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Power of choice: The case of electricity generation in Austria and the Czech Republic

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Abstract: The main aim of this thesis is to explain the differences in the resources used for electricity generation in the Czech Republic and Austria from two different perspectives: geographical and institutional. First, geographical conditions and available domestic resources are compared, followed by an analysis of energy policy in both countries. The institutional perspective concentrates on the concept of path dependence and its presence or absence in the development of electricity generation in the chosen countries. Concerning energy, the case of electricity is a good illustration of government's strategy towards renewable resources and nuclear power that differs significantly in Austria and the Czech Republic.

Key words: Czech Republic, Austria, electricity, path dependence, energy source

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Table of Contents

List of figures and tables

Figures

Tables

Introduction

Our society today is strongly connected to its electricity grid. An unlimited access to electricity and its stable supply symbolizes the difference between developed and developing countries. The economy would stand still without electricity, as most of the industries and services are in permanent need of electric power. It is not surprising then, that electricity and its sources have become an important issue for the economies of today's nation states. However, there is no worldwide consensus on the best combination of energy resources, or on energy policy. For that reason I have decided to compare two dissimilar European cases and to answer following question: How can we explain the differences in electricity generation in the Czech Republic and Austria?

The main aim of my thesis is to compare and analyze the resources used in electricity generation in the Czech Republic and Austria, using a twofold explanation: geographical and institutional. There is a common belief, when it comes to a composition of energy mix, that it depends mainly on the resources available in the country. However, as I will show in my thesis, this is not exactly the case of renewable energy and nuclear power, which is strongly dependent on the national policy. In an institutional perspective I will concentrate on the concept of path dependence and its presence or absence in the development of electricity generation in the chosen countries.

There are several reasons to compare Czech and Austrian energy mix. They are both Central European countries of similar size and population lying in the same climate zone. They are bound by common history of Austro-Hungarian Empire that was dissolved into small independent countries after the First World War. Since then already, the differences in the use of fossil fuels and CO_2 emissions have been apparent between the two countries as Czechoslovakia had the advantage of abundance of domestic coal (Gingrich et al., 2011). Despite the geographical and historical proximity, the two countries have been separated by the Iron Curtain in 1948 and their paths have diverged since. While Austria has adjusted its energy policy to the domestic conditions as well as to the international situation (such as oil crises of the 1970s or the nuclear disaster in Chernobyl), Czechoslovakia has mainly followed non-flexible five-year plans set by the communist government, supervised by the Soviet Union and determined by the needs of Council for Mutual Economic Assistance composed of the socialist countries. Until the end of 1980s

Czechoslovakian electricity came mostly from coal-fired power plants and their shares have begun to decline only after the fall of communism.

Since then, both countries have become members of the European Union and they are committed to its targets for emission reduction as well as to increase the shares of renewable resources in the energy sector. Still, the EU does not have a power to dictate the structure of energy mix or to forbid the use of certain resources, such as nuclear power. It is up to the national government to set a responsible energy policy and the EU can only offer its recommendations. Therefore the energy resources used in the electricity generation differ across the member states, with Austria and the Czech Republic as examples of markedly different mindsets when it comes to electricity. I believe this comparison is relevant because it shows the role of institutions and path dependence in such a vital part of the economy as electricity production. It brings a fresh outlook on national, as well as international disputes about energy security and sustainability. To my knowledge, there is no comprehensive study comparing two electricity sectors from institutional, as well as geographical point of view.

Among the various topics concerning energy sector I have chosen the case of electricity because it is a good illustration of government's strategy towards renewable resources and nuclear power. Today, most of the European countries are dependent on imports of energy resources (especially oil and natural gas) but they are still trying to secure domestic electricity production. However, there are still strong differences between EU Member states, illustrated by the example of the Czech Republic (net exporter of electricity) and Austria (net importer). Nevertheless, it is clear that the scope of my thesis is limited by the focus on electricity and further research is needed to expand this paper to a complex study of energy sector in chosen countries. My research is also limited by the time period as I concentrate on the recent development since the beginning of the 1990s.

Mainly qualitative methods are used in this research. The comparison is based on a qualitative analysis of academic articles, energy reports, policy documents and strategies, published by national as well as international institutions. The findings are supported by statistics and other quantitative data, when necessary. The resources were chosen to offer as objective perspective as possible, although some of the documents were written for specific political purposes and as such they need to be

analyzed. The main theoretical concept used in this paper – path dependence – is difficult to use in empirical work as it does not offer a given list of variables that might be tested in the research. Therefore it is upon the common sense and personal reasoning of the researcher to find the connection between the theory and empirics.

The paper is organized as follows. First, previous research and theoretical concepts are introduced, especially the difference between geographical and institutional explanations of economic growth. The institutional approach is represented by the concept of path dependence. In the empirical research, the geographical conditions and institutional development in Austria and the Czech Republic are analyzed and compared. The chapters concerning energy policy are divided into two periods, before and after 2004, which is the year when the Czech Republic entered the European Union and it therefore marks the end of the first post-communist transformation phase. The same time period was chosen for Austria as well to make the final comparison of the national policies easier. This section is followed by discussion that puts the empirical findings into a context of theoretical explanation. The possible existence of path dependence is discussed. The conclusion then repeats and stresses the main findings and arguments of this paper.

1. Theory

1.1. Previous research

To my knowledge, there is no academic work comparing the electricity sectors from geographical, as well as institutional perspective. However, I have found some relevant resources concerning energy and including the comparison between Austria and the Czech Republic. The most similar topic was addressed in the master thesis written by Chmelík (2011), comparing Czech and Austrian energy sector in the context of EU membership. This paper, however, concentrates mainly on the legislative and political framework and does not analyze possible long-term trends in national energy policy. On the contrary, Gingrich et al. (2011) analyzed CO_2 emissions and their main drivers in the two countries, comparing the evolution of technologies and energy strategies from a long-term perspective, between 1830 and 2000. Lofstedt (2008) wrote a paper on the dispute about nuclear power between Austria and Slovakia, which is also relevant in the case of the Czech Republic because of the similar argumentation used in the Czech-Austrian debate about Czech

power plant Temelín. Fawn (2006) then explored the character of Czech-Austrian relations in reaction to the construction of the nuclear power plant. The other resources used in this paper usually focus on one of the chosen countries and therefore it is up to this paper to formulate relevant comparison.

1.2. Theoretical framework[1]

According to my research, there is no comprehensive theory focusing on the character of energy structure in a country. Therefore, I will use different theories explaining the relationship between natural resources and policy, as well as the influence of geography and institutions on economic performance of a country.

One approach is purely geographical and is based on a belief that economic performance of a country depends on its climate and geographical preconditions. One of the founding fathers of the belief that "geography matters" was Paul Krugman, who studied geographical concentration of economic activities (Krugman, 1998). According to Rodrik (2004) and Sheppard (2011), the works of Jared Diamond and Jeffrey Sachs are the most notable representatives of the belief that geography is one of the most important determinants of economic development. These theorists argument with the wealth distribution around the world: countries situated in the tropics tend to be poor, especially when they do not have access to the coast. Landlocked countries in Western and Central Europe (both Austria and the Czech Republic) make an exception as they are well integrated in the regional structures (Gallup, Sachs & Mellinger, 1999). But despite the strong importance of geography and climate, the authors still recognize certain importance of institutions, as the socialist countries in Central and Eastern Europe used to have lower income, in spite of their favorable geographic location. However, they conclude that "geography is not necessarily destiny, but more than good policy is needed to foster economic growth" (Gallup, Sachs & Mellinger, 1999, p. 204).

This reasoning can also be used in the case of energy, as the primary energy sources used in the electricity generation depend strongly on the domestic availability of fossil fuels (or uranium deposits) and on favorable climate for renewable energy sources. In context of this paper, it will be necessary to test this theory while

[1] Parts of this section were used in the final paper for EKHM40 Research Design (Langmajerová, 2013).

comparing geographical preconditions and availability of natural resources in Austria and the Czech Republic, and put it into a context of the final energy mix used in electricity generation.

This idea is contested by the institutional approach stressing the importance of the quality of institutions, usually connected to the work of Douglass C. North (1991), who described institutions as a central issue of economic history that "create an economic environment that induces increasing productivity" (p. 98). Acemoglu et al. (2002) represent the view that relates economic performance to the organization of society, especially to the existence of property rights and opportunities for investment. The institutional economics usually express an interest in locally specific institutional framework in which the society operates and that determines economic development (Boschma and Frenken, 2006).

Although these theories usually focus on the relationship between institutions and economic development, similar reasoning might be used in energy policy. Well-developed and transparent institutions promote sustainable energy mix, preferable based on diversified and renewable resources. On the contrary, bad or corrupt institutions might prevent future development towards new energy sources, as they try to preserve existing relationships between policymakers, electricity providers, fuel producers and other actors. In my thesis I will concentrate on one main concept of path dependence.

The concept of path dependence is used in sociology, political science and economics. Simplistic motto of this theory is that "history matters" and previous events might have strong impact on current development. According to Margaret Levi (1997) once a country has started down a track, the costs of reversal are very high. In theory, the probability of further steps along the same path increases with each move down that path, as the relative benefits of this activity compared with other possible options increase over time (Pierson, 2000). Moreover, new institutional matrix emerges and it consists of an interdependent web of institutions and consequent political and economic organizations. Those organizations "owe their existence to the opportunities provided by the institutional framework" (North, 1991, p. 109).

Unfortunately, there is no list of variables that any historical development has to fulfill to be considered path dependent. However, Arthur (1994) identified three phases characterizing path dependence: (1) Preformation Phase resulting in a "critical

juncture" that symbolizes the beginning of new path; (2) Formation Phase in which dominant pattern emerges and makes the whole process more and more irreversible; and (3) Lock-in Phase where the dominant patterns becomes fixed and gains a deterministic character. This process does not necessarily lead to inefficiency, however, there is a threat that it might become inefficient over time and then it gets very difficult to change existing path (Sydow et al., 2009). Sometimes an exogenous shock is needed to start a new path. In the case of energy this might be illustrated by the oil shocks of the 1970s that pushed many Western economies towards different energy sources. At the same time, there is a possibility of endogenous reforms leading to "de-locking" through (1) diversification of current industries and technologies or (2) radical upgrading and enhancement of a region's industrial base through new technologies (Martin & Sunley, 2006).

In economic theories, the initial choice of the path might be caused by very small or random event, often illustrated by the case of the QWERTY keyboard.[2] However, political decisions are not usually based on random choices and the new path is usually seen as beneficial, at least in the initial phase. Vogel (1996) explored the nature of political and national decision-making and claims that governments tend to follow national trajectories and nationally specific paths. According to Thelen (1999), even reforms pushed by international pressure are shaped by prevailing domestic institutions. The main problem in politics is the short-term horizon connected to the logic of electoral politics: if a politician decides to initiate a change, he or she will have to deal with switching costs in the short run and the benefits of new path usually come later, that means, in the electoral term of someone else. Moreover, the policymaker needs to deal with the strong status quo bias existing within political institutions (Pierson, 2000).

The main point of path dependence is the moment of choice – any empirical research working with this concept should show that although there were other possibilities along the way, they weren't chosen because the process was already "locked-in". In the case of policy, it requires long-term evaluation of government programs and strategies in context of economic, as well as international, development.

[2] The layout of keys was chosen to avoid jams while typing on the old typewriter. However, this setting has not changed even though this technical problem has long been solved and different layout might make typing easier and faster.

Lehmann et al. (2012) and Neuhoff (2005) believe that path dependence might be an important factor in energy sector, as there exists "carbon lock-in" favoring fossil fuels over low-carbon technologies. The carbon lock-in is caused by the fact that the prices of fossil fuels do not reflect all the negative externalities (which could be added by the use of carbon tax or other policy measures), and markets do not take fully into account the uncertainty on future fuel prices and on post-2020 climate targets. If all those factors were reflected in the price of fossil fuels, renewable energy would emerge clearly as a more viable option. Path dependence in this area is also supported by underinvestment in R&D of renewable technologies, unfavorable structure of the energy sector or low community acceptance of projects using renewable energy (symbolized by the NIMBYism, "Not In My Back Yard" attitudes towards renewable energy facilities, for example wind turbines). However, Lehmann et al. (2012) and Neuhoff (2005) believe that it is possible to overcome this carbon lock-in endogenously, if the social costs of fossil fuels clearly outweigh the advantages.

2. Geographical approach

2.1. The Czech Republic

Historically, the area of the Czech Republic could rely on its own domestic reserves of energy resources. This also determines the electricity production, based on coal (55%) and nuclear energy (33%) (Sivek et al. 2012). However, reserves of energy sources are steadily declining and their use is limited by political decisions made in the 1990s, when almost all uranium mines were closed and limits on coal mining were set in several areas for ecological and health reasons. In reaction to declining resources, the shares in electricity generation are expected to change in the future: nuclear power is projected to account for 50–60 % of the power generation mix in 2040, as the share of coal is supposed to decline to 15–25 %. The energy from renewable sources is expected to rise to 18–25 %, together with the extended use of natural gas (Ministry of Industry and Trade, 2012). According to the report of independent expert commission led by professor Václav Pačes (chairman of the Academy of Sciences of the Czech Republic between 2005 and 2009) the ideal energy mix includes all available sources – coal and renewables among the domestic ones, together with growing importance of nuclear power. The commission recommended

extended use of natural gas as a viable alternative to declining coal reserves (Pačes et al., 2008). On the contrary, the opponent's review of this report mentions the possibility to abandon current limits on brown coal mining, which would extend the lifespan of coal reserves and it would avoid energy imports, especially natural gas (Stehlík et al., 2008).

2.1.1. Fossil fuels

The Czech Republic has its own reserves of hard (black) coal, mainly located in the Upper Silesian Basin in the regions bordering with Poland. This area is one of the largest hard coal basins in Europe, however, most of it lies on the Polish side of the border. Most of the black coal today is extracted in the area of Karviná, smaller part comes from mines located in Ostrava. In contrast to brown coal, black coal is extracted from underground mines. The map below illustrates location of black coal reserves in the Czech Republic: red color stands for known reserves and blue color represents mined out areas. The maximum lifespan of black coal reserves is estimated until 2030 (Pačes et al., 2008).

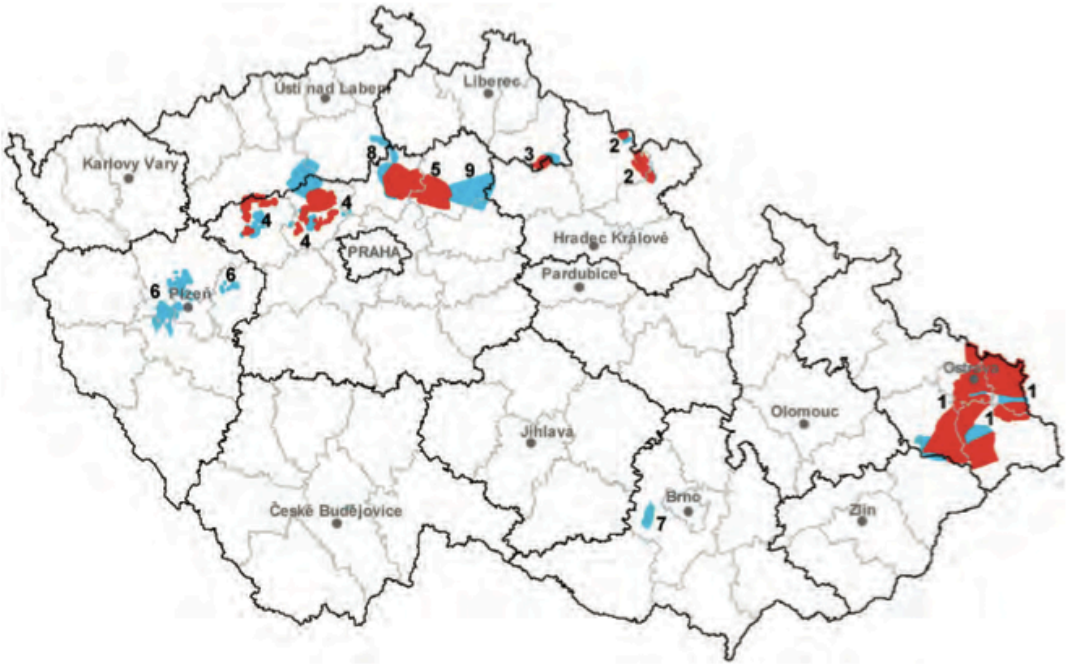

Figure 1: Black coal reserves in the Czech Republic (Source: Czech Geological Service, 2012).

The Czech Republic also has domestic reserves of sub-bituminous (brown) coal. Large part of those reserves is bound by the mining limits, which represent a significant difference in the lifespan of coal production in the country. Estimated amount of 0.9 billion tonnes of brown coal are located in the foothills of Ore

Mountains (Krušné Hory) and represent an equivalent of 18-years mining. (Sivek et al. 2012) If the mining limits are preserved, the lifespan of brown coal reserves is estimated up to 50 years (Ministry of Environment, 2010).

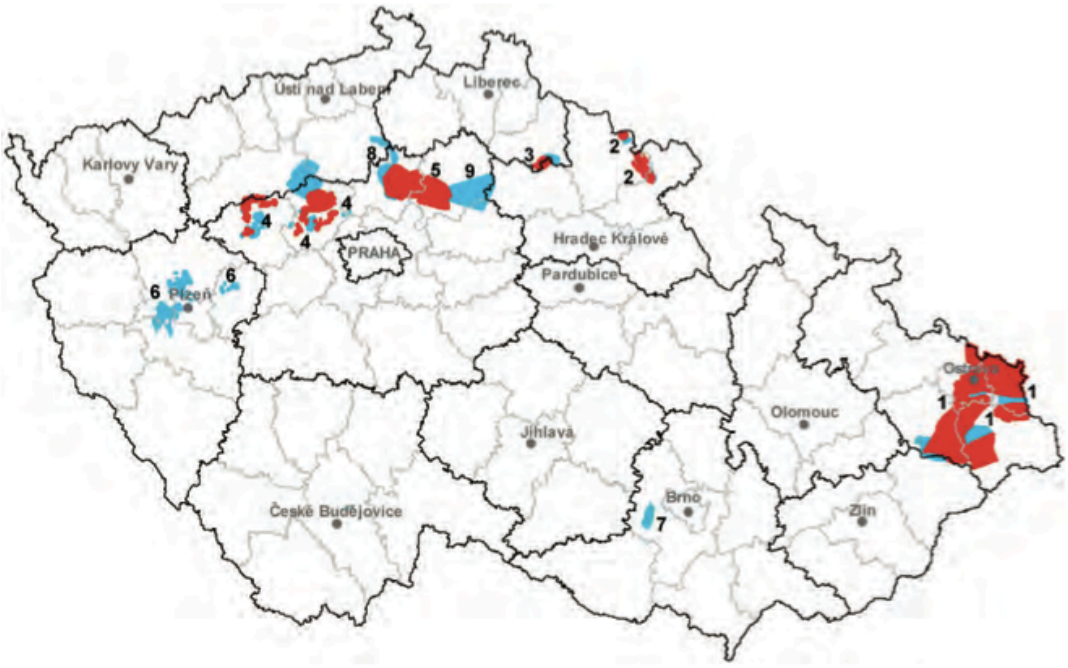

Figure 2: Brown coal reserves in the Czech Republic (Source: Czech Geological Service, 2012).

After the fall of communism, the coal extraction and connected electricity production was improved mainly to reduce the harmful impact on human health and living conditions in the affected areas. Beside the mining limits and reclamation works in the old mining regions, the old fossil-fuelled power plants were modernized to reduce the emissions of nitrogen oxides and sulphur dioxide. This had a positive effect on environment, landscape and living conditions but further steps need to be taken to reduce CO_2 emissions and increase the efficiency of coal extraction and electricity production in thermal power plants. Although the restructuring and modernization of industry and energy production led to a decrease of greenhouse gas emissions by over 30 per cent since 1990, the emission intensity in the Czech Republic is still one of the highest in OECD countries and higher than EU15 average (The Economist, 2011; see also figure 11).

Compared to the domestic reserves of coal and uranium, the resources of crude oil and natural gas are negligible and they play only minor role in the electricity generation. Local production of natural gas covers about 2-3% of domestic demand, while the Czech oil covers around 5% of domestic needs (Kavina et al., 2009). During

the communist regime, the imports of these fuels were secured by the Soviet Union and its satellites but since then Czech governments have tried to diversify the imports and secure stable energy mix for electricity and heat generation (Sivek et al., 2012).

2.1.2. Uranium

In the case of uranium, the Czech Republic was the tenth biggest producer worldwide with 111,000 tons of uranium mined between 1946 and 2009 (most of this amount was produced before 1993 when all the mines, except one, were closed). The last uranium mine is located near the village of Dolní Rožínka (location number 1 on the map below). Its operation was recently prolonged for economic reasons, however, Czech uranium deposits are understood as potential economic reserves and their exploration or preservation is thus dependent on the economic situation of the country. The amount of these reserves is estimated to be around 135,729 tons of uranium. (Sivek et al. 2013) Small amount of uranium is still being extracted during decontamination of the areas of closed mines. (Kavina et al. 2009) However, most of the uranium needed today for domestic electricity generation is being imported. There is a strong potential for renewal of uranium mining in the Czech Republic but this will depend on the development of the nuclear power worldwide and its effect on fuel prices (Pačes et al., 2008).

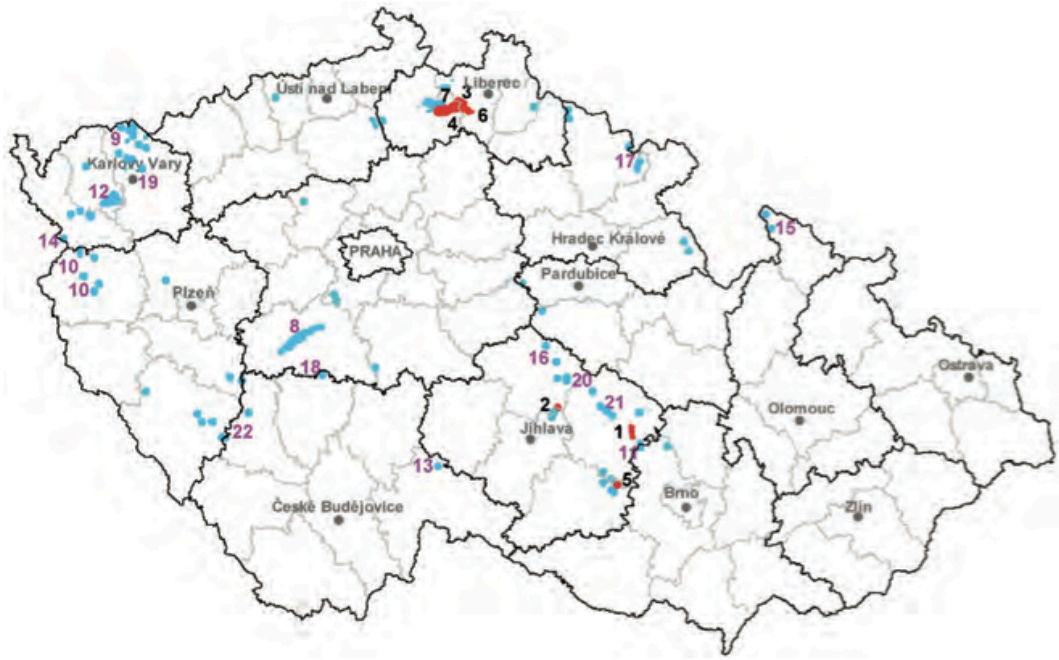

Figure 3: Uranium reserves in the Czech Republic (Source: Czech Geological Service, 2012).

The decision to focus on the extraction of uranium and its further use has been made already in the 1960s and the decision to build nuclear power plants in Czechoslovakia was confirmed by the treaty signed with the Soviet Union in 1970. Today, not only the uranium reserves are declining but also the lifespan of the old power station Dukovany (in operation since 1985/1987) is approaching, which is going to affect future electricity production (Sivek et al., 2012). The decision to build new nuclear power station Temelín was made already in 1978 by the communist government and the new facility was supposed to be completed in 1992. However, the construction was interrupted by the fall of the regime. Controls of International Energy Agency, which got an access to the facility in the 1990s, discovered design problems of the power plant and the necessary technical improvement further delayed the completion of the power plant.

At that time, the Czech Republic faced a political pressure from Austria, protesting against nuclear facility close to its borders and threatening to veto Czech entry into the EU. "The worst confrontation in post-communist Austro-Czech relations", writes Fawn (2006, p. 103), ended with opening of Temelín power plant in 2002, after the EU mediated talks between the countries that finally agreed to tie the operation of Temelín power station with the decision of international commission evaluating the safety and environmental impact of the plant (Fawn, 2006). Although there are nuclear reactors in France, Germany and Switzerland, Austrian protesters focused on power plants in the Czech Republic and Slovakia, partly because of their "Eastern European design". According to Lofstedt (2008), this damaged the trust between the post-communist countries and Austria, as the Czechs and Slovaks believe that the Austrians do not understand their need to be independent from Russia, when it comes to energy.

In 2008, the partly state-owned electricity producer ČEZ announced a plan to expand the Temelín power plant and in 2009 it opened a public tender for the construction of two more units (Energy Policies of IEA Countries: The Czech Republic 2010). Recently, the bids made by American company Westinghouse and Russian consortium Atomstroyexport are being evaluated, while the French company Areva has been surprisingly excluded from the tender (Prague Post, 2013). It is important to note that the tender is not only seen as a major decision in the field of

nuclear energy but also in foreign policy and its balance between the Western and Eastern influence.

Today it is possible to extend the lifespan of nuclear power plants up to 60 years. And although its construction is very expensive, the final electricity generation is cheap and does not produce any CO_2 emissions. Nowadays, Czech as well as European target for reduction of CO_2 emissions is strongly connected to the use of nuclear power (Pačes et al., 2008).

2.1.3. Renewable energy resources

Among renewable resources, the most powerful source of energy is hydropower. Before 1989 only a minor part of electricity production came from hydropower, mainly based on the cascade on Vltava River. Other large hydropower plants were opened during the 1990s and the electricity produced by hydropower grew significantly (CENIA, 2008). While nowadays the possibilities for electricity generation from large power plants have been mostly exploited, the Czech Republic has a potential for small hydropower installations and ranks as the eight largest producer of this kind in the EU. In 2011 the electricity production from small hydropower installations even exceeded that from large hydropower plants. However, small power plants are heavily dependent on weather and season. (Energy Policies of IEA Countries: The Czech Republic 2010)

The second most important renewable energy resource is biomass, mostly connected to the wood production. Currently, biomass sources are mostly composed of residual or waste material, not only from woodworking business but also from cereal or rapeseed production. However, further expansion of biomass is necessarily connected to intentionally planted energy crops. Currently, almost 54% of country's total area belongs to agricultural lands and more than one third of the Czech Republic is forested. This creates a large potential for future biomass production (Havlíčková and Suchý, 2010). According to Lewandowski et al. (2006), 10–20% of Czech agricultural land is available for energy crops, as the amount of land necessary for food and fodder production declines together with increasing productivity in agriculture. The authors believe that Czech agriculture could provide enough biomass for domestic demand, even with export potentials. At the same time, the use of energy crops competes with the so-called "food security" that reserves two thirds of the arable land for food production (Pačes et al., 2008).

In the recent years, the Czech Republic has experienced an unexpected boom in photovoltaics, caused by extremely favorable conditions for new producers, primarily through feed-in tariffs accompanied by rapid decline in investment prices. The vision of secured payments for solar power for the next 15 years together with falling prices of solar panels led to a spectacular photovoltaic boom in 2009 and 2010. At that time, the Czech Republic became the third largest solar market in terms of newly installed capacity in 2010. However, this boom caused significant imbalances in the prices of electricity and posed a risk to the stability of electricity grid and therefore required major policy intervention. Emergency measures were successful in stopping the uncontrollable expansion of photovoltaics and future policy support of renewable energy should not focus on a single technology anymore (OECD, 2011).

Wind power is not widely used in the Czech Republic (around 5% of green electricity comes from wind energy, see Table 1), as the suitable wind conditions are rather limited (see Figure 8). However, with the increasing energy capacity of wind turbines and their declining prices it is possible to increase the amount of electricity produced by wind power (Pačes et al., 2008).

2.2. Austria

2.2.1. Fossil fuels and uranium

Austria still relies on thermal power plants, using mainly coal and gas. Austria had small domestic resources of brown coal but its production definitively ended in 2006 (Euracoal 2012). Most of its demand is therefore met by imports, especially from Poland and the Czech Republic. In the case of natural gas, Austria has its own reserves but they were able to meet only about 17% of domestic demand in 2005. There is, however, still possible to find new gas reserves in the country (Energy Policies of IEA Countries: Austria 2007). Austrian main goal in this field is to diversify its imports and the government therefore promotes the construction of Nabucco pipeline that would bring Caspian gas to Europe.

At the same time, Austria is one of the countries that abolished the use of nuclear energy. There has been an active green lobby since the 1970s that managed to place the nuclear opposition to a nationwide law. Therefore, there is no nuclear power plant in Austria and Austrian activists often protest against nuclear power in neighboring countries. In the 1970s and 1980s their attention focused on nuclear facilities in Switzerland and Germany. Since the 1990s their interest switched to

nuclear energy in post-communist states like Slovenia, Slovakia and the Czech Republic (Lofstedt, 2008).

2.2.2. Renewable energy resources

Austria already has a large share of renewable resources and almost 65% of electricity comes from domestic renewables (Lebensministerium, 2013b). On the other hand, Austrian energy consumption grows steadily over time and current resources cannot keep pace with the demand. Austrian targets for further expansion of renewables will be probably accompanied by increased costs for energy (Energy Policies of IEA Countries: Austria 2007).

Hydropower is a traditional and well-established energy source in Austria and in 2011 it composed around 57% of electricity supply in Austria (BMWFJ, 2013). However, the share of hydropower has declined since the 1990s with increased demand for electricity and expansion of other renewable resources (Energy Policies of IEA Countries: Austria 2007). As the potential for large hydropower plants is mostly exhausted, Austrian policy concentrates on promotion of "new" renewable energy sources, such as wind energy, biomass and photovoltaics, but also includes the support for small hydropower plants (Lofstedt, 2008). Despite the high capacity of Austrian hydropower plants, their electricity production differs year to year in dependence on weather conditions: Austria experienced a sharp decline in electricity produced by hydropower in 2003 and 2010 (BMWFJ, 2011b).

In the case of wind power, there is a general rule that wind power plants are more effective in coastal areas, which is not the case of Austria or the Czech Republic. Furthermore, the production costs of wind power are higher in land-locked countries than elsewhere. The conditions for wind power are rather unfavorable in most of Austria and therefore it composes only around 5% of electricity production from renewable sources (Lebensministerium, 2013b). However, the share of wind power is expected to increase in the future and there are still unused areas suitable for deployment of wind turbines. According to Gass et al. (2013), there is an area of 5800 km^2 technically available for wind power production. Although the installation of wind turbines is supported by feed-in tariffs, the costs of wind power are still quite high; in addition to construction costs (that represent about 75% of the total investment) there are also significant operation and maintenance costs.

The share of solar power in electricity generation is even lower than in the case of wind power, although the conditions are better compared to the Czech Republic. However, solar power is frequently used as a complementary source of heating in residential houses (Lebensministerium, 2013b).

One of the rapidly expanding resources is biomass, often in a form of by-product in wood industry. Large part of Austria is covered by forests (47% in 2007) and this creates favorable conditions for biomass production. The forest-based industry, strongly interconnected to biomass production, accounted for about 3% of GDP and 9% of exports (Schwarzbauer et al., 2013). However, to meet its targets for 2020, Austria needs to expand its production of biomass, which is supposed to compose a large part of renewable energy sources. It is expected that there will not be sufficient amount of waste wood to satisfy the demand of energy sector, which might lead to rising prices of wood products in Austria. Further agricultural biomass production is then necessary to reach Austrian policy goals. On the other hand, the analysis of Schwazbauer et al. (2013) concludes that Austrian wood industry is flexible enough to resist even a very serious global economic crisis and has therefore good potential for the future.

2.3. Comparison

According to Gingrich et al. (2011), the use of fossil fuels and CO_2 emissions have been higher in Czechoslovakia than in Austria already since the end of World War I that marked the end of Austro-Hungarian Empire. The differences grew rapidly until the 1980s, as the countries followed entirely different political and economic trajectories. Coal has remained the most important energy carrier in the Czech Republic until today (see figure 4) but in Austria it was replaced by crude oil already in the mid-1960s, together with the expansion of hydropower and natural gas (see figure 6).

Nowadays, electricity production in the Czech Republic is based mainly on coal and nuclear power (see figure 5). The share of renewable resources has grown significantly in the 1990s but it is still low compared to Austria, where we can observe an expansion of new renewable sources with declining shares of hydropower (see figure 7).

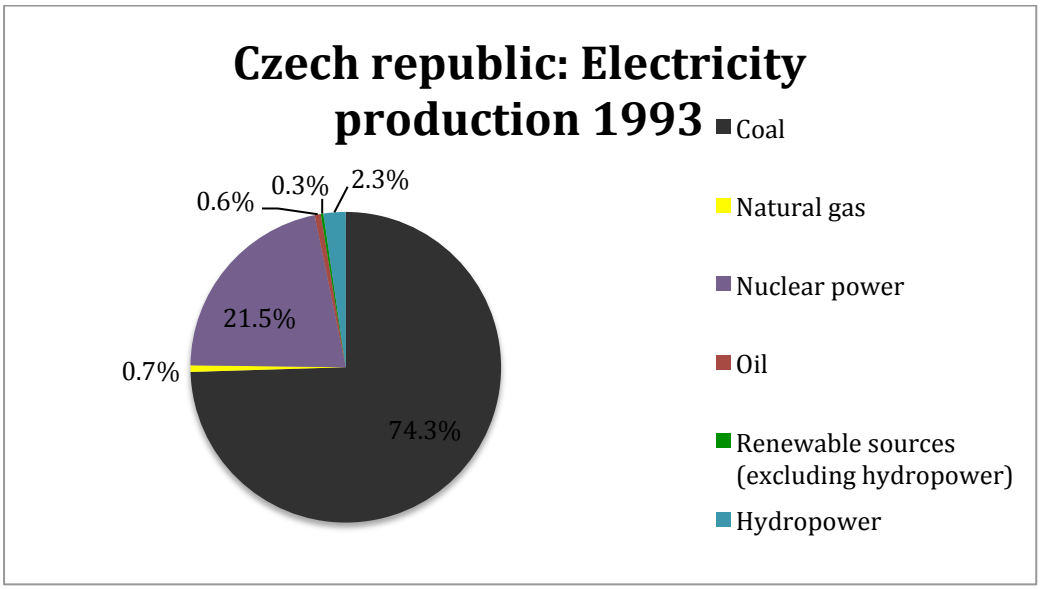

Figure 4: Electricity production in the Czech Republic in 1993 (Data source: World Bank, 2013a).

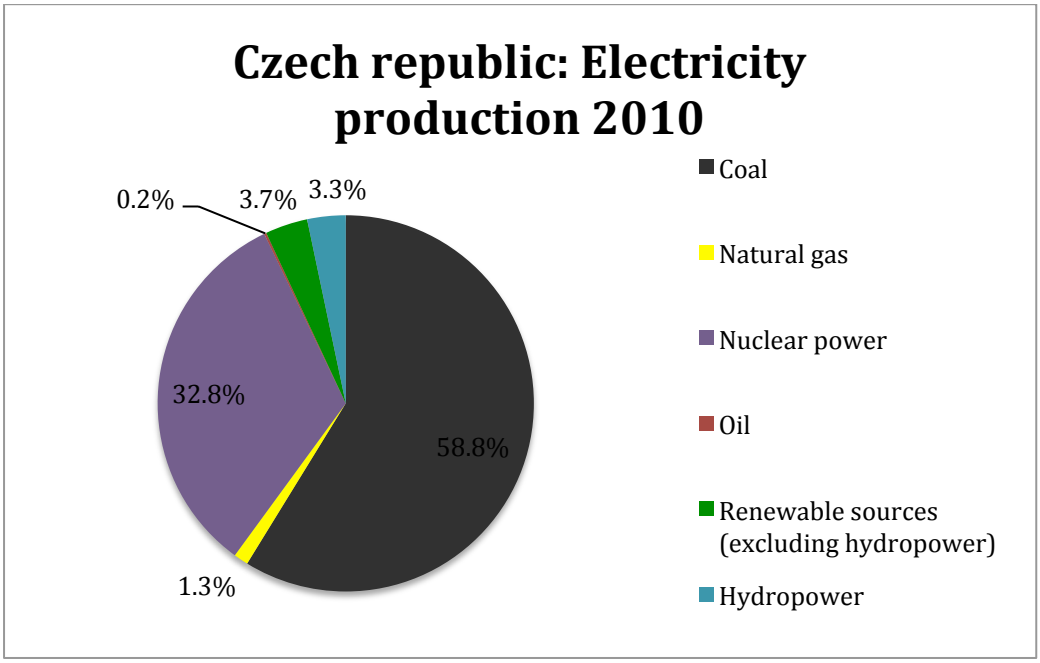

Figure 5: Electricity production in the Czech Republic in 2010 (Data source: World Bank, 2013a).

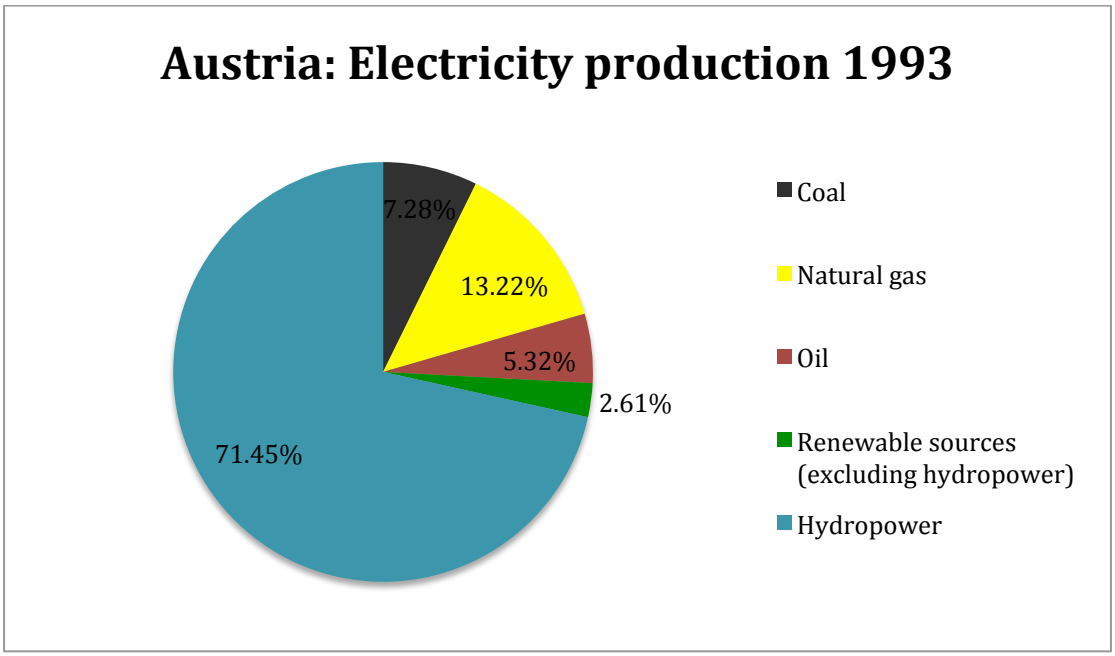

Figure 6: Electricity production in Austria in 1993 (Data source: World Bank, 2013a).

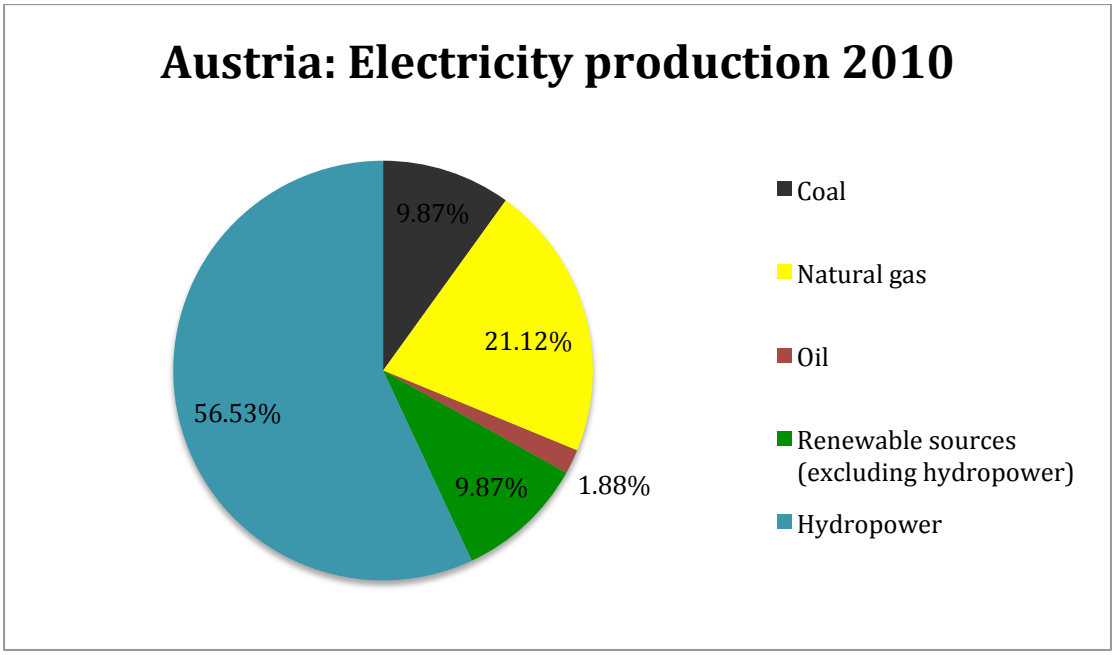

Figure 7: Electricity production in Austria in 2010 (Data source: World Bank, 2013a).

If we compare only the use of renewable resources, we can observe clear differences in their shares in both countries. In the past years we could see a significant change in the composition of renewable resources in the Czech Republic. The shares of hydropower, both large and small facilities, have decreased, while

photovoltaics expanded rapidly during the solar power boom since 2009 (see table below).

MWh	2007	%	2008	%	2009	%	2010	%	2011	%
Hydropower installations (under 10 MW)	1,001,845	30	966,884	26	1,082,683	23	1,238,819	21	1,017,878	14
Large hydropower installations	1,077,493	32	1,057,451	28	1,346,937	29	1,550,655	26	945,276	13
Wind power	125,098	4	244,661	7	288,067	6	335,493	6	397,003	5
Photovoltaics	1,754	<1	12,937	<1	88,807	2	615,702	10	2,182,018	30
Biogas	182,699	5	213,632	6	414,235	9	598,755	10	932,576	13
Biomass	993,360	29	1,231,210	33	1,436,848	31	1,511,911	26	1,682,563	23
Biological waste	11,260	<1	11,684	<1	10,937	<1	35,580	<1	90,190	1
Total	3,393,509		3,738,459		4,668,514		5,886,915		7,247,504	

Table 1: Electricity production from renewable resources in the Czech Republic (Data source: Energy Regulatory Office, 2012).

The electricity production from renewable resources changed in Austria as well, although not as surprisingly as in the Czech Republic. The share of hydropower slightly declined but it still represents the main source of renewable energy. In absolute numbers, Austria also experienced growth in photovoltaics, although it is still not a significant source of electricity and the increase is low compared to the solar boom in the Czech Republic (see table below).

MWh	2007	%	2008	%	2009	%	2010	%	2011	%
Hydropower	37,540,000	90	38,868,000	90	38,757,000	86	39,237,000	85	38,657,000	85
Wind power	2,019,000	5	1,988,000	5,5	2,024,000	4	2,035,000	4	2,089,000	5
Photovoltaics	15,000	<1	17,000	<1	49,000	<1	89,000	<1	174,000	<1
Biomass	2,194,000*	5	2,489,000*	4,5	4,371,000**	10	4,554,000**	10	4,522,000***	10
Geothermal energy	2,000	<1	2,000	<1	1,500	<1	1,500	<1	1,500	<1
Total	41,770,000		43,364,000		45,202,500		45,916,500		45,443,500	

* Includes solid, liquid and gaseous biomass and landfill gas.
** Includes biogas, biofuel, wood products and black liquors.
*** Includes solid, liquid and gaseous biomass and black liquors.

Table 2: Electricity production from renewable resources in Austria (Data sources: Lebensministerium, 2009, 2011 and 2013b).

When we compare the use of energy sources in the two countries, it is clear that the main source of energy is the one most available in the area – coal in the Czech Republic and hydropower in Austria, in smaller extent also the use of uranium or natural gas. However, other resources, especially wind and solar power, are

exploited on a different scale, although their availability is similar in both countries. Figure 8 shows the mean annual wind speed in Europe. We can see that wind conditions in the region are mostly unfavorable, except for north-eastern Austria and northern border areas in the Czech Republic. However, the absolute amount of electricity produced by wind turbines is much higher in Austria than in the Czech Republic, although their shares in green electricity production are similar (around 5% in both countries).

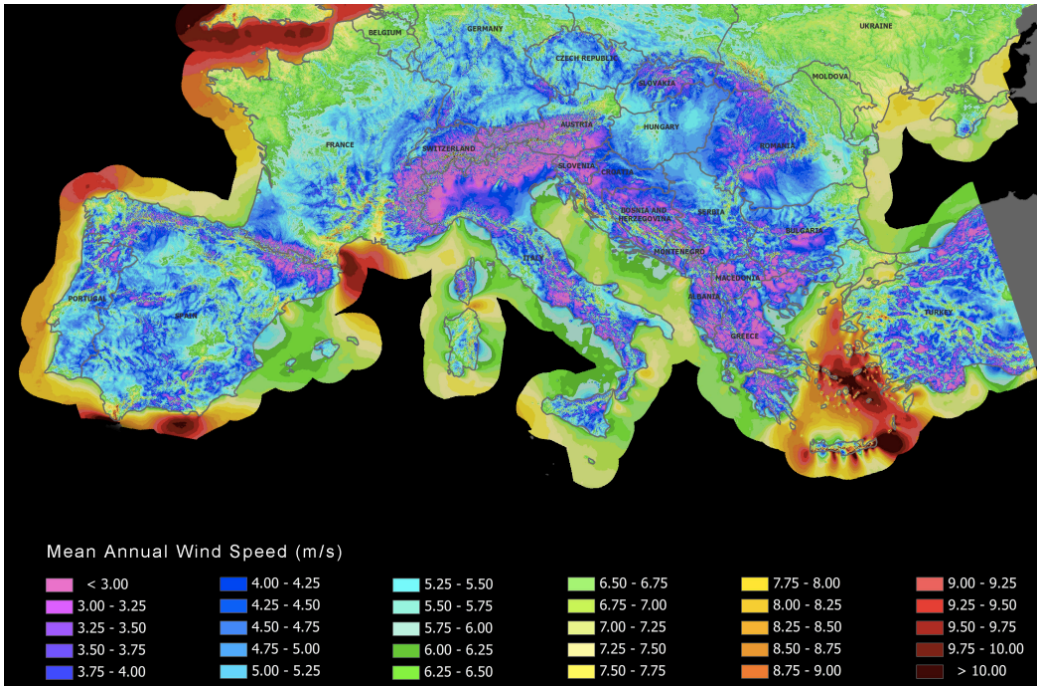

Figure 8: Mean annual wind speed in Europe (Source: AWS Truepower, 2012).

At the same time, the comparison of solar radiation (see Figure 9) shows that neither Czech Republic nor Austria lie in the most sunny regions in Europe. However, there is still stronger solar radiation in the south of Austria than anywhere in the Czech Republic. Despite this advantage, Austria uses photovoltaics for electricity generation on much smaller degree, preferring the use of solar panels for supplementary heating of water and houses. This brings us to the chapter about importance of policy on electricity production.

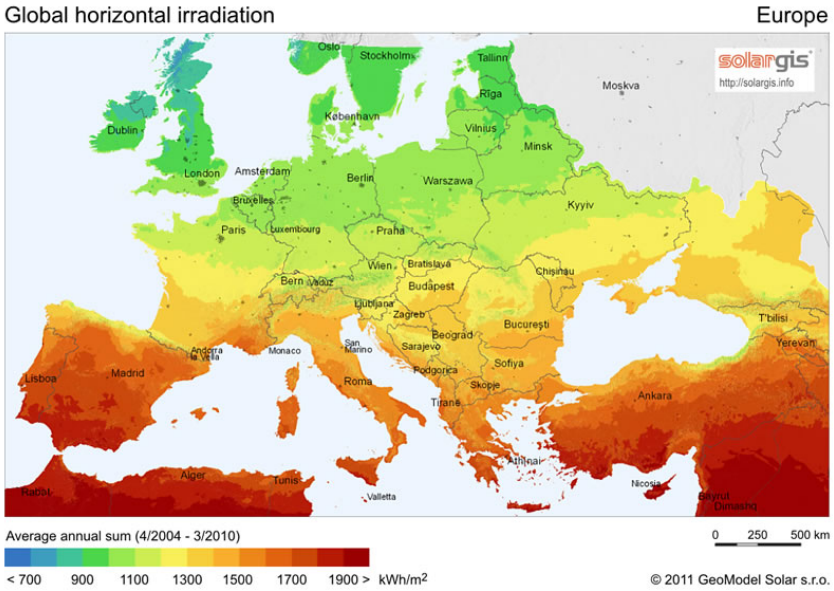

Figure 9: Solar radiation in Europe (Source: Solargis.info, 2011).

3. Institutional Approach

As suggested in the previous chapter, to fully understand the composition of energy sources used for electricity generation, it is necessary to compare the institutional background of the Czech Republic and Austria. First, the key institutions relevant in the energy sector will be introduced, followed by the analysis of main policy documents and strategies concerning energy. However, it is important to note that the quality of institutions, especially when it comes to functioning of the government or corruption, is different in both countries and therefore the outcomes from similar policy programs might differ in reality.

While the two countries are bound by the history of Habsburg Monarchy until 1918, they followed totally distinct trajectories since the Second World War. Socialist Czechoslovakia adopted the institutions and policy common for Eastern European countries and Austria started to call itself Western Europe, although Vienna lies east of Prague. Even today, when both of the states are considered free and democratic, there remain differences in the quality of institutions and policy priorities.

According to Democracy Index, used by The Economist Intelligence Unit, Austria is the 12th most democratic state in the world with a score of 8.62 (out of ten). The Czech Republic is five places behind with a score of 8.19. The main difference lies in the functioning of the government (8.21 in Austria compared to 7.14 in the Czech Republic) and political participation (7.78 in Austria and 6.67 in the Czech

Republic). However, compared to other former communist states, Czech Republic is the only country rated as a full democracy, with higher political participation and better political culture than other states in the Central and Eastern Europe (The Economist Intelligence Unit, 2013).

The Worldwide Governance Indicators, used by the World Bank, combine different data available in several categories: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and the control of corruption. Each country then receives a percentile in each category and according to the percentile, the country belongs to one of the six groups. In 2011 Austria got better results in all fields and it belonged to the best group in all categories. On the contrary, the Czech Republic belonged to the second group in all fields except control of corruption that puts it into the third group, with percentile of 67 compared to 90 in Austria. In comparison, Slovakia, Poland and Hungary lag behind the Czech Republic when it comes to government effectiveness, regulatory quality and rule of law. However, the control of corruption is higher in Hungary and Poland than in the Czech Republic (World Bank, 2013b).

Apparently, it is difficult to objectively compare or quantify the quality of institutions in countries that are considered democratic. However, in context of this paper it is still possible to analyze their institutions relevant in energy sector, as well as the development in energy policy in the last two decades.

When it comes to renewable energy resources, government might apply several strategies for their support. Direct strategies might focus either on (1) investment subsidies or on (2) support on generation level: that includes fixed feed-in tariffs (FIT) or a fixed premium. While for the FIT the total feed-in price is fixed, in premium systems there is a fixed amount to be added to the electricity price – therefore it is less predictable than FIT. Indirect strategies might be (1) eco-taxes on "dirty" technologies, (2) taxes or permits on CO_2 emissions, (3) abolition of support of fossil fuels or nuclear power. Renewable sources can be also supported by tax incentives (Haas et al., 2011).

3.1. Czech Republic

In this chapter, I would like to introduce the main institutions influencing energy sector in the Czech Republic and describe the policy development in the two

distinct periods: (1) between the fall of communism and 2004, when the Czech Republic joined the European Union and (2) recent development in the Czech Republic as a member state of the EU. For this purpose I will analyze the most important policy documents as well as the official programs released by the governments of that time.

3.1.1. Institutions

On the governmental level, the most important institutions concerning energy policy are the Ministry of Industry and Trade and the Ministry of Environment. The Ministry of Industry and Trade is the main body responsible for energy sector as well as the use of natural resources. It sets strategies for the future and prepares legislature in this field. However, it has to cooperate with the Ministry of Environment, which takes care of the environmental impact of energy sector. It promotes sustainable growth and keeps an eye on the right balance between economic growth and preservation of nature. Within ministries there exist expert committees that offer advise in their specific fields. In the case of energy, the most important permanent committees are the one specializing on strategies in energy and resources and committee for sustainable growth.

On the administration level, Energy Regulatory Office plays an important role. It regulates the prices of energy, promotes the use of renewable resources, supervises the competition on energy market (together with the Office for the Protection of Competition) and protects consumer interests. Another important body is The State Energy Inspection that is in charge of registering and investigating complaints regarding energy, except those concerning prices (that are controlled by the Energy Regulatory Office). The inspection imposes penalties for violations made by license holders within the energy sector.

Additionally, Market operator (OTE) is another institution that influences energy policy in the Czech Republic by being responsible for daily operation on electricity market, settling the differences between supply and demand of the electricity and preparing monthly and yearly reports. It also controls trading of greenhouse gas emissions. Furthermore, there are several other actors that play an important role in specific agenda, such the Administration of State Material Reserves or the State Office for Nuclear Safety.

On the electricity production level, the main player is ČEZ (Czech Energy Concern) that owns and operates most of the major power plants in the Czech Republic. If we compare the electricity generated in the Czech Republic in 2011 (as listed in the annual report by Energy Regulatory Office) and the amount of electricity produced by power plants owned by ČEZ Group (according to their website), we can easily calculate that 80 % of Czech electricity was produced by ČEZ Group. However, the distribution network is more diversified and ČEZ has about 45 % share on Czech electricity market. Other important actors on the distribution side are E.ON, a German company, and PRE (Prague Energy Industry), who together with ČEZ control about 75 % of the electricity distribution (Lidové noviny, 2012). However, the customers can still choose from another 30 distribution companies (Ceny Energie, 2013). The electricity transmission network is controlled by a single state-owned company, ČEPS. It was a part of ČEZ until 1998 but was separated in order with European legislation to secure "unbundling" of the electricity transmission and production (Búřil, 2011). In this sense, Czech electricity market has been fully liberalized since 2006 – aside from unbundling, there is a functional electricity market between the Czech Republic and its neighboring countries and the trading platform in Prague (called Power Exchange Central Europe) has been established in 2007. Even though consumers can freely choose their energy distributor, the competition in the Czech electricity sector is rather limited and the market is not as diversified as in other European countries. Consequently, since 2009, ČEZ has been investigated by the European Commission in suspicion of anti-competitive behavior (Energy Policies of IEA Countries: The Czech Republic 2010). The inquiry is recently coming to an end as ČEZ promised to sell one of its coal power plants to decrease its shares in the sector. This should give an opportunity for other actors to enter the market (iDnes.cz, 2013).

There are several NGOs active in the debate about sustainable energy mix, although the tradition of public participation and involvement in NGOs is very young. Until 1989 there were no officially recognized organizations that would be allowed to openly criticize the official policy of environment or energy. During the 1980s, international Greenpeace organization managed to display protest posters against air pollution in Czechoslovakia and they tried to inform people about nuclear disaster in Chernobyl. Those activists were arrested and expelled from the country and

Greenpeace opened its Czechoslovakian office only in 1991. Since then, it has contributed to the discussion and released relevant publications about nuclear power and future of coal mining in the Czech Republic (Greenpeace, 2013). Second most important NGO is Hnutí Duha (Friends of the Earth Czech Republic) that is successful in its public campaigns concerning green technologies and energy savings. The most relevant ecological organizations cooperate within an association called Green Circle that promotes better public participation in this policy area. "Mothers of South Bohemia" are special, yet quite influential organization that protests against nuclear power plant Temelín (located in this region) and tries to draw attention to the dangers of nuclear energy worldwide (Jihočeské matky, 2013).

The Green Party was founded right after the Velvet Revolution, already in December 1989. In 1992 it formed an election coalition with similar parties and formed the Social Liberal Union, which brought the party three mandates in the parliament (Týden, 2006). Since then, however, it got enough votes to get into parliament only in the elections in 2006 and was a part of coalition government in the period of 2007–2009. At that time, it blocked the expansion of nuclear energy and reevaluation of mining limits (Dobrovolná et al., 2008). Recently, it has been active only on regional level.

3.1.2. Energy policy in the Czech Republic until 2004

At the start of each term, every Czech government is supposed to present its program, highlighting the most important strategies in each policy area in the upcoming period. By reading these manifests, it is possible to identify the most poignant issues of that time. The period of the 1990s was marked by all-embracing restructuralization, privatization and liberalization. This was also the case of electricity sector and related industries, such as coal mining. One of the key tasks during this period was to improve the environment and face the ecological damage caused by the socialist economy. At first, governments needed to solve the "basic" environmental problems, such as air and water pollution, directly affecting people's health, as well as landscape devastation caused by extensive mining. Before 1990 the sanctions for air polluters were extremely low and the main arrangement for the protection of air quality was in form of basic filters for solid emissions. Strict emission limits were set only in 1991 (CENIA, 2008).

Aside from direct investment into ecological programs, governments of Václav Klaus (1992–1998) focused on price liberalization (abolishing state subsidies on energy prices) and creating a system of sanctions for companies polluting the environment, together with support for companies using cleaner technologies (Government of the CR 1992 and 1996). Additionally, stressing the importance of reasonable environmental protection within the scope of prosperous market economy, the government was forced to invest intensively into necessary environmental reforms that required 8% of the total state investment in 1994, compared to OECD average around 1-3% (CENIA, 2008). In 1992 the government approved the first comprehensive document called The Energy Policy of the Czech Republic that focused on deregulation of energy prices, setting the rules for nuclear power and reconstruction of coal power plants to reduce their emissions of sulphur dioxide and nitrogen oxides. As a result of the initial ecological improvements, the emissions of sulphur dioxide decreased by 60% in 1990–1998 and the amount of dust in the air fell by 80% in the same period (Ministry of Industry and Trade, 2000).

The Czech Republic successfully joined OECD in 1995 and its International Energy Agency in 2001. The country has also accepted the United Nations Framework Convention on Climate Change, as agreed on at the "Earth Summit" in Rio de Janeiro in 1992, and it has ratified the subsequent Kyoto Protocol. According to the protocol, the Czech Republic agreed to reduce its greenhouse gas emissions by 8% compared to their 1990 level. By 2008 it has reduced the emissions by 28% already and easily met the target (see Table 3).

Country	**Kyoto target (1990–2008)**	**Relative change (1990–2008)**	**GHG emission per capita (2008)***	**GHG emission per capita (relative change 1990–2008)**
Czech Republic	- 8%	- 28%	13.6	- 28%
Austria	- 13%	+ 11%	10.5	+ 2%
EU-27	-	- 11%	10	- 16%
EU-15	- 8%	- 6%	10.1	- 13%

* in tons of CO2 equivalent per person

Table 3: Change of GHG emissions between 1990 and 2008 (Data source: EEA Report No. 6, 2011).

Part of this process was the task to dismantle the monopolies, especially in the energy sector and thus secure competition on the market and reasonable energy prices. This was also connected to privatization of state energy monopolies, with the

most important example of ČEZ. The attempts to privatize the biggest energy concern were not successful in the 1990s, as they hoped for a strong foreign investor that would help ČEZ gain access to European market. On the contrary, in 2003 ČEZ bought shares in regional distribution companies and became a dominant concern, still mostly owned by the Ministry of Finance (Černoch, 2011).

In the end of the 1990s, Czech Republic began to prepare for its entry in the European Union and adopted several strategies in line with the EU, such as the idea of sustainable economic growth, promoted by the government of Miloš Zeman (1998–2002). Furthermore, an important issue during that period was the effective and reasonable use of non-renewable natural resources. Energy intensity, as well as CO_2 intensity has been higher in the Czech Republic than in other developed countries, and it became one of the main tasks for the government to change this trend. As we can see in the figure 10, despite significant improvements in energy use, Czech economy is still more energy intensive compared to other OECD and EU countries, with Austria as an example of effective use of energy. Czech Ministry of Industry and Trade (2000) explained it by lower economic productivity, high consumption of solid fuels and general structure of Czech industry, which concentrated on energy intensive sectors, such as metallurgy, construction materials, chemicals, etc. The steep decline in the energy intensity stopped in the year 2000 and it remained stable in the subsequent period of economic growth and expansion of industry until 2004. In spite of further economic growth until 2008, the energy intensity has steadily declined since 2004. The fact that the economy, together with the energy intensive industry grew without expanding the energy use shows that there have been certain improvements in effectiveness and productivity (CENIA, 2008).

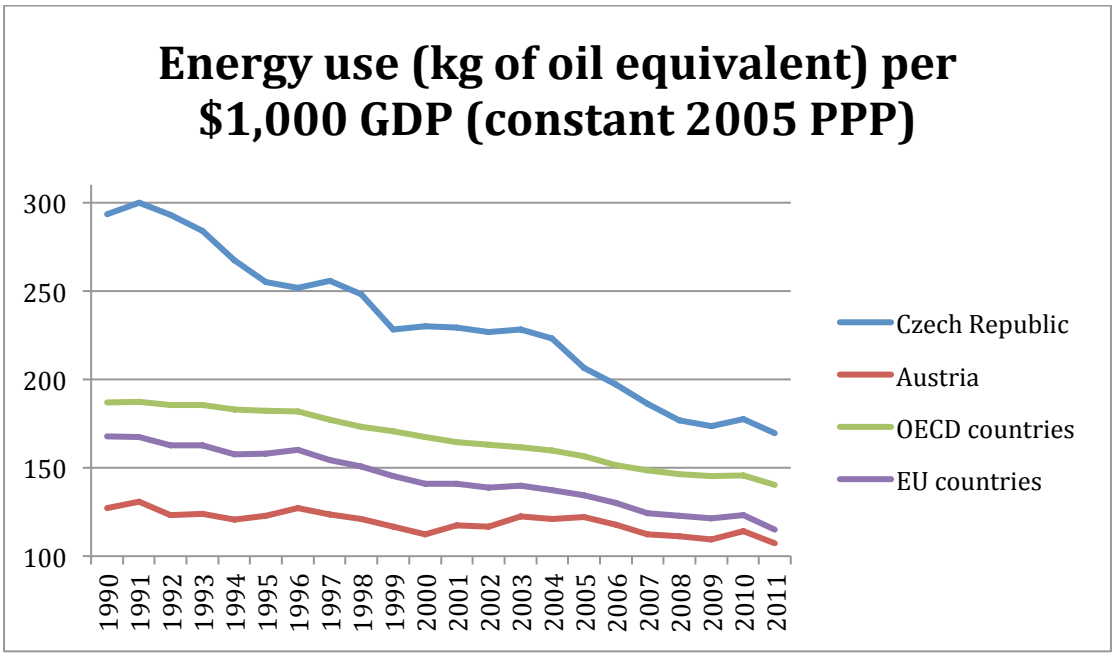

Figure 10: Energy intensity in selected countries (Data source: World Bank, 2013a).

We can observe similar trend in $C0_2$ intensity (illustrated in Figure 11), which also decreased rapidly in the last two decades, although it still remains significantly higher than in the above-mentioned countries for similar reasons as in the case of energy intensity: there is an extensive use of fossil fuels, especially coal, and Czech industry depends on energy intensive industries using those powerful energy carriers.

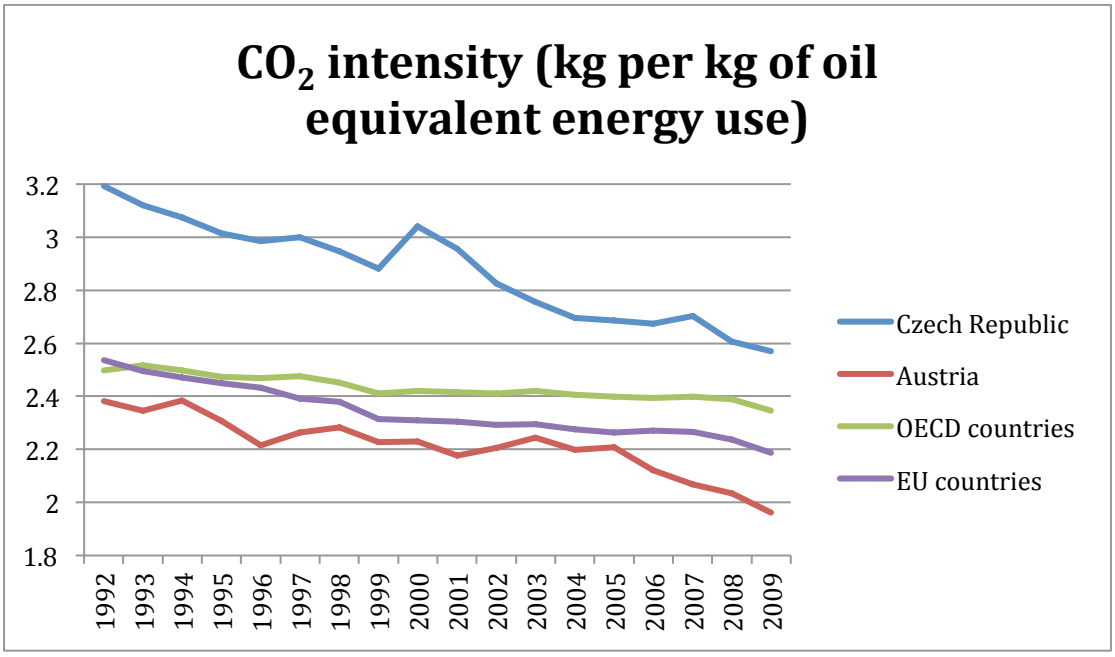

Figure 11: CO_2 intensity in selected countries (Data source: World Bank, 2013a).

The first plan for renewable energy sources was issued in 1999. The share of renewable resources was expected to grow to 3,5% by 2010 with biomass as a key source for electricity and heat generation. At the time, the expansion of renewables was limited by unfavorable prices of electricity produced by those resources (higher than in the case of domestic fossil fuels), low investments in the sector and extensive bureaucracy connected to slow planning and licensing of new facilities. However, already in 2011 the share was more than 9% and exceeded the modest goals from 1999. At the time, there were still state subsidies for electricity on household level and the coal industry was indirectly supported by the state. In preparation for joining the European Union, these subsidies were abolished step by step so the final prices of electricity reflected their real costs (Action Plan for RES, 1999).

The 1990s was a period of mining reduction, especially of uranium and coal. Between 1989 and 1998 mining declined by 20–50%, as the poorly accessible and non-profitable deposits were abandoned (CENIA, 2008). Coal mining was limited by the government resolution from 1991 that protects certain areas with coal deposits in northern Bohemia from mining (Government Resolution no. 444, 1991). These limitations have not been revised since then, although it remains an important political issue. According to the State Energy Policy from the year 2000, the Ministry of Industry and Trade believed that if the limits remain untouched until 2002, the coal deposits will be lost once for all or the mining conditions will worsen so much that the coal extraction will not be profitable anymore (Ministry of Industry and Trade, 2000).

3.1.3. The Czech Republic as a member state of the European Union

Between 2004–2006, social democratic governments promised to prepare favorable legislative environment for renewable resources, emission trading and tax reform introducing ecological tax (Government of the CR, 2004 and 2005). In 2004 the new State Energy Concept was released, already setting 8 % target for shares of renewable energy by 2010. The main goal was to transpose European regulations into Czech law and prepare for the opening of European emission trading system, together with respecting the targets of Kyoto Protocol and the emission limits. The law on support for electricity generation from renewable resources came into force in 2005. At the same time, the necessity of low import dependency was stressed, setting a limit

to 45% in 2010 and 55% in 2020 (Ministry of Industry and Trade, 2004). Recently, Czech energy dependency rate is among the lowest in the EU, about 29% in 2011, compared to 69% in Austria and European average of 54% (Eurostat Press Release, 2013).

The period of 2007–2009 was unique due to the presence of the Green Party in the government. In the government manifesto, there was a clear support for renewable energy and energy savings, as well as the decision to keep the mining limits and refusal to expand the nuclear power plant Temelín. This government, led by Mirek Topolánek (2006, 2007–2009) was the first one to explicitly support research and development in the area of alternative resources and energy-saving technologies (Government of the CR, 2006). During this period, the future of nuclear power in the Czech Republic depended on the position of the Green Party, as it was the only parliamentary party opposing the use of uranium as an energy source and promoting renewable technologies instead (Dobrovolná et al., 2008).

In regards to clean energy much of the impulse came from the European Union. In 2006 European Commission released the Green Paper, setting a strategy for "sustainable, competitive and secure energy". The Green Paper promoted expansion and effective use of European transmission network, strengthening cross-border trading and more effective use of available electricity across the EU. However, it does not offer any recommendations for ideal energy mix, neither it offers any joint European strategy for nuclear energy. The use of resources for electricity generation therefore lies on the decision of each member state, although the Commission admits that some decisions in this area strongly affect neighboring countries as well. According to the Green Paper (2006), both coal and nuclear power represent about a third of European electricity generation on the European level. Therefore, the use of coal in the EU should be accompanied by the expansion of cleaner technologies and there should be a balanced discussion about the future and safety of nuclear power. However, nuclear power is seen as an important source of electricity that does not add any CO_2 emissions, and it is therefore essential in European plans to decrease emissions (European Commission, 2008). At the same time, European Union has an ambitious plan to become the world hub of renewable energy and advanced, energy-saving technologies.

The Green Paper was followed by an action plan for securing energy supplies to the EU (European Commission, 2008). It promotes effective use of energy in households, especially for more energy effective buildings and appliances. This approach was also adopted by the Czech government that introduced a successful program for investments into reconstruction of buildings, financed by earnings from emission allowances. Czech membership in the EU also offered new opportunities for investors interested in clean technologies, who can apply for financial support from European funds. State Environmental Fund of the Czech Republic in cooperation with the EU introduced The Operational Programme Environment (2007–2013) that offers an opportunity to receive financial support for projects regarding the use of renewable resources, energy savings or emission reduction (OPŽP, 2013). Similar support was offered by The Operational Programme Enterprise and Innovations (2007–2013) in cooperation with the Ministry of Industry and Trade that offered support for activities leading to decreasing energy intensity of production and for extended use of renewable and secondary energy sources (Ministry of Industry and Trade, 2011).

The Czech Republic has joined the EU Emission Trading System (EU ETS), based on the Green Paper published in 2003, and together with other countries asked for emission allowances, based on the needs of the industry. However, in the first phase in years 2005–2007 the EU released more allowances than European producers actually needed and the prices of allowances fell rapidly. In the second phase in 2008–2012 the EU applied stricter rules and tried to release less allowances so the producers would be forced to emit less $C0_2$ than before (Pačes et al., 2008). However, today it seems that the whole EU ETS is at risk – the demand for carbon allowances in the second period was not as high as expected and European Commission planned to take part of the released allowances off the market and reintroduce them later, when the demand is stronger. However, European Parliament rejected this proposal and the situation on emission market is now uncertain (The Economist, 2013). The European Commission is not the only one to blame – the failure of EU ETS was partly caused by the governments that could not stand up to the pressure of their industries and resigned on the main goal decrease the amount of emitted CO_2 (Pačes et al., 2008).

In 2010 the Europe 2020 Strategy came into force and set ambitious targets for the EU in the next ten years. Energy goals for 2020 are illustrated in table 4. Czech

Republic has not set any specific target for the energy efficiency, although the need for its improvement is included in the government plans, such as the State Environmental Policy (Ministry of Environment, 2012) that set the goal to decrease energy consumption in 2008–2016 by 9% compared to the average consumption in 2002–2006.

	GHG emission reduction	**Energy from renewables**	**Increase in energy efficiency = reduction of energy consumption**
EU	20%*	20%	20% (368 Mtoe)
Czech Republic	9%**	13%	-
Austria	16%**	34%	7.16 Mtoe
Recent state (2010)			
EU	15%*	12.5%	57 Mtoe**
Czech Republic	29%*	9.2%	0.3 Mtoe
Austria	- 8%*	30.1%	- 0.1 Mtoe

* compared to 1990 level
** compared to 2005 level
Mtoe = million tons of oil equivalent

Table 4: Europe 2020 targets (Data source: Europe 2020, 2013a,b,c,d).

The biggest potential for energy savings is on household level (31% of the final reduction), followed by industry (25%) and transport (23%). The Europe 2020 Strategy is a good example of Czech policy towards the EU – the government never sets too ambitious targets so there is a good chance to fulfill them. On the argumentation level, it promotes economic prosperity and energy security rather than environmental issues and all the ecological reforms need to be "reasonable" in relation to business environment in the country (Government of the CR, 2010).

Renewable energy resources for electricity generation are supported by feed-in tariffs and "green bonuses". Electricity producers can choose, which regime is more profitable for them. Feed-in tariffs are set to secure the producers recovery of their investment in 15 years. Green bonuses, on the other hand, mean that a stable bonus is added to the market price of the electricity. This support is reflected in the final price of the electricity and the consumers are those who pay extra for the use of renewable sources (Ministry of Industry and Trade, 2010). There is a different support for each technology – the highest feed-in tariffs are set for biomass and small hydropower

installations (see table 5). However, there was a strong financial support for photovoltaics in the past years, which led to an unexpected solar boom. In the last years, the feed-in tariffs for photovoltaics decreased from 523€/MWh in 2008 to 110€/MWh in 2013 (ČSVE, 2013). Together with high tariffs, the prices of photovoltaic technologies fell rapidly and strong currency made their imports cheaper. All those factors contributed to faster returns of the investment – from 15 years they fell to 8 years (Ministry of Industry and Trade, 2011). After the adjustment of feed-in tariffs for photovoltaics, the level of financial support for renewable resources is comparable in the both countries, as shown in the table below.

Energy source	**FIT Czech Republic (€/MWh), 2013**	**FIT Austria (€/MWh), 2012**
Small hydropower	126	32–106
Windpower	82	95
Biomass	145	57–200
Photovoltaics	110	166–197

Table 5: Feed-in tariffs for renewable technologies (Data source: ČSVE, 2013; ÖSET-VO, 2012).

The most recent State Energy Concept (Ministry of Industry and Trade, 2012) that has been presented by the Ministry of Industry and Trade but not yet approved, presents a view more skeptical towards climate change and support for renewable resources. It focuses on necessary reduction of air pollution, caused by dust and emissions of SO_2 and NO_X that, in contrast to $C0_2$, directly affect human health. The share of coal in electricity production is expected to decrease together with declining coal reserves and it should be replaced by nuclear power and renewable resources (with biomass as a preferred source of energy). However, the support for renewables should be "low, flexible and gradually curtailed". According to the strategy, the economic burden of these energy resources should not be too high and in that sense, economic prosperity is more important than to achieve European goals. Economic support of renewable resources should be financed mainly by ecological taxes, CO_2 allowances and similar measures against "dirty" technologies. The view on future potential of renewables in electricity production is rather skeptical and describes those resources as too decentralized and limited to compose a larger part of final energy consumption (Ministry of Industry and Trade, 2012).

Despite the declining resources, the ministry expects the Czech Republic to still export electricity, at least until 2040. The key to this development is to expand

electricity production from nuclear power plants – not only by extending the capacity of current power plants but possibly also by building new nuclear facilities. Despite the skeptical attitude towards climate change and its prevention and the focus on economic growth, rather than environmental issues, the ministry does not consider to abolish coal-mining limits in its current strategy. In general, thermal power plants are supposed to be replaced by nuclear power (Ministry of Industry and Trade, 2012).

3.2. Austria

In this chapter I will follow the structure of previous section. First, I will introduce relevant actors in Austrian energy policy. Then, I will analyze the policy development in the same periods I set for the Czech Republic: before and after 2004, so it is easier to analyze similarities in the development in both countries. In the end of this chapter, the most relevant policies during those two periods will be summarized for better comparison.

3.2.1. Institutions

Austria is a federal republic composed of nine states with their own local parliaments. However, the main energy policymaking takes places at the federal level. The most relevant ministries are the Federal Ministry of Agriculture, Forestry, Environment and Water Management (called Lebensministerium for short) and Federal Ministry of Economy, Family and Youth (BMWFJ). Those ministries often cooperate in formulation of energy strategies for the country. However, it is the Ministry of Finance that sets energy taxes and the Federal Ministry of Transport, Innovation and Technology that is responsible for energy R&D. Academic and basic research is supervised by the Federal Ministry of Science and Research.

Together with the liberalization of the market that was completed in Austria in the years 2001 and 2002, the new regulatory office Energie-Control was founded. It oversees the competition on energy market (together with the Federal Competition Office) and regulates network tariffs. The Austrian Energy Agency provides research and advice in the area of energy efficiency, renewable resources and advanced energy technologies. It is a center for research, as well as policy institution that helps to formulate strategies for the future.

On the electricity generation level, the biggest company is Verbund: its facilities (more than 80% of them hydropower plants) produce around 40% of

Austrian electricity (Verbund, 2012). The shares of other electricity generation companies are hard to find but according to the report Energy Policies of IEA countries on Austria (2007) there are 53 companies that generate 95% of all electricity. The number of companies involved changes over time because the electricity generators tend to form groups and temporary alliances. At the same time, only a few producers operate on nation-wide level and many of them focus only on their region or federal state. However, according to the Austrian law (Second Nationalization Act 1947), the state must keep at least 51% share in every energy-producing company and therefore have a control over them all. On the supply side, there are about 140 distribution companies but foreign firms on Austrian market distribute energy only to large consumers. This is caused mainly by complicated rules in the distribution system for households: it is difficult for non-Austrian companies to entry this market. And because the personal consumption of electricity is rather small in a country of a size of Austria, it is not worthy for the companies to try to overcome these difficulties (Energie-Control Austria, 2011).

In the non-governmental sector, there are several organizations that are interested in environmental and energy issues. Austrian Greenpeace was founded in 1982 and has been active in all the main programs of this organization, including climate protection and refusal of nuclear power. Naturfreunde (Friends of the Nature), GLOBAL 2000 or Österreichisches Ökologie Institut (Austrian Institute of Ecology) are another examples of relevant NGOs when it comes to energy-related questions. Ökobüro is an umbrella organization for different ecological groups in Austria, coordinating their actions within specific policy areas. On the political level, Austrian Green Party plays an important role. Its roots lie in the civic movement resisting nuclear power in the 1970s. The Greens got even more supporters after the Chernobyl disaster in April 1986 and in November of that year the party got enough votes to gain 8 seats in the national parliament (Nationalrat). It has been present and active in the national politics since then. In the last election of 2008 the Green Party got 20 mandates (Die Grünen, 2013).

Table 6 shows the main institutions relevant in electricity sectors in both countries. As we can see in the table, the main difference between the two countries lies on the electricity production and distribution level with Austria having much more diversified supply of electricity than the Czech Republic. This is partly caused

by the federal structure in Austria, as many of the companies are active only in their federal state or particular region. We can also observe the difference in the role of Green Party that is well established in Austrian political system but is not present in Czech parliament and therefore it cannot influence national energy strategies.

	Austria	**Czech Republic**
Governmental level	Federal Ministry of Agriculture, Forestry, Environment and Water Management and Federal Ministry of Economy, Family and Youth	Ministry of Industry and Trade and Ministry of Environment
Green Party	20 seats in national parliament	No seats in parliament
Regulation and control	Energie-Control Austria, Federal Competition Office, Austrian Energy Agency	Energy Regulatory Office, Office for the Protection of Competition, The State Energy Inspection
Electricity generation	Verbund (40% of Austrian electricity), 59 companies generate 95% of all electricity	ČEZ (80% of Czech electricity)
Energy distribution	Around 140 companies	Around 33 companies (E.ON, PRE and ČEZ control about 75% of the distribution)
NGOs	Greenpeace, Friends of the Nature, GLOBAL 2000, Austrian Instituto of Ecology, Ökobüro (umbrella organization)	Greenpeace, Friends of the Earth Czech Republic, Mothers of South Bohemia, Green Circle (umbrella organization)

Table 6: Czech and Austrian institutions relevant in energy sector.

3.2.2. Austrian energy policy until 2004

Austria started to diversify its electricity production already after the WW2. In addition to thermal power plants the decision to build large hydropower plants came into reality already in the 1950s. In the end of the 1960s the Austrian government introduced a plan to produce electricity in nuclear power plants. The construction of the first nuclear facility in Zwentendorf started in 1971 and its opening was planned for August 1976. The energy plan of 1976 expected Austria to have 3 nuclear power plants until 1990 (Albrecht, 2012). However, the government at that time did not expect public resistance against nuclear energy that culminated during the construction of Zwentendorf power plant. The protests led to a referendum held in November 1978 that ended with an extremely tight victory of the opponents against

nuclear power: 50.5% voted against opening of the power plant, 49.5% voted "yes" (BMI, 2013). The referendum was followed by the law that has forbidden building and opening of any nuclear facilities in Austria (Demokratiezentrum Wien, 2013). The main goal of this law was confirmed in 1998 by the bill "about the prohibition to use nuclear fission or nuclear fusion for electricity generation in Austria". This decision changed significantly the energy policy of the country that faced growing energy consumption and needed to find other energy sources. The government focused on the potential of hydropower, which had the highest share in Austrian electricity generation in 1988/1989 (Albrecht, 2012). However, the refusal of nuclear power together with oil crises of the 1970s together led to a growing importance of coal-fired power plants during the 1980s (Geyrhofer, 2012).

The national energy report of 1986 already included a remark on environmental risks connected to CO_2 emissions that was a reason to focus on less harmful energy resources, such as natural gas instead of coal. The following report of 1990 commits to CO_2 reduction by 20% until the year 2000 and substitution of fossil fuels by renewable resources, especially biomass. This strategy was further expanded in the following years, showing a clear commitment of Austrian government towards environmental protection and extended use of renewable resources, supported by the new ecological tax on emission intensive technologies. Austria has accepted the need for reduction of CO_2 emissions as formulated in the Kyoto Protocol. The government has promised to cut the emissions by 13% between 1990 and 2008–2012. At the time, it was not planned to reduce emissions from electricity generation, as it was produced mostly in hydropower facilities and smaller, yet necessary amount of thermal power plants. The main emission reduction was to be made in other sectors, such as industry or transport (Albrecht, 2012). However, this initiative failed and Austria even experienced relative growth of GHG emissions between 1990 and 2008 (see table 3). On the other hand, it is important to note that the absolute amount of emissions differ significantly in the two countries and despite recent emission reduction, the Czech Republic emitted 139,523 kiloton CO_2 equivalent in 2010 compared to 84,594 kiloton CO_2 equivalent in Austria (United Nations, 2012).

Since 2001 the European Union pushed for liberalization of electricity markets in its member states. The liberalization created stronger competition on the electricity market and offered consumers the opportunity to choose freely their electricity

provider. Large industrial customers have been allowed to choose cheaper electricity providers already since 1999 and it has resulted into a stiff competition and large price cuts. At the time when the liberalization reached domestic customers, prices were already more or less stabilized and the following reductions averaged at around 10 %. It is important to note that electricity prices are not uniform around the country because there are different distribution network tariffs in federal states (Haberfellner et al., 2002). The lower prices set by electricity providers were also often neutralized by higher taxes and extra charges (Haider, 2004).

Around the turn of millennium, Austria felt as a leader on a European level in environmental protection and ecological technologies. The government program from 2000 even mentions the need to "raise EU standards on Austrian level" (Regierungsprogramm, 2000). The commitment to protect Austrian citizens against nuclear power played its role again before the enlargement of the EU in 2004. Austria then asked the candidate countries to close their old nuclear power plants – this has become a condition for entry the EU for Slovakia, Lithuania and Bulgaria. Moreover, Austria requested better information system between neighboring countries in the case of technical disorders or accidents in the nuclear power plants. This was the issue in the dispute between Austria and the Czech Republic before it joined the EU.

The main political parties in Austria reached a surprising consensus on energy policy. Therefore the strategy mainly concentrates on renewables and increasing energy efficiency. In contrast to their Czech counterparts, Austrian policymakers see renewable resources and advanced energy technologies as an impulse for innovation and future economic growth, rather than competing interests between environment and industry. With this support, Austria has an ambition to become European hub for energy technologies. This goes hand in hand with a long-term commitment to support technology and research in order to strengthen Austrian position on the world market (Regierungsprogramm, 1997). In energy strategies Austrian policymakers concentrate on energy efficiency to stop growing energy consumption in the country. Together with further expansion of renewable energy carriers it would consequently reduce Austrian dependence on energy imports (Geyrhofer, 2012).

State support for electricity generation from renewable resources is embedded in the Green Electricity Act (Ökostromgesetz). The first comprehensive version of this law was released in 2002 and has been already amended several times since then.

This law sets feed-in tariffs for renewable energy as well as investment support. The regulatory office E-Control is then responsible for annual reports evaluating the effects of adopted measures (BMWFJ, 2011a).

3.2.3. Recent energy policy in Austria

Recently, Austrian government follows similar argumentation as in the 1990s: because it is dependent on imports of fossil fuels, the main goal is to expand the use of renewable energy resources, increase the energy efficiency and promote research of energy technologies. This is a logical step for a country that does not only import fuels but also electricity. Electricity trade between Austria and its neighboring countries has nearly tripled since 1990, however, since 2001 Austria has imported more electricity than exported. Electricity imports come mainly from Germany, 61%, and the Czech Republic, 35% (BMWFJ, 2011a). Focus on domestic energy sources and extended electricity generation from renewables is therefore understandable. The energy strategy from 2009 specifically states that "the expansion of renewable energy in Austria has an enormous importance for national self-sufficiency and strengthening of energy security, it creates new demand for high-skilled labor, strengthens country's competitiveness and is necessary to achieve the energy and climate policy objectives" (Lebensministerium & BMWFJ, 2009). Similar argumentation is used for increasing energy efficiency: necessary improvements of buildings will create new jobs in construction sector and focus on energy efficient technologies will create a need for innovation and development of new products.

In terms of R&D investment and specialization, Austria concentrates on agricultural research, despite decreasing economic importance of this sector. The focus on energy research has been rather low but it seems the priorities and funds are changing in recent years. In the field of energy, the highest shares of the budget were allocated to energy efficiency, renewable energy research and bioenergy. In contrast, shares of fossil fuel research have been negligible and also the support for research in photovoltaic energy, wind power and hydropower were of minor importance. It does not correspond to the shares of those resources in electricity generation, with the biggest share of hydropower as and increasing capacity of wind power (Scordato, 2010).

The government program from 2007 set ambitious targets for the future: to increase the share of renewables in electricity generation to 80% by 2010 and to 85%

by 2020, to improve the utilization of hydropower and to double the use of biomass by 2010. Today we can see that Austria failed to reach the target of the share of renewables in electricity generation, although impressive 65 % of electricity came from renewables in 2010 (Lebensministerium, 2011). Similarly, electricity generation from biomass increased only by 18% between 2007 and 2010 (Lebensministerium, 2009 and 2011). On the other hand, the use of small hydropower facilities has improved significantly, almost doubling only between 2009 and 2010 (Lebensministerium, 2011).

The energy saving measures focused on improving energy efficiency of buildings – not only to invest in reconstruction but also to promote low-energy standards for new buildings. From 2015 on the standards should be strengthened to primarily support the construction of passive houses. The financial support of these costly measures has been provided through Climate and Energy Fund that also promotes research of energy technologies and climate protection (Regierungsprogramm, 2007). Annual budget of this fund has changed over the years (2007–2013) but ranged between the minimum of 120 million euro in 2009 to the maximum of 150 million euro in 2010 (Climate and Energy Fund, 2009 and 2010). This is further supported by klima:aktiv initiative, introduced in 2004, which offers programs for municipalities, households and companies to switch to greener energy and services (Lebensministerium, 2007). Moreover, klima:aktiv has evolved into a state-wide network that does not connect only governmental institutions but also other partners, including around 300 businesses. Next to subsidy programs, klima:aktiv now offers also further education and vocational training in related industries and services. Next to this initiative, there are also other programs focusing on improving the energy efficiency of public institutions and regional electrical utilities offer subsidies for their customers to purchase energy efficient electrical appliances. According to Austrian Energy Agency (2012), these measures led directly and indirectly in reducing the CO_2 emissions by 1.6 million tons a year. With Austrian emissions of 82.8 million tons of CO_2 equivalent makes a reduction of almost 2% a year (Lebensministerium, 2013a).

The more recent versions of the Green Electricity Act reduce the support for construction of small and medium hydropower plants as well as small photovoltaic installations under 5 kW. However, the state still supports existing facilities and offers investment subsidies for small installations for private use (that are not connected to

public electricity grid). According to the latest amendment, Green Electricity Act 2012, the total subsidies for new green electricity generation facilities grew from 21 million euro to 50 million euro (with a plan to annual decrease of the support to 40 million in ten years). Moreover, a one-time-only support of 110 Million euro was offered for construction of wind, solar and small hydropower facilities (Lebensministerium, 2012). Compared to current shares of renewable resources, the highest growth is expected for wind power and photovoltaics, followed by biomass and hydropower.

Austria has become one of the first European countries that introduced feed-in tariffs and investment subsidies for renewable technologies, first targeting photovoltaic technologies. Until 2004 feed-in tariffs were guaranteed for 13 years (Haas et al., 2011). Today, the level of feed-in tariffs depends on technology, capacity and the year of signing up the contract. Currently, the highest support is reserved for certain uses of biomass and photovoltaics (see table 5).

Austrian government keeps its commitment to oppose nuclear energy, mainly for safety reasons (especially in the neighboring countries). The government program from 2007 encourages the EU to support further decommission of older nuclear power plants across Europe (Regierungsprogramm, 2007). Both government programs from 2007 and 2008 explicitly mention the need to secure Czech-Austrian dialogue concerning the safety of Temelín power plant. This policy direction was strengthened after the nuclear disaster in Fukushima in March 2011 that brought further question about safety of nuclear power (Lebensministerium, 2012).

Austria has, as well as other EU member states, set its targets within the frame of Europe 2020 Strategy (see table 4). To reach these targets, Austria concentrates on modernization and higher energy efficiency in transport sector and buildings, it means the areas of highest waste of energy as well as $C0_2$ emissions outside the trading scheme (Paleczny, 2011). Moreover, according to the Energy Service Directive, passed by the European Commission in 2006, Austria is obliged to achieve energy savings of 9% by 2016 compared to the average energy use of 2001–2005 (Austrian Energy Agency, 2012). Transport sector, followed by industry and residential sector are also the main drivers of rapid increase in energy consumption since 1990, illustrated in figure 12. In Austria, energy use grew steadily between 1994 and 2005, when it more or less stabilized. This was also a period of stable economic growth in

Austria (Austrian Energy Agency, 2012). Czech Republic followed similar trend since 1999. However, both countries experienced steep decline in energy use in recent years, corresponding to the world economic crisis. However, when we analyze energy intensity (see figure 10), we can observe that it has remained relatively stable in Austria, especially in comparison to rapid decline in the Czech Republic.

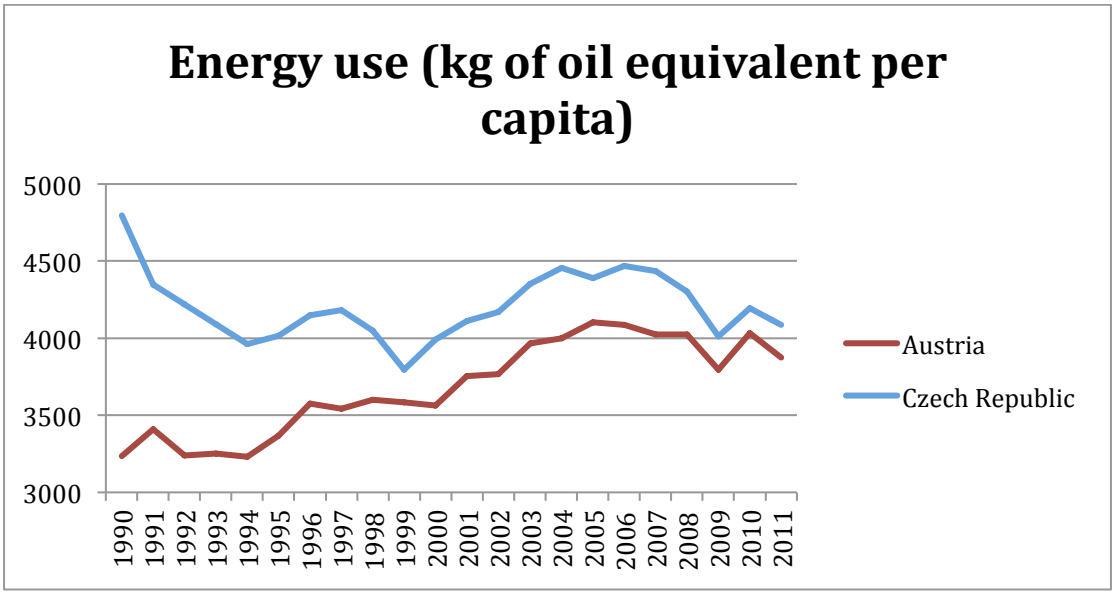

Figure 12: Energy use in Austria and the Czech republic (Data source: World Bank, 2013a).

To sum up, Austrian and Czech governments often focused on different priorities and strategies concerning energy policy. As table 7 shows, some of the plans might be in opposition (as in the case of nuclear energy) and arguments used in energy policy might differ significantly (as in the case of renewables that are seen as a limit for economic growth in the Czech Republic but in Austria they are described as a potential source for innovation and competitiveness.

Before 2004	**Czech Republic**	**Austria**
	Mining reduction of uranium and coal – setting mining limits	Extended use of renewable resources
	Solving environmental problems of the past (air and water pollution)	Reduction of CO_2 emissions
	Price liberalization (abolishing state subsidies on energy prices or coal industry)	Liberalization of energy market
	Privatization within energy sector	Need to stop growing energy consumption
	Opening of Temelín power plant	Opposition to nuclear power
	Restructuralization leading to reduction energy and CO_2 intensity	Renewables and energy savings as an impulse for innovation and economic growth
	Kyoto Protocol (successful)	Kyoto Protocol (unsuccessful)
After 2004	Liberalization of energy market	

	Limited promotion of renewable energy sources	Expansion of renewable energy sources and energy R&D – potential for future competitiveness and economic growth × growing electricity imports
	Focus on low energy dependence and continuous electricity exports, necessary balance between green energy and economic growth	
	Energy savings (programs for energy improvements of buildings)	Energy savings (Climate and Energy Fund)
	Expansion of nuclear power	Opposition to nuclear power
	Use of European funds (Operational Programme Environment and Operational Programme Enterprise and Innovations)	Klima:aktiv
	EU Emission Trading System	EU Emission Trading System
	Europe 2020 – setting very low targets that are easy to meet	Europe 2020 – setting high targets that often fail

Table 7: Energy policy in the Czech Republic and Austria in periods before and after 2004.

4. Discussion

The main aim of this thesis was to explain the differences in the resources used for electricity generation in the Czech Republic and Austria from two different perspectives: geographical and institutional. First, we can concentrate on geographical conditions and available resources in both countries. This follows arguments used by economists such as Paul Krugman, Jared Diamond or Jeffrey Sachs that believe that "geography matters" when it comes to economic development. In the case of electricity, we can see that both countries prefer to use domestically available resources: coal in the Czech Republic and hydropower in Austria. However, both countries recently experienced a shift towards other technologies: nuclear power and renewables in the Czech Republic and "new" renewable resources in Austria (such as small hydropower installations, wind power or biomass, excluding the traditional, yet mostly exhausted potential of large hydropower plants).

Currently, most of the uranium used in Czech nuclear power plants is imported from abroad. Although the country has its own domestic resources of uranium, those are not exploited for ecological and economic reasons, although this decision might change with rising prices on the world market. It is therefore not considered as a domestic source of energy. When it comes to renewable resources, both countries support further use of biomass that is domestically available. One example of a renewable source that is not used correspondingly to its availability is solar power. Neither of the countries have ideal geographic location for wide use of

solar power; however, the conditions in southern Austria are better than anywhere else in the considered region. However, solar power in Austria is mainly used for supplementary heating of water and houses and not for electricity production, where it had less than 1% share among other renewable resources. In contrast, in the Czech Republic electricity generated in photovoltaic installations has composed 30% of all renewable resources in 2011, ignoring rather unfavorable conditions in the country. Wind power is also used differently in both countries – although their shares among other renewable resources are similar, wind turbines in Austria produce higher absolute amount of electricity than in the Czech Republic, although the average wind speed is comparable in both countries. This leads us to another explanation of existing energy mix in electricity generation, considering the role of institutions and policy.

One of the concepts, used to explain the relationship between institutions and economic growth, is the idea of path dependence. Unfortunately, there is no universal set of variables that we can use to decide whether certain development is path dependent or not. However, we can still try to look for characteristics typical for path dependence. The main idea is that when a country starts down a track, the probability of following that path increases over time as the costs of reversal become very high (Levi, 1997; Pierson, 2000). According to Arthur (1994) there are three phases of this development: (1) Preformation Phase marked by a "critical juncture" that starts a new path; (2) Formation Phase that makes the movement along the same path more and more irreversible; and (3) Lock-in Phase that preserves dominant pattern and determines future development. To find a proof of path dependence it is important to show that although there were other possibilities along the way, they were not chosen because of existing lock-ins. The main question that needs to be answered is whether we can find such development in Czech or Austrian energy policy.

In the case of the Czech Republic, the key moment in recent energy policy was symbolized by the government resolution from 1991 that protects certain areas from further coal mining. The coal deposits in that area are no longer available for electricity generation and it had become clear that there was a strong need for another powerful source of energy for the future when there will be no domestic fuels for thermal power plants. At that time, the second nuclear power plant Temelín was under construction and it seemed as a viable option to solve this dilemma. Nuclear power has also become an ideal energy source when it comes to fulfilling international

commitments to reduction of emissions. Simultaneously, there is a future possibility to exploit domestic reserves of uranium when its price on world market becomes too high. Therefore, nuclear power fulfills the main goals of Czech energy policy: it is a powerful and cheap source of electricity (although it only becomes cheap after the costly construction of a nuclear power plant) and might be also considered as a good resource when it comes to energy security (even without domestic reserves there is still a possibility for diversified imports).

Since the Czech Republic has become a member of the EU, more stress has been put on renewable energy resources. Although their shares in electricity production have grown significantly in the last decades (from 2.6% in 1993 to 10% in 2012), their capacity is still nowhere close to the two Czech nuclear power plants (Energostat, 2012). The expansion of renewable resources is slow and they probably cannot become a key source of domestic electricity in the near future. Alternatives to nuclear power are therefore represented by coal or natural gas. Although Czech government received a recommendation from the expert commission led by professor Pačes to expand its use of natural gas, this is opposed by politicians stressing the importance of energy security: especially after the gas crisis of 2008/2009 caused by the dispute between Russia and Ukraine (Euroskop, 2009). As the Czech natural gas comes mainly from Russia, it seems risky to rely on these imports more than it is necessary.

The use of coal is limited by its declining reserves and the fact that the remaining resources are blocked by the mining limits from 1991. Although the breach of those limits would prolong the possible use of coal as a source for electricity generation, with more effective technologies maybe for decades, it seems politically impossible to discuss this possibility. Several attempts to reevaluate the scope of these limits failed immediately and the expert report from 2008 does not even consider it as a viable possibility (Pačes et al., 2008). It is widely accepted that the environmental costs would be higher than potential profits from coal mining, plus it would affect the level of CO_2 emission that are supposed to decline in the future. It seems that since the government resolution of 1991 the Czech governments are locked in the support of nuclear power, as the costs of switching technologies are very high. The only important political subject opposing the nuclear power is the Green Party that still

plays much smaller role than in other West European countries and it is not present in the national parliament.

In the case of Austria, the situation is rather opposite. Until the end of 1970s, Austria had its own plans for electricity generation in nuclear power plants but the strategy changed significantly in 1978 when Austrians voted in a referendum against the use of nuclear energy in their country. Since then, Austrian governments have been committed to anti-nuclear policy that was confirmed again by a new law in 1998. However, the growing demand for electricity still has to be satisfied. The number of coal-fired power plants increased during the 1980s and later on a switch towards natural gas has been initiated, in reaction to reports on the harmful effect of CO_2.

In the long term, Austrian governments promote extended use of renewable sources, especially biomass, small hydropower installations and wind power. However, the newly installed facilities cannot keep pace with growing energy demand and since 2001, Austria has been importing electricity, mostly from Germany and the Czech Republic. Simultaneously, the amount of CO_2 emissions was not reduced to levels promised in the Kyoto Protocol. Therefore it seems that the Austrian lock-in is symbolized by the refusal of nuclear power that would make the country independent on foreign imports of electricity and substitution of existing thermal power plants by nuclear facilities would decrease the amount of CO_2 emissions (however, other sectors rather than energy production is responsible for high emissions in Austria). Despite of deficiencies in Austrian electricity production, the reevaluation of nuclear energy is not an issue today, as all the main political parties reached a consensus on this topic.

It is important to note that path dependence does not necessarily lead to inefficiency (Sydow, 2009). Austrian governments support the use of renewable resources as well as expansion of energy-saving technologies not only to improve its energy security but also to boost innovation in those advanced sectors. According to this reasoning, Austria might then become a center of green technologies that might bring unique opportunities on the world market where the growing demand for energy-saving products and alternative energy sources is expected in the future. On the other hand, on a short-term horizon it might bring higher energy dependency of Austria and higher prices for Austrian electricity consumers as current production

cannot keep up with the consumption and the installation of new energy facilities is not fast enough.

In the case of the Czech Republic, the way out of current path-dependent development should not be made through the breach of mining limits. But according to Martin and Sunley (2006) there exists a potential for endogenous reforms that help a country escape the existing path. This can be made through (1) diversification of current production or (2) adoption of new technologies radically changing the functioning of the sector. I believe it would be helpful if Czech policy-makers adopted similar reasoning as their Austrian counterparts: that renewable resources and new energy technologies do not stand in opposition to economic development and industrial expansion but it might create a new sector using advanced technologies that have a strong potential for the future. At the same time, further R&D in energy sector is also necessary to improve efficiency of current technologies used in thermal or nuclear power plants. That cannot be achieved solely through financial support. Simultaneously, reforms need to be made also in the availability of human capital, as the number of high-skilled workers in the energy sector is declining over time (Pačes et al., 2008). Moreover, I believe that the Czech Republic should not cling to the hope of electricity export in the future, as the Ministry of Industry and Trade (2012) expect it until 2040, if it means an excessive use of "dirty" technologies.

It has been shown that an analysis of energy resources used in electricity production requires new, energetic explanation (illustrated in figure 13). The cases of Czech Republic and Austria showed that geography matters when it comes to the use of powerful domestic resources such as coal or hydropower. However, this analysis showed that history and institutions matter in the use of nuclear energy and renewable resources (other than large hydropower installations). In the Czech Republic, nuclear power represents a special case: its extended use is strongly connected to recent political decisions to substitute coal-fired power plants with nuclear power. This strategy is supported by the fact that nuclear energy is relatively cheap and it does not add any GHG emissions. However, uranium used in the power plants can be seen also as a domestic source, although it is not currently used. On the contrary, Austrian refusal of nuclear power can be explained mainly by prevailing institutions that have been shaped since the referendum in 1978.

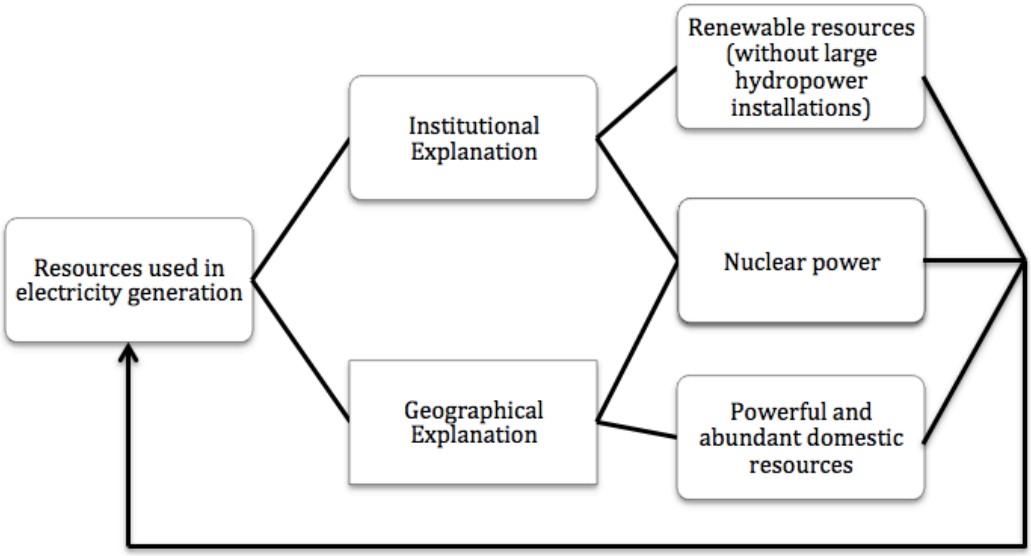

Figure 13: Institutional and geographical explanation of energy mix in electricity production.

Conclusion

In the beginning of my research, I was looking for an answer to following question: How can we explain the differences in electricity generation in the Czech Republic and Austria? First possible explanation lies in the geographical conditions in the two countries. The most important energy sources used in electricity generation are the ones that are the most abundant – hydropower in Austria and coal in the Czech Republic. However, this connection becomes loose in an analysis of other resources, especially nuclear power and renewables. Although there are still remaining reserves of uranium in the Czech Republic, they are not exploited today and the necessary fuel for nuclear power plants is imported from abroad. Nevertheless, nuclear power is widely used in the Czech Republic, in contrast to Austria, where it has been forbidden since 1978 when the Austrian government reacted to the public resistance against nuclear power and has not changed this decision since. It is clear that the turn away from uranium as an energy source was not made because of the unavailability of the fuel or economic disadvantages of this resource and the causes of this development have to be found elsewhere. The use of renewable energy sources also does not fully correspond to its availability in the country, especially when it comes to photovoltaics that is intensively used in the Czech Republic, although climatic conditions are more favorable in Austria, and in the case of wind power that produces five times more electricity in Austria than in the Czech Republic, although the wind conditions are

similar in both countries. However, these differences in the use of nuclear power and renewable energy resources can be explained from the institutional point of view.

One of the main goals of this thesis was to find possible signs of path dependence in the energy policy of selected countries. First, the analysis of recent policy development in Austria and the Czech Republic was conducted and main arguments and long-term strategies were highlighted. Consequently, possible path dependent processes were identified. In the case of the Czech Republic, the critical juncture of path dependence might be represented by the government resolution from 1991, when the environmental protection of certain coal-rich areas was set and mining was forbidden in this region. After the resolution, Czech governments needed to find another powerful source of energy to satisfy domestic demand for electricity. The decision was made to complete the construction of nuclear power plant Temelín that was initiated by the communist government in the end of 1970s. Since the late 1990s, Czech energy strategies focus on the intensive use of nuclear power with renewables as complementary sources of electricity. Today it seems politically impossible to reevaluate the mining limits from 1991 and the only parliamentary opposition to nuclear power was symbolized by the Green Party, which was part of the governmental coalition in 2007–2009. However, the influence of the Green Party has declined since 2010 when it lost the election and currently is active only on the regional level. Currently, natural gas is not seen as a possible alternative to coal because higher imports of gas would disrupt existing understanding of Czech energy security. Moreover, Czech policy arguments are based on a belief that an expansion of renewable resources and reduction of CO_2 emissions stands in opposition to industrial production in the country and can be therefore supported only on a scale that does not harm Czech economy. In contrast, Austrian government considers renewables and green technologies as a possible source of innovation in the future and Austrian focus on alternative and energy-saving technologies might improve country's competitiveness on the world market.

In Austria, the path dependent development is marked by the tight victory of opponents of the nuclear power in 1978, when 50.5 % of Austrians voted in a referendum against opening the nuclear power plant Zwentendorf. Since then, Austria has committed to anti-nuclear policy, although it created significant problems in its energy strategy. The refusal of nuclear power has led to an extended use of thermal

power plants (coal-fired plants in the 1980s, followed by the expansion of the use of natural gas in electricity generation in the 1990s), high energy dependency of Austria and growing imports of electricity since 2001, as well as expensive electricity for consumers. Despite these disadvantages, leading Austrian political parties have reached a consensus on this topic and future strategies are based on expansion of new renewable resources as well as improving energy efficiency in the country.

To sum up, the paper was showed that it is possible to describe Czech, as well as Austrian energy policy as path dependent because neither of the countries seems to consider switching of the existing path, although there exist different available alternatives. However, it is important to point out that path dependence does not necessarily lead to inefficiency, although the risk of lower productivity is used as a main argument against path dependent processes. Only the future and further research will show whether existing strategies of Czech and Austrian governments follow the dark path of inefficiency or whether they lead to effective and sustainable electricity production.

References

Articles and academic papers

- Acemoglu, D.; Johnson, S. & Robinson, J. A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly Journal of Economics*, November 2002, pp. 1231 - 1294.
- Alexeev, M. & Conrad, R. (2011). The natural resource curse and economic transition. *Economic Systems*, vol. 35, pp. 445-461.
- Albrecht, K. (2012). Energiepolitik in Österreich nach dem 2. Weltkrieg, Diplomarbeit, Faculty of Economics, Vienna University. Available at: http://othes.univie.ac.at/18121/ [Accessed 7 May 2013].
- Arthur, W. B. (1994). *Increasing Returns and Path Dependence in the Economy*. Ann Arbor: University of Michigan Press.
- Boschma, R. A. & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography*, vol. 6, pp. 273-302.
- Busse, M. & Gröning, S (2013). The resource curse revisited: governance and natural resources. *Public Choice*, vol. 154, pp. 1-20.
- Bůřil (2011). Evaluace energetické politiky ČR – bezpečnostně-strategické paradigma. Master Thesis, Faculty of Social Sciences, Masaryk University.
- Černoch (2011). Energetická politika EU a energetické zájmy ČR. Dissertation Thesis, Faculty of Social Sciences, Masaryk University.
- Chmelík, P. (2011). Comparison of the Czech and Austrian Energy Sector in the Context of the Power Industry Development in the European Union. Master Thesis, Faculty of Economics and Administration, Masaryk University. Available at: http://is.muni.cz/th/206509/esf_m/ [Accessed 7 May 2013].
- Di John, J. (2011). Is there really a resource curse? A critical survey of theory and evidence. *Global Governance*, vol. 17, pp. 167-184.
- Dobrovolná et al. (2008). Energetická politika České republiky – otázka prosaditelnosti, Working Paper č. 30, 2008, International Institute of Political Science of Masaryk University.
- Fawn, Rick (2006). The Temelín nuclear power plant and the European Union

in Austrian-Czech relations. *Communist and Post-Communist Studies*, vol. 39, pp. 101-119.

- Gallup, J. L., Sachs, J. D. & Mellinger, A. D (1999). Geography and Economic Development. *International Regional Science Review*, vol. 22, pp. 179-224.
- Gass, V. et al. (2013). Assessing the economic wind power potential in Austria. *Energy Policy*, vol. 53, pp. 323-330.
- Geyrhofer, A. F. (2012). Energiepolitik in Österreich [pdf]. Diplomarbeit, Faculty of Social Sciences, Vienna University. Available at: http://othes.univie.ac.at/18037/1/2012-01-22_8603053.pdf [Accessed 7 May 2013].
- Gingrich, S. et al. (2011). Long-term changes in CO2 emissions in Austria and Czechoslovakia - identifying the drivers of environmental pressures. *Energy Policy*, vol. 39, pp. 535-543.
- Haas, R. et al. (2011). A historical review of promotion strategies for electricity from renewable energy sources in EU countries. *Renewable and Sustainable Energy Reviews*, vol. 15, pp. 1003–1034.
- Haberfellner et al. (2002). Electricity Market Liberalisation in Austria: Further Down the Way, Working Paper Nr. 10, Energie-Control Austria.
- Haider, H. (2004). Investitionsbedarf und zukunftige Bedeutung der Versorgungssicherheit in Europa und Osterreich. *Elektrotechnik und Informationstechnik*, vol. 121, no.11, pp. 406-411.
- Havlíčková, K. & Suchý, J. (2010). Development model for energy crop plantations in the Czech Republic for the years 2008-2030. *Renewable and Sustainable Energy Reviews*, vol. 14, pp. 1925-1936.
- Kavina, P. et al. (2009). Some issues related to the energy sources in the Czech Republic. Energy Policy 37, pp. 2139-2142
- Krugman, P. (1998) What's new about the new economic geography? *Oxford Review of Economic Policy*, vol. 14, no. 2, pp. 7-17.
- Langmajerová, B. (2013). Path dependence in electricity generation: The case of Austria and the Czech Republic, Unpublished, EKHM40 Research Design, Department of Economic History, Lund University.
- Lehmann, P. et al. (2012). Carbon Lock-Out: Advancing Renewable Energy

Policy in Europe. *Energies*, vol. 5, pp. 323-354.

- Levi, M. (1997). "A Model, a Method, and a Map: Rational Choice in Comparative and Historical Analysis." In M. I. Lichbach & A. S. Zuckerman, (eds), *Comparative Politics: Rationality, Culture, and Structure*. Cambridge: Cambridge University Press, pp. 19-41.
- Lewandowski, I. et al. (2006). The potential biomass for energy production in the Czech Republic. *Biomass and Bioenergy*, vol. 30, pp. 405-421.
- Lofstedt, R. (2008). Are renewables an alternative to nuclear power? An analysis of the Austria/Slovakia discussions. *Energy Policy* 36, pp. 2226-2233.
- Martin, R & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography*, vol. 6, pp. 395-437.
- Neuhoff, K. (2005). Large-scale deployment of renewables for electricity generation. *Oxford Review of Economic Policy*, vol. 21, no. 1, pp. 88-110.
- North, Douglass C. (1991) Institutions. *Journal of Economic Perspectives*, vol. 5, no. 1, pp. 97-112.
- Paleczny, G. (2011). Österreich und die Europa 2020-Strategie. Diplomarbeit, Faculty of Social Sciences, Vienna University. Available at: http://othes.univie.ac.at/15322/ [Accessed 7 May 2013].
- Pierson, P. (2000). Increasing Returns, Path Dependence, and the Study of Politics. *The American Political Science Review*, vol. 94, no. 2, pp. 251-267.
- Rodrik, D. et al. (2004). Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development. *Journal of Economic Growth*, vol. 9, pp. 131-165.
- Schwarzbauer, P. et al. (2013). Economic crises: Impacts on the forest-based sector and wood-based energy use in Austria. *Forest Policy and Economics*, vol. 27, pp. 13-22.
- Scordato, L. (2010). Public Energy R&D Priorities in Small EU Member States: Evidence from Denmark, Austria and the Netherlands. *Journal of the Knowledge Economy*, vol. 1, pp. 202–218.
- Sheppard, E. (2011). Geography, nature, and the question of development. *Dialogues in Human Geography*, vol. 1, pp. 46-75.
- Sivek, M et al. (2012). Factors influencing the selection of the past and future strategies for electricity generation in the Czech Republic. *Energy Policy* 48,

pp. 650-656.

- Sivek, M. et al. (2013). Uranium and the Energy Strategy of the Czech Republic in *Electricity Production, Energy Sources, Part B: Economics, Planning, and Policy*, vol. 8, no.2, pp. 115-121.
- Sydow, J., Schreyögg, G. & Koch, J. (2009). Organizational path dependence: Opening the black box. *Academy of Management Review*, vol. 34, no. 4, pp. 689-709.
- Thelen, K. (1999). Historical institutionalism in comparative politics. *Annual Review of Political Science* (1999), vol. 2, pp. 369-404.
- Vogel, S. K. (1996). *Freer Markets, More Rules: Regulatory Reform in Advanced Industrial Countries*. Ithaca, NY: Cornell Univ. Press.

Data and Documents

- Action Plan for RES (1999). Akční plán pro obnovitelné zdroje energie: Akční plán pro politiku podpory využívání obnovitelných zdrojů energie v České republice pro období do roku 2010. SRC International CS, s.r.o.
- Austrian Energy Agency (2012). Energy Efficiency Policies and Measures in Austria. Monitoring of EU and national energy efficiency targets. ODYSSEE – MURE 2010.
- AWS Truepower 2012. Available at: http://www.awstruepower.com/wp-content/uploads/2012/07/Wind-Resource-Map-EUROPE-11x17-bleed-FINAL.pdf [Accessed 24 April 2013].
- BMI (2013). Elections: Results of previous referenda, Federal Ministry of Interior. Available at: http://www.bmi.gv.at/cms/BMI_wahlen/volksabstimmung/Ergebnisse.aspx [Accessed 7 May 2013].
- BMWFJ (2011a). Energiestatus Österreich 2011, Federal Ministry of Economy, Family and Youth.
- BMWFJ (2011b): Report for the year 2011 pursuant to Article 3(3) and Article 5(5) of Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market.

- BMWFJ (2013). Energy generation – electricity. Available at: http://www.bmwfj.gv.at/ENERGIEUNDBERGBAU/ENERGIEVERSORGUNG/Seiten/Elektrizit%C3%A4t.aspx [Accessed 22 May 2013].
- CENIA (2008). Economy and environment in the Czech Republic since 1989. (Hospodářství a životní prostředí v České republice po roce 1989.)
- Ceny energie, 2013. List of electricity distribution companies. Available at: http://www.cenyenergie.cz/elektrina/katalog-dodavatelu/ [Accessed 23 May 2013].
- Climate and Energy Fund (2009). Jahresprogramm 2009 des Klima- und Energiefonds [pdf]. Available at: http://www.klimafonds.gv.at/assets/Uploads/Jahresprogramme/jahresprogramm2009screenendversion-1.pdf [Accessed 7 May 2013].
- ČEZ (2013). Electricity produced by the ČEZ Group. Available at: http://www.cez.cz/cs/pro-media/cisla-a-statistiky/skupina-cez.html [Accessed 13 May 2013].
- Climate and Energy Fund (2010). Jahresprogramm 2010 des Klima- und Energiefonds [pdf]. Available at: http://www.klimafonds.gv.at/assets/Uploads/Jahresprogramme/Jahresprogramm2010Klima-undEnergiefonds2.pdf [Accessed 7 May 2013].
- ČSVE (2013). Development of prices of wind power and other renewable resources. Available at: http://www.csve.cz/clanky/graf-vyvoje-vykupnich-cen/278 [Accessed 13 May 2013].
- Czech Geological Service (2012) and the Ministry of Environment. Surovinové zdroje České republiky: Nerostné suroviny 2012.
- Demokratiezentrum Wien (2013). Available at: http://www.demokratiezentrum.org/wissen/timelines/das-atomkraftwerk-zwentendorf.html [Accessed 7 May 2013].
- The Economist (2011). Energy: The dirty, clean Czech Republic. Available at: http://www.economist.com/blogs/dailychart/2011/12/energy [Accessed 24 April 2013].
- The Economist (2013). Carbon trading: Below junk status, Apr 16th 2013. Available at: http://www.economist.com/blogs/schumpeter/2013/04/carbon-trading [Accessed 8 May 2013].

- The Economist Intelligence Unit (2013). Democracy index 2012: Democracy at a standstill [pdf]. Available at: https://www.eiu.com/public/topical_report.aspx?campaignid=DemocracyIndex12 [Accessed 13 May 2013].
- EEA Report No. 6 (2011). Greenhouse gas emissions in Europe: a retrospective trend analysis for the period 1990–2008.
- Energie-Control Austria (2011). 10 Jahre Energiemarkt-liberalisierung [pdf]. Available at: http://www.e-control.at/portal/page/portal/medienbibliothek/presse/dokumente/pdfs/bericht-10-jahre-energiemarktliberalisierung.pdf [Accessed 7 May 2013].
- Energostat (2012). Electricity in the Czech Republic. Available at: http://energostat.cz/elektrina.html [Accessed May 13 2013].
- Energy Policies of IEA countries: Austria 2007 Review. International Energy Agency.
- Energy Policies of IEA Countries: The Czech Republic 2010. International Energy Agency.
- Energy Regulatory Office (2012). Roční zpráva o provozu ES ČR v roce 2011 [pdf]. Oddělení statistik ERÚ, Praha 2012. Available at: http://eru.cz/user_data/files/statistika_elektro/rocni_zprava/2011/Rocni_zprava_ES_CR_FINAL.pdf [Accessed 13 May 2013].
- Europe 2020 (2013a). Europe 2020 targets [pdf]. Available at: http://ec.europa.eu/europe2020/pdf/targets_en.pdf [Accessed 23 May 2013].
- Europe 2020 (2013b). Share of renewable energy in gross final energy consumption [pdf]. Available at: http://epp.eurostat.ec.europa.eu/tgm/web/_download/Eurostat_Table_t2020_31PDFDesc_8920952f-9a4b-4220-b20b-0741b377ab38.pdf [Accessed 23 May 2013].
- Europe 2020 (2013c). Greenhouse gas emissions, base year 1990 [pdf]. Available at: http://epp.eurostat.ec.europa.eu/tgm/web/_download/Eurostat_Table_t2020_30PDFDesc_716e9138-5cc7-4b55-8621-f9a79f5ac3e9.pdf [Accessed 23 May 2013].

- Europe 2020 (2013d). Primary energy consumption [pdf]. Available at: http://epp.eurostat.ec.europa.eu/tgm/web/_download/Eurostat_Table_t2020_33PDFDesc_2cb5e090-78bf-4871-87c2-03da62335d84.pdf [Accessed 23 May 2013].
- European Commission (2008). Second Strategic Energy Review: An EU Energy Security and Solidarity Action Plan, COM(2008) 781 final [pdf]. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0781:FIN:EN:PDF [Accessed 7 May 2013].
- Eurostat Press Release (2013). Energy consumption EU27 energy dependence rate at 54% in 2011: Energy consumption down by 6% between 2008 and 2011, STAT/13/23. Available at: http://europa.eu/rapid/press-release_STAT-13-23_en.htm [Accessed 7 May 2013].
- Euracoal 2012. Non-producing EU. Available at: http://www.euracoal.be/pages/layout1sp.php?idpage=915 [Accessed 24 April 2013].
- Die Grünen (2013). Wahlarchiv. Available at: http://www.gruene.at/partei/chronik/wahlarchiv [Accessed 7 May 2013].
- Government of the CR (1992). Programové prohlášení vlády České Republiky. Available at: http://www.vlada.cz/scripts/detail.php?id=26624 [Accessed 7 May 2013].
- Government of the CR (1996). Programové prohlášení vlády České republiky [pdf]. Available at: http://www.vlada.cz/assets/clenove-vlady/historie-minulych-vlad/prehled-vlad-cr/1993-2010-cr/vaclav-klaus-2/Programove-prohlaseni-vlady_1.pdf [Accessed 7 May 2013].
- Government of the CR (2004). Programové prohlášení vlády České republiky [pdf]. Available at: http://www.vlada.cz/assets/clenove-vlady/historie-minulych-vlad/prehled-vlad-cr/1993-2010-cr/stanislav-gross/Programove-prohlaseni-vlady-Ceske-republiky_1.pdf [Accessed 7 May 2013].
- Government of the CR (2005). Programové prohlášení vlády Jiřího Paroubka [pdf]. Available at: http://www.vlada.cz/assets/clenove-vlady/historie-minulych-vlad/prehled-vlad-cr/1993-2010-cr/jiri-paroubek/Programove-prohlaseni-vlady-Jiriho-Paroubka_1.pdf [Accessed 7 May 2013].

- Government of the CR (2006). Programové prohlášení vlády [pdf]. Available at: http://www.vlada.cz/assets/clenove-vlady/historie-minulych-vlad/prehled-vlad-cr/1993-2010-cr/mirek-topolanek-1/Programove-prohlaseni-vlady_1.pdf [Accessed 7 May 2013].
- Government of the CR (2010). Programové prohlášení vlády České republiky. Available at: http://www.vlada.cz/assets/media-centrum/dulezite-dokumenty/Programove_prohlaseni_vlady.pdf [Accessed 8 May 2013].
- Government Resolution no. 444 (1991). Available at: http://racek.vlada.cz/usneseni/usnweb.nsf/0/7DCED4838DD30F36C12571B6006B9ABD [Accessed 8 May 2013].
- Green Paper (2006). A European Strategy for Sustainable, Competitive and Secure Energy, Commission of the European Communities, COM(2006) 105 final. Available at: http://europa.eu/documents/comm/green_papers/pdf/com2006_105_en.pdf [Accessed 8 May 2013].
- Greenpeace (2013). 20 Years of Greenpeace in the Czech Republic. Available at: http://www.greenpeace.org/czech/cz/O-nas/20/ [Accessed 13 May 2013].
- iDnes.cz (2013). Evropská komise ukončí vyšetřování ČEZ. Souhlasí s prodejem Chvaletic, 10.4.2013. Available at: http://ekonomika.idnes.cz/evropska-komise-ukonci-vysetrovani-cez-f0r-/ekoakcie.aspx?c=A130410_115832_ekoakcie_neh [Accessed 8 May 2013].
- Jihočeské matky (2013). Available at: http://www.jihoceskematky.cz/ [Accessed 13 May 2013].
- Lebensministerium (2007). Anpassung der Klimastrategie Österreichs zur Erreichung des Kyoto-Ziels 2008-2012.
- Lebensministerium (2009). Erneuerbare Energie in Zahlen. Die Entwicklung erneuerbarer Energie in Österreich im Jahr 2008.
- Lebensministerium (2011). Erneuerbare Energie in Zahlen. Die Entwicklung erneuerbarer Energie in Österreich im Jahr 2010.
- Lebensministerium (2012). Rechtliche Grundlagen Ökostrom.
- Lebensministerium (2013a). Aktuelle Treibhausgasbilanz. Available at: http://www.lebensministerium.at/umwelt/klimaschutz/klimapolitik_national/treibhausgasbilanz.html [Accessed 7 May 2013].

- Lebensministerium (2013b). Erneuerbare Energie in Zahlen. Die Entwicklung erneuerbarer Energie in Österreich im Jahr 2011.
- Lebensministerium & BMWFJ (2009). Energiestrategie Österreich.
- Lidové noviny (2012). Lidé houfně mění dodavatele energií. Největší hráči ztrácí, 9.2.2012. Available at: http://byznys.lidovky.cz/lide-houfne-meni-dodavatele-energii-nejvetsi-hraci-ztraci-pmu-/energetika.aspx?c=A120208_171454_energetika_apa [Accessed 8 May 2013].
- Ministry of Environment (2010). Strategic framework of sustainable growth. (Strategický rámec udržitelného rozvoje).
- Ministry of Environment (2012). Státní politika životního prostředí 2012-2020.
- Ministry of Industry and Trade (2000). Státní energetická politika.
- Ministry of Industry and Trade (2004). Státní energetická koncepce České Republiky (schválená usnesením vlády České republiky č. 211 ze dne 10. března 2004).
- Ministry of Industry and Trade (2010). Národní akční plán České republiky pro energii z obnovitelných zdrojů.
- Ministry of Industry and Trade (2011). Zpráva o plnění indikativního cíle výroby elektřiny z obnovitelných zdrojů za rok 2010.
- Ministry of Industry and Trade (2012). Aktualizace státní energetické koncepce ČR.
- OECD (2011), "Improving energy system efficiency", in OECD Economic Surveys: Czech Republic 2011, OECD Publishing.
- OPŽP (2013). Available at: http://en.opzp.cz/ [Accessed 8 May 2013].
- Pačes et al. (2008). Report of the Independent Expert Commission Evaluating Energy Needs of the Czech Republic in the Long-Term Horizon. (Zpráva Nezávislé odborné komise pro posouzení energetických potřeb České republiky v dlouhodobém časovém horizontu).
- Prague Post (2013). Temelín claim sparks confusion. Available at: http://www.praguepost.com/business/15832-temelin-claim-sparks-confusion.html [Accessed 24 April 2013].

- Regierungsprogramm (1997). Available at: http://www.parlament.gv.at/PAKT/VHG/BR/BRSITZ/BRSITZ_00622/SEITE_0008.html [Accessed 7 May 2013].
- Regierungsprogramm (2000). Regierungserklärung, Bundeskanzler Dr. Wolfgang Schüssel. Österreich Neu Regieren.
- Regierungsprogramm (2007). Regierungsprogramm 2007 – 2010, Bundeskanzleramt Österreich.
- Solargis.info (2011). Available at: http://solargis.info/imaps/ [Accessed 24 April 2013].
- Stehlík et al. (2008). Oponentní posudek ke Zprávě Nezávislé odborné komise pro posouzení energetických potřeb České republiky v dlouhodobém časovém horizontu. Office of the Government of the Czech Republic, 2008.
- Týden (2006). Kostrbatá historie zelených, 20.3.2006. Available at: http://www.tyden.cz/tema/kostrbata-historie-zelenych_260.html [Accessed 13 May 2013].
- United Nations (2012). Framework Convention on Climate Change, FCCC/SBI/2012/31 [pdf]. Available at: http://unfccc.int/resource/docs/2012/sbi/eng/31.pdf [Accessed 22 May 2013].
- Verbund (2012). 65. Ordentliche Hauptversammlung, Wien am 12. 4. 2012 [pdf].
- World Bank (2013a). Available at: http://data.worldbank.org/topic/energy-and-mining [Accessed 24 April 2013].
- World Bank (2013b). Worldwide Governance Indicators. Available at: http://info.worldbank.org/governance/wgi/sc_country.asp [Accessed 13 May 2013].