ENERGY POLICY AND RESOURCES: THE CZECH REPUBLIC CASE

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1. INTRODUCTION

Currently, a political and experts discussion about situation in the sector of energy takes place in the Czech Republic. The points of interest are questions of domestic energy sources, imported sources, energy safety and future of nuclear energy, which represents important section in electricity production. Our contribution is focused on consequences published in professional papers and does not aims on analysis of economical and political conditions that are often highly unprofessionally influenced by the Green party.

2. BASIC FACTS ABOUT CZECH REPUBLIC

The Czech Republic (CR) is an inland state with total area of 78 864 km^2 and a population of 10.2 million inhabitants. Since the 19th century the country has become highly industrial, and during the 20th century the industry played the most important role. Between 1948 and 1989 the country belonged to Soviet Union's (S.U.) place of interest, which led to strong market connection at S.U. In these years mainly heavy industry was being developed. After the change in 1989 the country went through great economical change caused by losing Soviet markets. Today economy still remains export-oriented and the industry produces particular part of the GDP. It means relatively high energy consumption per unit of GDP compared with other EU-countries, shown on following figure. Some of the best known trademarks in abroad are e.g. Škoda Auto, Škoda Plzeň, ČKD and Tatra.

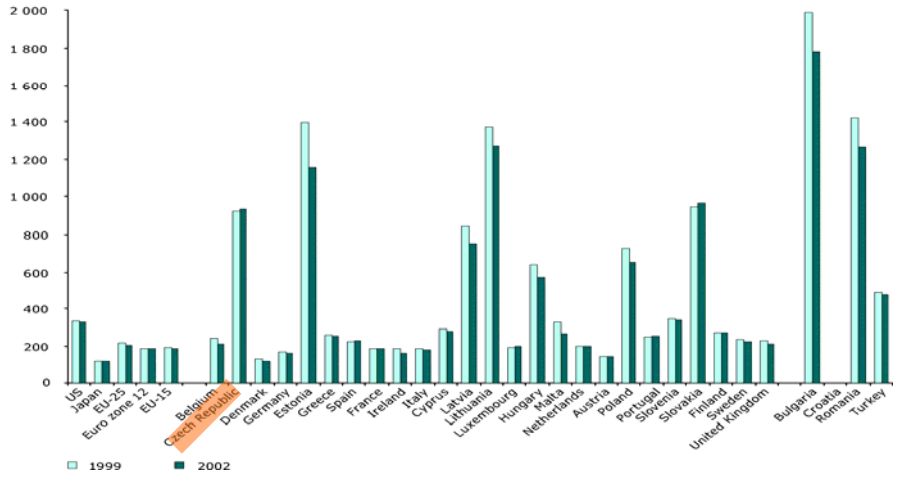

Figure 1- Gross inland consumption of energy divided by GDP, Kgoe per EUR 1000 (European Environment Agency, 2006)

3. PRIMARY ENERGY SOURCES

In the beginning, it is necessary to give an overview of primary energy sources distribution in the Czech Republic. The most important source for industry and energy production is lignite coal, followed by hard coal and natural gas. In transportation, the main source is oil. Natural gas and oil are almost 100% imported from abroad.

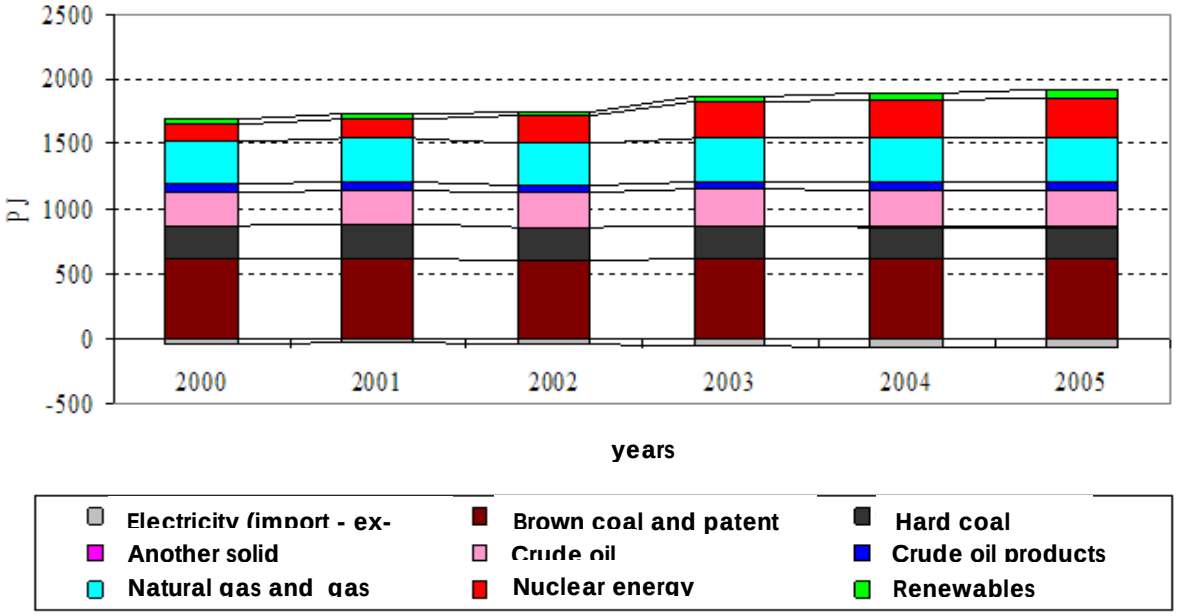

Figure 2 – Energy consumption by sort of primary energy sources (PES), (Vupek-economy 2005)

In the following part of the paper we will focus only on the energetics. The term "energy" includes energy for industry, production of electricity and production of heat and warm water for households. Energetic issues can be divided into following topics:

- electricity production;
- energy supply for industry;
- district heating system (district heating system with cogeneration plant);
- local (individual) heat production in households.

3.1. Electricity production

The most important source of electricity are thermal power plants using lignite coal (in smaller extent hard coal), the second one are nuclear power plants. These are complemented by large hydropower plants and combined steam and gas cycles. Renewable energy sources in electricity genera-

tion represent only negligible part with share of 3.87% gross production in 2007, (see following figure)[1].

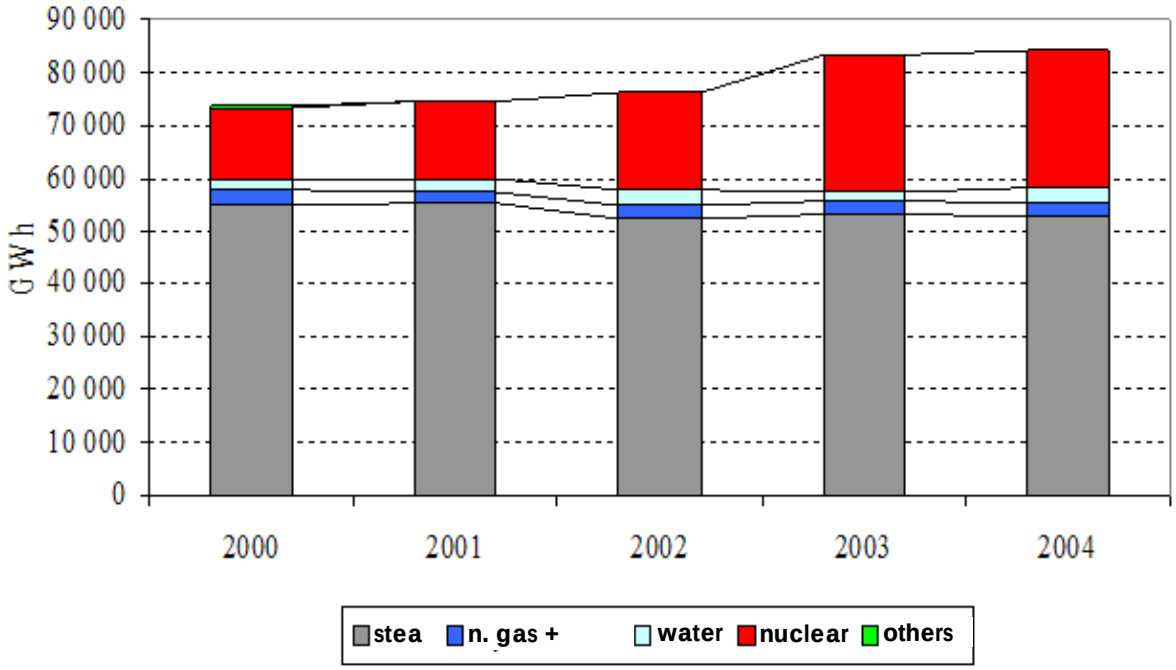

Figure 3 – Gross electricity production (Vupek-economy 2005)

3.2. Energy supply for industry

Industry is the most important energy consumer in the CR. It uses all kinds of primary energy sources (PES) and energy stocks. Large industrial companies use mainly lignite coal and hard coal, medium size companies mainly natural gas and rarely biomass. Large companies usually uses electricity self-supply by means of CHP, medium size and small companies usually buy electricity on the market.

3.3. District heating systems (District heating systems with Combined Heat and Power)

The heat supply for households is significantly ensured by CHP. The heat generation in CHP is important energy product. However, big problem of the CHP plants is fixed orientation on utilization of lignite coal, with small share of hard coal. Currently it increases the share of natural gas and biomass for energy generation.

[1] N. gas + comb. includes natural gas fired power stations and power stations with combined cycles.

3.4. Individual heat production

In this section are presented all sorts of PES including lignite, hard coal, natural gas and biomass, which are particularly used in rural areas.

Further in the text several PES issues will be discussed, particularly lignite coal, situation in nuclear energy and renewable energy sources.

4. LIGNITE COAL

Lignite coal is the most important PES. In the beginning of 90's, there have been introduced territorial ecological limits that mean limits for lignite coal exploitation by legislation. By the time going it turns out to be clearly political and energetically inconvenient decision.

Large energy companies that operate important production sources near the lignite coal mines do not expect any fuel supply failures in the following 40 years, because they directly own or influence the lignite coal mines. They can supply enough fuel even for newly constructed supercritical power stations and retrofitted power stations. The territorial exploitation limits will mainly influence the heat production sector, which currently makes strong benefit of the CR due to large share on heat production, with PES savings.

Supposed replacement of the lignite coal by natural gas or biomass (the most promising Renewable Energy Source) can not be economically effective. It is economically unbeneficial to provide enough biomass even in small share in lignite coal substitution. By the same energy content, biomass has 7 to 12 time higher volume than coal. In brings great problem into transportation, where would be required enormous growth of road cargo transport, because it would be not possible to use railway transport in the same extent. Current energy consumption of the heat production sector is about 11 times higher than total estimated biomass potential, average heat production plant would not be able to cover more than 3 – 15% of its fuel needs in biomass from 70-80 km surroundings.

When converting to natural gas the problem with insufficient capacity of main gas pipelines as well as local gas connections appears. In the time of the gas network construction there was no expectation of connecting so large consumers. Furthermore, the CR is fully dependent on natural gas import (domestic consumption approx. 9 269 mil. m^3/year). The growing rate in 5 years is expected up to 1 mld.m^3 (Nehoda, 2008).

Main advantage of the district heating is operating energy sources large enough to be able to use low quality fuels in economically, ecologically and energetically effective way. The high degree of fuel utilization is reached by extensive use of CHP.

If the use of natural gas and biomass would be increased, despite technological difficulties, the final products (heat, electricity) would be charged by increased fuel costs. The price of heat could be doubled and electricity production would become non-profitable. Limitation of CHP operation and following ecological impacts would be a result of household's conversion from district to individual heating supply.

All these facts confirm that the lignite coal plays non-replaceable role in conditions of the CR.

5. NUCLEAR ENERGY, A TABOO?

The second conference of European Nuclear Forum took place in Prague between 22-23 May 2008, with participation of European Commissions leaders and prime ministers of CR, Slovakia etc. The aim of this meeting was estimation of nuclear energy role, opportunities of its growth, safety. Another discussed concern was information of community about nuclear energy considerations and that in many countries still exist a gap on that issue. Europe today faces lack of energy sources and lack of skilled experts for nuclear energy as well. Who could be interested in a field without future prospect? "Supporting nuclear experts' education and training, as well as research of new generation reactors is our task" (Topolanek, 2008), insisted the Czech Premier. Nuclear energy is not included in the EU plans for providing energy safety by the year 2020. In despite of that, nuclear energy is a low-emission source. Furthermore, nuclear energy represents a hundred year guaranteed source. Though the situation in the EU is changing, still the share of nuclear energy decreases. Every year three reactors are closed, and less are constructed. One of the main tasks of European forum was to change this situation. This process has started with the meeting in Bratislava. Some aspects of nuclear power were taken into consideration as economic advantages, the assumed risk and methods of convincing people of nuclear necessity. Harmonization of regulations for nuclear energy, and disposal of nuclear waste was another important issue among the forum discussions. According to some surveys approximately 70% of Czech population agrees with construction of new nuclear power station. New energy sources exploitation is required. Now is time to act considering that construction of new power plants needs 7-8 years and perhaps longer time of 13-15 years. Actually, there is not much time left for decision makers. Only two real possibilities exist how to ensure the amount of energy required in the future: either coal or nuclear energy. The coal can not cover the whole energy consumption, otherwise coal resources would deplete in a very short time. A huge impact on environment is expected and reduction of emissions would remain an unfulfilled pledge. The second possibility is construction of new nuclear power plants. Nuclear energy presents today an efficient and flexible source, which could effectively solve the growing demand of energy and its variations. Fissionable fuel might be ensured from politically stable countries. Cost of electricity from nuclear sources in CR nowadays stands as the lowest compared to other countries, respectively 2.10EUR cents/kWh. Compared to coal and gas, electricity cost generated from nuclear is 22 % and >50 % lower respectively (according to World Nuclear Association, 2008). Nuclear power is advantageous regarding to COx, NOx emissions. It was estimated that CR possesses to some extent significant reserves of uranium. The main problem of nuclear power plants is the nuclear waste. However, this problem from technologic point of view seems to be solved. Nowadays new types of safe reactors are developed.

Thus, at the end of the European Nuclear Forum, some proposals have been pointed out (Energetika 7):

1. To set out that nuclear power is a low-emission energy source with positive impact on environment and on sustainable development;

2. Support of nuclear energy with respect to reduction of greenhouse effect gases by 20 % by the year 2020;

3. Developing cooperation among EU members and other countries with the aim to find common solutions in the field of disposal of high activity wastes;
4. Supporting development of nuclear power in member states, with programs for R&D of reactors of forth generation, and utilization of atom as potential energy source;
5. Support for training and education of qualified professionals in nuclear energy;
6. Support of educational programs and international exchange of experts;
7. Familiarization of communities with electricity production from nuclear energy and safety aspects.

6. RENEWABLE ENERGY SOURCES

Utilization of renewable energies is a high priority. According to EU objectives, optimal utilization of renewable sources is an important task. Reduction of dependency on external sources is aimed, increasing reliability of energy system, reduction negative impact of the energy on the environment. Promoting renewable sources will help in creating new job opportunities. The rate of renewables utilization is considerable and a growing trend of electricity and heat production from these sources is expected. Approach of CR takes into account the potential of each renewable energy kind. It is necessary to create a strategy based on economic evaluation and to propose actions and instruments for the enforcement of proposed trends. This strategy has to involve agricultural activity, forestry, and other branches that set up circumstances for biomass cultivation, biogas production, and biofuels. In reality the use of renewables as energy source grows slightly.

Table 1-Probable electricity production share embodied in Czech approach

TWh	2000	2005	2010	2015	2020	2025	2030
Total electricity	73,73	78,2	82,37	80,85	84,95	87,49	89,17
							15,06
Renewables	1,71	4,16	8,17	9,84	11,58	14,2	
Biomass	0,01	1,60	4,86	6,32	7,81	10,25	10,96
Small Hydropower	0,52	0,80	1,05	1,05	1,05	1,05	1,05
Wind	0,01	0,57	0,93	1,01	1,25	1,44	1,44
Photovoltaics	0,00	0,00	0,00	0,00	0,00	0,01	0,01
Biogas	0,01	0,01	0,01	0,01	0,01	0,01	0,16

6.1. Small hydropower plants

Predominant part of hydro potential is concentrated in small streams, where are not favorable conditions for building up large hydro plants (>10 MW). The potential of hydropower is estimated approximately to 1500GWh. However, other possibilities for utilization of hydro energy are offered:

- Utilization of flood basins and lakes eventually other accumulation basins, where is possible proper difference of water level;
- Use of water objects, constructed for drinking water or industrial water supply, where is possible to gain high constant drops without essential changes;
- Modernization of existed hydro power plants, which have outdated technology.
- Optimization may provide a new potential via low investment cost.

6.2. Wind energy

Since 1989 development of wind energy in CR has been variable. From 1990-1995 installations of wind turbines had the same trend as in other countries of EU. After this year this tendency declined. Until 1995, 24 wind turbines were built, with a total power capacity of 8220kW. In recent years 6 wind turbines were demounted with a capacity 1075kW and 11 of them have been stopped (2220 kW). The growing interest for wind energy recovered after 2002, and of course as a result of electricity price policy, where price of electricity from wind sources were 0.111 EUR/kWh. This trend has followed further decreasing and in 2006 electricity redemption value was established at 91 EUR/MWh. In 2006 the total capacity of wind power installations estimated at 55 680 kW. However, wind energy is not expected to have dominant role in Czech energy system, due to its geographic position, climate and other factors.

6.3. Biomass energy

Biomass is the most important source among RES behind hydropower in the CR. Biomass is classified as solid biomass utilized directly to electricity or heat production and to co-combustion with fossil fuels. Its products might be considered as stable source, though it is connected to weather conditions and location. Based on surveys, it is estimated that biomass will have a considerable role in energy supply. In 2007 total net electricity production from biomass is calculated at 403.706GWh. Heat production from biomass and its variations was 45.52 PJ.

6.4. Solar energy

For solar energy utilization CR is not favorable country, because of low number of sunny days and geographical position. As for current photovoltaic systems the repayment time of investments is very high. State support in order to minimize the repayment time is required. In 2007 gross energy produced by solar systems was calculated at 2127MWh. However the contribution of solar energy in RES remains unpretentious 0.02 %. The future for solar energy and especially of photovoltaics is strongly related to the political and economic priorities of government, individuals and the whole society as well as the technology development, science achievements etc.

7. THE PACES'S COMMISSION

The government of the CR in 2007 established an independent energy commission (IEC). The commissions' tasks were to estimate the long-term strategy in development of the energy sector, give recommendations to the government and find out paths of its realization.

The current situation of the Czech economy is stable. Energy consumption is currently higher than European average. On the other hand, emissions of gaseous pollutants have decreased by 25 % during 1990-2006. The Kyoto Protocol ratification obligates reduction of CO2 by 8 % until 2012, with reference to 1990.

Stability of energy and electro-energetic system will become critical if real and fundamental decisions are not to be made. A depletion of home energy sources is predicted, especially lignite coal and hard coal and there is not enough high potential of other sources for substitution. It is assumed that in forthcoming years 2015-2020 Czech Republic will face an electricity and heat insufficiency. It is not easy task today to make serious decision in the energy sector for the future. On one hand, energy policy of government follows the European trend with regard to liberalization and opening markets of primary energy sources and energy products. On the other hand, energy sources exports will lead to scarcity for home power plants. The exploration of new energy sources, especially RES. The government should create a commission advice is liberalization of decision-making of energy companies, towards legislative framework for all actors including the state.

7.1. European context

The decisions on energy issues have nowadays involved a global concern. European Union forecasts show that dependency on imports of primary energy sources will increase from 50 % to 70 % in the next 20 years and is predicted to reach 80 % in 2050 (Vupek, 2005). This is caused of course by the growing demand for energy and consequently by an increase of energy prices. European energy policy consists of four main directions: First, developing an inner effective market for stimulation of competitive advantages of European economy.

The open market could ensure the security and credibility of primary energy sources, support for utilization of renewable energies and emission reduction as well. Effective grid interconnection and construction of new grids is the second direction. Thirdly, support of research and utilization of clean technologies related to CO_2 emissions, new generation nuclear sources, hydropower, and renewable sources as well. The last field is energy savings and increase of energy efficiency in air heating and cooling in buildings.

7.2. Framework of energy strategy

The Paces' commission work concluded with some proposals for the government. The government should be aware of environmental conditions on long-term economic development that are in public interest. The commission proposed that the government should promote utilization of any energy source or technology which respect to following obligations. New economic and legislation parameters should be established. Development and breeding of energy market should be in the long-term governmental policy. Domestic and foreign capital should be given a significant promotion. The government should not intervene in energy sector except in case of public interest. The gov-

ernment should not support electricity import in the long-term outlook, meaning to consider domestic energy sources. Regarding to oil and gas imports should act in cooperation with partners. These tasks derive from:

- the economy possess advantages for production of heat and electricity in its territory;
- present positive impact of social and economic field (economic growth, exchange rate, employment rate);
- the need to minimize security risk.

The following assumptions are taken into consideration:

- economic and demographic growth. During 2010-2030 GDP growth is assumed to 3-4 % and later this figure will decrease by 1 %. A stagnation of population growth and migration to urban areas is taken into account.
- world energy prices. It is not easy to predict oil and gas prices in next 20 years. Forecast of hard coal imported to CR is also an uneasy task. However, according to general opinion a slow increase is predicted. Uranium ore prices are assumed to sustain constant growth.
- availability of conventional PES. Lignite coal production is estimated to stay in current limits. Energy demand is expected to be satisfied in case of oil and gas import prices.
- potential of RES. This is a very sensitive issue. Forecasts show an increase in energy production from RES, from 92.2 PJ in 2007 to 346.9 PJ in 2030. It is important to mention that biomass is the biggest contributor by 246 PJ, or 71 % of RES.
- energy saving. Reclamation of effective energy market is fundamental to achieve this goal. The commission proposed to consider savings per new energy sources equivalent. An energy efficiency plan, support of R&D, economic instruments from government and European funds, and education are considered of direct impact on energy savings.
- environmental aspects. Regarding to European directives has to be respected the emission releases in atmosphere. An increase is predicted in licensed prices as well.
- other parameters. Until 2015 maximal electricity export is estimated to be 20 TWh/year, and import up to 10 TWh/year. Then a balance between these two parameters is expected. Electricity consumption is expected to grow by 15 % within 2030. Consumption of oil products is assumed to decrease by 40 % until 2050.

7.3. Basic observations of performed analysis

- PES demand in long-term point of view is expected to stay in the same current level, because by 2030 a slight increase (+ 5 %) is estimated, and then decreases. How-

ever, total final energy consumption will rapidly increase by approximately 13 % by 2030;

- Domestic fossil fuels, nuclear energy and renewable energies (including biomass, solar and geothermal energy, hydro, as well as wind and waste in less percentage) are assumed to be fully utilized. Imports of oil product is expected to remain constant; meanwhile an increase in gas and dark coal imports is expected, in order to compensate domestic sources depletion;
- CR probably will remain independent of foreign electricity sources, though its consumption will further increase by 1.3 to 1.5 % yearly;
- The energy intensity of the Czech economy is estimated to achieve the European average within 15 or 20 years;
- A significant trend of emission reductions will meet the international requirements;
- Dependency on imports of PES will further grow by 70 % by 2030, which is considered the average of EU.

8. CONCLUSION

The Czech energy sector is being discussed in this paper. First, a brief introduction on primary energy sources consumption was presented. It is stated that CR is energetically stable country so far. However, a depletion of energy sources is predicted in next 10-20 years. Europe and CR will face a growing demand of energy. CR risks set an electricity dependent country, if proper decisions are not made. We have described the lignite coal situation and discussed future problems especially connected to the district heating systems. The government energy policy is also included, considering Paces' Commission proposals. The Czech energy sector trend is determined with respect to energy policy of the EU members. Lignite coal and hard coal will continue to play the major role in PES. A turning point regarding nuclear energy evaluation is required.

Nuclear energy is expected to increase its contribution mainly due to its potential. Renewable energies will remain an option, with continuous growing capacities. The Czech case estimates a higher potential of biomass in future. However, renewable energy contribution in total energy consumption is modest.

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