CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

Department of Economics

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Bachelor Thesis

Analysis of the Types of Subsidies for Renewable Energy Sources in the Czech Republic

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Department of Economics
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BACHELOR THESIS ASSIGNMENT

Dvořáková Kristýna

Economics and Management

Thesis title
Analysis of the Types of Subsidies for Renewable Energy Sources in the Czech Republic

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Objectives of thesis
Characterize renewable energy sources in the Czech Republic, analyze their future potential, development and compare feed in tariff and subsidies of them.

Methodology
In the theoretical part of the work, there will be used descriptive and comparative methods of research, in the practical part, there will be used analysis of development of feed in tariff and other subsidies.

Schedule for processing
Goal setting of work and methodology 1 - 3/2013
Literature, teoretic part of work 8 - 10/2013
Own work, analytic part of work - 11 - 12/2013
Own work, analyze of results, conclusion - 1 - 2/2014
Submission of work - 3/2014

The proposed extent of the thesis

35 - 40 pages

Keywords

renewable energy sources, hydro energy, solar energy, wind energy, geothermal energy, biomass, biogas, feed in tariff, subsidies

Recommended information sources

Kubín, M., 2009, Proměny české energetiky, Český svaz zaměstnavatelů v energetice, ISBN 978-80-254-4524-2, pp. 615
Kubín, M., Přenosy elektrické energie ČR (v kontextu evropského vývoje), ČEPS, a. s., Praha, pp. 567
Pokorný, O, 1973, Soupis lokalizace větrných mlýnů v Čechách, Studia geografica - svazek 18, geografický ústav ČSAV, pp. 180
Motlík, J., et.al., 2007, Obnovitelné zdroje energie a jejich uplatnění v ČR, ČEZ, a. s., available at: http://www.cez.cz/edee/content/file/energie-a-zivotni-prostredi/oze-cr-all-17-01-obalka-in.pdf

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Last date for the submission

March 2014

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Prague February 12. 2014

Declaration

I declare that I have worked on my thesis called “Analysis of the Types of Subsidies for Renewable Energy Sources in the Czech Republic” on my own and I have used only the scientific literature and other information resources that are mentioned in the references at the end of the thesis.

In Prague on 13 March 2014

Kristýna Dvořáková

Acknowledgement

I would like to thank doc. Ing. Mansoor Maitah Ph.D. et Ph.D. for his valuable recommendations, advice and professional leadership during writing my thesis. Furthermore, I would like to thank my family for their support during the whole study and schoolmates for the amazing years spent together.

Analysis of the Types of Subsidies for Renewable Energy Sources in the Czech Republic

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Analýza druhů podpory obnovitelných zdrojů energie v České republice

Summary

This bachelor thesis deals with renewable energy sources (RES) in the Czech Republic. The theoretical part of the work describes the most widely used renewable energy sources in the Czech Republic, especially their history technology, advantages and disadvantages. It also deals with the legislation of the European Union and the Czech Republic, describes the laws and mentions the State Energy Policy of the CR and the National Action Plan of the CR, which are essential to the operation and dealing with the renewable energy sources in the Czech Republic. The theoretical part is intertwined with the practical part and continues to the future potential and development of RES. The crucial part of this thesis focuses on the analysis of the types of the subsidies for renewable energy sources in the Czech Republic.

This work shows that renewable energy sources will be increasingly used in the following years and it is assumed that for at least another 20 years the conventional energy sources will be as important as they are at present.

Renewable energy sources should be seen as resources that ensure energy security of supply and in most cases they are environmentally friendly.

Key Words: renewable energy sources, hydro energy, solar energy, wind energy, geothermal energy, biomass, biogas, feed in tariff, subsidies

Souhrn

Tato bakalářská práce se zabývá obnovitelnými zdroji energie (OZE) v České republice. V teoretické části práce popisuje nejvyužívanější obnovitelné zdroje energie na území České republiky, zejména jejich historii, technologii, výhody a nevýhody. Dále se zabývá legislativou Evropské unie a České republiky, popisuje zákony a zmiňuje Státní energetickou koncepci ČR a Národní akční plán ČR, které jsou nezbytné k fungování a řešení problematiky obnovitelných zdrojů energie v České republice. Teoretická část se prolíná s částí praktickou a pokračuje k budoucímu potenciálu a vývoji OZE. Stěžejní část této práce je analyzovat druhy podpor obnovitelných zdrojů energie v České republice.

Z této práce vyplývá, že využití obnovitelných zdrojů energie bude růst i v následujících letech, ale je předpokládáno, že nejméně dalších 20 let budou stále potřeba konvenční zdroje energie, které jsou využívány také v dnešní době.

Obnovitelné zdroje energie by měly být brány jako zdroje, které snižují energetickou závislost na dovozu nerostných surovin, a ve většině případech jsou šetrné k životnímu prostředí.

Klíčová slova: obnovitelné zdroje energie, vodní energie, sluneční energie, větrná energie, geotermální energie, biomasa, bioplyn, výkupní cena, dotace

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List of Abbreviations

CR	Czech Republic
CZK	Czech Crown
ČSVE	Česká společnost pro větrnou energii (Czech Society for Wind Energy)
e.g.	*exempli gratia*, for example
etc.	*et cetera*, and so one
ERO	Energy Regulatory Office
EU	European Union
GWH	gigawatt hour
KW	kilowatt
MA	Ministry of Agriculture
ME	Ministry of Environment
MIT	Ministry of Industry and Trade
MW	megawatt
MWH	megawatt hour
SEP	State Energy Policy
WPP	Wind Power Plant
W/m^2	watt/square meter

1. Introduction

Most of the energy used by our civilization is obtained from non-renewable energy sources. These sources were formed hundreds of years ago but nowadays they are being used up at a speed that far exceeds the speed of their formation. These sources are limited and it is therefore important to look for alternative sources of energy that humanity will be able to use another hundreds of years to come. Another problem of using the non-renewable energy sources is that their mining and burning damages the environment, especially the atmosphere. Large quantities of methane and carbon dioxide are blown off into the atmosphere during coal, natural gas and oil mining. These gases belong to the group of the greenhouse gases. The climate changes, increasing dependence on non-renewable energy sources and rising prices for electricity are the reason why we have started to use the renewable energy sources. Renewable sources are essentially inexhaustible and constantly-renewing. They include hydropower, wind energy, solar energy, biomass, biogas and geothermal energy. Their contribution consists mainly of their ability to reduce greenhouse gas emission, protect environment, enhance security of electricity supply or create new job opportunities. Currently, the renewable energy sources are only an additional source of energy. Nevertheless, the reduction in intensity of energy production, saving energy and improving energy efficiency, can significantly contribute to slowing down of the progressive depletion of non-renewable energy sources and thereby to reducing emission.

This thesis, among other things, focuses on the description of the future potential and development of the renewable energy sources and, particularly, on the analysis of the types of subsidies for the renewable energy sources in the Czech Republic.

2. Aim and Methodology

2.1. Aim

This thesis deals with renewable energy sources in the Czech Republic. It has two aims. The first one is to describe renewable energy sources, their history, technologies and outline the advantages and disadvantages. Furthermore, it is to outline their future potential and development. Second one is to analyze and compare the feed in tariff and subsidies of the renewable energy sources in several years.

2.2. Methodology

This thesis uses descriptive and comparative methods of research of renewable energy sources. The author has used the publications by experts in the field of energy, publications issued by the Ministry of Industry and Trade, the Ministry of Environment and the Ministry of Agriculture. The author has also used the Internet resources and consultations with the experts.

In the practical part, these findings are used for evaluation of their future potential and for the analysis of development of feed in tariff and other subsidies.

3. Theoretical part

3.1. Renewable Sources of Energy

On our planet they are two types of energy sources - renewable and nonrenewable sources of energy. Their specifications are obviously different. The greatest difference is in that nonrenewable energy sources are exhaustible and harmful to the environment. For instance, nonrenewable sources include coal, oil, natural gas and also nuclear energy.

The consequences of climate changes, increasing dependence on fossil fuels, and rising energy prices, are the reason, why the renewable energy is becoming important. Contribution of renewable energy sources is significant, especially in their ability to reduce greenhouse gas emissions and pollution, enhance security of supply, promote industrial development based on knowledge, create jobs and improve economic growth (in competitiveness and regional development).

Renewable sources of energy will not rely on the availability of conventional energy sources in the future and try to reduce energy dependence on energy supplies from abroad. Renewable energy is a key element of sustainable energy for the future. (ME, 2013)

According to Act No. 458/2000 Coll. § 35 renewable energy sources are renewable, non-fossil natural energy sources, which include hydropower, wind energy, solar energy, solid biomass, biogas, geothermal energy and liquid biofuels.

3.2. Hydro Energy

Hydro energy is one of the cleanest sources of energy, it is also one of the most available, affordable and reliable. When the applicable environmental and noise limits are considered, hydro energy produces no emissions. (U.S. Department of Energy, 2011)

In the 20th century were constructed many large dams, whose realization wasn't always necessary. Today, we use small water flows, which represent the guaranteed performance and are therefore a great energy source. (ČEZ, 2013)

According to Mastný (2013) the importance of hydropower plants in the hydrological conditions of the Czech Republic is not in the volume of electricity production, but the specific characteristics of their operation. Water power plants can react very quickly to the immediate need for electricity in energy system and also these plants don't produce such a waste as a nuclear power station, it means they are good for the environment. Also, hydropower is a cheap source of electricity in variable costs, which is primarily used during peak consumption, because it ensures greatest profit.

3.2.1. History

Water, as the usable source, has been used for thousands of years. It has started in Greece and Rome more than 2000 years ago. Greeks used water wheels for grinding wheat into flour. Moreover, they used the power of water for sawing wood, power textile mills and manufacturing plants. A mill driven by water power was first built on the river Ohře near Žatec in 718, it was the first mill driven by water power in Central Europe. (MIT, 2013)

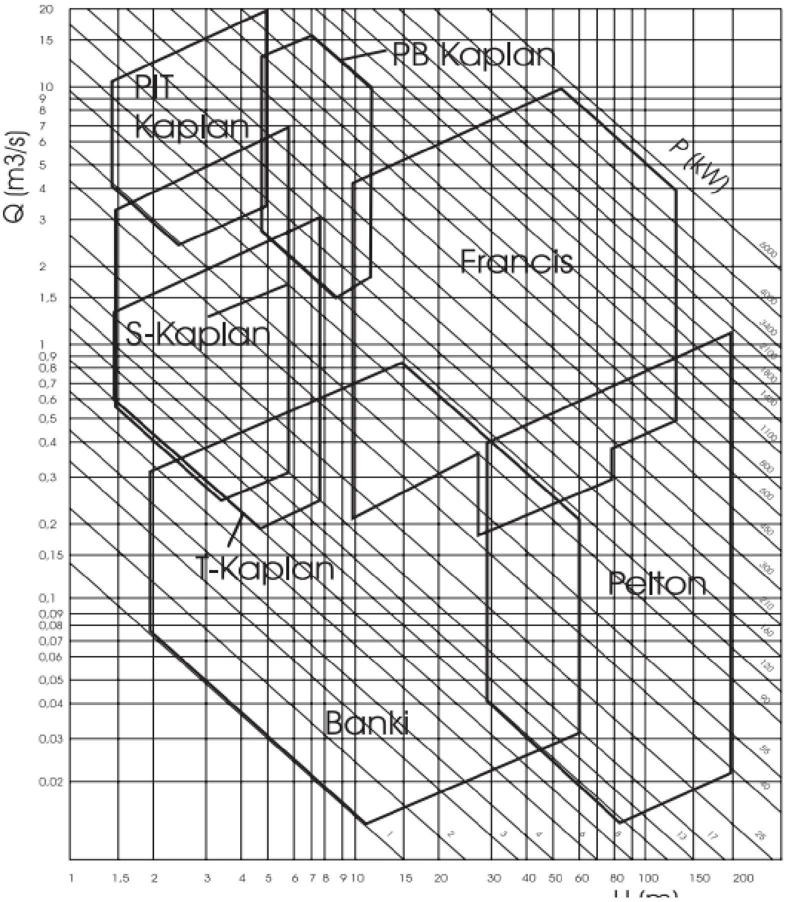
The first big moment happened to German physicist who constructed a water wheel with the reaction drive, thanks to him in the middle of the 17th century Bernard Forest de Bélidor (French hydraulic and military engineer) wrote a book (Architecture Hydraulique), where he described using a vertical-axis versus a horizontal-axis machine. This description became the evolution of the modern hydropower turbine. (U.S. Department of Energy, 2001)

Another important moment was the transmission of electricity over a long distance in the middle of the 18th century. It is important to mention, the first pressurized turbine was made in 1827 and it is called Francis turbine (called after B. Fourneyorn). In 1880 L. A. Pelton invented the Pelton turbine and the Kaplan turbine was invented in 1918. It can be said that these turbines are still very important for hydro power.

The last important moment in history was the first hydro power plant, which produced alternating electric current and was put into operation in 1896 in the USA. (Kubín, 2009)

According to Motlík, *et al.* (2007) in the picture below, it can be seen the basic characteristic of water turbines, which are mentioned in section 3.2.1. Their output power P and the definition of regional use depend on the available water source (q is flow turbine, H is the slope).

Scheme No. 1 – Characteristic of water turbines



Source: Kubín, 2009, Proměny české energetiky, page 451

3.2.2. Technology – how does the water power plant work

Water flowing spins the turbine inlet channel, which is on a common shaft with a generator of electricity. Together they form the turbo-generator. The mechanical energy of flowing water changes based on electromagnetic induction (in a rotating loop electrical conductor in a magnetic field induces an alternating voltage) into electrical energy. It is transformed and transferred to the place of consumption. (ČEZ, 2014)

Types of hydro power plants:

a) depending on their output

Table No. 1 – Types of Hydro power plants

Output	Power Plant
From 100 MW	large
Up to 100 MW	middle
Up to 10 MW	small
Up to 1 MW	small (industrial, public, racing)
Up to 100 KW	small (tiny)
Up to 2 KW	small (mobile resources)

Source: Motlík, *et al.*, 2007

b) depending on the connection

Individual are dependent on the public grid, transferring production to separate, divided into network for its own use

Connected are working parallel with public power network, with the power supply for the power distribution business (Motlík, *et al.*, 2007)

Specific hydro power turbines are required for the use of various types, sizes and designs according to specific hydrological and morphological conditions. Nowadays, the theory of hydraulic turbines is at very advanced level. An improvement cannot be expected. Machines are essentially perfect and very effective. (Motlík, *et al.*, 2007)

3.2.3. Advantages and Disadvantages

There are a lot of **advantages** of using hydropower, for example for their operation they don't produce waste and they are easy to operate. Also, due to fast putting into operation, plants can be used as an immediate source of energy during peak periods. (www.nazeleno.cz, 2014)

Disadvantage of large hydropower plants is building a dam, which is very expensive, it needs time for construction and what is the biggest problem it needs a large area for flooding. Another importance is steady flow of water, which is a problem mainly for small hydropower plants. (www.nazeleno.cz, 2010)

3.3. Wind Energy

Wind energy is, as other renewable energy sources, very friendly to the environment. Wind formed in the atmosphere based on the difference of atmospheric pressure as a result of the uneven heating of the Earth's surface. Warm air rises up and to its place is pushing cold air. (Motlík, *et al*., 2007)

The Czech Republic has due to its geographical conditions relatively limited use of wind energy. Areas with regular, sufficiently strong and stable wind are limited and are more located in the mountain areas. However, during the construction, investors are faced with resistance from local governments and residents as it is for example also in the construction of solar power plants. (State National Policy, 2012)

According to U.S. Department of Energy "*wind is a form of solar energy. The terms wind energy, describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wing into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity.*"

3.3.1. History

Wind energy has been used for thousands of years. For instance, the wind propelled sailing boats on the river Nile as early as 5000 B.C., also the wind-powered engines have been already found in ancient China. In the 11th century, in the Middle East, people used water mills mainly for the production of food. (U.S. Department of Energy, 2011)

The first water mill was built on the territory of today's Bohemia, Moravia and Silesia in the garden of Strahov Monastery in Prague in 1277. (Pokorný, 1973) The Dutch found a new technology of wind mills. In the 19th century, settlers used the technology from Dutch people and started to use windmills for farms and ranches, later for generating electricity for homes and industry. (ČSVE, 2013)

Modern wind power plants (WPP) in the Czech Republic started to be produced in the 1970s. Between the years 1990 – 1995 many wind power plants were built in the Czech

Republic, however, later on the production and also construction of WPP slowed down. (ČSVE, 2013)

3.3.2. Technology – how does the wind power plant work

It is necessary that the wind power plant is sufficiently high, so it brings a wind turbine above the atmospheric turbulences. It also must be solid enough so it resists the weight of all the devices and forces that are formed by wind currents. In general, the achievable efficiency of a wind power plant is basically affected by the height of the pole and the rotor diameter. (ČSVE, 2013)

"*A gondola contains a gearbox – the 8 to 17 rotations per minute are not sufficient for electricity generation, to drive an electric generator the speed must be increased to over 1.500 rotations per minute.*" (ČEZ, 2013)

The wind speed which is needed for use of energy generation is from 3 to 25 m/s. Every wind power plant has own safety reasons, for example, when wind speed exceeds 25 m/s, the plant stops by itself. (ČEZ, 2013)

Nowadays, new wind power plants have double-blade or triblade fixed blades with a diameter of 80 – 100 m. "*The rated capacity around 2 – 3 MW is achieved when the wind speed is around 13 m/s, so called start up wind speed is 3 m/s).* (ČEZ, 2013)

The categories of wind power plants are written in the table below.

Table No. 2 – Categories of WPP

Wind power plants								
Small			Middle			Large		
Propeller		Output	Propeller		Output	Propeller		Output
Diameter (m)	Surface (m2)		Diameter (m)	Surface (m2)		Diameter (m)	Surface (m2)	
<8	<50	10	16,1-22	200,1-400	130	45,1-64	1600,1-3200	1500
8,1-11	50,1-100	25	22,1-32	400,1-800	310	64,1-90	3200,1-6400	3100
11,1-16	100,1-200	60	32,1-45	800,1-1600	750	90,1-128	6400,1-12800	6400

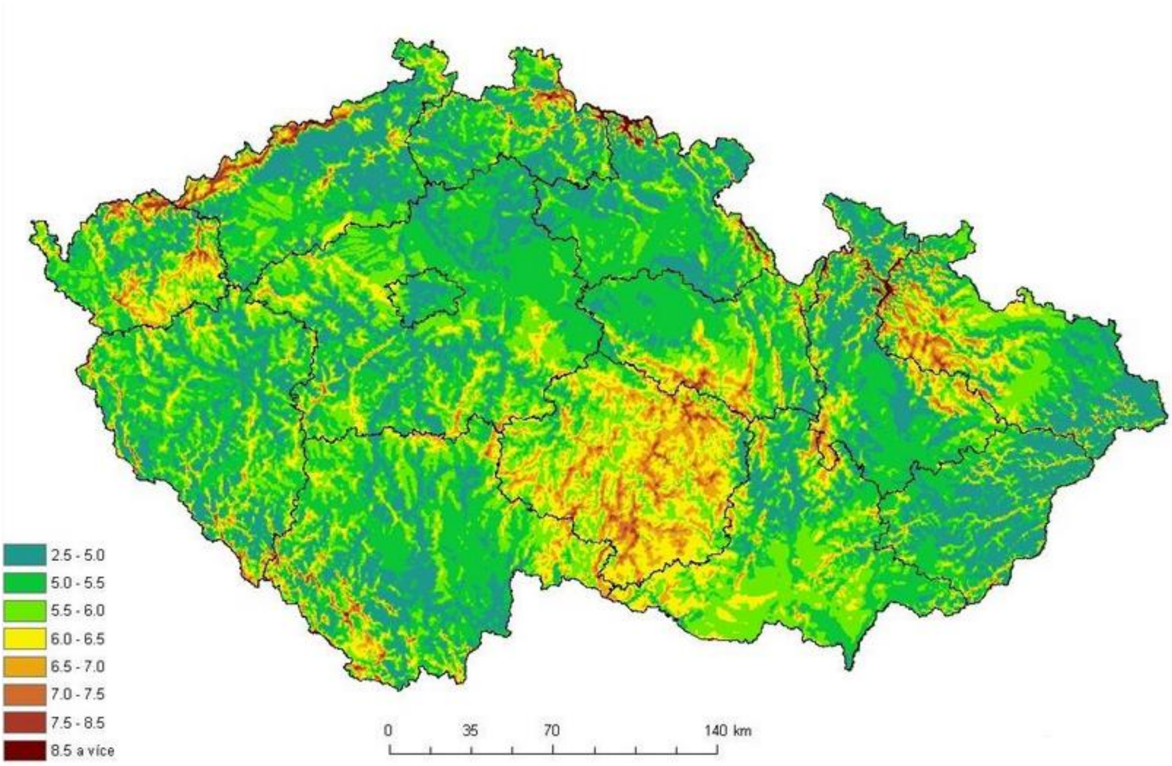
Source: ČEZ, 2013

3.3.3. Advantages and Disadvantages

Wind power plants have as each renewable energy source their own **advantages**, for example, they don't have an impact to the environment because there is no emission during operation and they are cheap for operation. (ČSVE, 2014)

Some experts have an opinion that wind power plants have a lot of **disadvantages**, like danger to birds, television problems with reception or noise. But for instance, only wind power plants constructed in the 90s are noisy, only 1 bird from 10 000 dies because of wind power plant and TV have problem only when plants are close to the transmitter. (ČEZ, 2014)

Scheme No. 2 – Wind Map of the Czech Republic



Source: Ústav fyziky atmosféry AV ČR, v.v.i., 2009

The map above shows the windy places in the Czech Republic which are in the north of Bohemia and in the south of Moravia. The areas, where wind power plants are mostly located you can find in the appendix No. 1 of this thesis.

3.4. Biomass

Wood is the oldest fuel known, and in many developing countries remains as a vital source of energy. It is estimated that wood, grass, and agricultural waste, which is called biomass, is the fourth largest source of energy in the world. Biomass covers about 14 % of total demand. (Biom, 2013)

The most used types of biomass include wood and wood waste, straw, cereal and oil crops, biogas, liquid biofuels, and energy crops grown for energy purposes.

In the Czech Republic biomass (besides geothermal energy) should take the position of the main renewable source. Purposely grown biomass brings extra benefit in a broader context. For instance, biomass improves the ecology of the landscape, makes efficient use of land, and social aspects are also important, *e.g*. new job opportunities. (Kubín, 2009)

3.4.1. Technology

Characteristic properties of biomass are different and depend on the type of biomass, growing conditions and moisture content. The main types of biomass in the Czech Republic are:

- wood waste: wood chips, sawdust, shavings, barks, branches, stumps
- non-wood phytomass: green biomass, cereals, rape straws, energy crops
- industrial and municipal waste of plant: paper waste
- animal products
- sorted municipal waste
- liquid biofuels (Kubín, 2009)

According to Energy Regulatory Office (2013), biomass is divided into three basic groups:

- waste from industrial processes
- waste from forestry and agricultural production
- purposely grown biomass

(This disposal is important for setting tariff in feed, which is important in the practical part of this thesis.) Anyway, this corresponding to valuation of produces value in the energy market.

Each technology requires specific properties of biomass, such as moisture content, particle size, calorific value, ash content and particle cohesion. One of the main factors influencing the processing of biomass, are water content and dry matter. The boundary between wet and dry processes is probably 50 % of dry matter. For instance, energy value of one ton of dry wood in the furnace is around 19 GJ. If the wood is wet, the value decreases to about 15 KJ/ton. (Kubín, 2009)

There are many technologies for processing biomass, which can be categorized as:

- dry processes: thermochemical conversion of biomass
- wet processes: the biochemical conversion of biomass
- physical and chemical conversion of biomass
- waste heat recovery in biomass composting (ERO, 2013)

3.4.2. Advantages and Disadvantages

The **advantage** of biomass is the local availability compared to fossil fuels. Its controlled production can have the benefit for biodiversity in the landscape. (Holý, 2010)

The biggest **disadvantage** is the low energy efficiency of biomass. (Murtinger, 2007)

3.5. Solar Energy

Direct use of solar energy is again one of the cleanest and most environmentally friendly methods of electricity generation. Solar power exceeds 40 trillion the theoretical consumption of humanity. Today, however, it can be used only a part. The amount of energy we receive from total solar radiation is negligible. Although the current contribution of photovoltaic to the total electricity production in the world is only about 0.01 %, the use of solar technologies have a great potential for growth, and developed countries count with this renewable source for the future. (ČEZ, 2013)

3.5.1. History

Solar energy has started in the 7th century B.C. when human started to use a magnifying glass to concentrate the sun’s rays to make fire and to burn insects. (U.S. Department of Energy, 2013)

In 1767 the Swiss scientist Horace-Benedict de Saussure invented the first solar collector. This collector, looked like an insulated box, became well known as the first solar oven, which could almost reach 230 degrees of Fahrenheit. The first photovoltaic cell was discovered by French physicist Edmond Becquerel in 1839.

The first commercial use of solar energy was in 1958. Solar energy was also used for power space exploration gear. In the 1960s and 1970s a discussion started about the efficiency of the solar energy, and in 1970 Exxon Corporation designed an efficient solar panel which reduces costs.

In the few last years, the solar energy has changed, many companies started to build solar panels on their roofs and the efficiency of this power increased. (Exploring Green Technology, 2013)

3.5.2. Technology – how does the solar power plant work

Electricity can be obtained from the solar energy directly and indirectly. Direct transformation utilizes the photovoltaic effect, in which the specific substance on exposure to light, emit electrons. The indirect electricity is based on obtaining heat.

The representative of the direct production of electricity from solar energy, are solar cells. Production of solar cells is used in semi-conductor materials. Semi-conductor has two options of conductivity, first one, N type (negative charge carries), the other, P type (positive charge carries).

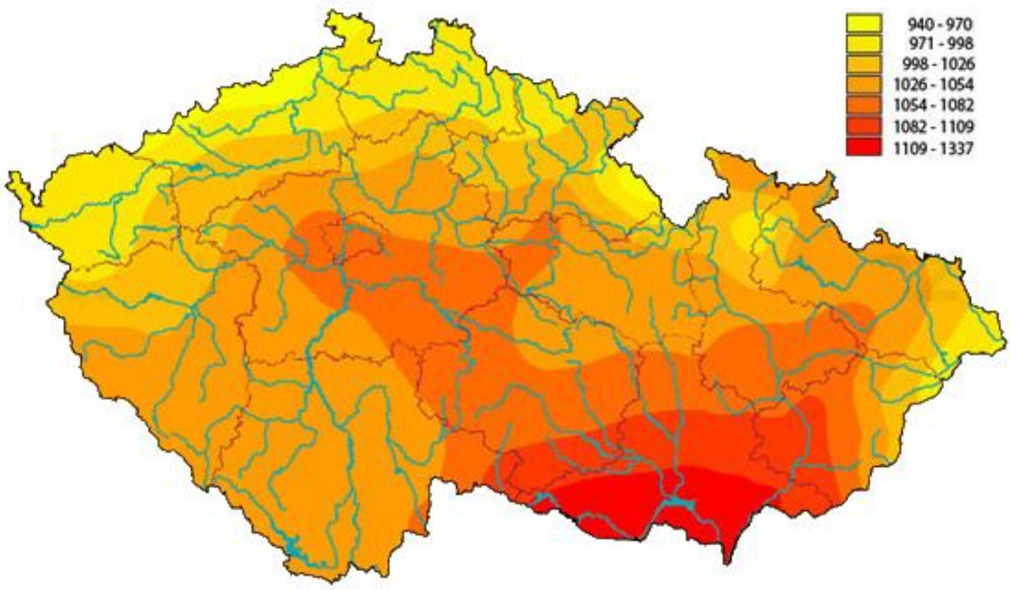
A solar cell is formed mostly by a thin plate of single crystal silicon also polycrystalline material can be used. One square meter of solar cells may produce up to 150 W DC (direct current) in a summer noon. To achieve the required voltage (in one cell there is 0.5 V) solar cells connect in a row.

To get more current, we plug cells next to each other. Attaching a lot of solar cells (side by side and behind) we create a solar panel. The size of one cell is about 10 x 10 cm, its connects to panels with outputs from 10 to 30 W. (ČEZ, 2013)

According to Motlík, *et al*. (2007) to use the electricity from the solar panels is necessary to connect to the panel, except electrical appliances, other technical elements, such as batteries, charging controller, voltage inverter, display, and measuring equipment. Assembly of photovoltaic panels, support equipment, appliances and possibly other elements is called a photovoltaic system.

The amount and composition of elements depend on the type of application. For instance, applications are power supply for cottages and houses, power traffic signal, telecommunications equipment, lighting and monitoring equipment in the field, garden lights, *etc.*

Scheme No. 3 – Map of Solar Radiation in the Czech Republic (W/m^2)



Source: Isofen Energy, 2014

The map of solar radiation shows the suitability of the locality for the use of solar energy. This map is based on long-term meteorological measurements, and the best place for solar power plants is in south of Moravia. In the appendix No. 2 you can see how many solar power plants are built in the Czech Republic.

3.5.3. Development in the Czech Republic

Before the year 1998 the use of solar energy was almost minimal. The system connected to the distribution network has been appeared very slowly. The first major photovoltaic power system was on the top of mountain Mravenečník in Jeseníky. A freestanding solar power plant with an output of 10 KW was financed by ČEZ, a. s. in 1998. Because of the problems related to the remoteness of the power plant, the owner decided to move the power plant to information center near the nuclear power plant Dukovany.

Since 2000, it has started a new period of development of solar energy in the country. Gradually, state administration and local self-government introduced tools to support of photovoltaic. The tools were: supporting demonstration projects and supporting research and development. (Motlík, *et al*., 2007)

In 2009 the "solar boom" started, in one year was built 400 MW of installed capacity and in the following years this number has continued to increase. The largest increase happened in the 2010, when amount of 1 960 MW of solar power plants were installed at the end of the year. The reason, why there were so many solar power plants realized and constructed, was large subsidies from the State. Connection and amount of solar power would mean a threat to the power system of the Czech Republic. For this reason subsidies were reduces and since 2014 stopped[1].

It is also important to mention the problems of using solar energy as the renewable source of energy, which are:

1. Unequal distribution between the doldrums and northern and southern areas
2. Complex and cumbersome construction solution
3. Extensive technical facilities for transportation and accumulation of energy (Kubín, 2009)

3.5.4. Advantages and Disadvantages

During the operation of solar power plants there are no emissions, the operation is noiseless, and also a great **advantage** is high operating reliability.

Disadvantages of solar power plants are low average annual intensity of solar light (in the Czech Republic), high investment costs of installation and relatively small lifetime (about 20 years). (ČEZ, 2014)

3.6. Biogas

Renewable Natural Gas (biogas) is "*also known as biomethan, swamp gas, landfill gas, or digester gas – is the gaseous product of anaerobic digestion (decomposition without oxygen) of organic matter. In addition to providing electricity and heat, biogas is useful as a vehicle fuel."*(U.S. Department of Energy, 2013)

3.6.1. Technology – how does the biogas power plant work

Biogas plants are modern and eco-friendly devices that typically operate in the Czech Republic and abroad. It processes many materials or waste organic origins through the process of anaerobic digestion.

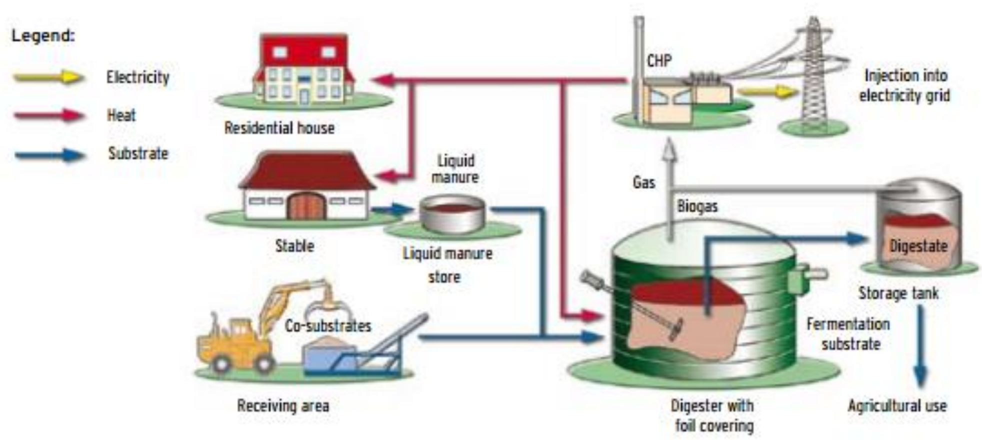
The result of the process is biogas, which is currently used mostly for the production of electricity, heat and also it can be used as high quality fertilizer (like compost). Biogas

[1] Note: according to oral communication with Ing. Vladimír Tošovský, Chairman of the Board of Directors of ČEPS, a.s.

plants process agricultural products and industrial and municipal waste management as well. (ČEZ, 2013)

A picture below shows an example of the Agricultural biogas plant. Also in the appendix No. 3, you can find a map of biogas plants in the Czech Republic.

Scheme No. 4 – Biogas plant



Source: European Biomass Association, 2009

3.6.2. Advantages and Disadvantages

Advantages of the biogas plants are for example: relatively cheap technology, reducing the greenhouse effect and applies to the use of untapped biomass. (www.conserve-energy-future.com, 2014)
Biogas stations don't have many technology improvements and other **disadvantage** is that biogas stations don't have enough big economic importance yet. (www.conserve-energy-future.com, 2014)

3.7. Geothermal Energy

The geothermal energy is the oldest energy on our planet. Geothermal energy is a manifestation of the thermal energy of the Earth's core that forms decay of radioactive materials and the action of tidal forces. Its manifestations are, for example eruptions of volcanoes and geysers and hot springs. (ČEZ, 2013) Geothermal energy, as all renewable sources, is clean and sustainable. (Renewableenergyworld.com, 2013)

3.7.1. Technology

Geothermal energy has two types:

1. Wet – energy of steam and hot water (production of electricity)
   Estimate of global reserves of wet sources is approximately 2 TWR/y (in populated areas). In 1920s in Japan, New Zealand and the USA they started to use the geothermal energy for production of electricity. In 1989 the European Union countries installed in power plants utilizing the high enthalpy geothermal energy in total 519 MW.
2. Dry – from deep wells
   Source of dry heat in 6000 m of the Earth's crust at temperatures of 200 °C is higher than the energy content of the world's reserves of fossil fuels. Due to the low heat conductivity of the rock, this heat is industrially unusable yet. Conduction of heat from the rock subsoil gets into the atmosphere and the oceans about 35 TWR/y.

In depths of the Czech Republic are available only sources of geothermal water at low temperature (about 25 – 35 °C), which are not suitable for energy purposes, to use them it is necessary to install heat pumps. (Kubín, 2009) Generally, in the Czech conditions suitable location is a place with already disturbed underground rock. Experts agree that acceptable places could be in Litoměřice, Losovice and Chomutov (ČEZ, 2013)

3.7.2. Advantages and Disadvantages

The **advantages** are very small effects on the environment (almost no environmental footprint), the independence of the fuel supply (can withstand operating at full power for decades), almost unattended operation and compared to other renewable energy sources also stability and performance. (ČEZ, 2013)

The **disadvantages** are the uncertainty of geological terms. The question is if we really manage to create a sufficiently large heat exchanger. (Conserve Energy Future, 2013)

4. Legislation of the European Union and the Czech Republic

4.1. European Union

In 2004 the Czech Republic started to be a member of the European Union. In many aspects of its operation, the Czech Republic is influenced by European legislation. This also applies to the field of energy, even if it is the sovereign right of each state to determine its energy mix.[2]

An important place for global policies changes related to renewable sources of energy became in the Japanese city called Kyoto. In 1997 there was a conference in Kyoto, the result of this conference was the Kyoto Protocol. "*The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on the Climate Change, which commits its Parties by setting internationally binding emission reduction targets.*" (United Nations Framework Convention on Climate Change, 2014)

According to the Kyoto Protocol – Reference Manual was one of the important establishments to reduce greenhouse gas emissions up to 8 % in some EU countries (*e.g.* the Czech Republic, Austria, Denmark, France, *etc*.)

It can be said, that the most important document of the European Union, which pointed out the importance of renewable sources of energy in the context of environmental protection and safety is the White Paper. The White Paper is about Transitioning to a Renewable Energy Future and was published in Freiburg, Germany in 2003. (International Solar Energy Society, 2003)

The White paper sets out the reasons for the establishment of effective government policies. Also there was important to mention the worldwide use of renewable energy sources, and to provide adequate information, such as how to accelerate the introduction of effective government policies. (The White Paper, 2003)

On the other hand, the European Union has many important directives, which are connected to the sector of energy and based on the documents above.

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[2] Note: The term **energy mix** „*refers to the distribution, within a given geographical area, of the consumption of various energy sources (crude oil, natural gas, coal, nuclear energy and the many sources of renewable energy).*" (www.planete-energies.com, 2014)

4.1.1. Directive 2001/77/EC

"*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*" (Official Journal of the EU, 2001) was the first and most fundamental document that ensued the White Paper. (Official Journal of the European Union, 2001)

4.1.2. Directive 2009/28/EC

"*Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC"* (Official Journal of the EU, 2009)

This Directive determines the share of renewable energy sources in final energy consumption in 2020. The European Union has accepted a commitment of increasing this share to 20 %. These 20 % are valid for entire the EU it does not mean that each country has to achieve this share. Each state has a historical predisposition to generate electricity from various types of source, and therefore it is not possible to compare all states like there wouldn't be a difference. (Directive 2009/28/EC)

For instance, in the Czech Republic the share of renewable energy sources in final consumption was in the year 2012 about 11 %. In contrast, the Nordic countries (Sweden, Finland) had a significant share in electricity production of renewable sources of energy already in 2008. Therefore, the proportion of the Czech Republic is set to 13 % and for example Portugal to 31 %. (Nezávislá odborná komise pro posouzení energetických potřeb České republiky v dlouhodobém časovém horizontu, 2008)

4.1.3. Directive 2009/72/EC

"Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC" (Official Journal of the European Union, 2009)

The Directive is again important for the energy sector. It mentions the possible use of renewable energy sources and efficient operation of the distribution network in the distribution of renewable sources of energy. (Official Journal of the European Union, 2009)

4.2. Czech Republic

Before the Czech Republic joined the European Union there was an amendment to the use of renewable energy sources in the two general laws and several standards. It was Act No. 458/2000 Coll. on the Conditions of Business and State Administration in Energy Industries and Changes to Certain Laws (the Energy Act) and Act No. 406/2000 Coll. on the Energy and Related Regulation.

This legislation ensured electricity producers preferred network connection from renewable sources of energy and repurchase of produced electricity. Increased costs associated with purchase were seen in the cost of distribution. Consequential decrees of the Energy Regulatory Office, which issued a pricing decision and set minimum regulated prices of energy from renewable energy sources. This system provided tax breaks and subsidies from public budgets. (MIT, 2014)

4.2.1. Act No. 165/2012 Coll.

Act No. 165/2012 Coll. of 31 January 2012 on the Supported Energy Sources and amending certain Acts, such as Act No. 458/2000 or Act No. 406/2000 Coll.

The Act, among other things, regulates the promotion of electricity, heat and bio methane from renewable sources of energy. The Act also governs the National Action Plan of the Czech Republic for energy from renewable sources, the conditions for issuing, recording and recognition of guarantee of origin of RES and financing the support.

The purpose of this Act is protection of climate and the environment, support the use of renewable energy sources, ensure the share increased of RES and also create conditions for achieving mandatory targets for the share of energy from renewable sources of energy in gross final energy consumption in the Czech Republic.

Price support is determined differently depending on the type and size of the source. Minimum feed in tariffs are announced by the Energy Regulatory Office annually, which is important for the practical part of this thesis. (Act No. 165/2012 Coll.)

It is also important to notice, that the Act No. 165/2012 Coll. has been changed by the Act No. 310/2013 of 13 September 2013. The changes in this Act are mostly “cosmetic” and these three acts above are still important for our energetic legislative.

In the Czech Republic there are other two important documents that deal with energy problematic, these are State Energy Policy and National Renewable Action Plan of the Czech Republic.

4.2.2. State Energy Policy

The State Energy Policy (SEP) is a strategic document expressing the government objectives in the energy sector in compliance with the needs of economic and social development, including environmental protection.

The State Energy Policy is formulated by the Government of the Czech Republic. It sets out the strategic objectives of the CR energy and defines the strategic priorities with a view of about 30 years.

The main mission of the State Energy Policy is to provide reliable, safe and gentle energy supply for the needs of the population and the economy of the country. It also needs to secure uninterrupted power supply in emergency situations to the extent necessary for the functioning of the most important components of the country infrastructure and for the survival of the population. (State Energy Policy, 2012)

4.2.3. National Renewable Action Plan of the Czech Republic

The Renewable Action Plan of the CR is prepared in accordance with the State Energy Policy, its goal is to fulfill and exceed the required objectives of the CR in the use of energy from renewable sources in 2020.

"The National Renewable Energy Action Plan for the Czech Republic (hereinafter the National Action Plan) being presented suggests a target of a 13.5 % share of energy from renewable sources in gross final energy consumption and the fulfillment of a target a 10.8 % share of energy from renewable sources in transport in gross final energy consumption.

(National Renewable Action Plan of the CR, 2012)

5. Practical part

5.1. Future Potential and Development

In the past, the potential of the renewable energy sources in the Czech Republic was estimated several times. For the first time in 2003, the research was affected because of economic evaluation. The main purpose was to provide an authoritative basis for the preparation of the State Energy Policy and also to prepare a draft law of supported energy of renewable sources. (Asociace pro využívání obnovitelných zdrojů energie, 2010)

At this moment, the diversification of sources increase safety of supply, because the renewable energy sources are available in the area of the Czech Republic, their use reduces energy dependence on other countries. Currently, the import of energy is about 40 %, mainly oil and gas.

Furthermore, it is important to mention that current renewable sources of energy cover about 5 % of usage of primary sources. Anyway, the theoretical potential of renewable energy sources exceeds current usage, but for using the renewable sources of energy we can use only economic available technologies, which decrease the potential. In 2030 the estimate use would cover 17 % of today’s consumption of primary energy.

Nowadays, we use the primary sources of energy only with an efficiency of 60 %, which is relatively low. Primary energy can be reduced, for example by energy savings, high efficiency of energy processes or reducing electricity exports. After this, renewable source of energy could cover a higher share of consumption. (ME, 2014)

5.1.1. Hydro Energy

The hydropower potential is almost depleted because of the historical interest of this source of energy. Most of the large water flows were regulated and the possibilities of large hydro power plants are considered as completely depleted. (ME, 2014)

Large hydro power plants (with installed capacity above 10 MW) produce approximately 50 – 60 % electricity from water in the Czech Republic. The rest are small hydro power plants. It remains only limited potential for small hydro power plants with the installed capacity of 10 MW. Increase production of energy is possible by increasing efficiency or construction of new dams. The remaining realized projects are usually located in places

whose usability has been considerably lower than the hydro power plants already constructed. The estimated value of our hydro power potential of small hydro power plants is about 1 400 – 1 500 GWH of energy per year. (Motlík, *et al*., 2007)
Perspective thing is above all reconstruction of existing small hydro power plants. Construction of new plants would be more problematic and expensive because of higher cost, the need of permission from river-basins and higher ecological demands. (ME, 2014)

5.1.2. Wind Energy

The first and most important step to properly determine the potential of wind energy is finding the real wind condition in the Czech Republic. For this purpose wind speed was calculated at height 100 m above the Earth's surface which is the typical height of the rotor axis in the current wind power. (ČSVE, 2013)

There are three potentials of wind energy:

1. <u>Theoretic potential</u> is determined by density of wind power or simply by the average annual wind speed. In both cases, it is important to find a threshold limit that determines this potential.
2. <u>Technical potential</u> can be defined as the total nominal performance and general annual production of wind power plants, which corresponds to the latest statement of their technical standard by using available theoretical potential and respecting the requirements for their construction and operation (according to The Law on Protection of Nature and Landscape *e.g.* transport, infrastructure, noise emissions, distance, *etc.*)
3. <u>Realized potential</u> explores the impacts of wind power plants to the environment.

Wind energy has greater potential than water energy but instability, inability to regulate and difficult to predict strongly affecting its possible use. (Motlík, *et al*., 2007)

As it is written above the development of wind power plants can be expected only in the areas with good conditions. The problem is that people still refuse to use wind energy, but experts think that the situation should calm down and wind power plants will be developed according to model scenarios in the State Energy Policy.[3] According to SEP by 2020, the

[3] Note: according to oral communication with Ing. Pavel Šolc, Vice-Minister of Ministry of Industry and Trade

average increase will be from 30 to 40 MW/year and a rate of the wind power plant will be up to 80 MW/year. (Directive 2009/28/EC)

5.1.3. Biomass

Biomass has, in contrast to wind or water power, the advantage that the actual atmospheric conditions is not important for it, and also it has a great potential for heating. Especially, it can be used as a replacement for the decline of coal.

Biomass is the only additional and larger scale system, available for the purpose of heating in the Czech Republic. Emissions of CO2 from biomass sources are significantly lower than from coal. Unfortunately, other types of emissions (*e.g.* airborne dust) are in some cases higher than the combustion of coal. Anyway, due to its properties, biomass is better controllable source. (Motlík, *et al*., 2007)

It is important to remember, that biomass is not an environmentally clean source of energy and we have to consider if the cultivation of energy crops is appropriate to the global food shortage. There is also the risk of overuse and excessive soil fertilization. In the future, further development will depend on feed in tariff and agricultural policy. (ME, 2013)

5.1.4. Solar Energy

The Czech Republic has due to its geographical condition relatively limited use of solar energy. In the recent years the use of solar energy for electricity production increased a lot, especially because of the high cost of support. Regarding this cost of support, the limits of networks started to be unjustifiable. Also, because of the protection of the environment, it resulted in limiting the cost of support. (ME, 2013)

Since the beginning of 2014, the cost of support for solar power plants newly commissioned stopped completely. In the future there will be a particularly appropriate to use solar energy as a source of low power for building in competitive conditions, which maintain market mechanisms to other sources without subsidies.

Anyway, according to Tošovský (2014) the potential of solar energy is very high, especially on the roofs of houses. In 2040 the potential development can be up to 6 500 MW. In practice, it still could mean an increase in installed capacity up to double to the current situation. The use of roof panels for their use is a very appropriate way to partially save fossil resources. Of course, it will depend on the control settings and combination with the current tariffs.

5.1.5. Biogas

In general, production of biogas has the benefit of reducing greenhouse emission and other positive and social benefits. In the Czech Republic this renewable source of energy has a great potential, especially in the agricultural sector.

The greatest potential for biogas production is in the agricultural biogas plants, which are mainly used for inputs for agricultural production, fertilizers and crops. These plants have meaning and importance, particularly if it is directly involved in the process of agricultural production.

For farmers, these stations are a new and stable source of income and also create and stabilize job opportunities and their produce clean energy and high-quality fertilizer. (MA, 2014)

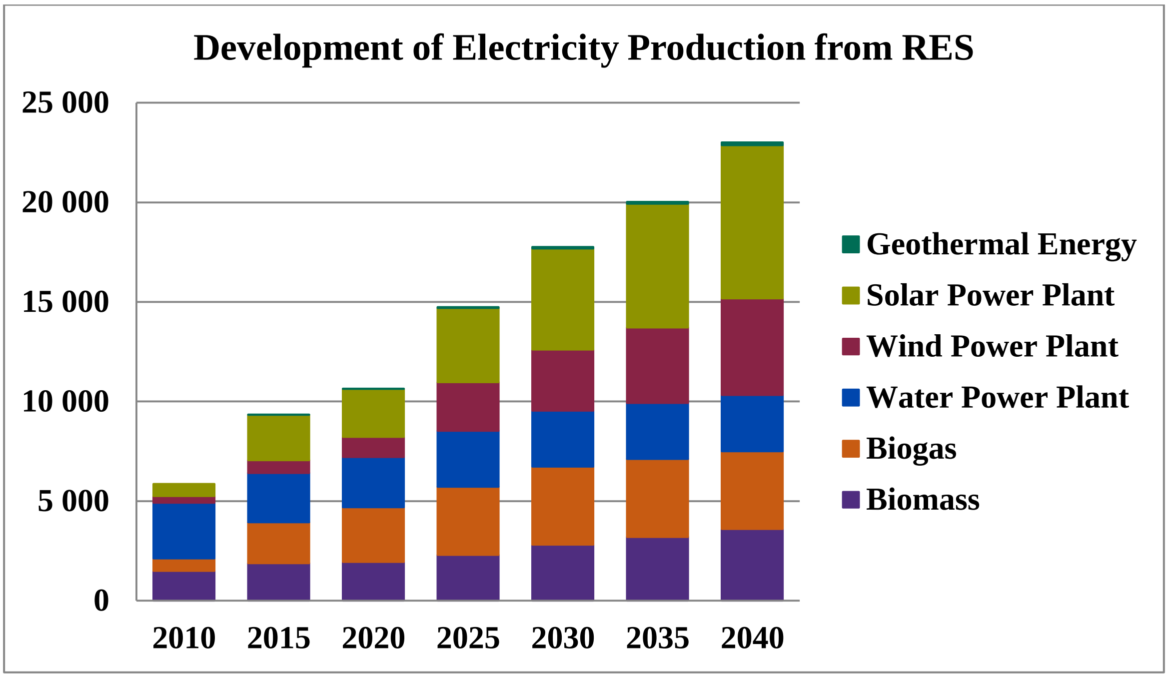
5.1.6. Geothermal Energy

The potential of geothermal energy in various parts of the Czech Republic is very changeable. Use of low potential energy of rocks and shallow groundwater is accessible everywhere in the country. It can be used by heat pumps (*e.g.* in Ústní nad Labem for heating swimming pools and zoo.) (Motlík, *et al*., 2007)

Due to the cessation of the support of the use of energy from renewable sources (I will get to this later), the development of renewable sources will be slower. Of course, on the graph below the development of RES is increasing but not as much as was expected few years ago.

Importantly, it is assumed greater use of wind and solar power. Again, I must point out that the condition of their competitiveness has to be observed. And the plants will be operated on a market mechanism.

Graph No. 1 – Development of Electricity Production from Renewable Energy Sources



Source: State Energy Policy, 2012

In the graph above the total amount of renewable energy sources has upward character. In this trend is included pursuit of the highest possible utilization of domestic energy resources, provided its economic benefit, but also the pursuit of the lowest possible impact on the budgets of the state and its people.

6. Support of the Use of Energy from Renewable Sources

As renewable sources weren't fully competitive compared to conventional sources, for the production of electricity from these sources was determined the support of the use of energy.

The main reason was the need to increase the share of electricity generation from renewable energy sources to accomplish our commitment to the European Union, which set a target share of the Czech Republic consumption to 13 %. (European Commission, 2013)

In 2005 Act No. 180/2005 on the Promotion of Renewable Sources of Energy was published. The basis was to set higher subsidies for the production of electricity from wind energy and solar energy. In the following years, this support resulted in the greater development of the construction of electricity from these sources throughout the Czech Republic, especially solar power plants. This Act was replaced by the Act No. 165/2012 Coll. (Act No. 165/2012 Coll.)

While against to the construction of wind power plants in many cases prevented the population and local authorities, the solar power plants were taken as an appropriate resource with appropriate subsidies. The technological development was faster than experts expected and caused cheaper components for the construction of photovoltaic power plants.

According to this technological development solar power plants became a business plan to many enterprises with overvalued subsidies. It also resulted to "solar boom", which meant a large number of applications to connect solar power into the electricity network, which could lead to the collapse of the power system.

At the same time, the transmission system operators and operator of distribution systems interfered, and together with the government slowed this growth by limiting the granting of permission to connect to the electricity grid with regard to the security of network operations[4].

6.1. Feed in Tariff and Green Bonus

Feed in Tariff of renewable energy source is set by the Energy Regulatory Office. *"The Energy Regulatory Office was set up on 1 January 2001 under Act No. 458/2000 Coll. of 28 November 2000, on the Condition of Business and State Administration in Energy Industries and Changes to Certain Laws (the Energy Act) as amended, as an administrative authority responsible for regulation in the energy sector."* (ERO, 2001)

Feed in Tariffs are set as the minimum prices. Annual and hours Green Bonuses are fixed for a given time period as fixed values. In one production of electricity is not allowed to combine support in the form of feed in tariffs and green bonuses. (ERO, 2013)

According to Price Decision of the Energy Regulatory Office number 4/2013 of 27 November 2013 Setting the Support for the Supported Energy Sources. Each of renewable sources of energy has had its own feed in tariff and green bonus per year.

[4] Note: according to oral communication with Ing. Vladimír Tošovský, Chairman of the Board of Directors of ČEPS, a.s.

It is important to notice, that producer of electricity is required to register the form of operational support for electricity by Public notice no. 346/2012 Coll. (ERO, 2013)

The data below are collected especially from Energy Regulatory Office, where it can be seen the changes of Feed in Tariffs and Green Bonuses per each year.

Table No. 3 – Small Water Power Plants

Small Water Power Plants				
Source	Date of Commisioning		Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	From	Until		
Small water power plant	-	31. 12. 2004	1 988	1 168
	01. 01. 2005	31. 12. 2013	2 549	1 729
	01. 01. 2014	31. 12. 2014	2 499	1 679
Small water power plant - after recontruction	-	31. 12. 2013	2 549	1 729
	01. 01. 2014	31. 12. 2014	2 499	1 679
Small water power plant - new localities	01. 01. 2006	31. 12. 2007	2 831	2 011
	01. 01. 2008	31. 12. 2009	2 997	2 177
	01. 01. 2010	31. 12. 2010	3 257	2 427
	01. 01. 2011	31. 12. 2011	3 184	2 364
	01. 01. 2012	31. 12. 2012	3 319	2 499
	01. 01. 2013	31. 12. 2013	3 295	2 475
	01. 01. 2014	31. 12. 2014	3 230	2 410

Source: ERO, 2013

The table above shows feed in tariff for small water power plant and for small water power plant after reconstruction is 2 499 CZK/MWH (mode called green bonus is 1 679 CZK/MWH), but feed in tariff for small water power plant in new localities is 3 230 CZK/MWH (green bonus is 2 410 CZK/MWH) all the tariffs are for the year 2014.

Table No. 4 – Wind Power plants

Wind Power Plants				
Source	Date of Commisioning		Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	From	Until		
Wind Power Plant	-	31. 12. 2003	3 777	3 297
	01. 01. 2004	31. 12. 2004	3 413	2 933
	01. 01. 2005	31. 12. 2005	3 247	2 767
	01. 01. 2006	31. 12. 2006	2 965	2 485
	01. 01. 2007	31. 12. 2007	2 913	2 433
	01. 01. 2008	31. 12. 2008	2 841	2 361
	01. 01. 2009	31. 12. 2009	2 591	2 111
	01. 01. 2010	31. 12. 2010	2 425	1 945
	01. 01. 2011	31. 12. 2011	2 373	1 893
	01. 01. 2012	31. 12. 2012	2 321	1 841
	01. 01. 2013	31. 12. 2013	2 162	1 682
	01. 01. 2014	31. 12. 2014	2 014	1 534

Source: ERO, 2013

Feed in tariff and green bonuses changed pretty rapidly for wind power plants, in 2003 was feed in tariff 3 777 CZK/MWH (green bonus was 3 297 CZK/MWH) but for year 2014 feed in tariff is 2 014 CZK/MWH and green bonus is “only” 1 534 CZK/MWH.

Table No. 5 – Biomass

Biomass					
Source	Date of commisioning		Category and Process of using	Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	from	until			
Clean Biomass (current factories)	-	31. 12. 2012	O1	2 830	1 980
	-	31. 12. 2012	O2	2 130	1 280
	-	31. 12. 2012	O3	1 460	610
Clean Biomass (new factories)	01. 01. 2008	31. 12. 2012	O1	4 580	3 730
	01. 01. 2008	31. 12. 2012	O2	3 530	2 680
	01. 01. 2008	31. 12. 2012	O3	2 630	1 780
	01. 01. 2013	31. 12. 2013	O1	3 730	2 880
	01. 01. 2013	31. 12. 2013	O2	2 890	2 040
	01. 01. 2013	31. 12. 2013	O3	2 060	1 210
	01. 01. 2014	31. 12. 2014	O1	3 335	2 485
	01. 01. 2014	31. 12. 2014	O2	2 320	1 470
	01. 01. 2014	31. 12. 2014	O3	1 310	460

Source: ERO, 2013

Feed in tariff for biomass depends on the category and on the process of using, these parameters are written in Public Notice no. 477/2012 Coll. on Determining the Types and Parameters of Supported Renewable Source for electricity, heat or bio methane.

Table No. 6 – Solar Power Plants

Solar Power Plants						
Source	Date of Commisioning		Installed Capacity (KW)		Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	From	Until	From	Until		
Solar Energy	-	31. 12. 2005	-	-	7 418	6 688
	01. 01. 2006	31. 12. 2007	-	-	15 585	14 835
	01. 01. 2008	31. 12. 2008	-	-	15 180	14 450
	01. 01. 2009	31. 12. 2009	-	30	14 243	13 643
	01. 01. 2009	31. 12. 2009	30	-	14 139	13 409
	01. 01. 2010	31. 12. 2010	-	30	13 265	12 665
	01. 01. 2010	31. 12. 2010	30	-	13 161	12 431
	01. 01. 2011	31. 12. 2011	-	30	7 959	7 359
	01. 01. 2011	31. 12. 2011	30	100	6 264	5 534
	01. 01. 2011	31. 12. 2011	100	-	5 837	5 107
	01. 01. 2012	31. 12. 2012	-	30	6 410	5 810
	01. 01. 2013	30. 06. 2013	-	5	3 478	2 878
	01. 01. 2013	30. 06. 2013	5	30	2 887	2 287
	01. 07. 2013	31. 12. 2013	-	5	3 050	2 450
	01. 07. 2013	31. 12. 2013	5	30	2 479	1 879

Source: ERO, 2013

Table No. 7 – Biogas Power Plants

Biogas					
Source	Date of Commisioning		Category	Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	From	Until			
Biogas stations	-	31. 12. 2011	AF1	4 120	3 270
	-	31. 12. 2012	AF2	3 550	2 730
	01. 01. 2013	31. 12. 2013	AF	3 550	2 700

Source: ERO, 2013

As it can be seen above in the tables neither biogas nor solar energy don't have in these tables feed in tariff for the year 2014, the reason is that they will not be supported.

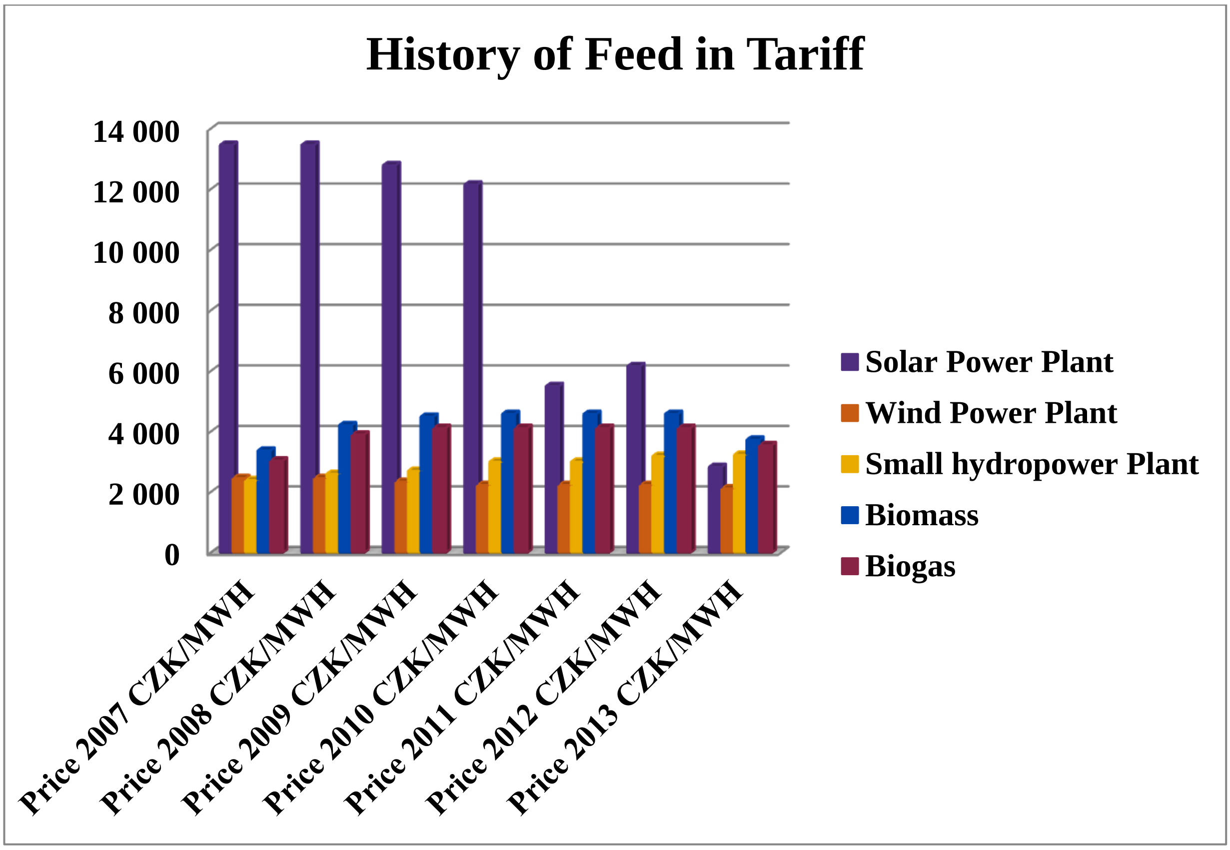
Table No. 8 – Geothermal Energy

Geothermal Energy				
Source	Date of Commisioning		Feed in Tariff (CZK/MWH)	Green Bonus (CZK/MWH)
	From	Until		
Geothermal Energy	-	31. 12. 2012	4 590	3 740
	01. 01. 2013	31. 12. 2013	3 356	2 506
	01. 01. 2014	31. 12. 2014	3 290	2 440

Source: ERO, 2013

Feed in tariff for geothermal energy is 3 290 CZK/MWH (green bonus is 2 440 CZK/MWH) for the year 2014. Therefore, it is of course several times more expensive than *e.g.* electricity from the nuclear power plant Temelín. It is because renewable sources of energy have zero variable cost (*e.g.* fuel costs) and because the government supports (green bonuses, subsidies) of these sources. And their price increases compared to conventional sources for the final customer. Also, it is important to say that the variable costs for the conventional sources are not zero because fuel is necessary for them. Anyway a core in nuclear power stations has the lowest variable cost from conventional sources and actual production of geothermal sources in contrast, is very cheap by comparison to other conventional sources.

Graph No. 2 – History of Feed in Tariff in the Czech Republic



Source: ERO, 2014

6.2. The Development of Support for Renewable Energy Sources

The support for production of electricity from renewable energy sources referred to operation from 1 January 2014 has been suspended. In 2014 will be a temporary period, which will allow install new sources for production of electricity from some types of renewable sources by the end of 2015 for existing support.

The amendment of the Act, which sets support limits, further establishes the maximum price limit for reimbursement of cost associated with the support of electricity to 495 CZK/MWH. Professional organizations also supported the proposal, although from the beginning they preferred the maximum amount around 420 CZK/MWH.

The solar tax will still be an item in the state budget of the Czech Republic but it is important to notice, that decreases from 26 % to 10 %. It should bring 6 billion CZK per year[5].

[5] Note: according to oral communication with Ing. Pavel Šolc, Vice-Minister of Ministry of Industry and Trade

6.3. Total Amount of the Support for Renewable Energy Sources

Table No. 9 – Total Amount of the Support for RES

Year	Total Amount (in thousands of CZK)
2002	613 985
2003	1 041 323
2004	1 487 771
2005	1 732 991
2006	2 331 722
2007	2 792 239
2008	3 377 921
2009	4 665 469
2010	13 219 312
2011	31 995 885
2012	34 937 906
2013	44 443 694

Source: ERO 2014

As it can be seen in the table above, in 2013 the total amount of support for renewable sources is 44.4 billion CZK. In 2014 the support should decline.

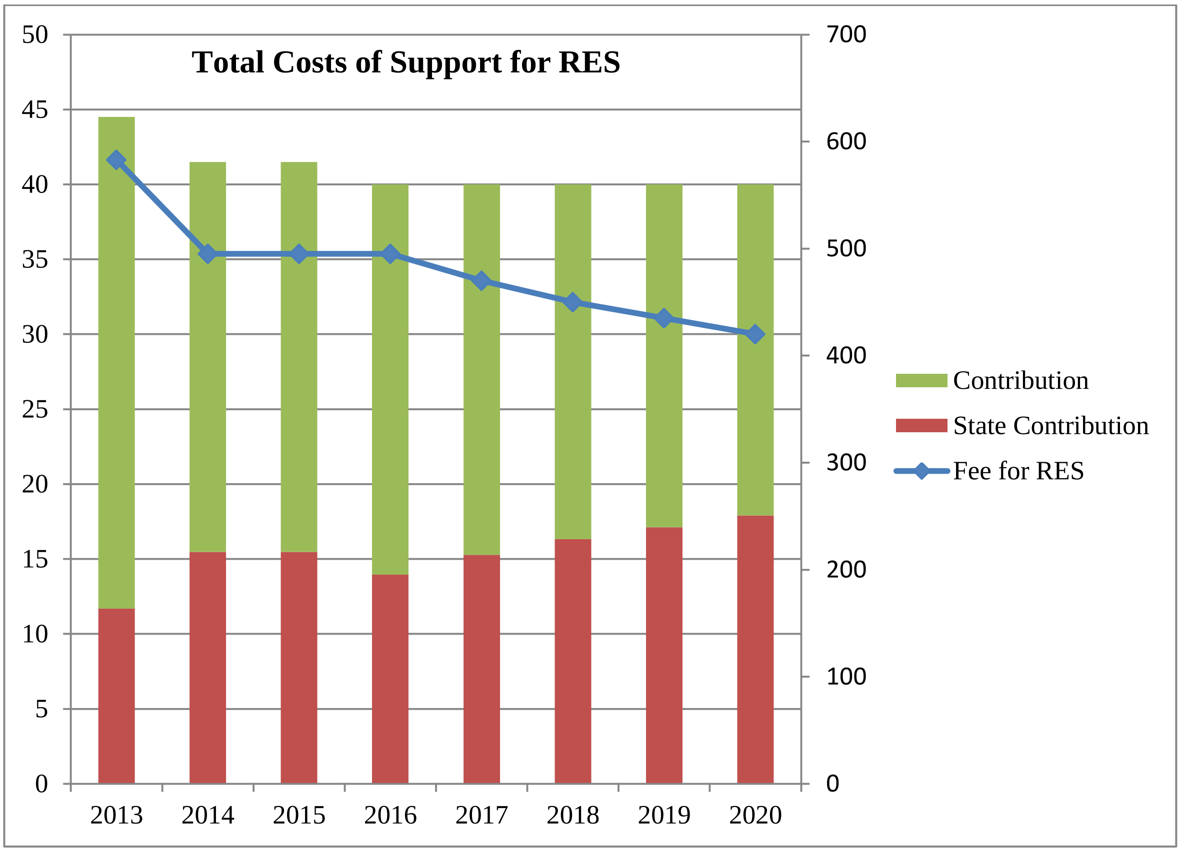
After consultation with several sources, and especially with expert from the Energy Regulatory Office, the amount of the support shouldn't be higher than 42.2 billion CZK in year 2014, but this number is only the estimation, the total amount of the support can change, for instance it depends on the weather.

According to Šolc (2014) in the year 2015 we can expect stagnation, even if there is a connection of other power plants, which would have the same condition as in the year 2013. It is also important to mention that the total amount should not change for the next few years.

As already mentioned, renewable energy sources are dependent on weather, so weather will have an important impact to the final costs. For example, in 2013 the decline in revenues for solar power plants was around 2 billion of CZK because of poor sunlight[6].

[6] Note: according to oral communication with Ing. Vladimír Tošovský, Chairman of the Board of Directors of ČEPS, a.s.

Graph No. 3 – Total Cost of Support for RES



Source: Český svaz zaměstnavatelů v energetice, 2013

The graph above shows the total costs of support for the renewable energy sources in the years of 2013, 2014 and mainly in the future. This graph is connected to the Table No. 9 on page 37, which lists the total amounts of renewable energy sources in the past.

7. Conclusion

The share of electricity production from the renewable energy sources will continue to grow throughout the European Union and the Czech Republic is no exception. However, it is important to ensure, that these sources are economically advantageous. In the past several years, and as well at the present time, the profitability of these sources is strongly disrupted by subsidies in the form of feed in tariffs and green bonuses, which give as many as twenty years of subsidies for the sources already built. When the subsidies will not be provided as much as they used to be, and sometimes still are, it will mean that renewable energy sources will be used only if economically profitable. This can be ensured only by increasing technological developments in this area and by introduction of the new technologies that will increase the usability of wind, solar and other sources. The solar, wind, biogas and biomass sources of energy are important under the Czech conditions. It is probable that technological development will not be as fast as expected. For this reason we need the subsidies to support renewable energy sources. Although in this year, they are either set at a lower amount or stopped completely. However, they will still have a negative impact on the final price of electricity for customers.

Finally, renewable energy sources will be increasingly used in the following years, but according to most international studies (excluding prepared associations focusing purely on the climate), it is expected that for at least another two decades they will be a complement of the conventional sources, which do not solve main energy consumption, but are suitable for the small and in some cases medium customers.

Renewable energy sources should be seen as a source that ensures energy security of supply and in most cases it is environmentally friendly.

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9. Appendix

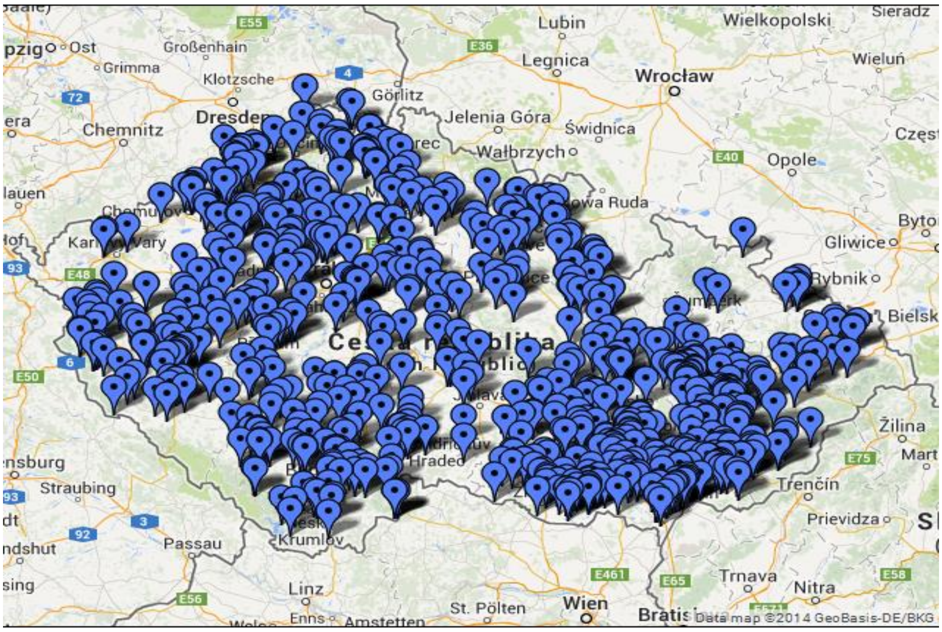
9.1. Appendix No. 1 – Wind Power Plants in the Area of the CR

Scheme No. 5 – Wind Power Plants in the Area of the CR

Source: ČSVE, 2014

9.2. Appendix No. 2 – Solar Power Plants in the Area of the CR

Scheme No. 6 – Solar Power Plants in the Area of the CR



Source: elektrarny.pro, 2014

9.3. Appendix No. 3 – Biogas Power Plants in the Area of the CR

Scheme No. 7 – Biogas Power Plants in the Area of the CR

Source: Česká bioplynová asociace, 2014