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ENERGY, ECONOMY, AND ENVIRONMENT IN THE CZECH REPUBLIC

L. Kopačka: *Energy, economy and environment in the Czech Republic*. – Geografie – Sborník ČGS, 107, 2, pp. 139 – 155 (2002). The author deals in this paper with contemporary situation and problems of energy and power industry in the Czech Republic with respect to the transition processes since 1989. The paper analyses the roots of structural deformations and concentrates itself on some aspects of production and consumption of primary energy resources and electricity. After historical introduction the paper attempts to analyze the core of energy problem, changes of the overall energy balance, special attention is given to the importance, exploitation and environmental impacts of the coal mining and to the crucial crossway between brown coal and nuclear energy by the production of electricity. Conclusion evaluates main results of transition in the energy industry and deduces strategic courses of the solution of the Czech energy as a part of the general economic development.

KEY WORDS: transition – primary energy resources – energy demandingness – energy balance – hard (brown) coal mining – electricity production – steam (nuclear) power plants – uranium industry – environment.

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1. Introduction

The paper deals with contemporary energy situation and problems in the Czech Republic and analyses some aspects of both production and consumption of primary energy resources and of electricity and the roots of deformations.

Some historical, political, societal, economic, locational, geographical, social, regional aspects have to be taken into account by the evaluation of changes of energy industry. Special attention is given to the problems with mining, utilize and consumption of brown and hard coal in connection with strategic controversy between coal and nuclear power plants with respect to environment.

2. Historical-economic background

Difficult process of transition of the Czech society and economy takes place after the year 1989 in the time of escalating tendencies of globalization, integration, and forming of the “new economy” and information society in the world.

The transformation of the world economy in the 1990s, to which the starting platform was created by transformation and restructuring processes after the oil crises in 1973, escalated at the same time as the communist block collapsed and the Czech Republic started with the solution of accumulated inherited major problems in conditions of the return to the traditional western-directed geopolitical and geo-economic including geo-energy position and orientation.

The Czech Republic followed the first period of the world transformation since 1973 isolated behind the iron curtain. The adaptation on changing conditions in the world was very weak and passive. The development slipped in many aspects against world tendencies. It concerns especially, energy industry (escalating character of coal mining, building of coal and nuclear power stations), environment (the most serious environmental damages fell on the period of so called normalization 1970 – 1989 after the occupation of Czechoslovakia by armies of Warsaw pact and energy industry played decisive role between them) and economy as a whole.

The Czech Republic follows the second period of the world transformation burdened by heavy heritage of deformations of all spheres of society, economic, social and regional life after fifty years of fascist and then communist totalities. The internal debts connected with amortization, deformations of structure and geographical distribution of activities, damage of environment were estimated on trillions of CZK.

An extreme absolute and relative resource demand (inclusive of energy) was one of the typical features of economic and industrial development during socialism. It was connected with an extensive character of the economy, and irrational territorial distribution and space organization. The overestimated and overloaded industry prevailed in the structure of economy (48 % of the economic active population) accompanied by hypertrophy of heavy industry (mining, metallurgy, chemistry, heavy machinery, building-materials), connected with transport and construction.

The development directed in this way left the traditions of the Czech economic history, contradicting the economic trends in the advanced countries among which Czechoslovakia was, even in terms of quality, before 1948. Moreover, it contradicted the geographical character of the Czech territory, raw materials, energy and natural conditions. Due to this, the disastrous environmental consequences logically accompanied the whole social and economic development in the long period between 1948 and 1989.

3. Energy and environment during transformation

While the energy industry belonged to the most preferred branches and spheres of life in the Czechoslovakia during socialist period (this tendency continues in the course of transition after 1989 too), environment was victimized to the high-ranking interests. Many of the regions and millions of people of the country suffered from immense damages, degradation and pollution of environment without corresponding real economic results.

Both transformation and restructuring of energy and power industry and solution of the environmental situation were counted between urgent targets in the post-November period. Both are interrelated and have international consequences. Let us to attempt analyse the energy problem in the Czech Republic according to some often and frequent questions.

3. 1. The core of the energy problem in the Czech Republic

Contemporary energy problems in the Czech Republic have several roots, reasons, and consequences. They have complex character and are close interrelated with the development and changes of the whole society, economy, industry, territory, landscape and environment.

Political, institutional, social, regional and other transition processes started in 1989 were not fully successful. The economic and industrial development passed from the initial deep decrease after November 1989 to the stabilization and successive growth. The hopeful economic development resulted into the economic decrease since 1997 (devaluation of the Czech currency by 20 %) with serious political impacts, to great extent due to the privatization failures (Švejnar 1997; Jonáš 1997, 2000). The economic growth was renewed again since 2000.

Transformation of energy industry including restructuring, modernization, improve of environment and other positive aspects belongs to the positive results of transformation. The energy problem of the Czech Republic has multidimensional character. Very often is reduced on the problem of coal mining and production of electricity in thermal coal and nuclear power plants. It is only a peak of the iceberg.

3. 2. Development and changes of the overall energy balance

Let us first to show the change of *overall energy balance* in the Czech Republic during transition according to Table 1. Total consumption of primary energy resources in the Czech Republic decreased by 23,5 % in the period 1989 – 2000 and the structure of consumption has been changed.

Production of domestic solid fuels decreased by 38 %. The share of domestic solid fuel on all domestic natural resources decreased from 92 to 86 % (8 and

Tab. 1 – Overall energy balance of the Czech Republic 1989 – 2000 (PJ, %)

	Gross consumption of primary energy resources			Domestic natural resources			Import			Export		
	1989	1990	2000 ¹⁾	1989	1990	2000 ¹⁾	1989	1990	2000 ¹⁾	1989	1990	2000 ¹⁾
TOTAL	2 151,2	2 076,1	1 628,8	1 884,1	1 730,5	1 232,2	664,8	592,1	735,8	222,5	158,9	354,8
Solid fuel	1 395,5	1 348,2	882,0	1 725,4	1 571,7	1 063,9	41,4	45,3	42,0	135,5	105,1	242,6
Liquid fuel	404,6	355,5	309,7	2,0	2,1	7,4	375,8	317,1	342,8	54,4	21,8	43,9
Gaseous fuel	212,7	226,4	319,3	8,5	8,4	7,1	229,4	209,8	319,5	20,8	24,1	0,8
Primary heat and electricity	138,3	146,0	117,8	148,2	148,4	153,8						
TOTAL	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Solid fuel	64,9	65,0	54,2	91,6	90,8	86,3	6,2	7,7	5,7	60,9	66,1	68,4
Liquid fuel	18,8	17,1	19,0	0,1	0,1	0,6	56,5	53,6	46,6	24,5	13,7	12,4
Gaseous fuel	9,9	10,9	19,6	0,5	0,5	0,6	34,5	35,4	43,4	9,4	15,2	0,8
Primary heat and electricity	6,4	7,0	7,2	7,9	8,6	12,5						

¹⁾ preliminary data

Source: Statistická ročenka České republiky (Statistical Yearbook of the Czech Republic) 2001 (2001). Praha, ČSÚ (and relevant other issues)

Tab. 2 – Changes of the structure of the final energy consumption of households in the Czech Republic 1990 – 2000 (%)

	1990	1995	1998	2000
TOTAL	100,0	100,0	100,0	100,0
solid fuel	47,1	33,0	21,5	19,1
liquid fuel	12,8	0,0	0,2	0,1
gaseous fuel	15,0	28,9	37,5	37,9
heat	15,8	16,8	19,2	21,6
electricity	9,3	21,3	21,6	21,2

Source: Energetická bilance České republiky v letech 1998, 1999, 2000 (Overall energy balance of the Czech Republic 1998, 1999, 2000). Praha, ČSÚ (Czech Statistical Office) 2002

14 % was share of Dukovany nuclear power plant and of hydro power plants), but export of domestic solid fuel increased by 70 %. The share of the solid fuel on the total consumption of primary energy resources decreased from 65 % in 1989 to 54 % in 2000 – in fact it continues very high in comparison with developed countries.

The “low quality” of the structure of overall energy balance is multiplied by low quality of the coal, especially of brown coal, burned in the steam power plants with serious environmental consequences in the past (Kopačka 1994) as well as today, and by the import of practically whole amount of consumption of both liquid and gaseous fuel. Six millions tons of crude oil was imported in 2001, consumption of liquid fuel decreased by 23 % since 1989 with the same share around 19 % in 1989 and 2000. Import of gas was 6 milliard m³ in 1990 and 9,2 milliard in 2000, consumption increased by 50 % since 1989 with share 9,9 % in 1989 and 19,6 % in 2000. Both low utilize of renewable energy sources and theirs inadequate support are another features of the Czech energy balance.

The development of the structure of the final energy consumption of households in the period 1990 – 2000 (Tab. 2) shows remarkable changes in the structure of final energy consumption and in utilization of individual energy sources. The shift is characterized by deep decrease of consumption of solid and liquid fuel and immense increase of gaseous fuel (from 15 to 38 %) and to a lower extent of electricity and heat.

The structure of overall energy balance is close connected with high energy-demanding economy. The resource demand at the end of socialism shows Table 3. The progress in reducing energy demands follows also from the fact that there is close relation between the consumption of primary energy sources, electricity and creation of GDP (Kopačka 2000b) on one side and between GDP and changes in the sectorial, or industrial structure, geographical distribution and organization structure on the other. More and more important role is played by both FDI and new technologies.

GDP created in the Czechia increased approximately by 3 % in the period 1989 – 2000, the consumption of primary energy sources decreased in the same period by 24 % and energy demand approximately by 26 % (production and consumption of electricity increased for comparison by 13 % and 2 % respectively). The development of indicators mentioned above in the transition period is depicted in Figure 1. With regard to the fact that at the beginning of the transformation the energy demand was per capita or per

Tab. 3 – Resource demand in Czechoslovakia (average 1981–85)

	per 1 inhabitant			per 1000 USD of GDP		
	Czecho-slovakia	Selected developed countries	Share	Czecho-slovakia	Selected developed countries	Share
Consumption of primary energy sources (GJ)	200	100	2,0	21	8	2,6
Production of steel (kg)	974	325	3,0	104	26	4,0
Consumption of steel (kg)	714	371	1,9	77	29	2,7
Production of cement (kg)	681	425	1,6	73	34	2,1
Freight rail-road transport (tkm)	9206	2108	4,4	971	175	5,6

Selected developed countries: Austria, Belgium, Denmark, Norway, Sweden, the Netherlands, Switzerland

Source: VINTROVÁ, R. (1988): *Kontinuita i přestavba?* (Continuity or restructuring?). In: *Politická ekonomie*, 36, p. 240

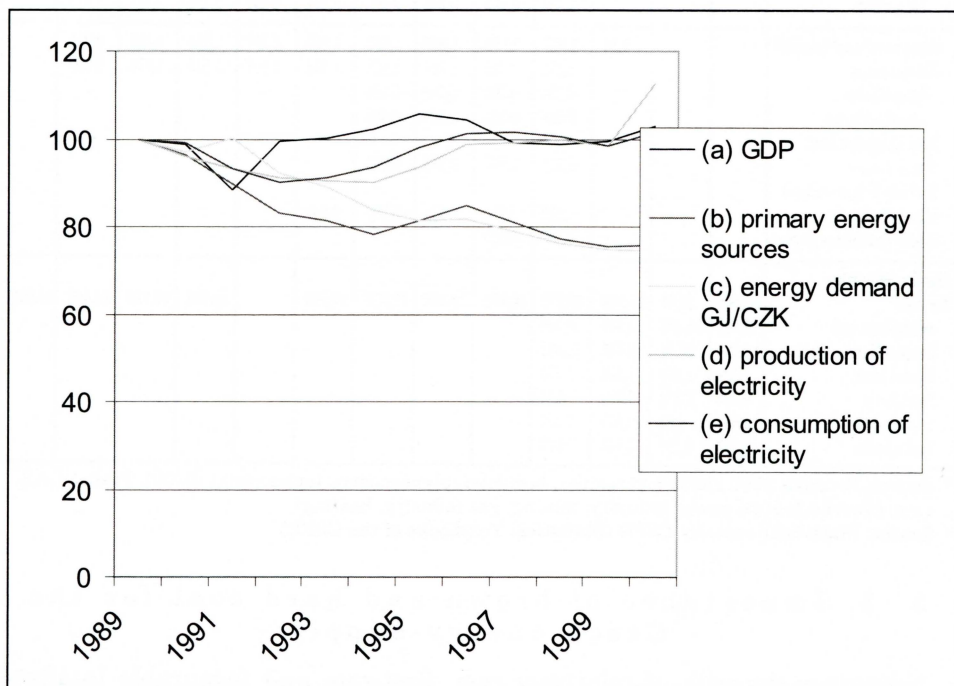


Fig. 1 – Development of GDP and energy demand in the Czech Republic 1989 – 2000 (1989=100)

GDP unit 2 – 2,6 times higher than in comparable advanced countries (Austria, Belgium, the Netherlands, Denmark, Switzerland, Sweden) the decrease was slow, insufficient and means actually a stagnation. Furthermore, during the last decade the advanced countries have kept on the tendencies of saving and decreasing the energy demands that since the period of the energy crisis have been encoded in science and research as well as in consumers' behavior.

Tab. 4 – Hard coal mining in the Czech Republic in the period of transition (mil. t)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Hard coal mining (brutto) ¹⁾				27,318	26,076	25,688	24,478	23,494	23,429	22,758	22,030	19,709	
Hard coal mining for sale ²⁾			23,19	19,877	19,378	18,296	17,491	17,006	16,394	16,038	15,863	14,419	
Ostrava-Karviná basin¹⁾			20,84	17,789	17,271	16,419	15,942	15,661	15,097	14,280	14,760	13,468	
Mine Darkov				1,968	1,845	2,469	2,598	4,125	4,310	4,310	4,170	4,265	
Mine 9. květen				1,264	1,370	1,197	1,251						
Mine Lazy				1,525	1,598	1,828	2,010	3,977	3,539	3,170	3,704	3,336	
Mine Dukla				1,670	1,567	1,452	1,258						
Mine František				0,633	0,623	0,596	0,606						
Mine ČSA				1,829	1,762	1,964	1,867	3,025	3,215	2,805	3,050	2,514	
Mine Doubrava				1,106	1,077	1,129	1,250						
Mine Paskov				0,590	0,690	0,618	1,960	1,773	1,479	1,577	1,460	1,131	
Mine Staříč				1,525	1,548	1,305							
Mine J.Fučík (Odra)				1,049	0,983	0,851	0,631	0,450	0,207	0,231	0,039		
Mine Odra				0,896	0,896	0,705	0,497	0,102					
Mine Heřmanice				0,639	0,638	0,138							
Mine Ostrava				0,811	0,544								
Mine ČSM				2,209	2,245	2,376	2,260	2,311	2,347	2,187	2,337	2,222	
other hard coal basins¹⁾			2,35	2,087	2,112	1,878	1,549	1,345	1,297	1,218	1,103	0,951	
Kladno mines				1,232	1,320	1,286	1,268	1,302	1,297	1,218	1,070	0,926	
Mine Kladno				0,724	0,797	0,780	0,780						
Mine Tachlovice				0,509	0,523	0,506	0,488						
East Bohemian Coal Mines Trutnov				0,525	0,560	0,373	0,095						
Western Bohemian Coal Mines Zbůch				0,240	0,222	0,219	0,186	0,043					
Rosice Coal Mines Zbýšov				0,090	0,010								
Hard coal mining for sale²⁾	25,503	25,07	22,082	19,522	18,486	18,297	17,376	17,169		16,069	16,112	14,342	14,855
coking hrad coal	15,748	15,495	14,139	12,704									
Ostrava-Karviná basin	22,578	22,31	19,735	17,371									
Kladno basin	1,659	1,606	1,322	1,233									
Plzeň basin	0,368	0,339	0,309	0,24									
Trutnov basin	0,661	0,62	0,575	0,525									
Rosice basin	0,237	0,196	0,141	0,09									

¹⁾ Source: Ročenka 2000 elektroenergetika, hornictví, plynárenství, teplárenství (2000). Praha, GAS s.r.o. (Yearbook 2000 power industry, mining, gas industry, heating)

²⁾ Source: Statistické ročenky ČSFR (Statistical Yearbooks of the CSFR)

3. 3. Importance of brown and hard coal for the Czech energy-supply

Numerous deposits of relatively rich, first-rate and favourable localized reserves of hard coal and brown coal played an important role in the economic history of the Czech Republic in last 150 years. Exploitation of coal acquired extraordinary importance in the time of totalitarian socialistic regime (1948 – 1989). To change this coal heritage and inertia in the form of huge mining – energy – power – metallurgy – heavy machinery – chemical complex was and is one of the main targets of transition after the year 1989. In a follow up to the considerable decrease in both the domestic brown coal mining (index 2000/89 58) and hard coal mining (59) the consumption of liquid fuels decreased as well and importance of gaseous fuels is increasing. As to these high-grade fuels the Czech Republic is fully dependent on the import, so far

Tab. 5 – Brown coal and lignite mining in the Czech Republic in the period of transition (mil. t)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Mining of brown coal (brutto) ¹⁾				78,352	69,830	68,511	61,025	59,026	60,690	56,165	51,964	45,369	
Mining of brown coal for sale ¹⁾			74,360	72,530	64,487	63,335	56,242	55,244	56,366	53,825	48,619	41,524	
North Bohemian brown coal basin¹⁾			60,700	58,925	51,654	51,431	46,633	45,932	46,952	46,019	40,289	34,499	
Most Coal Company Most				7,622	7,140	25,837	22,744	21,767	22,195	22,472	18,741	13,232	
Mines Ležáky Most													
Mines Komořany (open cast mining)				22,216	18,815								
Mines Hlubina													
Litvínov (deep mines)				0,819	0,488								
Mines Bílina				7,613	7,159								
Northern Bohemian Mines Chomutov						22,186	21,123	21,551	22,365	22,990	21,548	21,267	
Mines Nástup Tušimice				17,552	14,987								
Fuel Combine Ústí n.L.				3,103	3,065	3,408	2,766	2,614	2,392	0,557			
Sokolov brown coal basin¹⁾				12,105	11,414	10,641	8,699	8,528	8,512	7,059	7,678	6,513	
Sokolov Coal Company Sokolov				12,105	11,414	10,641	8,699	8,528	8,512	7,059	7,678	6,513	
Brown coal mines													
Březová				6,083	6,020								
Fuel Combine Vřesová				6,022	5,394								
South Moravian lignite basin¹⁾				1,886	2,203	2,165	0,524			0,747	0,652	0,512	
South Moravian lignite mines Hodonín				1,500	1,419	1,263	0,524						
Lignite Hodonín				0,386	0,784	0,902				0,747	0,652	0,512	
TOTAL COAL MINING IN THE ČR¹⁾				92,407	83,865	81,631	73,733	72,250	72,759	69,863	64,482	55,943	
Mining of brown coal (brutto)²⁾	92,066	87,022	78,588	76,859	68,084	66,884	59,568	57,163		57,446	51,419	44,790	50,307
deep mines	3,995	3,646	3,283	2,602									
open-cast mines	88,071	83,376	75,305	74,257									
North Bohemian brown coal basin	72,754	69,249	62,122	60,590									
Sokolov brown coal basin	19,312	17,773	16,466	16,269									
Mining of lignite²⁾	2,231	1,972	1,814	1,500									
South Moravian lignite mines	2,231	1,972	1,814	1,500									

¹⁾ Source: Ročenka 2000 elektroenergetika, hornictví, plynárenství, teplárenství (2000). Praha, GAS s.r.o. (Yearbook 2000 power industry, mining, gas industry, heating)

²⁾ Source: Statistická ročenka České republiky 2001 (2001). Praha, ČSÚ (Statistical Yearbook of the Czech Republic 2001) – and other former issues

mostly from Russia, as well as will be dependent on import of uranium fuel. Despite rapid decrease of production and consumption of domestic hard and brown coal took place during hitherto course of transition, these energy sources will retain an important role in the next decades too. The role of coal will be however much lower and will cease further social, regional, local as

Tab. 6 – Quality of the coal mined in the Czech Republic 1999

	Coal mining for sale (mil.t)	Content of energy MJ/kg	% of the measure fuel ²⁾	Humidity %	Ash %	Sulphur %
Ostrava-Karviná Mines	11,246					
suitable for coking	5,934	29,20	99,6	9,20	6,90	0,50
energetic	5,312	24,60	83,9	7,30	17,20	0,50
Czech-Moravian Mines¹⁾	3,148					
suitable for coking	2,222	27,89	95,2	10,60	10,00	0,62
energetic	0,926	17,70	60,4	14,34	30,79	0,43
Brown coal and lignite	41,524					
Most Coal Company, Most	13,232	13,75	46,9	28,43	29,54	1,31
North Bohemian mines, Chomutov	21,267	11,29	38,5	24,89	32,80	1,48
Sokolov Coal Company, Sokolov	6,513	13,47	46,0	39,38	19,82	0,86
Lignite Company, Hodonín	0,512	9,50	32,4	46,70	20,60	1,78

¹⁾ Mine ČSM in Ostrava-Karviná basin and Kladno mines

²⁾ 1 kg of measure fuel = 29,3076 MJ

Source: Ročenka 2000 elektroenergetika, hornictví, plynárenství, teplárenství (2000). Praha, GAS s.r.o. (Yearbook 2000 power industry, mining, gas industry, heating)

well as structural consequences. Despite the increasing role of nuclear power and imported gas and oil, coal will remain the principal energy resource for generating electricity in steam power plants.

The course of suppressing coal mining industry in the Czech Republic is in fact delayed adaptation on the processes which took place in the developed countries after the year 1973 (energy crises). The speed of adaptation of energy industry and coal mining to considerable extent depends on the process of modernization, and the restructuring of the whole Czech economy and on the acceptance of the Czech Republic by EU.

Tables 4 and 5 show the development of both hard coal mining and brown coal and lignite mining according to coal basins and individual mining companies (mines) in the Czech Republic during transition. There are one basic hard coal basin (Ostrava – Karviná basin located in North-East Moravia) and two basic brown coal basins districts (North-Bohemian brown coal basin located in North-western Bohemia and Sokolov – Cheb brown coal basin located in Western Bohemia between Cheb and Karlovy Vary) on the territory of the Czech Republic. Table 6 shows the qualitative parameters of the hard and brown coal mined in the Czech Republic 1999 (measure fuel, content of humidity, ash and sulphur dioxide). The main consumers and buyers of brown coal are now thermal power plants and in the case of hard coal we can add production of coke for metallurgy purposes and exports (however modernization reduce the demand for coke).

Let us to describe the situation in basic brown coal basins important for producing electricity in a greater detail.

3. 4. Exploitation of brown coal in North-western Bohemia and Western Bohemia

North-Bohemian brown coal basin concentrates typical transformation problems of the Czech energy and power industry. It consisted from four areas: Chomutov – Kadaň, Most – Litvínov, Teplice – Bílina, and Ústí nad Labem. Two private mining companies operate in the basin just now:

Mostecká uhelná společnost (Most coal company), a.s. Most (13,2 millions tons 1999) and Severočeské doly (North-Bohemian mines), a.s., Chomutov (21,3 millions tons).

Decrease of brown coal mining slows down exploitation of coal and spares deposits for future utilization, leads to concentration of mining into several huge open-cast mines, reduces partly changes of terrain and landscape and is accompanied by process of reclamation and revitalization.

More than 100 villages and towns were demolished during socialism in this area. Now typical features are the collapse and destruction of industrial, transport and other infrastructure of former economy and the speed and extent of these events. Special environmental, esthetic, urban, social, and geographic problems are involved. There are limited possibilities to use buildings, equipment, areas for new functions and purposes. Process of destruction of functions and facilities is quicker than the rise and development of new activities. Region named "moon-like landscape" introduces today a mixture of both new and inanimate activities, suffers by highest rate of unemployment (over 20 %), and concentrates social pathology.

Sokolov brown coal basin – there are localized two main consumers of brown coal in Western Bohemia – steam power plant Tisová and dominating huge power and chemical plant in Vřesová. There was built new modern gas turbines power plant burning both gas generated from coal in Vřesová and imported gas (it is used to enrich burning process) at the beginning of 90s. Mining of coal was so extended by decades despite of strong environmental opposition against this power plant. Social and political reasons played an important role as well as inertia of the past. Extensive environmental investments (modernization, desulphurization) were realized and environment was improved substantially. However brown coal mining survived and power generation was enlarged near the spa-town Karlovy Vary. This town struggled for come-back on list of world-known spas at the same time.

Approximately six main tendencies we can mentioned which lead to the substantially improvement of environment in brown coal mining districts: 1) decrease of the amount of mined coal; 2) concentration of coal mining into a limited number of open-cast mines (in the area of Most, Chomutov and Teplice – Bílina) and shut down of small open-cast and deep mines; 3) the shift of consumption of brown coal mainly for production of electricity in steam power plants; 4) desulphurization, reduction of emissions of solid air pollutants (fly ash) and modernization of steam power plants; 5) reduction of local burning places and substitution of consumption of brown coal for heating by another sources of energy (rapid increase of the gas prices is in contradiction with this tendency); 6) reclamation of former mining plots and dumps by individual forms (forests, fields, orchards and even vineyards, lakes, sport and recreational areas – we can mention as examples automobile racing circle and horse-race stadium in Most).

The consumption will be concentrate more and more to production of electricity, the using of coal (prevalled burning in steam-power plants) will be less dangerous from the point of view of environment (especially pollution of air) because of finished both reduction of fly ash and desulphurization and modernization at the 1.1.1999.

Due to remarkable progress in solution of heating problem (shift to the utilize of both central and local heating based on gas, oil, electricity, restructuring of some power plants for combination production of electricity and heating water, thermal isolation of buildings etc.) the environment, especially pollution of air,

Tab. 7 – Balance of electricity in the Czech Republic 1989 – 2000 (GWh)

	1989	1990	1995	1999	2000 ¹⁾
Production, total	65,132	62,558	60,847	64,692	73,466
steam power plants (%)	78,4	77,6	76,2	75,9	78,4
hydroelectric power plants (%)	2,5	2,3	3,7	3,4	3,1
nuclear power plants (%)	19,1	20,1	20,1	20,7	18,5
Imports		8,179	6,722	8,983	8,725
Exports ²⁾		8,871	6,304	12,258	18,742
Consumption in the CR	62,379	61,866	61,265	61,417	63,449
Index production/consumption	104,4	101,1	99,3	105,3	116,0
Consumption in energy processes	11,658	11,467	9,928	10,023	10,821
electricity generation (%)	39,2	38,7	39,9	48,8	52,9
pumped storage (%)	3,7	3,5	3,8	7,2	6,9
heat production for distribution (%)	16,9	16,7	17,0	15,7	14,3
fuel extraction, preparation and upgrading (%)	40,2	41,2	39,3	28,3	25,9
Losses in networks	4,075	3,996	4,768	4,627	4,683
Final consumption, total	46,646	46,403	46,569	46,767	47,945
Index final consumption/consumption	74,8	75,0	76,0	76,2	75,6

¹⁾ preliminary data

²⁾ 1990: including exports and imports between CR and SR

Source: Statistická ročenka České republiky (Statistical Yearbook of the Czech Republic) 2001 (2001). Praha, ČSÚ (and relevant other issues)

improved rapidly from the regional and local point of view. The consumption of low energy-demanding goods as well as change of energy behavior and mentality of inhabitants was influenced by rapid increase of prices (coal, coke, heat, petrol, electricity, gas, water, sewage) (Kopačka 2000a, 2000b).

3. 5. Crucial crossway of the Czech power industry – brown coal and nuclear energy

It will be useful to show overall balance of electricity in the Czech Republic during transition before we attempt to answer this suggestive and difficult “Hamlet” question “be or not to be” (Tab. 7). The consumption of electricity increased by only 2 % in the Czech Republic in the period 1989 – 2000, production of electricity was by 13 % higher due to growing role of exports.

Economic prognosis from the 90s counted with much higher consumption of electricity. Slower development of economy and other factors resulted into the actual controversy between nuclear and brown coal thermal power plants with all consequences including international ones (relations with Austria, Germany). Paradox is that all power plants mentioned are operated by only one monopoly stock company ČEZ (Czech Power Plants) with majority of the Czech state (68 %) and so this “conflict” takes place in the frame of one firm. The unsuccessful privatization attempted by the Czech government at the beginning of 2002 not only did not result into liberalization of the power industry, but even there is tendency to integrate production of electricity with several distributing companies. According to plan of Ministry of industry and trade the firm will be privatized as a whole. Quite different tendency of liberalization of energy sector prevails in EU at the same time.

The “rivalry” between nuclear and coal power energy resulted first from the past development (the construction of nuclear power plant Temelín started before “velvet” revolution) and difficult course of transition. For the time being the Czech energy industry is lacking the energy policy within the frame of the general economic policy embodied in the basic development trajectories of EU and general economic and energy policy of EU (Energie1998).

The technical and mining technology problems are connected with functioning of brown coal steam power plants in Northern Bohemia as well as with social, political, local and regional ones. There will be three actors in the case when Temelín will be in operation: both nuclear power plants (Temelín and Dukovany), desulphurized and modernized coal thermal power plants, and foreign trade. Enemy for them will be internal and external prices and business politics.

Total investment expenditures of both huge lucrative programs of modernization of coal steam power plants and building of Temelín nuclear power plant exceeded 150 billions CZK and were attractive for many domestic and foreign companies (Austrian, German, American, between them for example Westinghouse, ABB).

Beside technical and production of electricity factors political and social aspects in regions and mining districts played important role by decisions to survive, modernize and desulphurize coal power plants too. I think that the political representatives were afraid of too fast suppress of industrial activities in strong left oriented mining districts. Communist party won really the elections in new established Ústí nad Labem region in Autumn 2000. Decrease of coal mining and faster closing of coal power plants (recently desulphurized by investment expenditures over 50 billions CZK) could call forth the chain reaction of impacts and worsen difficult situation with high employment rate in the industrial areas.

The building of the first block of Temelín nuclear power plant was completed relatively soon after the desulphurization, but nearly 10 years later than was primary term. Examining operation took place from September 2000 and is accompanied by plenty technical problems mainly in secondary circle and from the beginning by demonstrations both the Austrian and domestic environmental and local movements. There are tens of nuclear power plants located on the territory of the Europe, but nowhere there are such complications. It is the safety of nuclear power plants that is the prior issue in the nuclear power industry at the present, and it has to be taken into account in the nuclear power plant Temelín as well. But the risks of the nuclear power plants operation are not associated only with the former socialist countries. With energy resources the Czech Republic has available it is difficult to decide whether to stop nuclear power project.

Contemporary era is envious to nuclear power plants because people are in fear of safety and security and radioactive wastes. But measured by number and intensity of demonstrations it is envious to World Bank and International Monetary Fund too.

3. 6. Possibilities to produce electricity in the Czech Republic

There are three predominant and classic natural energy resources used for generation of electricity in the Czech Republic:

First is coal (brown coal and lignite, partly hard coal – domestic and imported). Production of electricity by steam coal power plants was about 57,6 GWh (78,3%) in 2000.

Second is nuclear energy. Production of electricity by only one nuclear power plant in operation Dukovany was 13,6 GWh (18,5%) in 2000.

Third is hydro energy. Production of electricity by hydro power plants fluctuates about 3 – 3,5 % according to climatic conditions. It was 2,3 GWh (3,1%) in 2000. The geographical conditions are not favourable for production of hydro electricity and most worthy is production by pumped storage plants to cover peak consumption of electricity.

Other two energy resources could have strong indirect influence on environment and energy demand. Both depend on the development of society and economy:

First is the development of production of electricity by small-scale producers and on the base of renewable or alternative energy resources (small hydro-, wind-, solar-, and biomass-power plants). This modern, in the world preferred and supported form has not favourable conditions in the Czechia from the point of view of technical, economic, institutional and legislature preferences like in western-European countries (for example Denmark, the Netherlands, Germany). These producers are not able to compete to huge thermal power plants, when great surplus of electricity is exported. Many wind-power plants are in operation on the German side of common boundary with the Czechia in Krušné hory Mts., on Czech side attempts to built wind-power plants too were not successful.

Last but not least savings are great energy resource in the Czech Republic. Development of economy and energy industry during the period of transition showed, that changes of structure of consumption of individual primary energy sources, modernization, savings of fuel and energy, prices etc. are the biggest energy source. The modernization of energy sphere to great extent depends on restructuring, modernization and level of the whole economy.

3. 7. Uranium industry and nuclear power industry in the Czech Republic – past, present, future

Nuclear power industry was based on the domestic deposits of uranium. The deposits in Jáchymov mining district were exhausted during 50s and in Příbram districts during 70s. Both served mainly for military purposes of former USSR. Uranium from Dolní Rožínka mining district (since 60s) and from Stráž pod Ralskem – Hamr na Jezeře district (since 70s) was exported to USSR (Russia) and enriched uranium fuel was imported.

Development of heavy industry was restored after the occupation of Czechoslovakia by armies of Warsaw pact in 1968 and based on the new escalation of coal mining (with addition of growth of oil and natural gas import) with the extremely demanding program of the nuclear industry covering the uranium mining and both machinery and construction of nuclear power plants. To give a clear idea, their installed capacity considered in the conception of the 2nd half of the sixties should have reached in Czechoslovakia at present 26 500 MW (Kopačka 1968), in the modified version 11 280 MW (Hospodářské noviny 1988). Today, only nuclear power plant Dukovany (1760 MW) is in operation in the Czech Republic.

The uranium mining gradually ended after collapse of socialist regime, when lost support and grants end. Uranium mining appeared quite ineffective in comparison with the price of uranium on world market. Now only a small amount of uranium is mined irregular for nuclear power plants in Dolní Rožínka. This deep mine will be shut up in the year 2004. Czech nuclear power industry will be since 2004 totally depended on export of nuclear fuel.

The core of the energy problem is not from the long-term point of view the choice between brown coal and nuclear energy. This argument is very frequent, in fact it is only one of many problems of the difficult process of transformation after the year 1989 in the Czech Republic. It is hardly imagine, that finished Temelín nuclear power plant will be closed and the production of electricity will be based on brown coal power plants. Controversial construction of Temelín nuclear power plant (original planned total installed capacity of 4 000 MW was reduced to 2 000 MW – first block 1 000 MW is just now prepared to operation, second block 1 000 MW is finished to start process of preparation to operation) and its permanently postponed completion was dramatized not only by the ecological movements and sensitive relationship with Austria, but particularly by high costs and long time of construction.

Nuclear power industry has some qualitative aspects in the Czech Republic. One of them is, that ambitious and from the point of view investment and technological demanding nuclear power program from 70s to the end of 80s advanced the level of the Czech engineering industry and machinery and of many branches of economy (industry, research and development, science). Experiences and experienced people could work in transformed and restructuring economy after 1989. Another schizophrenic aspect relates to environment. On one side nuclear power plants are “ecologic-friendly” and clean from the point of view of classic pollution and damages (air pollution by sulfur, nitrogen, and carbon dioxides, ash, vegetation). On the other they represent potential threat of nuclear catastrophe, produce radioactive waste, warmer the water, dominate the landscape.

3. 8. Energy and environment

Environmental situation had been improved substantially during the period of transformation after 1989. The reasons were mentioned in the chapters above. “Strategically” most important were: change of geopolitical and geoeconomic orientation including installation of democratic regime and market-like economy; transfer of capital, know-how, methods, and goods from developed countries; decrease of economy and industry on one side and modernization, rationalization, restructuring and redistribution on the other; reduction of coal mining and end of metal ore and uranium mining, desulphurization, modernization and structural rebuilding of energy industry and heating, especially of power plants; reduction of chemical fertilizers and means; environmental investments (water cleaning stations).

The best example of environmental improve is decrease of air pollution. It was the most serious environmental problem during socialism.

4. Conclusion

Regards energy industry epochal changes took place during transformation. Extremely high and demanding investments were realized and given into restructuring energy industry in the state weakened by forty years of totalitarian regime.

Remarkable changes were realized in the structure, utilize, consumption, distribution and effectiveness of energy during a relatively short time of transformation. The structure of consumption of primary energy sources (solid, liquid, gaseous, primary electricity) was changed substantially as well as production of electricity.

Solution of many problems accumulated in the energy sphere during socialism and unsolvable during this regime advanced expressively during the period of transformation since 1989. Change of the structure of Czech energy industry is extremely exacting (capital), requires rational conception of economic, industrial and energy policies, and is long-term aim. There is shortage of all these factors.

Impressive statistical numbers of the absolute decline in the consumption of primary energy sources, imposing restrictions of the brown and hard coal mining, unique speed of solving the desulphurization and reduction of fly ash of coal thermal power plants owned by the monopoly power company ČEZ, all this can be counted to positive as well as controversial merits of the transformation.

In 21st century the Czech Republic will have to face not only the impact of diminishing high-grade energy resources of oil and natural gas (with corresponding price development and territorial aspects connected with the over-lasting orientation to Russia). It will also have to face the increasing influence of diminishing domestic resources of fossil fuels as well as will have limited capacity to solve the energy issue either by alternative (renewable) energy resources that in EU should cover 12 % of consumption, or by nuclear energy.

It is high time – or might be already late, to solve the future of the power industry by investing into consumers and thus into the whole structure of economy and not to prefer power industry. Being tied down by economic parameters the sphere of power companies does not admit it. Monopoly position based on flexible price adjustment and non-liberalized environment do not create a competitive environment and consequently develop no pressure on price and quality.

There are two basic strategic ways to solve energy situation of the Czech Republic. Both are tightly connected with the general characteristics of the transformation, i.e. the priority of setting key targets (vision of the 21st century) and speeding up the process of EU entry.

The first is the conceptual restructuring of the whole Czech economy including industry and energy industry. On still enormous energy consumption it can bring *savings that are potentially great energy resource*. At the time when oil and natural gas reserves will be exhausted and the world returns to the coal, the Czech coal reserves will already be exhausted.

The second way is associated with the integration of the Czech economy into Europe and into the world, where *the solution to the Czech energy, ecological, social, regional and other issues becomes a part of European policy and solution*. This is proved by the extending liberalization of the power industry within EU and creation of internal electricity or natural gas market.

It can be proved that a number of current problems are fabricated and are impossible to solve due to the unwillingness to make final principle decisions.

The issues of Czech energy industry have to be solved within a long-time and not a short-time effect. That applies to the entire society and economy whom, unlike to past, the power industry serves.

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ENERGETIKA V HOSPODÁŘSTVÍ A ŽIVOTNÍM PROSTŘEDÍ ČESKÉ REPUBLIKY

Obsahem příspěvku je problematika současného stavu energetiky v České republice jako výsledku vývoje a strukturálních a teritoriálních změn v období transformace po roce 1989. Průběh hlubokých transformačních změn energetiky, které budou pokračovat i v budoucím hospodářském a průmyslovém vývoji, výrazně ovlivnila jak změna systému a zahraniční orientace, tak míra deformací z předchozího socialistického období. Ani v samotné transformaci se nepodařilo vyhnout se řadě dalších deformací.

Autor se soustřeďuje na vybrané aspekty tuzemské produkce a celkové spotřeby primárních energetických zdrojů a elektřiny. Hodnocení vývoje a změn energetické sféry je zasazeno do širších souvislostí historického, politického, společenského, geografického a regionálního vývoje s ohledem na vývoj životního prostředí. Hlavní pozornost je v článku věnována černému a hnědému uhlí (zde až do úrovně dvou hlavních revírů, které tvoří základ výroby elektřiny) jako dosud hlavnímu a navíc domácímu energetickému zdroji a strategické dichotomii mezi uhelnými a jadernými elektrárnami s ohledem na ekologické a mezinárodní souvislosti.

V historickém přehledu jsou uvedeny hlavní rysy vývoje české energetiky ke stavu v roce 1989, ze kterého vycházela kvalitativně nová fáze dosavadní transformace. Hlavním znakem výchozího stavu byla enormní energetická náročnost spojená s předchozím extenzivním vývojem a hypertrofií průmyslu, zejména těžkého.

Vývoj energetiky a elektroenergetiky v transformaci po roce 1989, který je sledován v ekologických souvislostech, je rozdělen na osm dílčích okruhů. *První* si všímá obecně toho, co je jádrem energetického problému a proč je pro ČR tak důležitý. *Druhý okruh* dává přehled o vývoji a změnách celkové energetické bilance, o tendencích objemových a strukturálních přesunů v domácí produkci a celkové spotřebě primárních energetických zdrojů a o minulé, současné a rámcové i o budoucí potenciální úloze domácích a dovážených zdrojů. Názornou ukázkou hlubokých změn struktury spotřeby podle zdrojů je vývoj konečné spotřeby v domácnostech v období 1990 – 2000. Zvýrazněny jsou kvalitativní parametry nejen z hlediska vlastních zdrojů, ale i jejich využití a spotřebitelů. *Třetí okruh* přechází k měnící se úloze černého a hnědého uhlí jako útlumového energetického zdroje, který však v současnosti i nejbližší budoucnosti stále představuje hlavní zdroj. Protože cílem článku je spojitost mezi energetikou a elektroenergetikou, je náplní *čtvrtého okruhu* těžba a využití hnědého uhlí ve dvou hlavních revírech - severočeském a sokolovském. Uvedeno je šest hlavních tendencí, které vedly ke zlepšení životního prostředí v hnědouhelných revírech. Jednou z nich je další posun ke spotřebě uhlí pro výrobu elektřiny v elektrárnách, které byly modernizovány a odsířeny. Navazující *pátý okruh* hodnotí vzniklou „hamletovskou“ otázku rozporu mezi výrobou elektřiny v modernizovaných a odsířených uhelných elektrárnách a v jaderných elektrárnách zejména v souvislosti s postupným uvedením jaderné elektrárny Temelín do provozu. Vytvořená rivalita má závažné mezinárodní, hospodářské, ekologické, sociální, regionální, zahraničně-obchodní (vývoz elektřiny) souvislosti. *Šestý okruh* se proto soustřeďuje na možnosti výroby elektřiny v ČR v současnosti a zejména budoucnosti. Rozděluje je na ty, které souvisí s využitím dostupných energetických zdrojů včetně obnovitelných (a se změnou v přístupu k nim), a na velké zdroje v podobě úspor vyplývajících ze strukturálních změn celého hospodářství i samotné energetiky, integrace v rámci EU a z pokračujících kvalitativních změn. Obsahem *sedmého okruhu* je problematika uranového průmyslu a jaderné energetiky v ČR z rozporuplného ekonomického a ekologického hlediska. Uvedeny jsou „schizofrenické“ aspekty relace mezi jadernou energetikou na straně jedné a uhelnými elektrárnami resp. životním prostředím na straně druhé. Právě vztah mezi energetikou a životním prostředím je stručně zhodnocen v posledním *osmém okruhu*.

Závěr studie shrnuje a zobecňuje závěry z dílčích kapitol v širším kontextu pozitivních a negativních aspektů transformačního vývoje. Ten však zasazuje do strategických výzev vyplývajících jednak z očekávaných prognostických změn v globální energetické situaci ve 21. století, jednak z vlivu blížícího se integračního začlenění ČR do EU. Z těchto tendencí vyplývá nezbytnost jasné, dlouhodobě zaměřené energetické koncepce provázané s celkovou koncepcí hospodářského, průmyslového a regionálního vývoje českého prostoru.

Obr. 1 – Vývoj HDP a energetické náročnosti v ČR 1989–2000 (1989 = 100). a – HDP, b – primární energetické zdroje, c – energetická náročnost GJ/Kč, d – výroba elektřiny, e – spotřeba elektřiny.

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