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A KOMUNIKAČNÍCH TECHNOLOGIÍ

DEPARTMENT OF FOREIGN LANGUAGES
ÚSTAV JAZYKŮ

RENEWABLE ENERGY SOURCES: ARE THEY ALWAYS CONTRIBUTIVE TO THE ENVIRONMENT?
ALTERNATIVNÍ ZDROJE ENERGIE: JSOU PRO ŽIVOTNÍ PROSTŘEDÍ VŽDY JEN PŘÍNOSNÉ?

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

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Bakalářská práce

bakalářský studijní obor **Angličtina v elektrotechnice a informatice**
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Alternativní zdroje energie: jsou pro životní prostředí vždy jen přínosné?

POKYNY PRO VYPRACOVÁNÍ:

Analyzujte a porovnejte přínosy a zápory využívání obnovitelných zdrojů energie a jejich vliv na životní prostředí.

DOPORUČENÁ LITERATURA:

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ABSTRACT

Bachelor´s thesis deals with renewable energy sources and their use. It seeks to bring to the reader the basic principles of the operation of both renewable and non-renewable resources and the production of electricity related thereto. At the same time, it seeks to highlight the many issues and problems with renewable resources that we are currently experiencing as electricity dend continues to rise and natural non-renewable resources such as oil and coal slowly but surely disappear. It addresses basic problems with renewable resources and highlights the pros and cons of their use in the future.

ABSTRAKT

Bakalářská práce se zabývá obnovitelnými zdroji energie a jejich využitím. Snaží se přiblížit i laickému čtenáři základní principy fungování obnovitelných i neobnovitelných zdrojů a výrobu elektřiny s tím spojenou. Snaží se zároveň poukázat na mnoho otázek a problémů s obnovitelnými zdroji se kterými se v dnešní době potkáváme, jelikož poptávka po elektřině stále roste, a přírodní neobnovitelné zdroje jako je ropa či uhlí pomalu ale jistě mizí. Nastiňuje základní problémy s obnovitelnými zdroji a uvádí klady a zápory jejich využití i do budoucna.

KEY WORDS

renewable sources, non-renewable sources, electricity, power, plant, station, production, nuclear, oil, gas, efficiency

KLÍČOVÁ SLOVA

obnovitelné zdroje energie, neobnovitelné zdroje energie, elektřina, elektrárna, elektrárna, stanice, výroba, jaderná, ropa, plyn, účinnost

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PROHLÁŠENÍ

„Prohlašuji, že svou bakalářskou práci na téma Renewable energy sources: Are they always contributive to the environment? jsem vypracoval samostatně pod vedením vedoucí bakalářské práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

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CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

Abbreviations:

AC - Alternate Current

C - Celsius

CO - Carbon Dioxide

EUR – Euro

GJ – Gigajoule

ha - Hektar

ie. - id est from Latin, meaning in English : “that is”

JE - Jaderná Elektrárna

kJ – kilojoule

km – kilometers

MW - Megawatt

RES – Renewable Energy Sources

RSA - Republic of South Africas

TWh – TeraWatt-Hour

UK - United Kingdom

Symbols:

€ - Euro

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1. INTRODUCTION

Energy has been with us since the very early age and is directly connected with humanity. I think this theme is important because renewable sources and non-renewable sources occupy the first ladders ranks of global problems because as we know nowadays, oil reserves are not inexhaustible, and the loss of oil and other important elements for energy (for example: coal, wood) is beginning to put the emphasis on finding new resources for these previous ones to replace. In this bachelor thesis I would like to make people realize how it is really difficult with renewable resources and what they involve and how important they are in the future. I would like to present here the essential and important facts of its production and outline the future of their use a little. I would like everyone to make their own opinion on renewable resources after reading this bachelor thesis. In my work, I would also like to focus on how renewable energy is handled by countries in Central Europe, including the Czech Republic and other countries. My work focuses on working with data and sets the truth about renewable resources and their use. It outlines the main ideas and problems associated with them and tries to introduce the reader to this complex issue. It forces the reader to think about the future of our civilization because oil reserves are not inexhaustible and we must find some ways to replace it. The work also explains and describes vast majority of the problems associated with it.

1.1 A brief history into electricity

Electricity is surrounding us since the beginning of the world, not in the form we know today, but in a slightly different form (like fire, lightning and others). For example: without lightning, humanity would never explore a fire (according to theories about birth of life). Archaeologists found out that maybe even old Egyptians could know electricity (according to paintings found on the walls in pyramids).

However, the most important development came after the discovery of the first usable source of constant electricity - Volta's article - in 1800. During a short period of time in the first half of the 19th century, most of the electrical properties of substances under normal conditions were investigated, the laws of electrical circuits were discovered and

the connection of electrical energy with magnetism was discovered. The most prominent names of the time are Alessandro Volta, André-Marie Ampère, Georg Simon Ohm, Hans Christian Oersted, Michael Faraday. (remeslnici, n.d.)

The pioneering period ended in 1865 with a dynamic theory of electromagnetic field, in which James Clerk Maxwell expressed all the essential findings of the discovery with just four equations (and three materials), and at the same time, as a result of their equations, predicted other yet unknown electromagnetic events. (remeslnici, n.d.)

The second half of the 19th century was marked by technical applications of electricity, inventions of various electrical appliances (generator, arc lamp, bulb, electric motor, telephone) and their introduction into production and households. Heinrich Hertz, William Thomson (Lord Kelvin), Thomas Alva Edison, Werner von Siemens, Nikola Tesla, Alexander Graham Bell, and Czechs František Křižík are the famous physicists and inventors of that time. (remeslnici, n.d.)

The third period began with the detection of the electron in 1897 by J. Thomson. It has overturned the concepts of electrical fluids within the fabrics and has enabled us to reliably explain the essence of most electrical phenomena. Max Planck and Albert Einstein laid the foundations to explain the quantum properties of electromagnetic radiation. The next steps were Lorentz's theoretical knowledge of electromagnetic field and ether, which correctly interpreted Einstein's special theory of relativity, naturally explaining magnetism as the relativistic effect of electrical action and the discovery of other subatomic particles - the proton in 1911 and the neutron in 1932. However, Maxwell's theory failed to build a consistent theory of charged elemental particles, which proved to be quantum electrodynamics. In electrotechnics, the new component was a vacuum tube, which allows radio broadcasting and reception. Otherwise, during the first half of the 20th century there was a characteristic mass distribution of electricity (electrification of municipalities, construction of power stations). (remeslnici, n.d.)

In the second half of the 20th century, the most important discovery was the transistor phenomenon of 1947 by John Bardeen, William Brattain and William Shockley. After

today's processing of processors or microprocessors, microconversions of millions to millions of microscopic transistors are used to form the basis for a computer, mobile phone and many other electronic devices. It was also important to allow telephoto transmission to be remotely televised, first black and white, later colored. (remeslnici, n.d.)

1.2 Renewable versus non-renewable sources and why we need them

Manny battles have been won, more are yet to come. We live in a world. a world which is addicted to electricity and electrical sources. As the world population grows, claims on energy supply grow with it. It is exponential. The main problem is a creation of electricity. We can produce electricity in larger quantities only in power plants. We have two main types of power plants that employ non-renewable source.

1.3 Thermal power station (which needs brown coal to heat turbine and generate electricity)

Main problem is that thermal power stations are still generating 44% of worldwide electricity, in Czech Republic it is 1/3 of all types of power stations. British Petroleum (Oil Industry Company with headquarters in London) statement is telling us that we have coal reserves for the next 200 years, but as the population grows, more electricity facilities will be built, and demand for electricity will be higher and higher. Other than that, the amount of coal which those thermal power plant consume is enormous (Official statistic from ČEZ: „Basically we can say that one average power plant block with installed power 200 Megawatts consumes 200 tons of coal per hour. This means that average thermal power plant consumes 10 trains (every train has 30 wagons) with coal daily“. That is 300 wagons filled with coal. One wagon contains 10 000 kilograms of coal, multiply it by three hundred, and you have 3 tons of coal every day, which is 1095 tons every year. For one thermal plant. This is enormous load for „mother“nature.

1.4 Nuclear power plants

Burning a gram of coal will release energy of 20 kJ. By splitting the gram of Uranium u235 will be released energy equivalent of 88 GJ. I had mentioned this difference in the previous paragraph.

Droll fact is that we have only 2 nuclear power stations in Czech Republic (Dukovany and Temelin), and yet they are producing ± 35% of our whole produced energy. This is enormous. Someone might say that Uranium is a dangerous substance and whole nuclear industry is not safe at all just because of the disasters in the past, for example: Three Mile Island, Chernobyl or Fukushima. But they are one of the easiest ways how to be independent in terms of electricity.

Other than that, we are addicted on oil. In 21st century, almost ¾ of all products created by human endeavor, are created from oil. Plastic bags, plastic bowls, toys for kids, medicaments and other, but the main product still remains the same for over 100 years: petroleum (in Czech: ropa). Very optimistic prognosis from British Petroleum says that we have oil reserves for the next 40 years, natural gas for 65 years.

2. FIVE IMPORTANT QUESTIONS EVERYBODY NEEDS TO ASK

Are they cheap?

Are they really clean?

Are they inexhaustible?

Will they replace coal and core?

Will they replace non-renewable sources in the future?

2.1 Are they cheap?

Renewable sources are all around us. Wind, water, sun, earth heat, biomass…They are everywhere around us. The first idea that comes to mind, of course, is that those resources are enough to tame and we can start to use their potential. I think it is not as easy as it may seem, mainly because it will become a bit difficult when you choose one of those sources, and you will try to create electricity from one of those specific source, and you will try it with huge mass, more than insignificant. Renewables have one major disadvantage - and this is the very low concentration of the energy carrier in space and time.

Over 12 000 wind power stations would be needed to cover all power created in one of two Czech nuclear power plant – Temelin: Collector area (area with photovoltaic panels, author´s note) needed to be equal to 2 blocks of Nuclear power station Temelin (which is 12 000 000 MWh (megawatt hours). Average solar power station generates 600 MWh per year, and collector´s area 0,62 ha. You would need area of 12 400 hectares to equal that nuclear station. In today´s world where space saving has such a priority as never before, it is not appropriate.

2.2 Are they really clean?

One may ask if all renewable sources are clean or not. They are clean in their own right, but this is their „raw“ form. Sun, wind, water, mass. They are all clean in their natural form, but the problem is that we need a sophisticated device to use all those renewable forms. And those devices are not clean at all. I will mention some of the most known facts which I will describe in more detail afterwards.

For the production of photovoltaic cells we need a large number of highly pure silicon, germanium, various compounds and polymers of all kinds, which are manufactured and refined using a wide range of metallurgical and chemical technologies. (Redakce Nazeleno.cz, 2018)

Wind parks make the public annoyed by noise and stroboscopic effects. (Redakce Nazeleno.cz, 2018)

For the cultivation of giant biomass, it would be necessary to use a considerable amount of nitrogen fertilizers and to transfer biomass to plants from a wide range of fossil fuelled vehicles. Also, biogas stations would have to concentrate huge amounts of biological material, such as livestock manure. (Redakce Nazeleno.cz, 2018)

Drilling of geothermal power stations may cause local earthquakes with a magnitude of 2-4 degrees on the Richter scale, and a variety of gases, mainly carbon dioxide and hydrogen sulphide, escape from the boreholes. Notwithstanding that water in geothermal wells usually contains almost the entire periodic table of elements. (Redakce Nazeleno.cz, 2018)

Energetically important waterworks require the occupation of large areas and the relocation of the population. Just remember, for example, the Chinese superpowered Three Gorges, which will require the resettlement of approximately 1,2 million people. All this for performance equivalent to nine times the current Temelin. (Redakce Nazeleno.cz, 2018)

2.3 Are they inexhaustible?

Imagine it as a car modification. You have a car that has a power of 100kW. You can modify the car by various modifications and replacements of important components, with engine upgrade and some major modifications we can get up to 2-3 times higher performance than it was on the beginning. But this cannot be done with renewable resources. Because they don't have the potential for it as for now. Once you have installed a renewable resource with some performance, you will only be able to lift it very hard. You may be able to increase their performance by 10%, but you will hardly get more out of it. If you want stronger power from a renewable source, you'll have to build it all new, from the ground up.

Another problem is that for more energy you need more place to build power stations, so technically word by word they are inexhaustible until we have place to build power stations.

The fact that renewable sources of energy are in principle inexhaustible does not mean that we can produce energy at a particular place and time without any restrictions. (Redakce Nazeleno.cz, 2018)

We can compare it to our known renewable sources: Wind, Biomass, Water and Geothermal. In a certain location, we can only install a certain amount of wind turbines that operate in a certain wind speed range. We will talk about it later in wind sources (author´s note).

Biomass is almost the same as wind. The biomass power plant consumes a certain amount of biomass that can be produced on a certain amount of agricultural area, with the use of a number of livestock.

In the case of water turbine, you need to create ideal terms for water flow, water needs to flow with (if possible) almost constant speed and pressure to allow turbines to work with their highest efficiency. (Redakce Nazeleno.cz, 2018)

Geothermal energy moves this on the next level. From geothermal wells at a certain depth, we can only get some heat. And ideal soil for geothermal wells is volcanic active soil, which has optimal temperature around 200° C.

"Do you know how many propeller wind turbines would be needed to replace Temelin's power? 12 000." (Redakce Nazeleno.cz, 2018)

2.4 Will they replace coal and ore?

By any means fossil fuels will be exhausted. It is a matter of time.

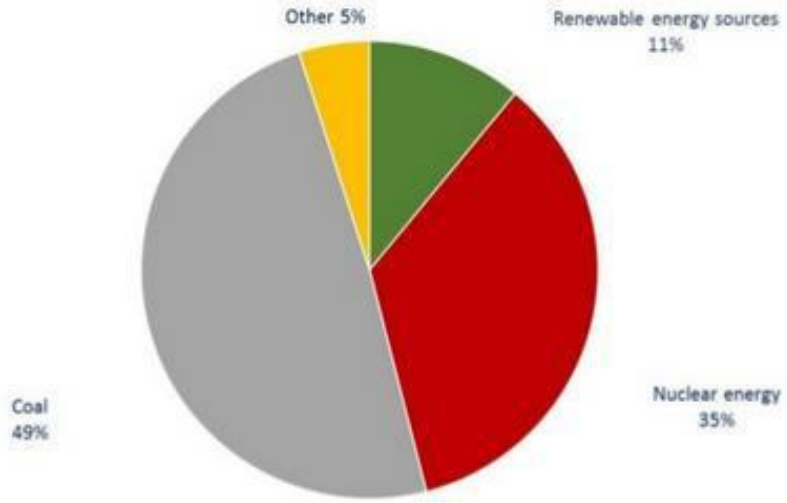

Figure 1. Share of resources on electricity in Czech Republic

This figure shows us percentage share of electricity distribution in Czech Republic in year 2014. Coal and Nuclear energies hold over 85% of total electricity creation in our country. Renewable sources are sharing 11% of electricity generation (some sources say it is even less up to this day). The question here is: If you want to replace non-renewable sources by renewable sources, you would need to somehow find a plan how to replace existing electricity production from fossil fuel. Which means, how is it possible to replace ¾ of the total production from renewable sources?

On top of this, half of renewable sources are devoted to „power of mother nature “. What I mean is that sun not shining on Earth all day long, same for wind. We would not have ideal wind conditions for the whole year.

2.5 Will they replace non-renewable sources in the future?

Based on the four previous questions, I do not think so, this would need a huge change for society, and in today´s life and we do not have the necessary infrastructure built. We are missing good distribution of electricity. Czech Republic only creates about 8% more electricity than it consumes. Imagine if 2 000 000 people would like to buy an electric car. How do you want to support them with those 8% abundance energy?

Another idea behind this is the future of core (Uranium). From the geopolitical aspect, we can focus on Austria. Austria is lobbying for over two decades to stop production of electricity from JE Temelin, and JE Dukovany. Paradox is this whole conflict. Those facilities are also creating electricity for them!

Maybe renewable sources will somehow replace coal in the future, nevertheless question about core is speechless, even after those nuclear disasters like Chernobyl and Fukusima, people are still interested in that type of energy, because this type is the most powerful source to create energy. If humanity will be able to discover new technologies in the future, then I suppose non-renewable sources would not stand here at all.

3. WIND SOURCES

Wind is surrounding us every day. It is an energy we do not see, but we can still capture it and use it for our benefit

Firstly, we need to explain what exactly wind is:

Wind is the air flow in the atmosphere which causes differences in air pressure and rotation of the earth. The surface of the earth is very diverse and some of its parts are rapid and more distinct than others (the colour and nature of the surface play an important role). The desert will blaze much more than the ocean or the forest. Keeping the lower latitude, it gets more heat from the sun. The atmosphere itself then heats up (much more than solar radiation). In the atmosphere there will be places with different temperatures and therefore also physical properties (cold air is heavier than warm). Subsequently, these differences are offset. Pressure builds up and down. The masses of air are spreading… (Forrest & SYMBIO Digital, n.d.)

Basic principle:

By acting on aerodynamic forces on rotor blades, the wind turbine placed on the mast changes wind power into mechanical rotary energy. This is then a source of electrical energy through the generator. Along the rotor blades aerodynamic forces arise; the leaves therefore have a specially shaped profile very similar to that of the aircraft wings. With increasing airflow velocity, buoyancy forces with the second velocity of wind speed and the third power generated by the generator is increased It is therefore necessary to ensure that the rotor performance is efficiently and quickly adjusted to prevent mechanical and electrical overloading of the power plant.

Figure 2. Block diagram of wind energy turbine system

4. WATER SOURCES

Energy from the water gets into our homes through water power plants. In order to be able to generate electricity from the water, it is usually necessary to build a giant high concrete barrier, which eventually fills with water to create the ideal conditions for the operation of hydropower and the subsequent production of electricity. As far as the production and production of hydropower plants in our country. Hydro power plants are used as a renewable resource in large numbers. Hydroelectric power plants are occasionally used as pumping stations. Named, for example, in the Czech Republic, the well-known water pumping station Dalešice, which is located under the water reservoir Dalešice and forms the Mohelno water reservoir. It is well known in the Czech Republic because it belongs under the Dukovany Nuclear Power Plant.

The most powerful hydropower plant in the Czech Republic is the Dlouhé Stráně power plant, which has an installed capacity of 650 MW (Dalešice has a 475 MW output).

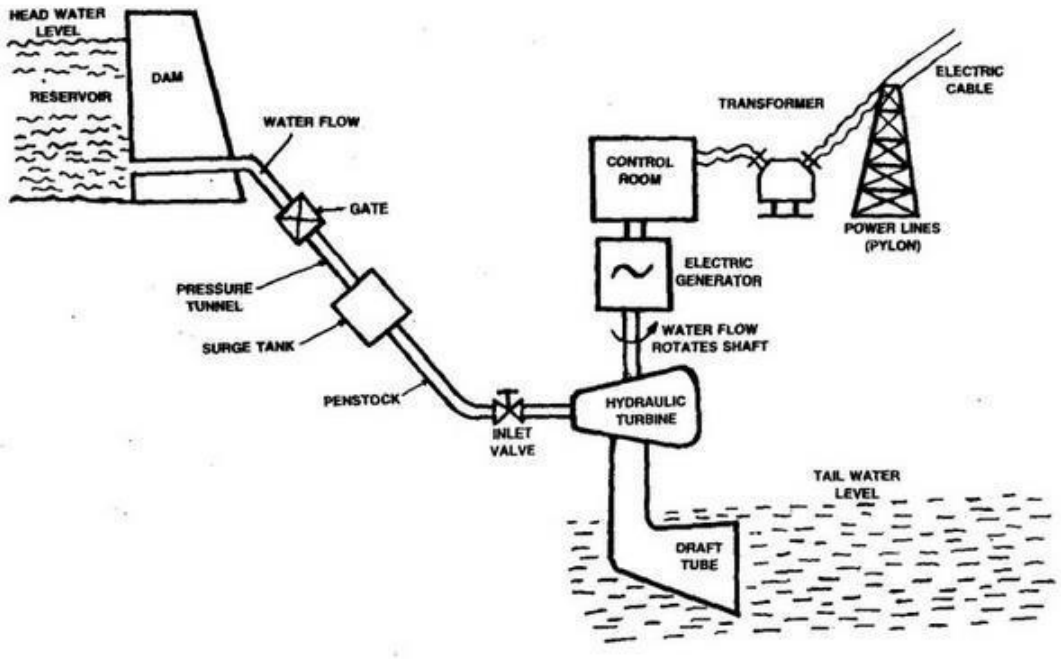

Figure 3. Layout of a hydro-electric power plant

Basic principle:

The water flowing through the feed channel rotates the turbine, which is located with the power generator on the common shaft. The device forms together a so-called turbo-generator. The mechanical energy of the flowing water varies by electromagnetic induction (electric current in the rotating loop of the electric conductor in the magnetic field induces AC voltage) to the electrical energy. It is then transformed and diverted by the network to consumers.

4.1 Three Gorges Dam

It is a hydroelectric gravity dam that spans the Yangtze River by the town of Sandouping, in Yiling District, Yichang, Hubei province, China. The Three Gorges Dam is the world's largest power station in terms of installed capacity. Installed power is 22 400 MW (!).

But it has one big negative. For creation of Flooded Area, Chinese government needed to move over 1,2 million people. Completely flooded area to allow this enormous dam to work contains 17 big cities, 140 villages, and over 3000 dorp.

In a world where great emphasis is placed on saving space, this is an immense problem.

Figure 4. Water difference in Lake Oroville between years 2011-2018

Next problem is water. As we can see on the example from the water tank in Lake Oroville in Northern California.

5. GEOTHERMAL SOURCES

This energy was gained by the Earth at its origin from the mother's nebula, the subsequent collisions of cosmic bodies. Recently, energy is partly generated by the radioactive decay of some elements in the Earth's body.

Basic principle:

Geothermal energy is extracted from the ground by pumping natural heat from deep wells. The geothermal power plant operates on the principle of two heat exchangers, one of which is underground, at a depth of about 3 to 5 km (ie. below the groundwater level). Here, the water injected into the borehole heats up naturally and draws on the surface where its energy is subsequently used to propel the turbine. The chilled water is reintroduced into the underground, which is a closed free-water cycle. Thus, the plant does not leave any ecological footprints.

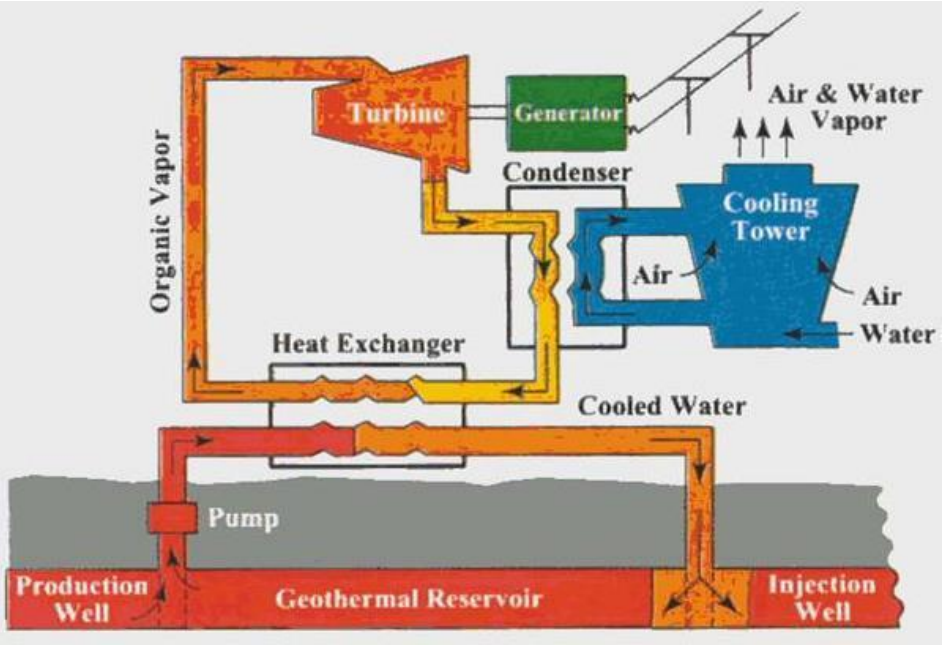

Figure 5. Basic principle of geothermal power plant

Main negative of geothermal power station consists of danger to the adjacent inhabitants and their homes and the overall urban infrastructure since geothermal wells are able to trigger an earthquake in the range of 4 to 6 on the Richter scale. In practice, this means that buildings and cities in the vicinity of geothermal wells would have to be built as earthquake-resistant, which would increase the already high costs of building in the cities due to lack of space and high worldwide population.

6. BIOMASS SOURCES

When we say biomass, it means all the organic matter on our debt, which is part of the recycling cycle. We consider by it bodies and waste of all organisms (animals, trees, plants, fungi and so on).

Basic principle:

The oldest method of obtaining energy from biomass is combustion. This is a thermochemical process in which the organic material decomposes into combustible gases and other substances and subsequently in the presence of air to oxidation (combining combustible elements contained in the fuel with oxygen), which releases carbon dioxide, water and heat, the amount of which depends on the calorific value of the fuel used. Unlike fossil fuels, biomass combustion is practically zero carbon dioxide. The amount of released gas into the atmosphere is approximately the same as the amount that plants absorb during their lifetime during photosynthesis.

This is a fairly complex fuel because the volatile matter is very high and the gases produced are characterized by different combustion temperatures, often only burning a portion of the fuel. The condition for perfect combustion is high temperature and effective mixing with air. Highest efficiency achieves biomass when used for heat production - more than 90%. Biomass is very often used in cogeneration - combined heat and power (50-90% efficiency). In pure electricity production, the efficiency is below 50%.

Biomass is very often used as a source of thermal energy in households, whether as wood or in the form of pellets or briquettes in special boilers.

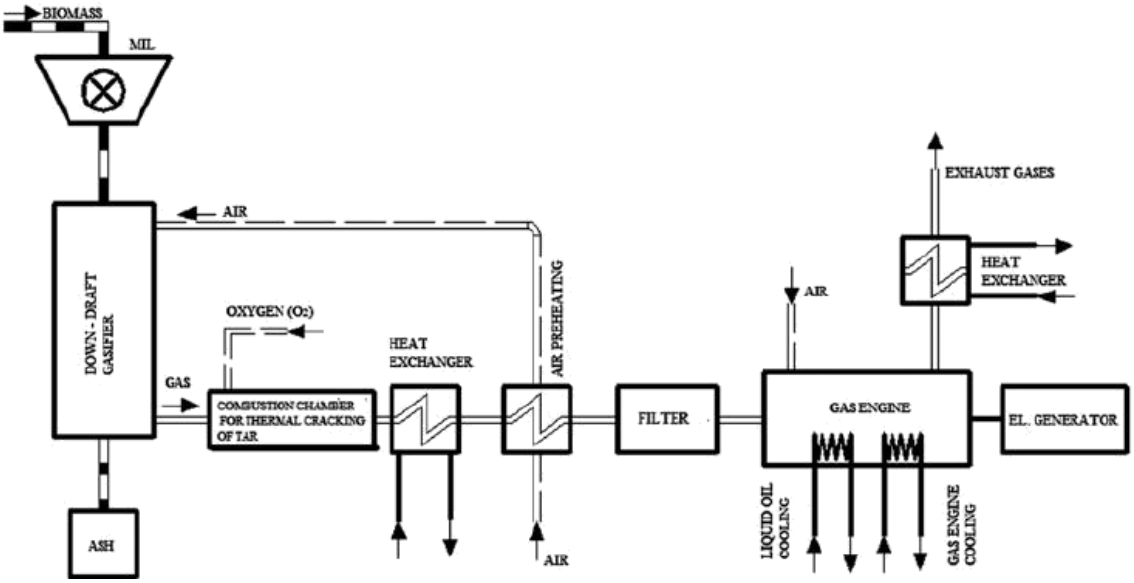

Figure 6. Basic scheme for generating electricity from biomass

Negatives of biomass energy:

As we can see from the scheme, the production of biomass is not without emissions, which in practice means that it is not completely o = pure = energy source. In some cases, it is also necessary to modify biomass for subsequent treatment (for example, paper for flammability, sewage, branches, bark, and other forest stands), which makes it even less effective. We must also not forget the complexity of transporting the biomass components to the firing process which leads us to another problem – we need space for material which is about to be burnt. But despite those negatives, there are still many countries that openly support biomass, despite producing CO emissions.

7. ALTERNATIVE SOURCES OF ENERGY

I would like to focus here on how renewable resources work in important European countries that have the largest share of the energy network in Europe. There are outlined the ways in which states want to achieve savings in the use of non-renewable resources and how they have made progress in renewables.

7.1 Tidal power plants

Sea wave energy can be converted to electricity in different ways. Vertically oriented buoys or lying tubes either directly move the magnets against the coils, thereby inducing electric current, or (more often) their movement is hydraulically transmitted to the turbine of the rotary electric generator. Ideal is the installation in places where the sea reaches a depth of 40 to 100 meters - there is the energy of the waves the largest. Science magazine quotes Jeff Scrugg from the American Duke University, according to which such an energy source has surprisingly great potential. In the UK it could cover up to fourteen and in the United States six percent of total electricity consumption. The cost could soon be comparable to wind energy, but it does not suffer from its ailments. Above all, it is much more reliable, the waves are not as creepy as the wind.

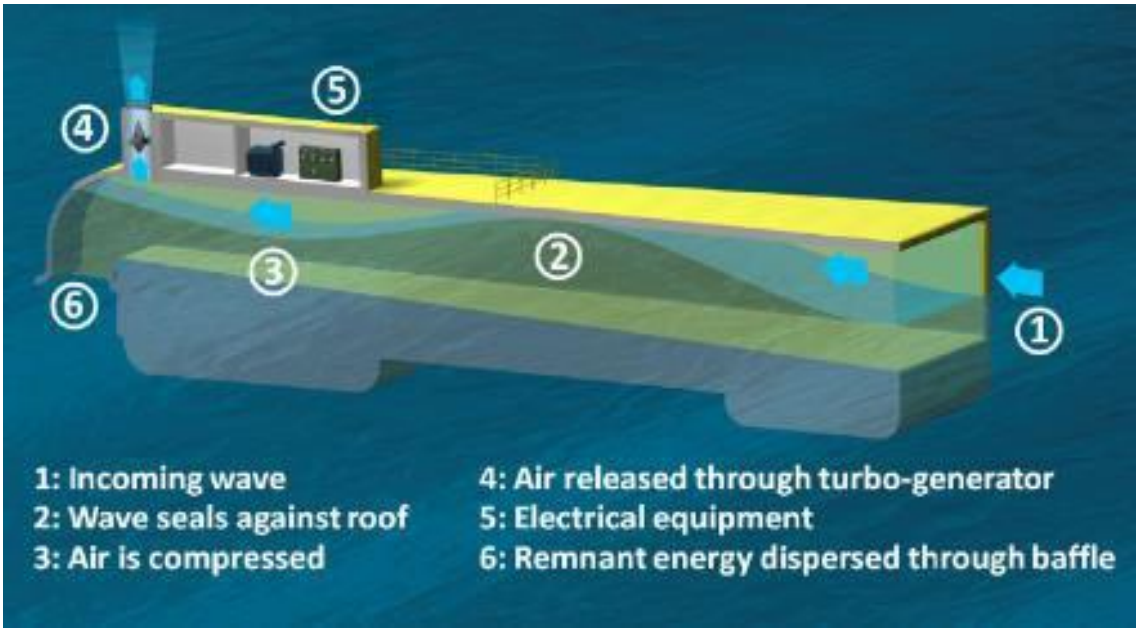

Figure 7. Basic principle of wave generator

7.2 Energy of Sunny wind as an alternative to space travel

Sun has enormous energy potential, that can be used for future space travelling. NASA is testing potential of this new-discovered technology slightly (Condie, 2016), but with poor results.

There are positives and negatives of this concept:

Positives: They work without any fuel

Negatives: Low speed, spaceship must be lightweight to allow wind process to happen

8. RENEWABLE SOURCES UNDER SPECIFIC CONDITIONS

8.1 Renewable electricity in Norway

In Norway, 98 percent of the electricity production come from renewable energy sources. Hydropower is the source of most of the production.

Hydropower has been the basis for Norwegian industry and the development of a welfare society since we started utilizing the energy in rivers and waterfalls to produce energy in the late 1800s. Since then, the Norwegian hydropower has become an increasingly important part of the Norwegian society. The usage of electricity has increased in line with the modernisation and economic growth in Norway.

In Norway, 98 percent of all electricity production come from renewable sources. This puts us in a unique position in both a European and global perspective. Electricity production in Norway is for the most part based on flexible hydropower, but both wind and thermal energy contributes to the Norwegian electricity production. In 2013, Norway produced 134 terawatt hours (TWh) of electricity. One TWh equals one billion kilowatt hours (kWh). By comparison, the Norwegian capital, Oslo, consumes around nine TWh each year. Brief renewable resources generation is below:

Source	Amount (TWh)
Hydropower	129 TWh
Wind power	1,9 TWh
Thermal power	3,3 TWh
Total	134 TWh

Table 1. Electricity generation in Norway

The dominant role of hydropower in the electricity production makes sufficient precipitation and inflow to the dams and reservoirs vital. At the same time, having flexibility in the power production makes it possible to both export and import power to or from our neighbouring countries through interconnectors, depending on the demand.

In the last decade, wind power has increasingly become a part of the Norwegian power production. For now, wind is still only a small part of the total output, but the number of wind turbines increases year on year. (Ministry of Petroleum and Energy, n.d.)

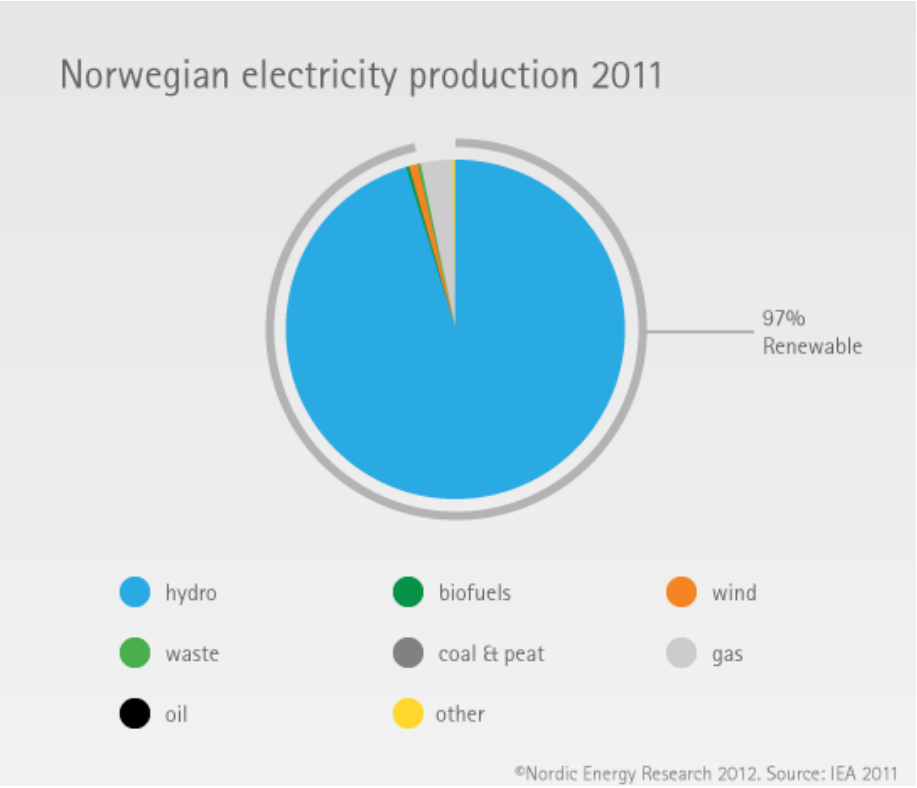

Figure 8. Electricity production in Norway, year 2011

8.2 Renewable electricity in Czech Republic

I had difficulty finding resources about this information, the information provided here regarding the Czech Republic is based only on 2 verified sources (author's note).

Renewable energy production in the Czech Republic has stagnated for at least 2014, representing only 15% of total energy consumption, according to recent statistics from the Ministry of Industry and Trade. To at least 24%, the share of clean energy should be increased by 2030, the Chamber of Researchers found. The largest increase The RES Chamber is expected for wind power plants, solar thermal collectors, photovoltaics on buildings and heat pumps.

The most apparent stagnation is evident from sources for electricity generation, ie water, wind, photovoltaic and biomass power plants and biogas stations. Since 2013, they have virtually 13% of the electricity consumed.

"At the same time, the Czech Republic has the greatest potential for growth in power generation: especially in wind power plants and photovoltaics on buildings. Citizens,

communities and entrepreneurs from around the world will be involved in their construction. An insignificant potential remains with small hydropower plants. On the contrary, biogas production will stagnate and move to support services and transport, "analyzes Štěpán Chalupa, chairman of the Renewable Energy Chamber. (Průmyslová ekologie s.r.o.,2017)

The share of RES in heating and cooling practically stopped in 2014 to 19%. Small year-on-year increases are driven by the use of biomass in households and heat pumps, which last year installed over 15,000. Only about a third with subsidies.

"Sustainable biomass for heating plants is no longer available in the Czech Republic, we expect biomass development in smaller domestic boilers, in the transition from wood heating to more comfortable pellets," adds Chalupa. (Průmyslová ekologie s.r.o.,2017), The share of RES in transport fluctuates from 6% to 7% already in 2012. This would be the case for the current biofuels even during the next decade. Only sustainable biofuels should be supported which can save at least 65% of greenhouse gas emissions. "The development of RES in the Czech Republic has been stagnant since the phasing out of the financial support for RES in 2013, which was the reaction to the uncontrolled regulation of photovoltaics in 2009 during the time of Jan Fischer's government. Since then, the situation has been steadily improving mainly through the Operational Programs and New Green Savings. Renewable sources are no longer seen as something undesirable or marginal, but a thoughtful approach to RES in the Czech Republic is still lacking, "explains Chalupa. (Průmyslová ekologie s.r.o.,2017)

8.3 Renewable electricity in Finland

Finnish government approved the law on the ban on the production of energy from coal. It will come into force in the year 2029.

The use of coal is in line with the Finnish National Energy and Climate Strategy 2030. Coal is the first fossil raw material to be banned for energy production. Finnish legislators promise to align public and private interests from a long legislative deadline so that the transition does not place too much strain on the economy and people's lives. Energy production from coal is already declining today. By the time the law is to come into effect, production is expected to be between 4.3 and 3.4 TWh. (Vrbová, 2019)

The Act on Fuel Distribution Obligations, which was translated to the Presidential Signature along with the Diversion Act, entered into force on 1 April. Among other things, it introduces an obligation to ensure that biofuels account for 30% of total consumption in 2030. These measures, together with the other elements in the energy strategy - for example, increase the number of electric vehicles or improve energy efficiency - ensure a 50% reduction in transport emissions by 2030. Further obligations are also placed on light fuel oil distributors for heating or machinery. (Vrbová, 2019)

Finland, like most of the Nordic countries, has been a country that has been restricting energy production from non-renewable resources since the early 1980s. This law, which entered into force this April 2019, only confirms the Finnish aspirations for a cleaner and greener environment. At the same time, Finland is also a country that seeks to reduce its independence from oil products and to increase the share of electricity generation by biofuels. Their goal is to make up at least 30% of biomass production, from the country's total electricity generation by 2030. All the efforts of the Nordic countries to use renewable resources are primarily in their location. Finland, like Norway or Sweden, is a country with a huge potential to produce renewable resources, either because of its mountains or because of its stunning river system, which makes it possible to produce energy from wind farms and hydroelectric power stations in huge quantities. However, we must not forget that the Finnish population is (in 2019) 5.1 million inhabitants, making them one of the smaller states in Europe.

8.4 Renewable electricity in Germany

At the end of January 2019, there was a breakthrough in the sharply pursued negotiations of the German "Coal Commission", which can fundamentally accelerate the end of the coal-mining period in Europe. Representatives of Länder historically associated with coal mining and coalition, along with industry, trade unions and environmental organizations, agreed on a compromise after 20 hours of final negotiations - Germany said they should abandon coal producing and coal mining by 2038 and, if possible, as early as 2035. Almost ten years earlier, all coal resources in the UK, France, Italy, Belgium, the Netherlands, Austria and the Scandinavian countries will be shut down. (Koželuh & Hrábek & Sequens, 2019)

Germany is rank 8th in the usage of coal in the energetical sources. (#1 is China, #2 USA, #3 India, #4 Japan, #5 Russia, #6 RSA, #7 South Korea). With that it won´t be possible to remove non-renewable sources that are based on coal such as thermal power plants. And the results are showing up now, more than 10 years before the conclusion has to be done.

According to the German Minister for Economic Affairs and Energy Peter Altmaier, the country will continue to need its coal resources to ensure secure electricity supply and reduce electricity price increases. (Majling, 2019) Germany will also close its last nuclear units by the end of 2022 and, according to Altmaier, will need more time to shut down coal production than, for example, Finland and France. Nevertheless, the security of electricity supply should, according to the Minister, be secured by market means and not by capacity mechanisms that would be more costly for German customers. “Electricity will certainly be cheaper for our economy if we continue to open up to the European electricity market. By allowing cross-border interconnections to enable cheaper electricity from Denmark, Scandinavia and other parts of Europe to flow more easily into Germany, "said Peter Altmaier. (Majling, 2019)

However, if Germany wanted to build a submarine cable to Norway, which would allow the country to import electricity from its hydroelectric power during high winter demand, while ensuring energy self-sufficiency, the Altmaier Germans would have to pay three times for transforming their energy sector - for renewable resources, for cheap foreign electricity and for the power reserve. (Majling, 2019)

ICIS – Independent Chemical Information Service

ICIS, in its modeling comparing coal commission recommendations with the scenario of operating power plants up to their lifetime (50+ years), states that the decommissioning of German coal-fired power plants will increase electricity exports from France and the Netherlands to Germany and make Poland, the current net importer, clean exporter. (Vobořil, 2019)

The gradual diversion of Germany from coal-fired power generation will increase electricity prices in the region, according to ICIS, the average price increase in all directly linked markets will be € 0.2 / MWh for 2019-2022 and € 2.2 / MWh for 2023-2030. The highest increase in electricity prices is expected in the Nordic countries and the Netherlands due to the strong use of interconnectors to minimize price differences, while electricity prices in Poland and the UK will be least affected. (Vobořil, 2019)

8.5 Renewable electricity in United Kingdom

The UK Ministry of Commerce, Energy and Industrial Strategy expects renewable energy production to grow by almost 75% compared to 2018 by 2035 in its updated UK energy development forecast. production decline. Coal-fired power plants then report the last produced TWh in 2022. (Salavec, 2019) The UK's Energy and Emissions Development Report, published on the 11th of April (Department for Business, 2019) by the British Department of Trade, Energy and Industrial Strategy (BEIS), estimates a significant increase in renewable energy production and a decline in gas production.

By the year 2035, the production from renewable energy sources according to the baseline scenario should increase to 211 TWh, which is a 74.4% increase compared to 2018, a share of almost 60% in total production. By contrast, in the case of gas sources, production is expected to decline to 34 TWh over the next 16 years, down 71.4% from 2018. (Salavec, 2019) Even in 2017, gas sources produced 40 TWh more electricity than RES, but in 2018 renewable sources already outperformed gas (119 TWh vs. 121 TWh). Coal-fired power plants have also seen a steep decline, with production declining from 118 TWh to 8 TWh over the past decade. (Salavec, 2019)

The United Kingdom plans to replace some of the installed capacity in nuclear power sources, in addition to new production from RES and the reduction of coal and gas

resources. Production at British nuclear sources should begin to grow with Hinkley Point C joining in 2026 to help reverse the trend of declining electricity production in the country. (Salavec, 2019) Of course, we must not forget one important plan that is going to be in the UK in 2025. At that time, the country should be able to 'survive' a moment of energy peaks only on renewable sources, totally emission-free. Also, the year 2025 is expected to shut down the last coal-fired power plants. However, according to Juan Leslie, the plan is based on the position of high-tech devices such as flywheels and capacitors. However, Leslie expects, however, that the time for which renewable resources alone will be able to tighten the entire UK energy network will range from 30 minutes to 1 hour. Leslie himself says he is just beginning, and over time, he should be able to increase the network's retention period. The advantage of the UK energy system is that their giant coal-fired power stations and natural gas power stations give the country some adaptability to the environment. However, we must not forget that the coast of Britain is dotted with wind and hydroelectric power, and especially windmills are dependent on the whims of the weather. (Bloomberg News Editors, 2019)

8.6 Renewable electricity in Austria

Throughout Austria, the share of Renewable energy sources in electricity generation is 75%, the remainder comes from fossil fuels. In 1978, in a referendum, the Austrians commented on nuclear power. This year, Austria filed a lawsuit against the construction of the British Hinkley Point C nuclear power plant. In addition, Austria is known to provide financial support to Czech nuclear opponents. (Krutiš, 2015)

Also, Austrians announced in 2015 that their Land of Lower Austria produced 100% renewable energy. Only 2% of the electricity generated comes from solar power stations, while hydropower plants cover 63%, another 26% of the electricity comes from wind and 9% from biomass. (Krutiš, 2015)

It is very strange that Austria (even in one of the Länder) was able to make such progress and create everything from renewable sources. Austria is not known to be dominated by river flows as in other countries, and yet their Land has managed to cover 63% of its consumption by hydroelectricity.

However, it should be noted that Austria has been engaged in renewable resources for a long time. In 1978, they opposed the use of nuclear energy and since then have been trying to invest and develop renewable resources. The country said that since 2002, they invested more than 2.8 billion euros in the construction of renewable resources. (Krutiš, 2015)

8.7 Renewable electricity in Slovakia

In 2017, Slovakia reached only 11,5% of renewable energy production.

Slovakia is a country that has been struggling for so long to comply with European limits on the use of renewable resources. Some believe that this may be due to weak demand for renewables, while others say that this will happen precisely if people are not aware of renewables and how they must be treated. Unfortunately, the fact remains that Slovakia probably no longer has the chance to meet the EU limit set, ie. to have a minimum renewable energy share of 14% by 2020.

"The decline in the share of renewable energy sources was due to lower growth in the use of renewable energy sources compared to the growth in final energy consumption. The growth in electricity consumption and, in particular, the significant increase in the use of motor fuels, which have caused dynamic growth in energy consumption, are a reflection of Slovakia's economic growth. The long-term priority of the Slovak Republic is mainly energy efficiency, which leads to the reduction of energy consumption and thus to the saving of fossil fuels and greenhouse gas emissions,"the press department of the Ministry of Economy responded to the latest statistics for EURACTIV.sk. (Szalai, 2019)

9. PUBLIC OPINION ON RENEWABLE SOURCES

To find out the public opinion on renewable sources, I created a questionnaire consisting of several questions about renewable resources. Where I got 105 replies from the entire age spectrum.

52% of respondents were working, 34% were studying. The rest includes persons with a self-employed person, pensioners, people on maternity leave and others.

I asked the question: **What is the most important non-renewable resource**?
61 respondents replied Petroleum, 31 Core (nuclear energy), 26 natural gas, 17 coal. Last 6 were mixed answers.

From the question about potential of the renewable sources, 47 respondents replied water, 46 sun, 33 wind, 30 said another types of energy (sea-waves and others) 24 geothermal, 14 biomass. Rest 4 were mixed answers even containing cold fusion and nuclear fusion.

The most important question of the questionnaire: **What is the biggest problem of renewable resources?**
46 respondents replied that they are not cheap, 43 said that they are not that effective, 24 replied they are not readily available, 23 said they are not clean, 19 said that most of them are harassing the surrounding population (author´s note: this answer was not even in options, which means 19 people wrote this same answer, for me as the one who is writing this thesis the result of this answer is astonishing and amazing at the same time), 14 said that they won´t be successfully run without population intervention.
About question: 64% believes that renewable sources will replace non-renewable ones in future, 36% are sure they won´t.

I have also asked one question about electric cars. Here are the results:
Electromobiles have been here at the beginning of the 20th century, why do you think they are starting to shine again?

44 respondents replied: More people's interest in ecology, 38 replied political reasons, 25 replied Declining oil and coal reserves 23 replied lower emissions, 21 said market globalization.

We can make our own picture of how people are informed about the issue. It should be noted that the overwhelming majority of people have already encountered the subject, knows the basic words and principles of what renewable resources are working on and, more generally, what they are talking about. However, we need to be aware of the need to make people more familiar with terms and to be honest with them. Communicating them with positive and negative effects and outlining possible solutions to problems with renewable resources.

10. CONCLUSION

Bachelor´s thesis is focused on the use of renewable and non-renewable resources in practice. It also tries to explain the basic concepts and principles in generating electricity. At work I highlighted the main advantages and disadvantages of renewable resources. The renewable sources mentioned here are the most widespread in the Czech Republic (with the exception of geothermal power plants) and will find the largest use here. Personally, I do not identify much with renewable energy because I think it is necessary to move very slowly and carefully to the replacement of renewable with non-renewable resources. I definitely prefer nuclear energy because it has tremendous potential and is relatively safe today and does not generate carbon dioxide emissions. Renewable resources have the potential to take a place in future, I have no doubts about it. However, humanity must learn to use it in the right direction and not be subject to rapid decisions.

I would like to highlight a few facts which we should accept and adapt to:

Massive reduction of production from non-renewable sources is not a solution. It is the same as the transition from cars that are runned by petrol and diesel to switch to electricity. For example, if 2 000 000 people purchase an electric car because they want to be environmentally friendly, they forget about three important things.

The first is that the production of the batteries themselves is not ecological. Many lithium batteries are required to produce every main battery in the car, making it slowly becoming a strategic raw material along with oil.

The second concerns the infrastructure itself. It is not possible to power such an enormous number of cars with electricity. Suddenly, new infrastructure must be built for this human need, as the power grids do not manage such an onslaught. In the Czech Republic, only 8% more electricity is produced than consumed, try to imagine what would happen if we would need to power another 2,000,000 cars. The network would not be able to power those cars, and we would be without electricity, which is hardly

imaginable today. This is the same problem with non-renewable resources. We have to slowly replace them with the renewable one, but we must be clear. We need to thoroughly reflect our strategy on energy issues and adapt it to our conditions and requirements accordingly.

The third and last thing that is psychologically the most difficult is the adaptation of people to these problems. People need to understand how renewable resources work. We have to inform them, make lectures and hold their opinions. I would like to give an example of how this is NOT to be done. We should never take an example from Norway. Yes, they have a lot of electric cars, but no one is used to it, they do not have the streets capability and the recharge stations for themselves. And then it turns out as we can see at the bottom of the picture:

Figure 9. Problems with electric cars in Norway

In the picture, we can see a bunch of cars with cables pulled from nearby houses, where they are hardly forced to do it, just because the Norwegian government has given its citizens a subsidy for electric cars, but they did not even think that anyone would want to power it. Therefore, there are nowhere to be recharging (except for the reserved places but not that many of them were built) recharging stations at the homes and

apartments where people live. Yes, this is reality of the evening in Norway. But we can also learn from renewable sources. We only need to use them in a correct and intelligent way.

Furthermore, I would like to conclude by mentioning nuclear energy. Nuclear power has been with us for over half a century, and while everyone can cope with disasters like Chernobyl or Fukushima, the fact is that Nuclear Technology is one of the most effective and, in my opinion, the best technologies we currently have for electricity generation. However, there is a huge problem that lies in the total cost of nuclear power plant construction, whether in the Czech Republic or anywhere else. The initial investment is huge and the return on investment is uncertain in the future. Just take an example from Slovakia and their Mochovec nuclear power plant, where its construction is already expensive and delayed. In the initial phase, the construction of the Mochovec nuclear power plant cost EUR 2.78 billion, but now it is already known that completion will cost over EUR 5.4 billion EUR.

Despite all this, I stand behind the view that without nuclear power we cannot get around in the Czech Republic. Renewable sources have their future and potential, but in my opinion it is too early to convert energy systems from non-renewable to renewable. We need more nuclear power plants and other energy sources before we can make better use of the potential of the renewable resources, and it will take some time before we will be able to do that.

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