add also the cost of social security and health insurance for the personal cost. It is quite difficult to predict these costs, since it depends mainly on the changing Income Act, so the best prediction is to set the current values also for the future. So, we will estimate the social security rate – 13.5% and health insurance 26% from the wage paid by employer. The staff will be devoted to their job in the middle of the year, so personal costs given in the first year are calculated as the half of the year 2011. We also additionally estimate that from year 2012 the wages increase every year by 5%.

2. Maintenance and service costs

These costs are usually calculated as a ratio on the investment cost. Usually this ratio is set at about 2-3 percent. We will calculate with the ratio of 2.5% of investment cost for every year of investment.

3. Insurance costs

Insurance costs are usually calculated as certain percent of the maintenance and service costs. We calculate the insurance costs as a 30% of maintenance and service costs.

4. Other costs

Other costs are the costs not mentioned before. They represent the costs connected with the functioning of the building and external buying of the services. There are usually included costs of consumption energy in the plant, phone expenses, internet, consultancy etc. We will suppose that the other costs will amount to 600 000 CZK per year. According to assumption, these costs are increased by 5% during the project period.

5. Depreciation

We consider the accounting depreciation in the same value as tax depreciation. The power plant is grouped according to valid law in group 4 (in compliance with Articles 26-31 and Article 33 of the Income Tax Act No. 586/1992 Coll., as amended.), where the straight line depreciation is set in the first year 2.15% and in the following years 5.15%. The value of the investment is 81 000 000 CZK, so the first year depreciation value is 1 741 500 CZK and in the following years 4 171 500 CZK.

6. Financial costs

We calculate the financing of the project by a bank loan (80%) and the equity (20%), so the loan will be 64 800 000 CZK at the beginning of the project. We suppose that the bank will charge 8% bank interest and thus this interest will create the financial cost of the project.

7. Income tax

We calculate the tax rate of 19% for year 2010 and for following years. According to valid legislation the project will be relieved from income tax in years 2010-2015 (the year when the plant is put into operation and following 5 years)

The detailed calculation of the cost can be seen in pro forma income statement in Appendix No. 1

4.8.2 Balance sheet

Assets, equity and liabilities are calculated from the above mentioned assumptions and P/L calculations. We will suppose that the fixed assets (technology and building of the CHP plant) are depreciated during the life-time of the investment. We have chosen the linear depreciation of the plant.

The ratio of liabilities and equity is changed during the time of the project due to the fact that the investor will repay interest and the principal to the bank.

Table 11. The simplified balance sheet of the project

	31.12.2010	31.12.2011	31.12.2012	31.12.2013	31.12.2014	31.12.2015	31.12.2016
Fixed Assets	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000
Accumulated Depreciation	1 741 500	5 913 000	10 084 500	14 256 000	18 427 500	22 599 000	26 770 500
Net Fixed Assets	79 258 500	75 087 000	70 915 500	66 744 000	62 572 500	58 401 000	54 229 500
Current Assets	875 433	8 725 574	16 141 469	23 101 407	29 582 590	35 561 080	40 102 441

Total Assets	**80 133 933**	**83 812 574**	**87 056 969**	**89 845 407**	**92 155 090**	**93 962 080**	**94 331 941**
Equity	15 333 933	21 399 128	27 221 003	32 793 118	38 109 172	43 163 043	47 039 535
Liabilities (bank loan)	64 800 000	62 413 445	59 835 967	57 052 289	54 045 918	50 799 037	47 292 405
Total = Equity + Liabilities	**80 133 933**	**83 812 574**	**87 056 969**	**89 845 407**	**92 155 090**	**93 962 080**	**94 331 941**

	31.12.2017	31.12.2018	31.12.2019	31.12.2020	31.12.2021	31.12.2022	31.12.2023
Fixed Assets	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000
Accumulated Depreciation	30 942 000	35 113 500	39 285 000	43 456 500	47 628 000	51 799 500	55 971 000
Net Fixed Assets	50 058 000	45 886 500	41 715 000	37 543 500	33 372 000	29 200 500	25 029 000
Current Assets	45 050 884	49 418 399	53 175 810	56 292 474	58 736 204	60 473 194	61 467 931
Total Assets	**95 108 884**	**95 304 899**	**94 890 810**	**93 835 974**	**92 108 204**	**89 673 694**	**86 496 931**
Equity	51 603 641	55 889 790	59 893 047	63 608 945	67 033 567	70 163 640	72 996 628
Liabilities (bank loan)	43 505 243	39 415 108	34 997 762	30 227 029	25 074 637	19 510 053	13 500 303
Total = Equity + Liabilities	**95 108 884**	**95 304 899**	**94 890 810**	**93 835 974**	**92 108 204**	**89 673 694**	**86 496 931**

	31.12.2024	31.12.2025	31.12.2026	31.12.2027	31.12.2028	31.12.2029	31.12.2030
Fixed Assets	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000	81 000 000
Accumulated Depreciation	60 142 500	64 314 000	68 485 500	72 657 000	76 828 500	81 000 000	81 000 000
Net Fixed Assets	20 857 500	16 686 000	12 514 500	8 343 000	4 171 500	0	0
Current Assets	61 683 115	61 079 566	67 186 682	72 505 749	76 885 490	80 095 178	81 844 194
Total Assets	**82 540 615**	**77 765 566**	**79 701 182**	**80 848 749**	**81 056 990**	**80 095 178**	**81 844 194**
Equity	75 530 842	77 765 566	79 701 182	80 848 749	81 056 990	80 095 178	81 844 194
Liabilities (bank loan)	7 009 773	0	0	0	0	0	0
Total = Equity + Liabilities	**82 540 615**	**77 765 566**	**79 701 182**	**80 848 749**	**81 056 990**	**80 095 178**	**81 844 194**

4.8.3 Setting the cost of equity – r_e

a) Risk free rate – r_f

Risk free rate was set according to the "Issuance Calendar of Treasury Bonds - I. Quarter 2010"[32], that was published by the Ministry of Finance of the Czech Republic. The earning of the 15-year old T-Bonds was set to 5.70%.

Table 12. Setting the risk-free rate

Name of Issue	ISIN Number	Issue Number	Auction Date	Settlement Date	Maturity Date	Original Maturity (Years)	Estimated Volume (CZK bln)
T-Bond of the Czech Republic 2009-2024, 5.70 %	CZ0001002547	58/5	10.2.2010	15.2.2010	25.5.2024	15	6

Source: The Ministry of Finance

[32] Data can be found on http://www.mfcr.cz/cps/rde/xchg/mfcr/xsl/state_debt_51490.html

b) Risk premium (r_m-r_f)

The value of risk premium (r_m-r_f) was set according to risk premiums estimators for markets based upon the country ratings assigned by Moodys. These figures are published on the website of Damodaran[33].

Table 13. Setting the risk premium

Country	Long-Term Rating	Total Risk Premium	Country Risk Premium
Czech Republic	A1	5.85%	1.35%

Source: Damodaran

c) Coefficient beta – systematic risk

Table 14. Setting the coefficient beta

Industry Name	Number of Firms	Average Beta	Market D/E Ratio	Unlevered Beta
Power	77	1.23	103.58%	0.63

Source: Damodaran

We may calculate the value of levered beta for the different years of the project from the value of unlevered beta according to the formula:

$\beta_{\text{levered}} = \beta_{\text{unlevered}} * (1+(1-t)*D/E)$

Thus generally calculated systematic risk for the power industry we amend by expert opinion since the industry is supported by state and the feed-in tariffs are guaranteed by the laws. However, on the other hand there is a bigger risk of investment due to the relative magnitude of the project and there is also non-possibility of diversifying the risk for the investor. For the above mentioned reasons we correct the β_{levered} by multiplying of 0.5 each year.

4.8.4 Setting the cost of debt – r_d

In case of the project the cost of debt is the interest that the bank asks for lending money to the investor. The bank loan is the only source of debt for the investor. According to our assumptions the bank asks for 8% p.a. for the whole time of the investment (paying principal and interest from 2011).

4.8.5 Setting the cost of capital of the project

From the above mentioned figures and from formula (4) we may calculate cost of capital of the project that is necessary for the discounting of

[33] More on http://pages.stern.nyu.edu/~adamodar/

the future free cash flow necessary in the calculation of several evaluation methods.

The calculation of average cost of capital for each year can be seen in following Table 15. We may see that the r_d is the same during the valuation of the project (assumption of the same interest rate demanded by bank), but the r_e is decreasing due to the increasing ratio of equity financing, so there is diminishing default risk. The total cost of capital is influenced from year 2016 by tax rate.

Table 15: Calculation of cost of capital of the project

	2010	2011	2012	2013	2014	2015	2016
E/C	0.19	0.26	0.31	0.36	0.41	0.46	0.50
D/C	0.81	0.74	0.69	0.64	0.59	0.54	0.50
r_d	8%	8%	8%	8%	8%	8%	8%
r_e	15.3%	12.9%	11.6%	10.7%	10.2%	9.7%	9.0%
t	0	0	0	0	0	0	0.19
WACC	**9.4%**	**9.3%**	**9.1%**	**9.0%**	**8.9%**	**8.8%**	**7.8%**

	2017	2018	2019	2020	2021	2022	2023
E/C	0.54	0.59	0.63	0.68	0.73	0.78	0.84
D/C	0.46	0.41	0.37	0.32	0.27	0.22	0.16
r_d	8%	8%	8%	8%	8%	8%	8%
r_e	8.8%	8.6%	8.4%	8.3%	8.1%	8.0%	7.8%
t	0.19	0.19	0.19	0.19	0.19	0.19	0.19
WACC	**7.7%**	**7.7%**	**7.7%**	**7.7%**	**7.7%**	**7.6%**	**7.6%**

	2024	2025	2026	2027	2028	2029	2030
E/C	0.92	1.00	1.00	1.00	1.00	1.00	1.00
D/C	0.08	0.00	0.00	0.00	0.00	0.00	0.00
r_d	8%	8%	8%	8%	8%	8%	8%
r_e	7.7%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
t	0.19	0.19	0.19	0.19	0.19	0.19	0.19
WACC	**7.6%**	**7.5%**	**7.5%**	**7.5%**	**7.5%**	**7.5%**	**7.5%**

4.9 Evaluation of the investment due to different methods

4.9.1 Payback period

The payback period gives the company information about the length of time it takes to return all initial investments. We may conclude that the amount invested into the project will return approximately in 6 years and 2 months from the results in Table 16. This period seems to be quite favourable in comparison to the investment payback period of 15 years mentioned in the Act No. 180/2005.

Table 16. Calculation of payback period

Time	Future CF	Cumulative CF
1.7.2010 - Initial investment		-81 000 000
1.7.2010-31.12.2010	875 433	-80 124 567
1.1.2011-31.12.2011	15 420 695	-64 703 872
1.1.2012-31.12.2012	14 986 450	-49 717 422
1.1.2013-31.12.2013	14 530 493	-35 186 929
1.1.2014-31.12.2014	14 051 737	-21 135 192
1.1.2015-31.12.2015	13 549 044	-7 586 148
1.1.2016-30.6.2016	5 669 885	-1 916 262
1.7.2016-31.12.2016	5 669 885	3 753 623

4.9.2 Discounted payback period

The method of discounted payback period that takes into consideration the discounted cash flow gives us the values mentioned in Table 17.

Table 17: Calculation of discounted payback period

Time	Future discounted CF	Cumulative CF
1.7.2010 - Initial investment		-81 000 000
1.7.2010-31.12.2010	836 124	-80 163 876
1.1.2011-31.12.2011	14 104 844	-66 059 032
1.1.2012-31.12.2012	12 553 997	-53 505 034
1.1.2013-31.12.2013	11 160 521	-42 344 513
1.1.2014-31.12.2014	9 906 429	-32 438 085
1.1.2015-31.12.2015	8 776 302	-23 661 783
1.1.2016-31.12.2016	6 784 066	-16 877 717
1.1.2017-31.12.2017	6 046 933	-10 830 785
1.1.2018-31.12.2018	5 370 110	-5 460 675
1.1.2019-31.12.2019	4 748 847	-711 828
1.1.2020-31.3.2020	1 044 696	332 868

Taking into account the discounted payback period as a method of evaluation of the project, we may see that the total initial amount invested into the project will return approximately in 10 years and 9 months. We may consider acceptable this criterion for the investor as well.

4.9.3 The Average Accounting Return (AAR)

The Average Net Income during the whole time of the investment is CZK 2 783 016 and the Average Book Value is CZK 37 742 143. By dividing these two numbers we receive 7.37% as Average Accounting Return.

4.9.4 The net present value (NPV)

We may see the amounts of discounted cash flow of the project in the Table 18. The precise calculation of NPV is shown in Appendix No. 2. The total net present value of the project is CZK 22 437 thousand. This reasonable high value leads us into persuasions that the project will create positive NPV and even if the project will not receive the subvention from the Czech Ministry of Agriculture in the Rural Development Programme it will have the high net present value. However, if the subvention is granted, the NPV of the project will increase even more.

Table 18. Discounted cash flow of the project

(in CZK)	2010	2011	2012	2013	2014	2015	2016
Discounted FCFF	-80 163 876	13 993 431	12 358 627	10 903 793	9 606 951	8 449 378	5 555 784
(in CZK)	2017	2018	2019	2020	2021	2022	2023
Discounted FCFF	4 943 439	4 385 082	3 876 131	3 412 403	2 990 078	2 605 662	2 255 957
(in CZK)	2024	2025	2026	2027	2028	2029	2030
Discounted FCFF	1 938 033	1 649 204	1 386 325	1 147 319	930 265	733 394	1 046 057

4.9.4.1 Sensitivity analysis

Sensitivity analysis can be applied to our project. The basic idea of sensitivity analysis is to freeze all of the variables except the chosen one and then see how sensitive our estimation of NPV is to the changes of that chosen variable. If estimation of NPV turns out to be very sensitive to relatively small changes in the projected value of some component, then we may conclude that the forecasting risk associated with that variable is reasonably high.

The total revenues, investment costs, operation expenses (excluding depreciation) and the WACC were chosen for sensitivity analysis.

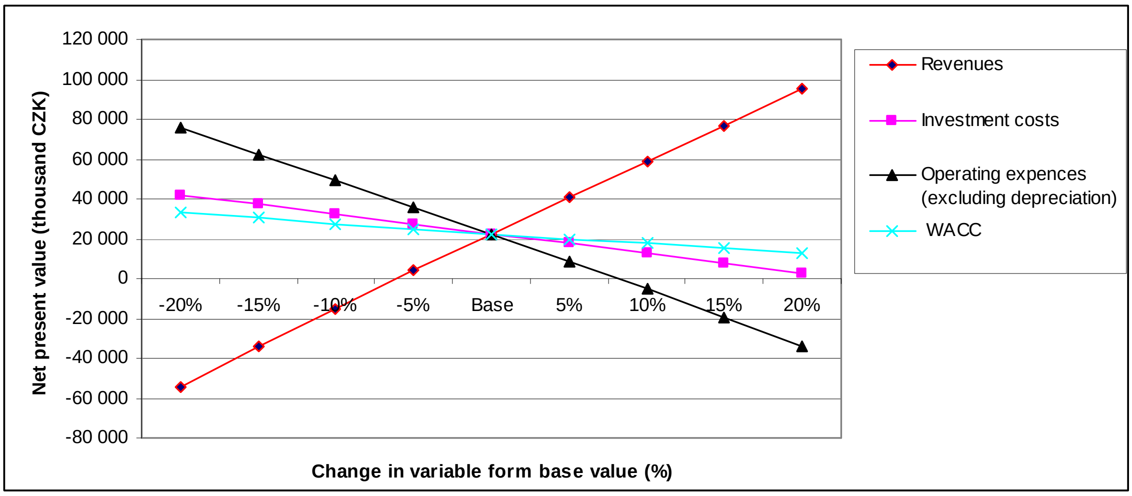
Table 19. Sensitivity analysis

Change (%)	-20%	-15%	-10%	-5%	Base	5%	10%	15%	20%
Change in	Resulting NPV (thousand CZK)								
Revenues	-54 294	-34 379	-14 991	3 956	22 438	40 584	58 688	76 792	94 896
Investment costs	42 035	37 133	32 227	27 329	22 438	17 539	12 645	7 757	2 859
Operating expenses (excluding depreciation)	75 480	62 250	49 007	35 750	22 438	8 827	-5 150	-19 400	-33 913
WACC	33 309	30 420	27 649	24 990	22 438	19 986	17 629	15 364	13 185

We may see that if the estimation of revenues were to decrease by roughly 6 percent or more from the base case, our project's net present value turns negative. For investment cost, however, the increase would need to be roughly 22 percent or more from the base to turn the project into the negative net present value.

The data contained in Table 19 can also be presented graphically in a NPV sensitivity graph (see Fig. 8)

Fig. 8. Sensitivity graph



We may notice that the "total revenues" line is quite steep and the decrease by 20 percent would cause the negative NPV of about -55 million CZK. Since the price for power is guaranteed (and for steam very probably), the key issue is to ensure that the equipment will operate without difficulty and generate the estimated quantity of power.

We may also conclude that the "investment costs" line is not as steep as "operating expenses" line and thus the price of the investment will not influence dramatically the NPV. For operating expenses, however, the investor will have to concentrate on the price of the fuel (woodchips) since it creates the highest portion of these expenses.

It is also noticeable that the change in hurdle rate of the project (WACC) will not dramatically influence the positive NPV of the project.

4.9.5 The internal rate of return (IRR)

The internal rate of return may be calculated from Table 18 and equals 13.48%. If we compare this number and demanded cost of capital during the years of the project, we may see that the project provides a sufficient rate of return for the investor and for the bank.

4.9.6 The Profitability Index

The profitability index is 1.28. This relatively high value ensures the financial attractiveness of the proposed project.

4.9.7 Free Cash Flow to Equity

It is also suitable to evaluate the project from the investor point of view. So, we may also use the FCFE discount model to calculate cash flow to equity, payback period and equity rate of return. The discount rate is the cost of equity, since the cash flows are cash flows to equity investors. The calculated values can be seen in Table 20, the detailed calculation is done in Appendix No. 3.

Table 20. Discounted cash flow to Equity

(in CZK)	2010	2011	2012	2013	2014	2015	2016
Discounted FCFE	-15 386 892	6 878 623	5 788 692	4 886 867	4 120 067	3 457 086	2 400 916
(in CZK)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Discounted FCFE	1 960 485	1 567 420	1 215 294	898 890	613 868	356 542	123 734
(in CZK)	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Discounted FCFE	-87 338	-279 137	1 375 612	1 114 842	876 246	622 479	315 936

The payback period for the investor is about 2.5 year, discounted payback period about 3 years. IRR for the equity holder is about 43.2%. NPV calculated from FCFE equals 22 820 thousand CZK. This value is very similar to NPV calculated from FCFF. It is due to the fact that at the beginning of the project the r_e is bigger than the r_d (due to the quite high initial indebtedness of the project), but later on it falls slightly bellow the r_d (thanks to repayment of debt and also guaranteed state price).

4.9.8 Overall result of evaluation of investment

By implementing the above mentioned methods in our evaluation, we conclude that the project is highly profitable, with a short payback period, a high internal rate of return, and a positive NPV. All these calculations ensure that the project will generate enough cash-flow in a relatively short time and throughout the whole project.

In our calculations, we did not include the possibility of receiving financial support from the Rural Development Programme, as it is currently unknown whether or not the project will receive such a subvention. Such a grant could subsidize up to 42 % of the total investment and would therefore substantially increase the economic attractiveness of the project. Since the money is paid back several months after successfully starting the operating phase (thus at the beginning of the project), the NPV would be increased approximately by the subvention discounted by appropriate hurdle rate. The more precise calculation of the different values of initial investment is carried out in the sensitivity analysis.

5 Conclusion

In the thesis, the evaluation of the project - combined heat and power plant that uses renewable sources of energy (biomass) as a fuel - was carried out. This concrete analysis was the subject of the empirical part of the study and since this business activity is highly influenced by the energy policies, the world, European and Czech “green policies” were described.

It was shown that the demand for an increase of the using renewable energy sources is the political consensus all over the world. This goal has been incorporated into world policy and into several international agreements. Moreover, the EU parliament also adopted ambitious targets for using renewable energy sources, some of them focusing directly on the production of electricity from renewable energy sources. However, the EU directives did not determine the precise way, how to foster the production and let the Member States choose the way of support. The majority of the Member States, including the Czech Republic, has chosen so called “feed-in tariff” system of support (sometimes combined with the green bonuses) and thus the investor may expect the fixed purchase price for every kWh produced in a given time.

The guaranteed price per kWh is the key information for the investor, since knowing the purchase price the revenues may be predicted quite exactly. We used this information for calculation the different decision criteria used by the investor in the decision making process. It is also necessary for the investor in the field of technology using renewable sources of energy to follow the current legislation related to support of renewable energy sources in the Czech Republic. The most important valid Acts (especially Act No. 180/2005 Coll. on promotion of electricity production from renewable energy sources and The Energy Regulatory Office’s Price Decision No. 5/2009) were described and crucial paragraphs were highlighted.

The different criteria used by the investor to analyze a project were discussed. Particularly, the length of payback period, discounted payback period, average accounting return, the net present value, and the internal rate of return were calculated in the empirical part. All of these criteria are quite favourable for the investor and support the decision to construct the plant. We consider these significantly positive characteristics of the project as the result of the state support and we may also conclude that the investment would not be profitable without the state support.

The sensitivity analysis was carried out showing the most challenging possible issues for the investor. It was shown that the key factor is a well-working technology producing the projected quantity of electricity and steam.

Therefore, it is necessary to take care of choosing of the well-functioning technological equipment and to make sure that the guarantee for technology part and building part together is sufficient, so the investor could lodge a claim and consequently the plant would be repaired in the short time and the possible loss in revenues are paid by an insurance company.

It may be concluded from the thesis that the investment into renewable energy sources (especially biomass) is an area with the huge economic potential for the investors. It is more than probable that due to climatic and geographic conditions of the Czech Republic the share of electricity produced using biomass will enlarge both in energy renewable sources mix and in the absolute values as well. We may assume that due to improving of the technological progress of plants producing energy from biomass and surplus of agriculture soil non-suitable for the food production, the state support for this source of energy will also continue in the future.

References:

Brealey, R. A, Myers, S. C, & Allen, F. (2008). Principles of corporate finance. 9th ed. Boston, Mass.: McGraw-Hill Irwin. ISBN 0-07-111551-X, pp. 89-109

Commission Staff Working Document SEC(2008) 57. The support of electricity from renewable energy sources. Accompanying Document to the Proposal for a Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources {COM(2008) 19 final}. Brussels, 23 January 2008.

Copeland T. E., Weston J. F., Shastri K. (2005) Financial Theory and Corporate Policy, 4th ed. Pearson Higher Education, ISBN-13: 9780321223531

Damodaran, A. (2001). Corporate Finance: theory and practice – 2nd ed., New York: John Wiley & Sons. ISBN 0-471-28332-0.

Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market. OJ L283, 27 October 2001, pp. 33–40.

Ehrhardt M. C., Wachowicz J. M. (2006) Capital Budgeting and Initial Cash Outlay (ICO) Uncertainty, Financial Decision, Summer 2006, Article 2

European Commission (2004). EUR 21346 European research spending for renewable energy sources, Luxembourg: Office for Official Publications of the European Communities, ISBN 92-894-8286-9

Fouquet D., Johansson T. (2008). European renewable energy policy at crossroads – Focus on electricity support mechanism

Klaus V. (2007) Modrá, nikoliv zelená planeta, Co je ohroženo: klima, nebo svoboda?, 1st ed. Praha, Dokořán s.r.o., ISBN 979-80-7363-152-9

Kloz M. et al. (2007). Využívání obnovitelných zdrojů energie, 1st ed. Praha, Linde – ISBN: 978-80-7201-670-9

Kolouchová P. (2008). Cost of Equity Estimation Techniques Used by Valuation Experts, IES, Charles University.

Kramer M, Urbaniec M.,Obršálková I et al., Mezinárodní management životního prostředí, 1st ed. Praha, C.H. Beck, 2005, ISBN: 80-7179-919-X

Lesser, J.A., Su, X. (2008). Design of an economically efficient feed-in tariff structure for renewable development. Energy Policy 36 (3), pp. 981-990

Lomborg B., Skeptical Environmentalist: Measuring the Real State of the World. Cambridge University Press, 2001, ISBN-13: 978-0521010689

Mach P. (2009) Úřad na zrušení – Energetický regulační úřad, Laissez Faire, měsíčník pro svobodu jednotlice, December 2009, ISSN 1212-8597

Madlener, R.; Stagl, S. (2000). Promoting Renewable Electricity Generation through Guaranteed Feed-in Tariffs vs. Tradable Certificates: An Ecological Economics Perspective, 3rd Biennial Conference of the European Society for Ecological Economics (ESEE), Vienna, 3-6 May 2000.

Menanteau, P., Finon, D., Lamy, M., (2003). Prices versus quantities: choosing policies for promoting the development of renewable energy. Energy Policy 31, pp. 799–812.

Niedermayer L. (2009), Slunce, sviť, Respekt 43/2009, Respekt Publishing a.s, ISSN 1801-1446

Ringel, M. (2005). Fostering the use of renewable energies in the European Union: the race between feed-in tariffs and green certificates. Renewable Energy 31 pp. 1-17

Ross, S. A., Westerfield R. W., Jordan B. D. (2008). Fundamentals of corporate finance. 8th ed., Mass.: McGraw-Hill Irwin. ISBN 978-0-07-353062-8, p. 264

Ross, S. A., Westerfield R. W., Jordan B. D. (2008). Fundamentals of corporate finance. 8th ed., Mass.: McGraw-Hill Irwin. ISBN 978-0-07-353062-8, pp. 264-290

Ross, S. A., Westerfield R. W., Jordan B. D. (2008). Fundamentals of corporate finance. 8th ed., Mass.: McGraw-Hill Irwin. ISBN 978-0-07-353062-8, pp. 264-290

Simanov, V. (2002) Palivo nebo organická hmota? Odlišné pohledy na využití odpadního dřeva z lesních těžeb, LEA (http:/ /www.ecn.cz)

Synek M. et al. (2001), Manažerská ekonomika.2th ed. Praha, Grada Publishing, s.r.o., ISBN 80-247-9069-6, pp. 285-333

The New Palgrave Dictionary of Economics (2008). Second Edition, Edited by Steven N. Durlauf and Lawrence E. Blume, Volume 4, Macmillan Publishers Ltd.

Toke, D. (2007) Renewable financial support systems and cost-effectiveness. Journal of Cleaner Production 15 (2007) 280-287

Internet sources:

Akční plán pro biomasu pro ČR na období 2009 – 2011 (2009) available on http://biom.cz/upload/93a6e8e6b11e93816bea14d0c95745a2/AP_biomasa_09_01.pdf

http://europa.eu/legislation_summaries/environment/tackling_climate_change/l28188_en.htm

http://nahlizenidokn.cuzk.cz/

http://pages.stern.nyu.edu/~adamodar/

http://respekt.ihned.cz/c1-38667200-slunce-svit

http://www.ceps.cz/

http://www.cr-sei.cz/

http://www.energiprojekt.com/

http://www.energy.eu/

http://www.ipcc.ch/

http://www.justice.cz/

http://www.kara.nl/

http://www.mfcr.cz/cps/rde/xchg/mfcr/xsl/state_debt_51490.html

http://www.mpo.cz/dokument42645.html

http://www.mpo.cz/zprava64928.html

http://www.nrdc.org/globalwarming/cost/contents.asp

http://www.orgalime.org/publications/conditions.htm

http://www.vyncke.be/

http://www.zemcheba.cz/

Appendix No. 1. Pro forma income statement 2010-2030

(in CZK)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Revenues from electricity (E.ON.)	2 184 300	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600
Revenues from electricity (free market)	136 400	1 636 800	1 718 640	1 804 572	1 894 801	1 989 541	2 089 018	2 193 469	2 303 142	2 418 299	2 539 214
Revenues from steam production	816 667	9 800 000	10 290 000	10 804 500	11 344 725	11 911 961	12 507 559	13 132 937	13 789 584	14 479 063	15 203 017
Operating revenues total	**3 137 367**	**37 648 400**	**38 220 240**	**38 820 672**	**39 451 126**	**40 113 102**	**40 808 177**	**41 538 006**	**42 304 326**	**43 108 962**	**43 953 831**
Cost of wood chips fuel	1 534 884	18 418 605	19 339 535	20 306 512	21 321 837	22 387 929	23 507 326	24 682 692	25 916 826	27 212 668	28 573 301
Personal costs	551 550	1 103 100	1 158 255	1 216 168	1 276 976	1 340 825	1 407 866	1 478 260	1 552 172	1 629 781	1 711 270
Yearly cost of spare parts for machinery; (2,5% of investment)	135 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000
Insurance costs	40 500	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000
Other costs		600 000	630 000	661 500	694 575	729 304	765 769	804 057	844 260	886 473	930 797
Depreciation	1 741 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Operating expenses total	**4 003 434**	**26 399 205**	**27 405 290**	**28 461 679**	**29 570 888**	**30 735 558**	**31 958 461**	**33 242 509**	**34 590 759**	**36 006 422**	**37 492 868**
EBIT	**-866 067**	**11 249 195**	**10 814 950**	**10 358 993**	**9 880 237**	**9 377 544**	**8 849 716**	**8 295 497**	**7 713 567**	**7 102 540**	**6 460 962**
Financial net interest	0	5 184 000	4 993 076	4 786 877	4 564 183	4 323 673	4 063 923	3 783 392	3 480 419	3 153 209	2 799 821
Earnings before income taxes	**-866 067**	**6 065 195**	**5 821 874**	**5 572 115**	**5 316 054**	**5 053 871**	**4 785 793**	**4 512 105**	**4 233 148**	**3 949 332**	**3 661 141**
Tax rate	0	0	0	0	0	0	0.19	0.19	0.19	0.19	0.19
Tax	**0**	**0**	**0**	**0**	**0**	**0**	**909 301**	**857 300**	**804 298**	**750 373**	**695 617**
Net income	**-866 067**	**6 065 195**	**5 821 874**	**5 572 115**	**5 316 054**	**5 053 871**	**3 876 493**	**3 654 805**	**3 428 849**	**3 198 959**	**2 965 525**

(in CZK)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Revenues from electricity (E.ON.)	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600	26 211 600
Revenues from electricity (free market)	2 666 175	2 799 483	2 939 458	3 086 431	3 240 752	3 402 790	3 572 929	3 751 576	3 939 154	4 136 112
Revenues from steam production	15 963 167	16 761 326	17 599 392	18 479 362	19 403 330	20 373 496	21 392 171	22 461 780	23 584 868	24 764 112
Operating revenues total	**44 840 942**	**45 772 409**	**46 750 450**	**47 777 392**	**48 855 682**	**49 987 886**	**51 176 700**	**52 424 955**	**53 735 623**	**55 111 824**
Cost of wood chips fuel	30 001 966	31 502 064	33 077 168	34 731 026	36 467 577	38 290 956	40 205 504	42 215 779	44 326 568	46 542 897
Personal costs	1 796 834	1 886 675	1 981 009	2 080 060	2 184 063	2 293 266	2 407 929	2 528 325	2 654 742	2 787 479
Yearly cost of spare parts for machinery; (2,5% of investment)	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000	1 620 000
Insurance costs	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000	486 000
Other costs	977 337	1 026 204	1 077 514	1 131 389	1 187 959	1 247 357	1 309 725	1 375 211	1 443 972	1 516 170
Depreciation	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	0
Operating expenses total	**39 053 637**	**40 692 443**	**42 413 191**	**44 219 975**	**46 117 099**	**48 109 079**	**50 200 658**	**52 396 816**	**54 702 781**	**52 952 545**
EBIT	**5 787 305**	**5 079 966**	**4 337 259**	**3 557 417**	**2 738 583**	**1 878 807**	**976 042**	**28 139**	**-967 159**	**2 159 278**
Financial net interest	2 418 162	2 005 971	1 560 804	1 080 024	560 782	0	0	0	0	0
Earnings before income taxes	**3 369 143**	**3 073 995**	**2 776 455**	**2 477 393**	**2 177 801**	**1 878 807**	**976 042**	**28 139**	**-967 159**	**2 159 278**
Tax rate	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Tax	**640 137**	**584 059**	**527 526**	**470 705**	**413 782**	**356 973**	**185 448**	**5 346**	**0**	**410 263**
Net income	**2 729 006**	**2 489 936**	**2 248 928**	**2 006 688**	**1 764 019**	**1 521 834**	**790 594**	**22 793**	**-967 159**	**1 749 016**

Appendix No. 2: Calculation of FCFF of the project

(in CZK)	2010	2011	2012	2013	2014	2015	2016
EBIT	-866 067	11 249 195	10 814 950	10 358 993	9 880 237	9 377 544	8 849 716
Tax rate	0	0	0	0	0	0	0.19
Tax (amended)	0	0	0	0	0	0	1 681 446
Operating expenses after tax	-866 067	11 249 195	10 814 950	10 358 993	9 880 237	9 377 544	7 168 270
Depreciation	1 741 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Investment	-81 000 000	0	0	0	0	0	0
FCFF	875 433	15 420 695	14 986 450	14 530 493	14 051 737	13 549 044	9 658 324
WACC	9.40%	9.26%	9.12%	9.00%	8.89%	8.79%	7.76%
Discounted FCFF	-80 163 876	13 993 425	12 358 616	10 903 780	9 606 937	8 449 363	5 555 773

(in CZK)	2017	2018	2019	2020	2021	2022	2023
EBIT	8 295 497	7 713 567	7 102 540	6 460 962	5 787 305	5 079 966	4 337 259
Tax rate	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Tax (amended)	1 576 144	1 465 578	1 349 483	1 227 583	1 099 588	965 193	824 079
Operating expenses after tax	6 719 353	6 247 989	5 753 058	5 233 380	4 687 717	4 114 772	3 513 180
Depreciation	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Investment	0	0	0	0	0	0	0
FCFF	9 314 708	8 953 912	8 575 075	8 177 297	7 759 629	7 321 079	6 860 601
WACC	7.74%	7.72%	7.70%	7.68%	7.66%	7.64%	7.61%
Discounted FCFF	4 943 430	4 385 074	3 876 124	3 412 397	2 990 072	2 605 657	2 255 953

(in CZK)	2024	2025	2026	2027	2028	2029	2030
EBIT	3 557 417	2 738 583	1 878 807	976 042	28 139	-967 159	2 159 278
Tax rate	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Tax (amended)	675 909	520 331	356 973	185 448	5 346	-183 760	410 263
Operating expenses after tax	2 881 508	2 218 252	1 521 834	790 594	22 793	-783 398	1 749 016
Depreciation	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Investment	0	0	0	0	0	0	0
FCFF	6 377 099	5 869 421	5 336 360	4 776 646	4 188 946	3 571 862	5 510 253
WACC	7.58%	7.54%	7.54%	7.54%	7.54%	7.54%	7.54%
Discounted FCFF	1 938 030	1 649 201	1 386 323	1 147 317	930 264	733 393	1 046 055

Appendix No. 3. Calculation of FCFE of the project

(in CZK)	2010	2011	2012	2013	2014	2015	2016
Net income	-866 067	6 065 195	5 821 874	5 572 115	5 316 054	5 053 871	3 876 493
Depreciation	1 741 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Capital expenditures	16 200 000	0	0	0	0	0	0
Debt repayments	0	2 386 555	2 577 479	2 783 677	3 006 371	3 246 881	3 506 632
FCFE	875 433	7 850 141	7 415 896	6 959 938	6 481 183	5 978 490	4 541 361
r_e	15.3%	12.9%	11.6%	10.7%	10.2%	9.7%	9.0%
Discounted FCFE	-15 386 896	6 878 577	5 788 633	4 886 806	4 120 009	3 457 034	2 400 878

(in CZK)	2017	2018	2019	2020	2021	2022	2023
Net income	3 654 805	3 428 849	3 198 959	2 965 525	2 729 006	2 489 936	2 248 928
Depreciation	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500
Capital expenditures	0	0	0	0	0	0	0
Debt repayments	3 787 162	4 090 135	4 417 346	4 770 734	5 152 392	5 564 584	6 009 750
FCFE	4 039 143	3 510 214	2 953 113	2 366 291	1 748 114	1 096 852	410 678
r_e	8.8%	8.6%	8.4%	8.3%	8.1%	8.0%	7.8%
Discounted FCFE	2 135 371	1 855 743	1 561 220	1 250 985	924 174	579 872	217 113

(in CZK)	2024	2025	2026	2027	2028	2029	2030
Net income	2 006 688	1 764 019	1 521 834	790 594	22 793	-967 159	1 749 016
Depreciation	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	4 171 500	0
Capital expenditures	0	0	0	0	0	0	0
Debt repayments	6 490 530	7 009 773	0	0	0	0	0
FCFE	-312 342	-1 074 254	5 693 334	4 962 094	4 194 293	3 204 341	1 749 016
r_e	7.7%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Discounted FCFE	-165 126	-567 925	3 009 891	2 623 307	2 217 394	1 694 037	924 651