

Czech University of Life Science Prague

Faculty of Economics and Management

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Bachelor Thesis

**Natural resources and their economic
role in the Czech Republic**

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Statutory declaration

I hereby declare that I worked on my bachelor thesis titled “Natural resources and their economic role in the Czech Republic” by myself and I used only the sources mentioned at the end of the thesis.

In Prague

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Přírodní zdroje a jejich ekonomická role v České republice

Natural resources and their economic role in the Czech Republic

Summary

The purpose of this thesis is to investigate the influence of natural resources on the economy of the country, compare it to world and demonstrate the positive and the negative impacts of mining on the environment and the society. The thesis closely focuses on the mining of coal in the Czech lands.

The project is divided into two subsequent parts: theoretical and practical. The theoretical part introduces its natural resources occurring in the Czech Republic, describes the classification of mineral reserves and divides them into different categories of mined products. Introduction to coal and coal mining in the Czech Republic makes readers more familiar with the different types of coal along with methods used to process the coal and its historic development as well as the current potential. The final part of the theoretical part further discussed coal deposits and reserves in 21st century which leads reader in the second part of the thesis.

The practical part provides an overview of coal production as well as coal consumption in the Czech Republic and compares these concepts with global situations. The coal import and export data show the most important export markets for Czech companies, the main import countries to the Czech Republic and the world leading exporters and importers of coal. The next part analyses the connection between coal price and energy production. The thesis is also an initial attempt to investigate the relationship of regional localisation of coal and the ecological mining limits in the Czech Republic and the impact on regional employment. The last topics of the practical part deal with the ecological influences of coal mining.

Keywords: Natural resources; The Economy of The Czech Republic; Influence of Coal mining industry; Affects of mining; Employment; Environment

Souhrn

Cílem této práce na téma „Natural resources and their economic role in the Czech Republic” je prozkoumání vlivů přírodních zdrojů na českou ekonomiku, porovnání se světovou těžbou a popsání pozitivních a negativních vlivů uhelné těžby na životní prostředí a společnost. Tato práce se úzce profiluje těžbu uhlí v Českých zemích.

Práce je rozdělena do teoretické a praktické části. Teoretická část popisuje přírodní zdroje nacházející se v České republice a charakterizuje klasifikační metodu dělení minerálních zdrojů do různých kategorií těžebních produktů a následně tyto kategorie blíže definuje. Uvedením uhlí a uhelné těžby v České republice se čtenář blíže seznámí s různými typy uhlí spjatými se zpracováním uhlí a jeho historickým vývojem stejně tak jako současným potenciálem. Závěrečná kapitola teoretické části práce se dále zabývá uhelnými ložisky a zásobami 21. století, které vedou čtenáře k druhé části práce.

Praktická část poskytuje přehled o produkci uhlí, stejně jako její spotřebě v České republice a porovnává tyto koncepce se zbytkem světa. Data importu a exportu uhlí představují největší vývozní partnery českých firem, hlavní dovozce do ČR a prezentuje světové lídry vyváženého a dováženého uhlí. Druhá polovina praktické části analyzuje vztah mezi cenou uhlí a produkcí energie. Práce také zkoumá vztah regionálních zdrojů uhlí, ekologických územních těžebních limitů v České republice a jejich dopad na zaměstnanost v regionech. Poslední téma praktické části se zabývá ekologickými vlivy z uhelné těžby.

Klíčová slova: Přírodní zdroje; Ekonomika České republiky; Vliv uhleného těžebního průmyslu; Důsledky těžby; Zaměstnanost; Životní prostředí.

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List of abbreviations

CSDP	Czech Social Democratic Party
CZSO	The Czech Statistical Office
ČTK	The Czech News Agency (Česká tisková kancelář)
DMMRT	Dictionary of Mining, Mineral, and Related Terms
ESDS	European Statistical Data Support
EU	The European Union
HKK	Hradec Králové Region (Královéhradecký kraj)
ILO	International Labour Organization
JHC	South Bohemia Region (Jihočeský kraj)
JHM	South Moravia Region (Jihomoravský kraj)
KVK	Karlovy Vary Region (Karlovarský kraj)
LBK	Liberec Region (Liberecký kraj)
MSK	Moravian-Silesian Region (Moravskoslezský kraj)
MŽP ČR	Ministry of the Environment of the Czech Republic (Ministerstvo životního prostředí České republiky)
OLK	Olomouc Region (Olomoucký kraj)
PAK	Pardubice Region (Pardubický kraj)
PHA	Prague

	(Hlavní město Praha)
PLK	Plzeň Region (Plzeňský kraj)
SČK	central Bohemian Region (Středočeský kraj)
ULK	Ústí Region (Ústecký kraj)
USSR	The Union of Soviet Socialist Republics
VYS	Vysočina Region (kraj Vysočina)
ZLK	Zlín Region (Zlínský kraj)

1 Introduction

Today's world needs a significant amount of energy for modern technologies and human consumption every day. This energy is produced from different types of natural resources drawn from nature. Some of the natural resources can be renewed, others were created many years ago and cannot be restored, such as fossil fuels, for example coal.

Coal and its utilization to produce heat have been used by humans from prehistory. During the centuries, the coal mining process has undergone a number of changes. Machinery and other equipment have replaced the manual extraction of coal. Humans learned how to find the strata with high quality coal then extract it in the most effective way and use coal processing to produce products from raw coal. Nowadays, this fossil fuel is one of the most important non-renewable resources for the Czech economy and energy production in the Czech Republic. However, the mining process and the usage of coal have negative impacts on the environment of the Czech Republic.

The theoretical part defines the natural resources found in the Czech Republic and categorises the mineral reserves of the country. The second part focuses thoroughly on coal and the mining of it in the Czech Republic which includes the types of coal, a graphical demonstration of its historic development and current potential, types of coal mining and the description of coal processing. The theoretical part comprises of a subsection analysing the Czech coal deposits and reserves in the 21st century and illustrates them on a map of the Czech country.

The practical part of the thesis analyses the impacts of coal and coal mining on the Czech economy by evaluating factors, such as coal production and consumption, coal imports and exports of the Czech Republic, changes that have occurred and comparisons to the rest of the world. The next subsection studies the relationship between coal price and the development of the energy production industry. The following subsection includes a discussion of the environmental mining limits in north Bohemia and will analyse the problematic situation in the Czech Republic caused by these limits. The influence of these on the labour market is also discussed as is the current potential. The last part of the fourth chapter will intensely focus on the influence of coal mining on employment in the country.

The regions of the Czech Republic and the relationship between the types of employment and specific regions are also analysed.

The final part of the thesis focuses on the positive and negative influences of coal mining on the Czech environment and ways that possible problems could be solved.

2 Objectives and Methodology

2.1 Objectives

The main objectives of this bachelor thesis are explained by the extension the natural resources, especially coal, the influence to the Czech economy and its positive and negative impacts. It also takes into account the current difficult situation, such as the ecological mining limits in the Czech Republic and analyse if and to what extent will coal mining be profitable in the future.

2.2 Methodology

The main theoretical methodological tools of this thesis are analysed the information about the presence of underground deposit of coal, methods used in extraction, sell process and using, it analysing the classical labour market in relation to the coal industry and the aggregate demand and supply for energy and the other outputs of the industry. “The law of increasing relative costs” is also used to explain the utilization of coal resources. The basic factors of production will be assessed taking into account the specifics of the region in question. The labour market can be examined by looking at labour supply and demand curves which might fluctuate depending on changes in the economy - price of coal, wage rates, etc.

3 The natural resources of the Czech Republic

Natural resources have a very important economic and environmental role in the Czech Republic. The Oxford Dictionary defines natural resources as: “materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain.”¹ This definition indicates that the natural resources are renewable² or non-renewable³ materials that satisfy humans’ wants to produce source of benefits for economic use.

3.1 Mineral reserves and resources

3.1.1 Classification

The first Czechoslovakian classification of mineral reserves and resources was the USSR model in 1948. Four years later, a Commission for the Classification of Mineral Reserves (KKZ) was established for the purpose of categorisation and estimation of reserves⁴ into groups depending on industrial utilisation and the category of deposit found. During the 20th century the categorizing has been developed with a deeper focus on predicted reserves. The combination of categories can determine prospective reserves and explored reserves, (def.) which those content of the terms were not defined by any regulation. The international classification,⁵ which evolved quickly at the end of the last century, could define 36 categories but less than one third of them exist in real life.⁶

“An important aspect of the European and similar reporting codes is the concept of the “competent person”. He/she is responsible for the calculation of reserves and its categories, is a member of an acknowledged professional society (which sees to the expertise and ethics of its members via sanctions), and has expert and moral qualities. His estimates are accepted as

¹ *Definition of natural resources in English*. [online]. 2014. The Oxford Dictionaries, 2014. Available on: http://www.oxforddictionaries.com/us/definition/american_english/natural-resources

² **Renewable resources** are natural resources that can be replenish itself naturally over time, for example water, biomass, solar, wind etc. (DMMRT, 1997)

³ **Non-renewable resources** are limited Earth resources that cannot be replenished if they are used up, for example oil, coal. (DMMRT, 1997)

⁴ **Reserve** is the quantity of mineral that is calculated to lie within given boundaries. It is described as total (or gross), workable, or probable working, depending on the application of certain arbitrary limits in respect of deposit thickness, depth, quality, geological conditions, and contemporary economic factors. Proved, probable, and possible reserves are other terms used in general mining practice. (BS, 1963) (DMMRT, 1997)

⁵ **The international classification** is meant The European Code for Reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves which has been published in 2001.

⁶ *Mineral Commodity Summaries of the Czech Republic 2012* [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

reliable by banks and securities exchanges.”⁷ Based on the classification, the mining companies make decision about their future mine production.

3.1.2 Domestic mine production

The Czech Republic currently mines more than 20 types of domestic mine products. The Ministry of the Environment of the Czech Republic created⁸ four groups of mine products based on their purpose: energy minerals, industrial minerals, construction minerals and metallic ores.

Table 1: Mine production in the Czech Republic

Currently mined	Currently not mined		
Bituminous coal, Brown coal, Crude oil, Natural gas, Uranium		<i>With resources and reserves</i>	<i>Without resources and reserves</i>
	Bentonite, Clays, Diatomite, Dolomite, Feldspar, Gemstones, Gypsum, Kaolin, Industrial sands, Limestone and additives for cement production, Silica minerals	<i>Minerals mined in the past</i>	Lignite Barite, Fluorspar, Graphite
Copper, Germanium, Gold, Lead, Manganese, Silver, Tin, Tungsten, Zinc			
Brick clays and related minerals, Crushed stone, Dimension stone, Sand and gravel	<i>Minerals not mined in the past</i>	Lithium, Rubidium, Cesium, Molybdenum, Rare earths, Selenium, Tellurium, Tantalum, Niobium, Zirconium, Hafnium	Andalusite, kyanite, Sillimanite, Mullite, Asbestos, Magnesite, Perlite, Rock salt, Sulphur, Talc, Other raw materials used in industrial fertilizers production
			Aluminium, Beryllium, Bismuth, Cadmium, Chromium, Cobalt, Gallium, Indium, Magnesium, Mercury, Nickel, Thallium, Thorium, Titanium, Vanadium

- Energy minerals
- Industrial minerals
- Construction minerals
- Metallic ores

Source: Ministry of the Environment of the Czech Republic, prepared by the author

⁷ *Mineral Commodity Summaries of the Czech Republic 2012* [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁸ *Mineral Commodity Summaries of the Czech Republic 2012* [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

In Table 1, those four groups are highlighted by different colours. The mine production in the Czech Republic is divided into two parts: currently mined and currently not mined. The currently unmined section is separated into four groups based on the source of resources and reserves and on whether the minerals and ores were mined in the past or not.

4 Coal and coal mining in the Czech Republic

4.1 General definition of coal

The Dictionary of Mining, Mineral, and Related Terms defines coal as: “A readily combustible rock containing more than 50% by weight and more than 70% by volume of carbonaceous material, including inherent moisture; formed from compaction and induration of variously altered plant remains similar to those in peat. Differences in the kinds of plant materials (type), in degree of metamorphism (rank), and in the range of impurity (grade) are characteristic of coal and are used in classification. ” (AGI, 1987)

This fossil fuel⁹ was formed in the late Paleozoic era¹⁰ but only in the part named the Carboniferous period that spanned 360 million to 290 million years ago. The mosses, horsetails, ferns and other prehistoric vegetation growing in different hydrological environments were buried in swamps and peat bogs in great depths because of tectonic movements [1]. The physical and chemical changes, due to high temperatures and pressures, helped plants to absorb the solar energy from photosynthesis¹¹ and prevented the release of the stored energy and changed into the fossil fuels as we know them today.[2]

4.2 Types of coal

The coalification, the process by which plant remains become coal, formed coal which has different qualities such as equivalent carbon content and releases different types of emissions. Those physical and chemical properties of coal are determined by the type of vegetation from which the coal originates, the depth of burial and the temperatures and

⁹ **Fossil fuel** is coal, petroleum, or natural gas. (DMMRT, 1997)

¹⁰ **The Paleozoic era**, called the Palaeozoic, ran from about 542 million years ago to 251 million years ago and had two sub-eras - The Lower Palaeozoic sub-era that is combination of Cambrian, Ordovician, and Silurian periods, and the Upper Palaeozoic sub-era formatted by the Devonian, Carboniferous, and Permian periods. Its end was being of mass extinctions. (<http://www.livescience.com/37584-paleozoic-era.html>)

¹¹ **Photosynthesis** is the process by which green plants and certain other organisms transform light energy into chemical energy. During photosynthesis in green plants, light energy is captured and used to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds. (Encyclopædia Britannica)

pressures experienced, and the length of formation in the deposit.¹² Table 2 represents the chemical properties of each type of coal.

Table 2: Chemical properties of coal numbers

Sloupec1	C ^{daf} (%)	O ^{daf} (%)	H ^{daf} (%)	N ^{daf} (%)	V ^{daf} (%)	W _t ^r (%)	Q _i ^r (MJ/kg)	R ₀ (%)
Peat	50-60	33-40	4.5-6	0.9-3.5	> 60	75-95	< 14.7	< 0.20
Lignite	< 65	19-33	< 6	< 1	52-40	> 30	14.7-17.0	> 0.20
Sub-Bituminous (brown coal)	65-69	10.19	< 6	< 1	52-40	> 30	17.0-24.4	0.40-0.60
Bituminous (black coal)	69-92	10.2	< 5	< 1	40-8	> 5	24.4-32.6	0.60-2.65
Anthracite	86-98	< 2	< 3	< 1	8.2	> 2	> 32.6	> 2.65

Source: Institut geologického inženýrství, VŠB - Technická univerzita Ostrava

C ^{daf}	combustible carbon content
O ^{daf}	oxygen content
H ^{daf} (%)	hydrogen content
N ^{daf} (%)	nitrogen content
V ^{daf} (%)	content of volatile matter
W _t ^r (%)	the water content of the original sample
Q _i ^r (MJ/kg)	calorific value of the original sample
R ₀ (%)	Vitrinite reflectance

The carbon content (C^{daf}) indicates that each type of coal burns differently and the calorific value (Q_i^r) determines the amount of different types of emissions that are released by the burning process. The rank of coalification is measured by the content of volatile matter (V^{daf}) and the Vitrinite reflectance (R₀). If the percentage of the content of volatile matter is high, the coal is less coalification. The lower the Vitrinite reflectivity, the lower the degree of coalification (the coal substance).¹³

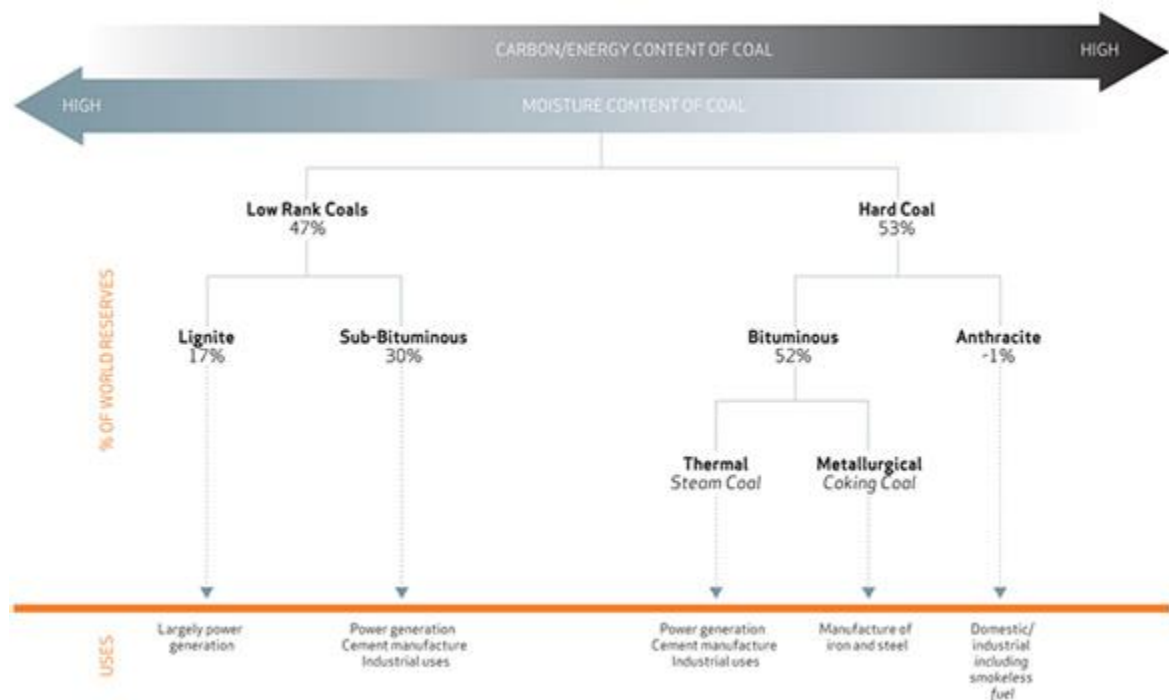
In the Czech Republic six types of coal are produced: peat, lignite, sub-bituminous (brown coal), bituminous (black coal), anthracite and graphite. The youngest coal type is peat which is use for gardening, therapeutic purposes or as a fuel. Lignite is a softer version of sub-

¹² *What is Coal?*. [online]. World Coal Association. Available on: <http://www.worldcoal.org/coal/what-is-coal/>

¹³ *Využití uhlí*. [online]. Institut geologického inženýrství, VŠB - Technická univerzita Ostrava. Available on: http://geologie.vsb.cz/loziska/suroviny/vyuziti_uhli.html

bituminous coal, brownish coal of the lowest level ranking. This type of coal can be easily converted into gas and liquid petroleum products rather than coal with higher calorific value. It is often burned for power production. The higher ranking coal is sub-bituminous coal (brown coal) which gives more energy than lignite and is used as a fuel. The bituminous coal is black coal of a high rank and is used for coking. It also has a low phosphorus content where phosphorus is a damaging element in the steel making process. Anthracite is the hardest and oldest coal producing the greatest amount of heat because of the highest carbon content. This type of coal is used in steel-making and other metallurgical industries. Graphite is the outcome of the last phase of the transformations of organic matter and it is not usually used as fuel.[1, 2, 7]

Picture 1: Types of coal



Source: The World Coal Association¹⁴

¹⁴ **The World Coal Association (WCA)** is a global non-profit and non-governmental industry association formed of major international coal producers and stakeholders. The original name, World Coal Institute (WCI) was changed in November 2010.

4.3 History of coal mining in the Czech Republic

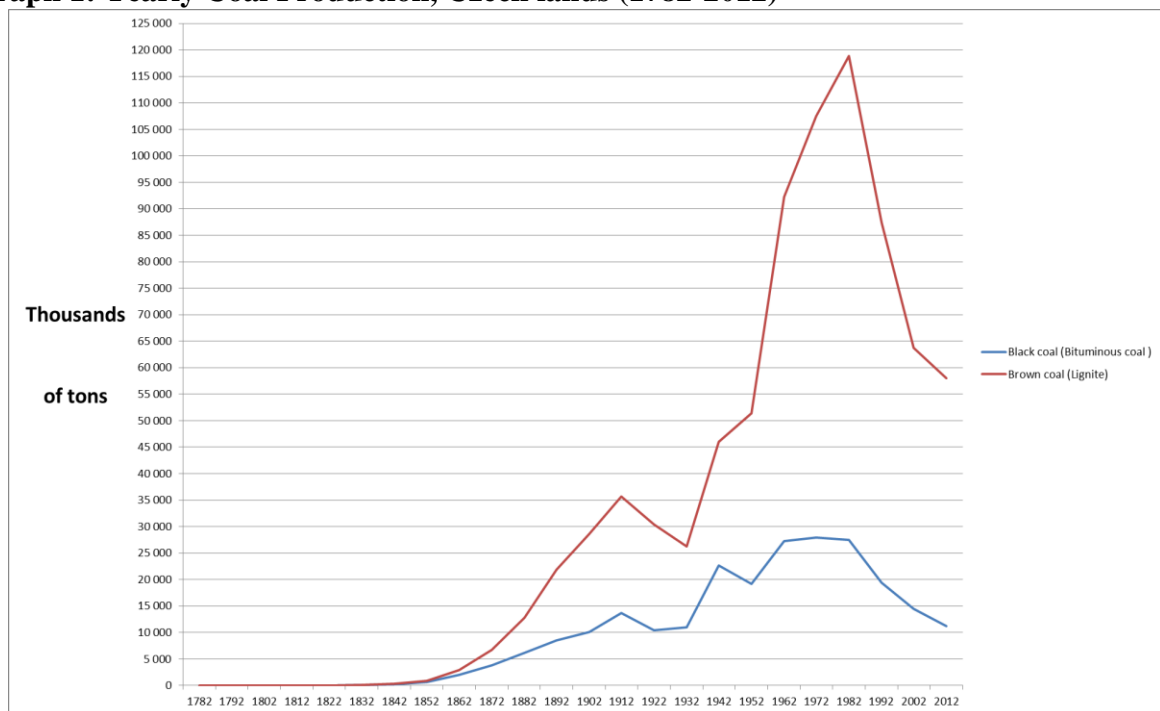
The human race has utilized coal since prehistory. The first use of black coal as a heating fuel was in the foothill of Landek which lies above the place where the rivers Odra and Ostravice joint together. A campfire, with burned coal in it, that humans had made dating from around 23,000 years ago was found there. This archaeological evidence is unique and is evidence of the first use of fossil fuel for heating purposes.[17]

Coal mining on Czech lands has a long tradition. The oldest written record of coal mining on Czech lands is in the north Bohemian town Duchcov where in the local chronicle there is a note about the mining of brown coal in the district in 1403. In the 16th century the brown coal mining areas were expanded to Žacléřsko in north Bohemia and Přílepy and Otrokovice in the East Moravia. Despite this expansion, the utilization of coal was very low.[5]

In the 17th .century, the main demand for coal was during the Thirty Years' War and the increasing use of manufacturing techniques in the production of textiles and glass. The increase of domestic and foreign markets in the second half of the century also led to an increase in demand for coal. Most of the coal fields were opened at the end of the 18th century which affected the geological research and its focus on the registration of assets.[5] The first written record about mining black coal is from the town Ostrava in 1763. The first comprehensive statistics (statistical data) of coal production was gathered in 1782 and has continued from that date. More recently the data has been collected from the mining annuals of each region by the Czech Statistical Office.[5]

During the 19th .century many positive changes for industry in the Czech lands occurred. The industrial production was increasingly influenced by the changing methods brought about by the Industrial Revolution. During this industrial period, new industrial sectors were created, for example, the food industry and the sugar industry. The development of industries and the increasing population led to the connection of Czech lands by railroad tracks. The production of coal decreased at the end of the 19th century and many people lost their jobs. The reason for this decline was the rising costs of underground mining. Many middle sized companies were closed in some regions.[12] The changeover from underground coal mining technology to surface coal mining technology reduced the cost by increasing work productivity by one fifth to required mining intensity.

Graph 1: Yearly Coal Production, Czech lands (1782-2012)



Source: Czech Statistical Office, 2013, author calculations

Graph 1 shows the yearly production of coal on the lands of today's Czech Republic since 1782. The production of coal increased during the First World War because of the military needs. The war had a negative impact on the labour force because a lot of men were taken away to war. The first anomaly is reported in the year 1918. The newly created Republic of Czechoslovakia had to face coal mining competitors and a lower demand for coal affected mining production also. The second anomaly shows the influence of the Great Depression in 1929. In most countries of Europe it started in 1930 and had a smaller effect on Czechoslovakia and coal mining in the country compared to other countries.

During the Second World War, most of the coal mines were taken over by the occupiers of the Third Reich. This change negatively affected mining. It led to the easiest and quickest mining techniques being used for war purposes which led to a neglecting of work safety. At the end of war, some of the industries were damaged.¹⁵

¹⁵ *Průmyslové dějiny Ostravska*. [online]. 2011. Available on: <http://tezba-a-vyuziti-cerneho-uhli.webnode.cz/historie/prumyslove-dejiny-ostavska/>

After the war ended in 1945, the Decrees of the President of the Republic¹⁶ caused the nationalization of mines and created a new management plan. The Communist regime promoted industrialization¹⁷ with a preference for heavy industry which fortified coal mining in The Czechoslovak Republic.

The production of electric power was mainly based on the burning of brown and black coal until the middle of the 80's. In 1985, the first block of nuclear power plant was commissioned which affected coal mining and the demand for coal. The next influence was the relative decline of heavy industry compared to the growth of light industry in the same period as after the revolution in 1989. The electric power plants have made many changes to protect the environment. They had to shutdown the oldest production units, and modernize or install desulphurization devices. Some coal mines had to be closed and had to be disposed of Mining limits. The limits were applied between the years 1990 - 1991 and the mining production rapidly decreased. Since 1994, the project 'Gas installation' had the aim to replace the use of coal by gas in the heating plants and Czech households.[3]

4.4 Types of coal mining

The coal mining companies use two types of coal mining – underground mining and opencast or surface mining. The type of mining method depends on many factors, such as the quality, the type, the size, and the depth of accumulated coal and the capital available for mining purpose.[7]

The underground mining of coal is based on creating tunnels that are made by underground mining equipment, for example longwall coal cutters¹⁸. The tunnels lead into the deep coalbed of mineral ore. The miners haul¹⁹ mined coal away by the intermediate haulage system.²⁰ Each mine is of a different depth depending on the depth of the coalbed. Underground coal mining is usually used for mining black coal, or bituminous, and anthracite

¹⁶ **The Decrees of the President of the Republic** ("Benes Decrees") are a series of laws that claimed collective postwar responsibility of ethnics of Germans and Hungarians living in Czechoslovakia, and deprived them of their rights, loss of citizenship and expropriation of property after World War II.

¹⁷ **The industrialization** is the process of converting to a socioeconomic order in which industry is dominant. (Encyclopædia Britannica)

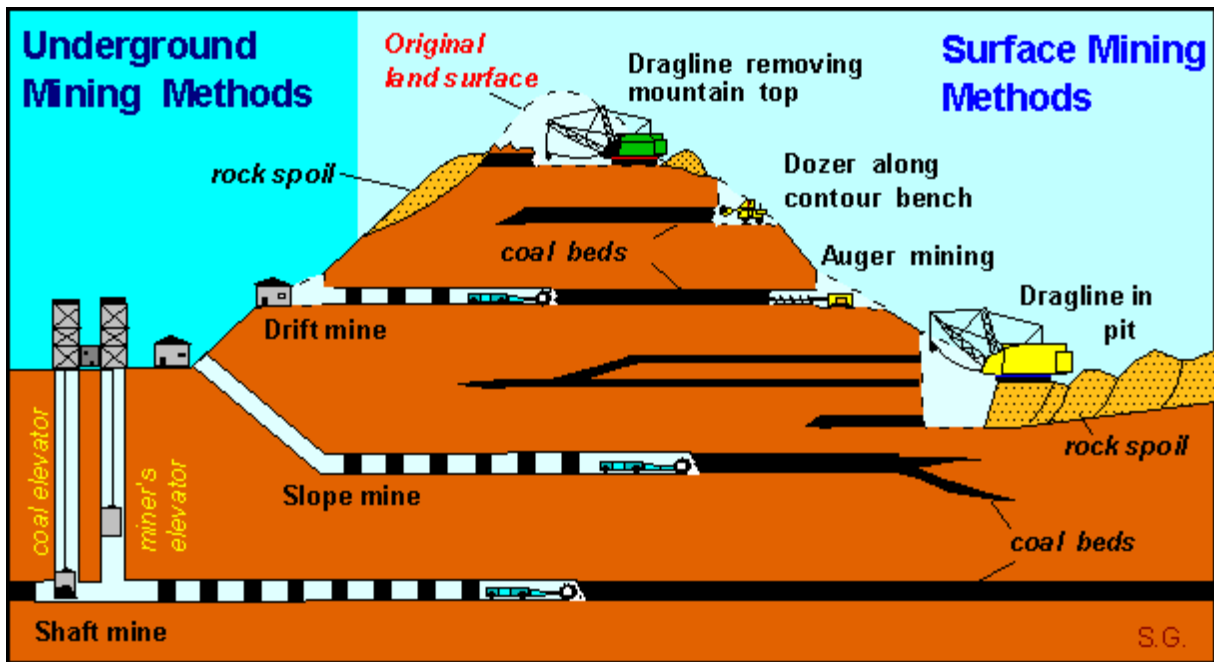
¹⁸ **Longwall coal cutter** is compact machine, driven by compressed air or electricity, that cuts the coal face with its jib at right angles to its body. (Pryor, 1963) (DMMRT, 1997)

¹⁹ **Coal hauling** is the drawing or conveying of product of the mine from the working places to the bottom of the hoisting shaft, or slope. (Zern, 1928) (DMMRT, 1997)

²⁰ *Modern Coal Related Technology* [online]. 2007. Kentucky Foundation. Available on: http://www.coaleducation.org/technology/modern_equipment.htm

because their deposits are situated deeper than deposits of lignite or sub-bituminous (brown coal).[2] The Ostrava coalbed is shallower with 0.8 – 1.5 meters deep compared to the Karviná coalbed which is 1 – 6.5 meters in depth.²¹

Picture 2: Types of coal mining



Source: The Kentucky Department of Mines and Minerals

The underground mining is a more expensive and a more difficult process than the other type of mining. This mining type greatly impacts miners' health, the local population as well as the local environment. The dust in the mines affects the health of workers and there is a greater danger for accidents, for example gas explosions in the mine. The coal mining companies do not produce tailing ponds²² anymore but they produce the mine tailings²³ which add to the unaesthetic elements in the environment. The underground mining causes terrain subsidence which can affect the foundations of buildings and cause changes to the surroundings. The pollution in mine water and the emissions of mine gases (CO, CO₂) have a negative impact on the environment of the Czech Republic. However, the underground

²¹ *How coal is mined in OKD*. [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/coal-mining/how-coal-is-mined-in-okd>

²² **Tailing ponds** were created during the process of coal preparation. It is a mixture of small pieces of coal, clay, sand, and residual bitumen mixed with water. Ponds are usually situated in basins which were made by the mining process. The negative effect to the environment is contamination of soil by toxic metals and can also pollute surface water and groundwater. (DMMRT, 1997)

²³ **Mine tailings** are materials left over from coal mining or other minerals from ore. (DMMRT, 1997)

method is less environmentally harmful because the mining is located below the surface and the mines can be used for tourism after the mining process.²⁴

The Kentucky Coal and Energy Education Project defined surface mining as: “A mine in which the coal lies near the surface and can be extracted by removing the covering layers of rock and soil.” For surface mining, miners use different equipment than for underground mining. For example, they use draglines, shafts, haul trucks and another equipment and use them for making the placer mining, milling pits or open glory-hole.[4]

During the surface mining process, the companies usually provide new infrastructure, such as roads, railways etc. and introduce the mechanization of the mining process.²⁵ This method is economically advantageous because it exploits 90% of coal reserves. Miners have a lower risk of accidents and fewer crisis situations at work. The coal mining places can be reused as protected natural phenomena, recreational and sports facilities or parking places. On the other hand, this method has a higher negative impacts to the environment, villages and urban areas. Sometimes historical monuments have to be transported to different places.²⁶

4.5 Coal processing

The raw mined coal has varied technical and industrial characteristic. Elements contained in the raw coal, such as rocks, soil, pieces of wood or iron, have to be separated from coal because sorted coal is more requested by customers more than untreated coal. The coal process includes washing, dry cleaning and sorting or their combination depends on size of coal grain. The coal materials that come from the mines are sorted on belt filters of different shapes. Larger pieces are crushed and screened into the suitable size and the future utilization determines the size. The coal preparation plant includes pre-treatment, the cleaning process and subsequent treatment produce.²⁷ The washing procedure is usually used for smaller sized grain coal and removes minerals from the coal material for the purpose of increasing coal quality and its market value. The coal is separated by quality that is determined by the chemical analysis of its ash, moisture, fixed carbon and volatile matters of

²⁴ *Vliv hlubinného dobývání na životní prostředí*. [online]. 2011. Available on: <http://tezba-a-vyuziti-cerneho-uhli.webnode.cz/vlivy-hlub-dobvani-na-ziv-prostredi/>

²⁵ *Modern Coal Related Technology* [online]. 2007. Kentucky Foundation. Available on: http://www.coaleducation.org/technology/modern_equipment.htm

²⁶ *Surface phenomena in the course of exploitation* [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/the-environment/surface-phenomena-in-the-course-of-exploitation>

²⁷ *Coal preparation plant flowsheet*. [online]. Available on: <http://www.mine-engineer.com/mining/coal/coalflow.htm>

coal.[2] . The chemical processes, such as dry distillation, devolatilization and gasification, transform coal into solid, gaseous or liquid chemicals, for example tar, amoniak, benzol, fuels, coke and other. The final products are transported to wholesaler by trains, boats or other transportation.[2]

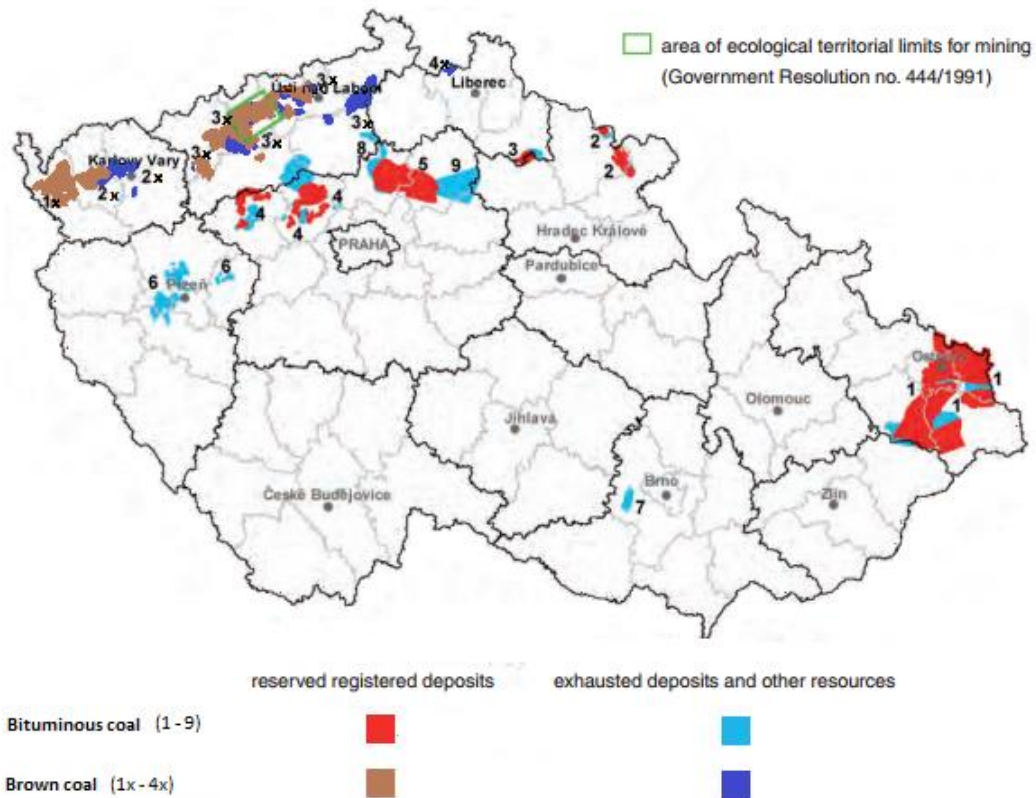
4.6 Coal deposits and reserves in the Czech Republic between 2000-2011

In the year 2000, 67 deposits of bituminous coal were explored in the Czech Republic and 15 of them were exploited. The total number of these deposits decreased between the years of 2000-2011 to 62 explored deposits and 8 exploited deposits mined in 5 mines. Nowadays there are 4 open mines and all of them belong to the only producer of bituminous coal called OKD a.s., Ostrava.²⁸ The total coal reserves (both bituminous and brown) are divided into economic explored reserves, economic prospected reserves, potentially economic reserves and exploitable reserves that indicated type of economic utilization of reserves. The average of the total bituminous reserves was 16 227 387 kt and its median was 16 176 649 kt in 2000-2011.

The brown coal deposits are lower compared to bituminous coal deposits. The total number of deposits decreased from 60 to 53 deposits in 2000-2011. The exploited deposits decreased by one to 9 in 2002 but increased back to the same quantity in 2009. The average amount of brown coal deposits is 9 332 242 kt in this period and the median is 9 307 965 kt. The statistical data shows that the year 2004 was the highest for brown coal deposits and the year 2011 the lowest. The mining companies of the Czech Republic are Severočeské doly a.s. in Chomutov, Vršanská uhelná a.s. and Litvínovská uhelná a.s. in Most, Sokolovská uhelná, a.s. in Sokolov and Důl Kohinoor a.s. in Dolní Jiřetín.

²⁸ *About us.* [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/about-us>

Picture 3: Deposits of bituminous and brown coal in CR



Source: MŽP ČR, 2012, prepared by the author

- | | |
|---|--|
| 1 Czech part of the Upper-silesian basin | 8 Roudnice Part of Mšeno-Roudnice Basin |
| 2 Czech part of the Intra-Sudetic Basin | 9 Mnichovo Hradiště Basin |
| 3 Krkonoše Mts. Piedmont Basin | 1x Cheb Basin |
| 4 Central Bohemian Basins
(namely Kladno-Rakovník Basin) | 2x Sokolov basin |
| 5 Mšeno Part of Mšeno-Roudnice Basin | 3x North-Bohemian basin |
| 6 Plzeň Basin and Radnice Basin | 4x Czech part of the Zittau (Žitava) Basin |
| 7 Boskovice Graben | |

5 Coal and the Czech economy

5.1 The coal production

As mentioned above, coal mining production has a long history in the Czech lands. The end of the 1980s of the 20th century was characterised of changing political situation that also brought changes into industries. The changeover to market economy affected the coal mining industry and other industries, such as the ore and uranium mining industry. Many mines were closed or their mining production was regulated. During the following ten years, 100 000 miners lost their job because of closing the mines.²⁹ Europe was influenced by the deindustrialization and by the need for ecological production of the energy earlier than the Czech Republic. The decrease in coal mining production has been occurring in the west of Europe since 1960 and the production is still decreasing.³⁰

In 1993, the Czech Republic was formed and the Czech statistical office took over the agenda of collecting the data of coal production in the Czech Republic. The state of decreased coal mining from the previous decade had continued. One reason for the decrease in coal mining is competition in the production of energy by other industries, for example, the opening of the Temelín plant in 2003.³¹ Another impact on the mining industry was the import limits and their compliance. The regulation 560/1991 Coll.³² about the conditions of issuing of the permits for the import and export of goods and services and later its amendments 192/1995 Coll.³³ and 115/1995 Coll.³⁴ were limiting the import of coal into the Czech Republic in the 1990s. The problem was that the import limits were exceeded. Today we cannot improve it because previous documents were largely destroyed by the Ministry of Industry. However, the E15 journal wrote about the existence of evidence that provide the

²⁹ *Těžba českého uhlí klesla za posledních deset let na polovinu (1999)*. [online]. 2008. Lidové noviny. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/minulost/tezba-ceskeho-uhli-klesla-za-poslednich-deset-let-na-polovinu-1999/>

³⁰ *Útlum českého hornictví*. [online]. 2008. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/soucasnost/utlum-ceskeho-hornictvi/>

³¹ *Těžba českého uhlí klesla za posledních deset let na polovinu (1999)*. [online]. 2008. Lidové noviny. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/minulost/tezba-ceskeho-uhli-klesla-za-poslednich-deset-let-na-polovinu-1999/>

³² *Předpis 560/1991 Sb.* [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=560&r=1991>

³³ *Předpis 192/1995 Sb.* [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=192&r=1995>

³⁴ *Předpis 115/1995 Sb.* [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=115&r=1995>

breaking of coal imported limits by almost 60% more from Poland in 1996.³⁵ These limits were cancelled in 2000.

The Paskov bituminous mine was closed down by the government in 1999 due to poor economic performance of the mine and the recession in coal mining.³⁶ The total production of the Paskov mine was more than 18 000 000 tons of black coal.³⁷ The quarry Chabařovice of brown coal has reserves of high quality coal but they cannot use these resources because of the conflicts of interests and the complex hydrogeological conditions. The quarry was closed in 1997.³⁸ Some other closed mines included the Heřmanice mine (closed in 1993, liquidated in 1998), East Bohemian coal mines (“Východočeské uhelné doly”, closed 1994), Svinov and Mariánské Hory (1996), Slezská Ostrava (1996), I.máj in south Moravian lignite basin (1996), Odra-J. Fučík mine (1998) etc.

The difference in the total Czech coal production between the years 1993 and 2011 is almost 32%. The production was constantly decreasing in this period of time, some divergences were the increase in the production by 2.1 million tons in 1996 and by 7.7 million tons at the beginning of 21.century.³⁹ The production of bituminous coal did not decrease as rapidly as the production of brown coal because the bituminous coal mines have a shorter extension than the brown coal mines. In 2008, the economic crisis affected many countries and their industries. The production of coal dropped due to a decrease in demand, particularly from the metallurgical industry.⁴⁰ Coal production was reduced by 5.5 million tons in 2008-2010. In 1993-2011, the total number of mined coal was 1 374.49 million tons and an average of coal production is 72.34 million tons per year.⁴¹

The total world coal mining production was constantly increasing in 1993-2011. The only deviation was between the years of 1998-1999 when the world production decreased by 127.35 million tons of coal. The coal market demand increased in 2013 as a result of higher

³⁵ MICHL, J.: *Jak cinká uhlí*. [online]. 2001. Euro. Available on: <http://euro.e15.cz/jak-cinka-uhli-819185>

³⁶ <http://www.zdarbuh.cz/reviry/okd/v-dole-paskov-se-zrejme-prestane-tezit-uhli/>

³⁷ *Důl Paskov*. [online]. 2009. Available on: <http://www.zdarbuh.cz/reviry/okd/dul-paskov/>

³⁸ *Mineral Commodity Summaries of the Czech Republic 1998*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

³⁹ *Overview data for Czech Republic*. [online]. 2013. U.S. EIA. Available on: <http://www.eia.gov/countries/country-data.cfm?fips=EZ&trk=m>

⁴⁰ *Mineral Commodity Summaries of the Czech Republic 2010*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁴¹ *Overview data for Czech Republic*. [online]. 2013. U.S. EIA. Available on: <http://www.eia.gov/countries/country-data.cfm?fips=EZ&trk=m>

world steel production that increased by 3% compares to expectation for the given year.⁴² The other factors were increase of the total primary energy production and consumption.⁴³

However, the bituminous coal production in Europe is constantly been reduced due to the low price of coal from overseas countries and low cost of sea transport⁴⁴. The world energy bituminous coal production is strengthening by the production of Asia and Latin America which comprised 60 % of it in 2008. The dynamically growing countries of coal production of the end of 20th century and beginning 21th century were China and India. The production in Indonesia, Kazakhstan and Columbia is also growing. Compared to world production of bituminous coal, the world brown coal production stagnated in the second half of 90's 20th century. In recent years, the production of the brown coal has been slowly increasing.⁴⁵

⁴² BOYCE, G.: *Howard Weil Annual Energy Conference*. [online]. 2013. Peabody Global Analytics, World Steel Association. Available on:

<http://www.peabodyenergy.com/mm/files/Investors/IR%20Presentations/PeabodyEnergy-HowardWeilConference031813.pdf>

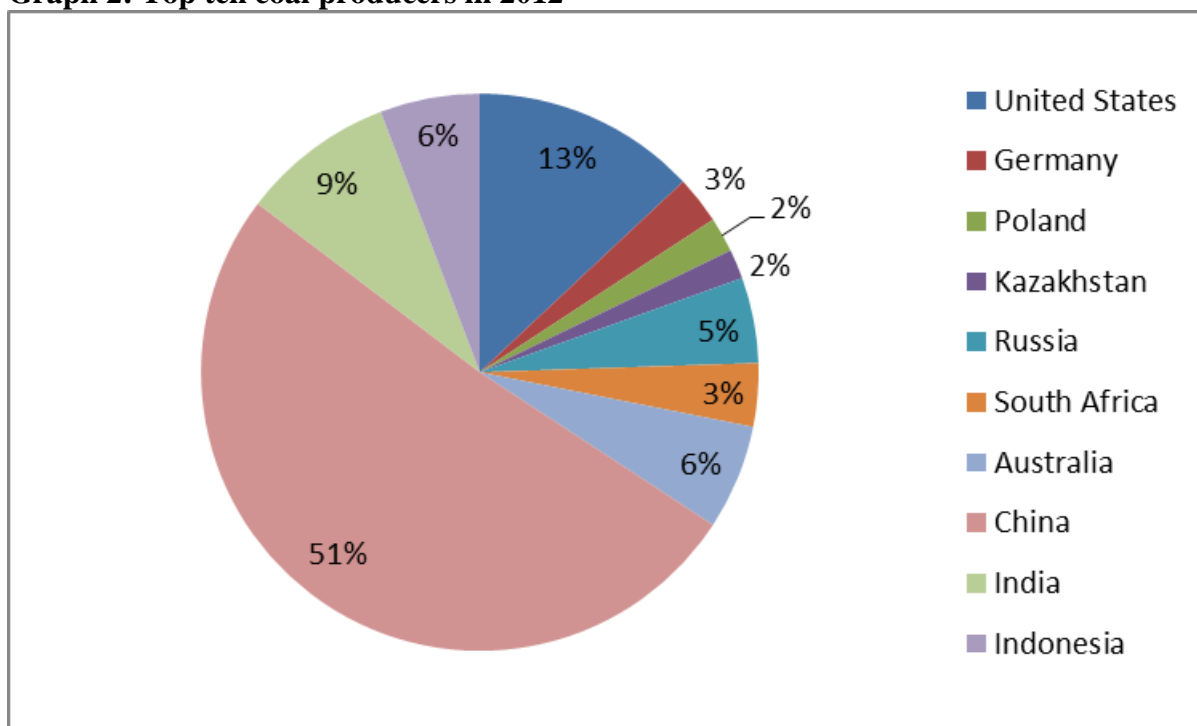
⁴³ *International Energy Statistics - Total Oil Supply* [online]. U.S. EIA. Available on:

<http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=53&aid=1&cid=ww,&syid=2008&eyid=2012&unit=TBD>

⁴⁴ *Mineral Commodity Summaries of the Czech Republic 2009*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁴⁵ *Mineral Commodity Summaries of the Czech Republic 2008*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

Graph 2: Top ten coal producers in 2012 ⁴⁶



Source: US EIA, International Energy Statistics, author calculations

Graph 2 represents the top ten coal producer in the year 2012. The biggest producer was China that produced 3 991 million tons of coal which was more than 50% of the top ten countries production. The second producer was the United States of America with 1016 million of tons and the third was India with 693 million tons of produced coal. Compared with the first three producers, an interesting fact is that China's production of coal increased 40 times faster than the US production and 6.8 times faster than India's production between 1993 and 2012.⁴⁷ The important European producers of 1970's, such as Germany, the United Kingdom or Poland, had huge decreased in production of coal during the years compared with other countries.⁴⁸

⁴⁶ **Graph 2:** The percentage of coal production of each country is based on comparing these top ten producers of coal.

⁴⁷ **Graph 2 – first three producers:** The difference of coal production in 1993 and 2012 was 2757 million tons of coal in China, 70 million tons of coal in the US and 405 million tons of coal in India. The China's production rapidly increased mainly in 21st century. The production of India is constantly increasing since 1993. The US production is unstable and ranged from 945 million tons of coal to 1171 million tons in 1993-2012. (data of U.S. EIA)

⁴⁸ *Mineral Commodity Summaries of the Czech Republic 2011*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

5.2 The coal consumption

The coal consumption is in direct proportion with the coal production in the Czech Republic. When comparing the consumption of coal in 1993 and 2012, the amount of consumed coal has decreased but in this time frame the consumption in some years was higher than in the previous years. This means that the consumption in the Czech Republic was unstable even when the total quantity of consumed coal had decreased during the 1993-2012 period.

However, the Czech Geological Survey reported in their annual report from 2011 that “Coal consumption has been growing faster than that of any other fuel, including oil, over the past years. In 2010 coal consumption grew by 7.6 % and recorded the fastest global growth since 2003. Coal now accounts for 29.6 % of global energy consumption, up from 25.6 % 10 years ago.”⁴⁹

The world coal consumption has increased from 1980 due to increase in coal demand. Compared with the year 2010, the world consumption has almost doubled. Nevertheless, the demand for coal consumption rapidly increased mainly through Asian demand that grew by 403% between the years of 1980-2010 and is mainly led by China. The China’s consumption takes up 73% of Asia's consumption and almost half of the world consumption. The consumption in other regions has also increased⁵⁰ except for Europe and former Soviet Union where the consumption of coal decreased by 32% and 42% in 1980-2012.⁵¹ The European Union consumption of coal has decreased from 25% to 9.5% of the world consumption since 80’s.⁵² The main reason for this decline is the environmental legislation that has caused the stagnation of the coal consumption in EU regardless of increasing energy consumption. The energy production from coal is lower than decades ago in EU.⁵³

⁴⁹ *Mineral Commodity Summaries of the Czech Republic 2011*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁵⁰ **The other regions** and their growth of coal consumption: North America (50%), Africa (92%), Oceania (96%), Central and South America (156%) (U.S.EIA, 2011)

⁵¹ *Rising Asian demand drives global coal consumption growth*. [online]. 2011. U.S. EIA. Available on: <http://www.eia.gov/todayinenergy/detail.cfm?id=4390>

⁵² *World Energy Outlook 2010*. [online]. 2010. France: IEA PUBLICATIONS, 2010. Available on: <http://www.worldenergyoutlook.org/media/weo2010.pdf>

⁵³ **The EU energy production** from coal was 40% in 1990 and 29% in 2011. (EU Energy in figures: Statistical pocketbook 2012, Publications Office of the European Union, 2012)

5.3 The coal import and export

The Czech Republic exports 4.3 times more of coal to foreign countries than it imports. The bituminous coal could be used for coking and energy.⁵⁴ The energy is mainly exported to Austria, Poland, Germany and Slovakia. The coking coal is exported to the European producers of steel. Some of the main customers for bituminous coal are ArcelorMittal⁵⁵, U.S. Steel⁵⁶, The voestalpine Group⁵⁷, Dalkia⁵⁸, ČEZ⁵⁹, Verbund⁶⁰, Moravia Steel⁶¹ and ThyssenKrupp.⁶² The export of coal into foreign countries is important for the Czech market. The brown coal is primarily used for production of electric energy and heat and has an important role in the Czech energy industry.⁶⁴

The Czech main importers of bituminous coal are Poland and Russia.⁶⁵ An important exporter of brown coal to the Czech Republic is Germany. In 2012, the German mining company Mibrag imported 161 thousand tons of coal to the Czech power plant Opatovice.⁶⁶

In 2007, the biggest exporters were Australia with exportation of 244 million tons of coal, Indonesia with 202 million tons of coal and Russia that exported 100 million tons of coal. The major importers of this commodity were Japan with 182 million tons of coal, South Korea with 88 million tons and Taiwan with 69 million tons of coal. This quantity of coal is

⁵⁴ *Surovinová politika České republiky*. [online]. 2012. Ministerstvo průmyslu a obchodu. Available on: <http://www.spov.org/data/files/surovinovapolitika072012.pdf>

⁵⁵ **ArcelorMittal Ostrava a.s.** are focusing mainly on production and processing of hot metal and steel and rolled products production. The company has registered office in Ostrava.

⁵⁶ **U. S. Steel Kosice** is an integrated steel company with strong American plant management. It is located in town Košice, Eastern Slovakia.

⁵⁷ The **voestalpine Group** is an Australian steel-based goods group and producer of sophisticated steel products. They supply technology-intensive sectors, such as the automotive, railway, aviation, and energy industries.

⁵⁸ **Dalkia**, a member of the France-based transnational group (Veolia Environnement) is producer and supplier of thermal and electrical energy in the country and a provider of ancillary services to the national transmission system.

⁵⁹ **ČEZ, a.s.** is electricity producer and seller and is also engaged in the production, distribution, and sale of heat.

⁶⁰ **Verbund** is Austria's leading electricity company and one of the largest producers of electricity from hydropower in Europe.

⁶¹ **Moravia Steel** is the biggest Czech steelmaking company with domestic capital. There are located in Třinec, Moravia.

⁶² **ThyssenKrupp** is supplier of solutions for vertical and horizontal transport of persons (elevators, escalators and moving walkways, etc.) on the Czech market.

⁶³ *FAQs*. [online]. 2014. New world resources. Available on: <http://www.newworldresources.eu/en/media/faqs>

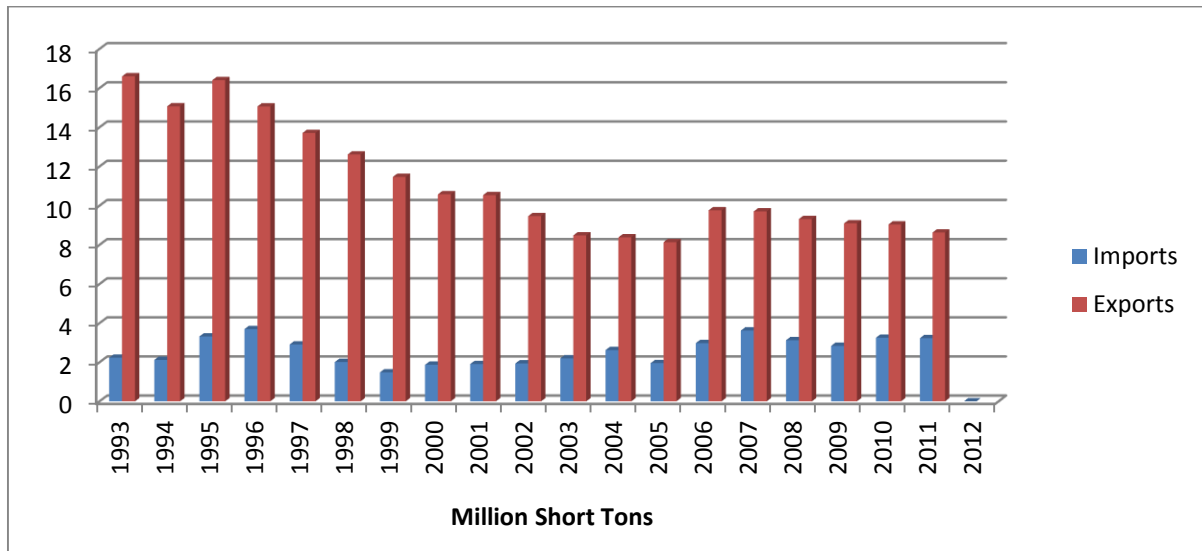
⁶⁴ *Surovinová politika České republiky*. [online]. 2012. Ministerstvo průmyslu a obchodu. Available on: <http://www.spov.org/data/files/surovinovapolitika072012.pdf>

⁶⁵ *Dovoz černého uhlí do Česka raketově roste, ale klíčový zůstává vývoz*. [online]. 2011. ČTK. Available on: <http://byznys.ihned.cz/c1-50348540-dovoz-cerneho-uhli-do-ceska-raketove-roste-ale-klicovy-zustava-vyvoz>

⁶⁶ RŮŽIČKA, J.: *Elektrárna Opatovice si koupila povolenky a spaluje méně kvalitní uhlí*. [online] 2014. iDNES.cz. Available on: http://pardubice.idnes.cz/elektrarna-opatovice-emise-siry-povolenky-f2h-/pardubice-zpravy.aspx?c=A140129_173028_pardubice-zpravy_mt

mainly bituminous coal. The brown coal covers the demand of the domestic consumption and the export is low. The Czech Republic exports 1-2 million tons of brown coal per year to Slovakia and the export to the Germany decreased in the past couple of years.⁶⁷

Graph 3: The import and export of the coal of the Czech Republic



Source: MŽP ČR, 2012, author calculations

Graph 4 compares Czech export and import. The export of the Czech Republic has decreased since 1993 apart from the slight increase in 2006. The import is unstable but on the average it amounts to 2.6 million of coal per year.

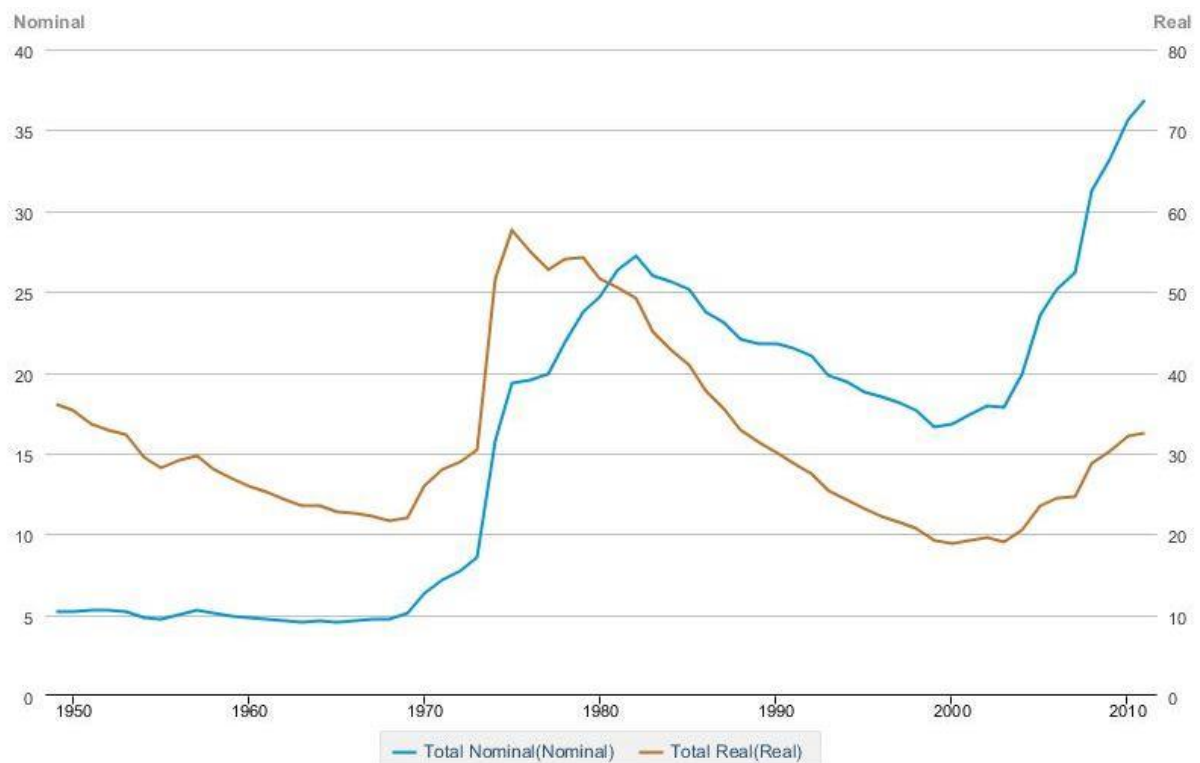
5.4 The coal price

The mining companies usually keep the price of their coal contracts as company secret in case of competition from other companies but this information can be found in annual reviews of independent statistics and analysis institution, such as U.S. Energy Information Administration. The world market distinguishes the coal prices of spot transactions and the long-term contracts. The price of coal is also determined by the quality of coal, such as the contents of sulphur, ash and volatile constituents.⁶⁸

⁶⁷ *Mineral Commodity Summaries of the Czech Republic 2009*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁶⁸ *Mineral Commodity Summaries of the Czech Republic 2009*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

Graph 4: Coal prices in dollars per short ton, 1949-2011



Source: EIA, Annual Energy Review, 2012

Since 2004, the nominal price of bituminous coal started to increase by 20-75% per year but its growth is influenced by the unstable value of the US dollar. There are two reasons for the rise in the coal price. The first, the global price of coal⁶⁹, oil and nature gas surged in the case of demand growth. The second, the changeover in the Third World that used to export huge amount of coal to developed countries at the expense of their own consumption. Because the consumption of coal has usually increased in many countries in the past couple of years, the produced coal stays in the countries where it was produced. In 2006, the price of coal was different in some countries due to the price difference between the American coal, the Australian coal⁷⁰, the Chinese coal and the remaining coal with price stagnation.⁷¹ “The trend has changed and the prices decreased by the end of 2008 and beginning of 2009 as a

⁶⁹ **The brown coal** is negligible part of world trade. The businesses with brow coal are usually cross-border trade based on contractual prices.

⁷⁰ The American coal and the Australian coal have 55% of participation in the world trade. (Mineral Commodity Summaries of the Czech Republic 2009)

⁷¹ *Mineral Commodity Summaries of the Czech Republic 2007*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

consequence of the global financial and economic crisis, which afflicted also metallurgical industry, which resulted in the drop in demand for coking coal and coke. The situation started to improve again in the second half of 2009.”⁷² Graph 4 shows the slight decline in the real coal price in 2011 because of cheap natural gas, the economy recession and the oversupply of coal in the market. Nevertheless, the prognoses have indicated an increase in the price of all energy commodities in the long-term view.⁷³⁷⁴

5.5 The energy industry and use of coal

Coal has a significant role in the energy industry. Sixty percent of the Czech electric energy is produced from coal. In the ratio of the brown coal to the bituminous coal, the brown coal has a larger proportion of the energy production by 87% and the bituminous coal only 13%. The negative aspect of the production of energy from coal is its impact on the environment but it is the most effective exploitation⁷⁵ of coal in the opinion of the Minister of Industry and Trade of the Czech Republic.⁷⁶

The example of the energy law is the Resolution No. 112/1992 on the Energy Policy of the Czech Republic that defined the strategic principles of transformation and restructuring of the Czech economy in the energy sector and was supplemented by a resolution for coal mining in the government resolution No 691/1992.⁷⁷⁷⁸

“The world economy needs ever-increasing amounts of energy to sustain economic growth, raise living standards, and reduce poverty. But today's trends in energy use are not sustainable. As the world's population grows and economies become more industrialized,

⁷² *Mineral Commodity Summaries of the Czech Republic 2010*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁷³ ELS, F.: *CHART: Oversupply pushes thermal coal price to 2009 levels*. [online]. 2013. Available on: <http://www.mining.com/thermal-coal-heading-for-97298/>

⁷⁴ TRAXLER, J. *Jak vydělat na uhlí*. [online]. 2011. Available on: <http://www.finez.cz/odborne-clanky/oborove-analyzy/jak-vydelat-na-uhli>

⁷⁵ With the support of new technologies, such as Clean Coal Technologies – the technology of more efficient combustion

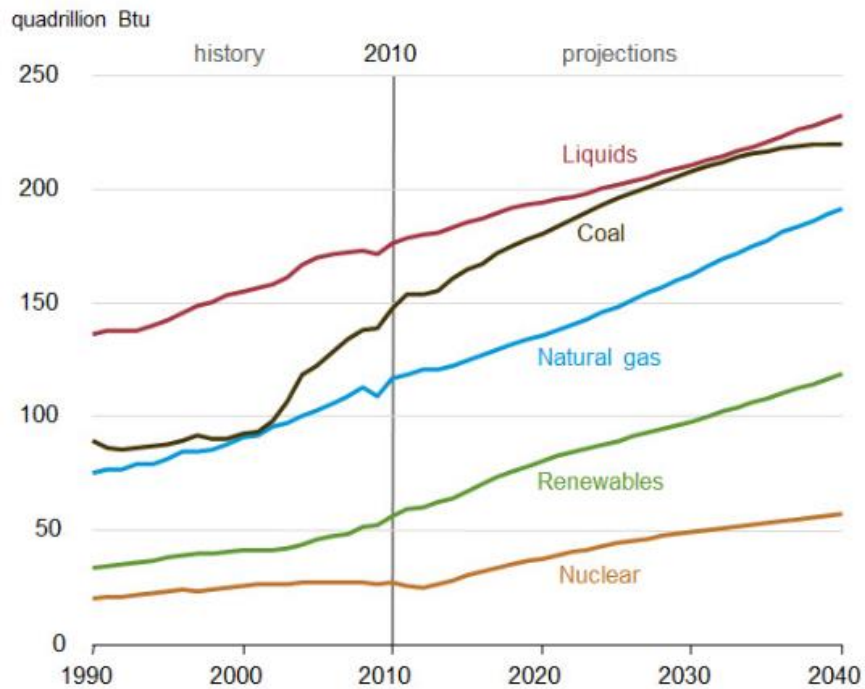
⁷⁶ *Surovinová politika České republiky*. [online]. 2012. Ministerstvo průmyslu a obchodu. Available on: <http://www.spov.org/data/files/surovinovapolitika072012.pdf>

⁷⁷ *Vývoj uhelného hornictví v ČR v 90. letech*. [online]. 2009. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/minulost/vyvoj-uhelneho-hornictvi-v-cr-v-90-letech/>

⁷⁸ *Czech Republic Mining Laws and Regulations Handbook: Strategic Information and Basic Laws* [online]. 2013. Int'l Business Publications, 2013. Available on: <http://books.google.cz/books?id=dW-8AAAAQBAJ&printsec=frontcover&hl=cs#v=onepage&q&f=false>

non-renewable energy sources will become scarcer and more costly.”⁷⁹ More than one third of world coal is used for energy production and 20% of coal has an important role in metallurgy industry, for example for the production of steel and aluminium.

Graph 5: World energy consumption by fuel type, 1990-2040



Source: EIA, International Energy Outlook, 2013

Graph 5 demonstrates the world energy consumption by different fuel types: liquids⁸⁰, coal, natural gas, renewables and nuclear. The energy produced from coal had the steepest increase in the world consumption in 21st century. The liquid fuels are the largest source of energy, especially petroleum liquids. The prognoses for the future world consumption by fuel types made by EIA (in IEO 2013) predicts that the high world oil prices will cause a switch away from liquid fuels and the fastest growing of energy consumption with renewable and nuclear sources.⁸¹

⁷⁹ *Energy & Mining*. [online]. 2014, The World Bank Group. Available on: <http://data.worldbank.org/topic/energy-and-mining>

⁸⁰ The term liquids included petroleum liquids (crude oil and lease condensate, natural gas plant liquids, bitumen, extra-heavy oil and refinery gains) and other liquids (gas-to-liquids, coal-to-liquids, kerogen, and biofuels.) (IEO 2013, U.S. EIA., 2013)

⁸¹ *International Energy Outlook 2013*. [online]. 2013. U.S. EIA. Available on: <http://www.eia.gov/forecasts/ieo/>

5.6 Environmental mining limits in the north Bohemia

A frequently discussed topic in the past twenty years has been the environmental limits of the North Bohemian brown coal basin. In 1991, the Government of the Czech Republic passed Governmental Resolution No. 444/1991 and was taken on the proposal of the former Environment Minister Ivan Dejmál. This resolution established mining limits for coal and uranium that have caused unutilization of the reserves with approximately 750 million tons of brown coal situated in this area. The coal mining limits influenced mainly the north Bohemian brown coal basin which is a very important Czech coal deposit located between the Ore Mountains and the Czech Central Mountains.⁸² The limits were established to protect the inhabitants, their homes and the environment of north Bohemia. In October 2009, the Energy and Trade Ministry wanted to start again the mining of coal in some areas in their 5-year energy plan. That led to protests of the environmentalists, people living in affected area and other groups and the plan had not been passed but stay under consideration.⁸³ The topic of breaking the limits is very often used in the campaign promises in the Czech politics. The opinions of the Czech government about breaking the limits are not identical. Some of the politicians think that breaking the limits is regression to the 20th century, the other see the future benefits from coal mining. The Czech president Miloš Zeman has supported heavy industry and coal mining for a long time. At the end of January 2014, Miloš Zeman had a meeting with the Minister of Industry Jan Mládek (CSDP) and both agreed on the approach to break the mining limits in northern Bohemia.⁸⁴ However, the bill about breaking these limits has to be passed by the parliament and government of the Czech Republic.

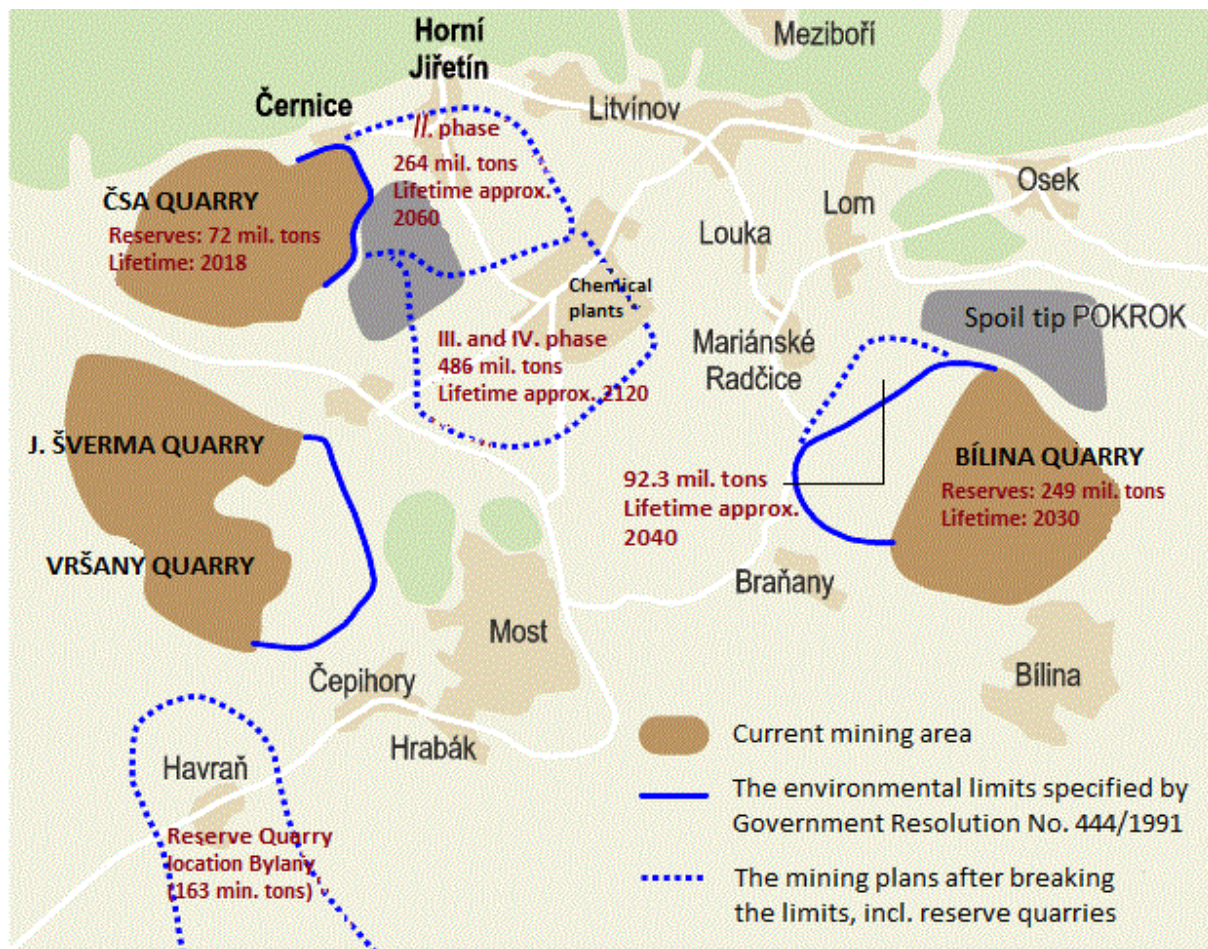
⁸² *The Past and Present of Mining Brown Coal in Northern Bohemia. And the Future...?* [online]. 2007.

Available on: <http://www.allforpower.com/clanek/378-the-past-and-present-of-mining-brown-coal-in-northern-bohemia-and-the-future/>

⁸³ PEREZ, A.A., Soto-Viruet, Y. et al.: *Minerals Yearbook 2011* [online]. U.S. Department of the Interior, U.S. Geological Survey. Available on: <http://minerals.usgs.gov/minerals/pubs/country/europe.html#ez>
<http://minerals.usgs.gov/minerals/pubs/country/2010/myb3-2010-ez.pdf>

⁸⁴ *Kandidát Mládek byl u Zemana. Ten mu prý dával otcovské rady.* [online]. 2014. Available on: <http://www.parlamentnilisty.cz/arena/monitor/Kandidat-Mladek-byl-u-Zemana-Ten-mu-pry-daval-otcovske-rady-301117>

Picture 4: The environmental limits of the North Bohemian brown coal basin, 1991



Source: ČTK, 2013

In case of limited current resources and the unattainable resources in the environmental limits' area, the coal mining companies declined the supply of brown coal to market. The consequences of it would increase the risk of blackout for more than 750 thousand⁸⁵ people in sectors of the Czech Republic. The decrease of the supply of brown coal might increase twice or three times the price of heat for Czech consumers. The replacement of coal for energy production by other resource will cause decreasing the production of coal and lead to increase its price of production. The Czech Republic is relatively self-sufficient in energy production but the limits might cause the import of other fossil fuels (mainly natural gas and bituminous coal) from foreign countries hand by hand with decreasing the energy production by 17% in the Czech Republic. The other negative influence of keeping the limits would be in unemployment rate of specific regions that will increase due to closing of

⁸⁵ The population of Praha (Mělník), Hradec Králové, Pardubice, Strakonice, Příbram, Zlín and Otrokovice

unusable mines and solving this problem will cost the government 3 billion per year.⁸⁶ On the other hand, the villages Havraň and Horní Jiřetín would be destroyed in case of breaking the limits and other villages would be strongly influenced by mining production near their homes. Many hectares of environment would be destroyed or affected.

The breaking of the limits would increase the lifetime of the ČSA quarry, Vršany quarry and Bílina quarry by another 18 years. The future of the limits is uncertain but the pressure of the limited reserves and the important role for energy production in the Czech Republic might call them off.⁸⁷

5.7 The influence of coal mining to employment in the Czech Republic

The labour market in each region of the Czech Republic has specific development and requirements for employees. The Czech Republic has 14 regions (PHA, SČK, JHC, PLK, KVK, ULK, LBK, HKK, PAK, VYS, JHM, OLK, ZLK and MSK) and each region has different job opportunities. The comparison of future changes in the economy and the regions' potential is important to a successful development strategy of the region.⁸⁸

5.7.1 The employment branch in each region of the Czech Republic

More than 26% of people worked in the largest employment branch - the processing industry. The processing industry produces a large range of products, such as cars, furniture, wood products, jewellery, medication, musical instruments, machinery, sports equipment, textile products, toys, office supplies, recycling of raw material etc. The largest part of production is in LBK, VYS and PAK. The VYS had important role with 5.8% in agricultural and forestry industry and the region JHC had only 0.2% lower percentage than VYS. The region PHA was more focused rather than industry production or agricultural production on business, personal and other services and the high-technology industry. The PHA had also the highest salary average and productivity of work as well as in SČK. In cause of brown coal mining, the region ULK is second region with the biggest number of employed people in mining industry with 2.1%. In 2011, the ULK was the region with second highest productivity

⁸⁶ *Výhled hnědouhelné energetiky v ČR13*. [online]. Available on: <http://www.czechcoal.cz/cs/novinky/zprava/2011/ur25.html>

⁸⁷ *Mineral Commodity Summaries of the Czech Republic 2010*. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁸⁸ *Trhy práce v regionech v roce 2011*. [online]. 2014. Národní vzdělávací fond. Available on: <http://www.budoucnostprofesi.cz/trhy-prace-v-regionech/regiony2011.html>

in the Czech Republic and the advantage of border positions. This region had likewise the highest percentage of employed people in the construction industry. The SČK and ULK are focused on storage and transport branch. The SČK has large infrastructure that connected PHA with other regions and is used for building new storehouses and logistics centres. The tourists well known “spa region” with large hotels and restaurants infrastructure followed with great health and social care is the region KVK. In other hand, KVK had the lowest working productivity.⁸⁹

Table 3: The employment in the Czech Republic by regions (2011)

Region	The structure of the population by economic activity (aged 15+) (%)			The unemployment rate (%)	Long-term unemployment rate (%)	The branch of employment	
	Employed	Not active	Unemployed			Mining and extraction	Electricity, gas, heat
ČR	54.5	41.6	3.9	x	x	0.9	1.2
MSK	51.2	43.5	5.4	8.5-10.0	48.0-56.9	3.8	1.5
ZLK	53.2	42.4	4.4	7.0-8.4	48.0-56.9	0.1	1.2
OLK	51.6	44.2	4.2	7.0-8.4	48.0-56.9	0.4	0.7
JHM	53.6	42.3	4.1	7.0-8.4	48.0-56.9	0.5	1.1
VYS	53.8	42.9	3.3	5.5-6.9	48.0-56.9	0.5	1.3
PAK	54.1	42.5	3.4	5.5-6.9	39.0-47.9	0.2	0.7
HKK	53.7	43.0	3.3	5.5-6.9	39.0-47.9	0.2	0.9
LBK	53.9	42.0	4.2	7.0-8.4	30.0-38.9	1	0.8
ULK	52.4	42.1	5.5	8.5-10.0	57.0-65.9	2.1	1.5
KVK	54.7	40.3	5.0	7.0-8.4	57.0-65.9	4.2	1.4
PLK	56.9	40.0	3.1	4.0-5.4	48.0-56.9	0.7	1.4
JHC	55.5	41.4	3.1	4.0-5.4	30.0-38.9	0.2	1.7
SČK	56.6	40.0	3.3	5.5-6.9	39.0-47.9	0.3	1.2
PHA	59.0	38.2	2.8	4.0-5.4	30.0-38.9	0	0.9

Source: budoucnostprofesi.cz⁹⁰, prepared by the author

Table 3⁹¹ shows KVK, MSK and ULK as the regions with the highest percentage of employed people in the mining and extraction industry. However, in 2011 ULK and MSK had the highest unemployment rate and KVK had the second highest with the percentage rate 7.0-

⁸⁹ *Regionální portréty*. [online]. 2005. CZSO. Available on: <http://www.czso.cz/csu/2004edicniplan.nsf/p/1362-04>

⁹⁰ *Trhy práce v regionech v roce 2011*. [online]. 2014. Národní vzdělávací fond. Available on: <http://www.budoucnostprofesi.cz/trhy-prace-v-regionech/regiony2011.html>

⁹¹ **The not active population:** people who are not actively looking for work and do not comply with the conditions of ILO unemployed but they show their interest in work. In the 2nd quarter of 2011 their number amounted 186.2 thousand of people.

8.4%. ULK and KVK had 57-65.9% of the long-term unemployment rate⁹² and MSK had better rate 48-56.9%. The main reason of this high unemployment rate is the reduction of heavy industry and the urban migration cause low job opportunity in countryside of the Czech Republic. In these regions, the mining and extraction industry is important for dropping of unemployment rate and sometimes the only job opportunity.⁹³ The comparison of years 1993 and 2012 indicates by constant decreasing the change in the employment of mining and extraction industry by 20.6 thousand people in UKL, 4.8 thousand in KVK and 33.3 thousand in MSK. The total employment of each region was more unstable. Nevertheless the amount of employed people in 1993 and 2012 declined by 45.5 thousand in UKL, 12.5 in KVK and 31.8 thousand in MSK.⁹⁴

5.7.2 The economic situation of coal mining enterprises⁹⁵

In the period 2007-2011, the number of enterprises that produced bituminous coal and brown coal decreased and cause the decreasing of employees in mining companies. The amount of employees in bituminous coal mining sector decreased by 23% and 29% in brown coal sector in 5 years. The average salary increased by 23% for brown coal miner and 29% for bituminous miner. It is much higher than job branch, for example education, health and social care or agriculture. However, the real value of their salary has decreased by 2% since 1988. The important fact is that increase of salaries was mainly done for specific group of employees. The salary of the most of the employees is decreasing.^{96,97}

⁹² **The long-term unemployment rate** is the share of unemployed more than one year in total unemployment.

⁹³ *Regionální portréty*. [online]. 2005. CZSO. Available on: <http://www.czso.cz/csu/2004edicniplan.nsf/p/1362-04>

⁹⁴ *Veřejná databáze - Zaměstnanost a nezaměstnanost od roku 1993*. [online]. 2014. CZSO. Available on: http://vdb.czso.cz/vdbvo/tabparam.jsp?voa=tabulka&cislotab=PRA1010CU&&kapitola_id=3

⁹⁵ **The data** is explaining the situation in the period 2007-2011.

⁹⁶ Mineral Commodity Summaries of the Czech Republic 2012. [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

⁹⁷ Supplements - Appendix 1,2

6 Mining and ecology

The electricity production from coal mining produces more than 50 percent of power from power plants. This production of coal mining is also connected with the influence of mining in positive and negative ways to environment, nature and inhabitants.⁹⁸

6.1 Positive impacts

The coal mining does not have only the negative impacts to the environment. The protected and endangered species of plants and animals (e.g. birds), which have been driven out from territories populated by men live, starts to live in slumps of the area of past mining. Recultivation and reclamation projects are used by coal mining companies and can be divided into two groups: technical recultivation and biological recultivation. The technical recultivation focuses on forming area, restoring streams and relocating of utilities. The second form of recultivation, biological recultivation, focuses on nature, such as greening the landscape, creating appropriate conditions for animal and plant species.⁹⁹

6.2 Negative impacts

One third of negative impacts on the environment is caused by coal mining activities, the rest of them are of different origin (uncontrolled dumps, etc.). The negative impacts to hydrosphere are changes in groundwater levels and polluting of surface water and groundwater. The atmosphere is polluted by particulate matter (PM), sulphur dioxide (SO₂), nitrogen oxide (NO_x) and carbon monoxide (CO). The lithosphere is affected by degradation and destruction of soil profiles. The other negative impact is noise pollution from coal mining.

⁹⁸ Some of the positive and negative impacts were already mentioned in part Types of mining and processing of coal

⁹⁹ *Reclamation*. [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/the-environment/reclamation>

Picture 5: ČSA mine



Source: Prepared by the author; March, 2013

6.3 Problem solving

The problem solving of coal mining impacts in the Czech Republic is to minimize the negative effects of mining and processing of coal. The surface mining should be concentrated in one place rather than opening new mines until the current ones are fully extracted. The coal mining companies should be made responsible for extraction of natural resources for reasonable purposes. Finding renewable resources (e.g. solar power) would limit dependence of humanity on coal.

7 Conclusion

The negative impacts of mining on the environment provide us with many arguments against mining and the utilization of coal. However, the future prognosis of the world coal production and consumption predicts increasing amounts of coal being produced, mainly in Asian countries, due to the price increase of other types of fuels. In more than one third of the world coal is used for energy production. In the Czech Republic, coal has a significant role in the energy generating industry and sixty percent of Czech electric energy is produced from coal. Nevertheless, the production of coal in the EU is constantly decreasing and the future of coal mining in the Czech Republic is determined by decisions about environmental mining limits in north Bohemia.

Europe has been influenced by deindustrialization and by the need for the ecological production of energy which has caused a decrease of coal production, closing many mines in the Czech Republic with more than 100 000 miners losing their job. In 2007-2011, the number of employees in the bituminous coal mining sector decreased by 23% and 29% in the brown coal sector in this period. The Karlovy Vary Region (KVK), Moravian-Silesian Region (MSK) and Ústí Region (ULK) regions are the regions with the highest percentage of employed people in the mining and extraction industry but also the regions with the highest unemployment rate. The main reason for these high unemployment rates is the reduction of heavy industry and the urban migration because of the low job opportunity in the countryside of the Czech Republic. From the current research it can be suggested that employment in mining and extraction industry will not increase in the future but the mining and extraction industry is important for the reduction of the unemployment rate in these regions and sometimes the only job opportunity.

8 Literature and Resources

8.1 Bibliography

1. ALPERN, B., LYONS, Paul C.: *Peat and Coal: Origin, Facies, and Depositional Models*. Elsevier, Amsterdam ; New York, 1989
2. BENEŠ, K.: *Uhlí – Poklad země a člověka*. 1. vyd, Naše vojsko / Universita vojáka, Sv. 46, Praha, 1953.
3. Collective of authors: *The Economy and the Environment in the Czech Republic after 1989*. CENIA, Czech Environmental of the Czech Republic, 2008
4. *Dictionary of Mining, Mineral, and Related Terms*. 2nd ed. Alexandria, Va.: American Geological Institute in cooperation with the Society for Mining, Metallurgy, and Exploration, Inc., c1997.
5. KARNÍKOVÁ, I.: *Vývoj uhelného průmyslu v českých zemích do r. 1880*. Michiganská univerzita, Nakl. Československé akademie věd, 1960
6. KREJČÍŘOVÁ, S.: *Ochrana životního prostředí s ohledem na těžební činnost*. Brno, 1977.
7. LANDA, S.: *Paliva a jejich použití*. 2. Vyd., Státní nakladatelství technické literatury, Praha, 1956.
8. MAITAH, M.: *Macroeconomics*. Praha, Česká zemědělská univerzita, 2009.
9. MAITAH, M.: *Macroeconomics – Issues and Exercises*. Praha, Česká zemědělská univerzita, 2010.
10. MAITAH, M.: *Makroekonomie v praxi*. Praha, Wolters Kluwer ČR, a.s., 2010.
11. MATĚJ, M., KLÁT, J.: *Kulturní památky rosicko-oslavanské průmyslové aglomerace*. Praha, Národní památkový ústav, 2012.
12. MATĚJČEK, Jiří: *Vývoj uhelného průmyslu v českých zemích po průmyslové revoluci (do roku 1914)*. Michiganská univerzita, Academia, 1984.
13. PERMAN, R., MA, Y., MCGILVRAY, J., COMMON, M.: *Natural Resource and Environmental Economics*. Harlow, Pearson Education Limited, 2003
14. PEŠEK, J., SIVEK, M.: *Uhlonosné pánve a ložiska černého a hnědého uhlí České republiky*. Praha, Česká geologická služba, 2012.
15. SÁDLO, J., TICHÝ L.: *Sanace a rekultivace po lomové a důlní těžbě*. 1. vyd. Brno: ZO ČSOP Pozemkový spolek Hády, 2002. Neuveden. ISBN 809031211-X.
16. SMOLOVÁ, I.: *Těžba nerostných surovin na území ČR a její geografické aspekty*. 1. vyd. Olomouc: Univerzita Palackého v Olomouci, 2008. ISBN 978-80-244-2125-4.
17. VOPASEK, Stanislav. Landek: svědek dávné minulosti. Český Těšín: FINIDR, 2003.
18. ZÁMYSLICKÝ, Jan: *Historická ročenka statistiky energetiky*. Praha: Český statistický úřad, 2012

8.2 Internet sources

Udržitelný rozvoj a pozice hnědouhelné energetiky v ČR. [online]. Czech Coal. Available on: <http://www.czechcoal.cz/cs/novinky/zprava/2008/ur25.html>

Výhled hnědouhelné energetiky v ČR13. [online]. Available on: <http://www.czechcoal.cz/cs/novinky/zprava/2011/ur25.html>

Significant geological localities of the Czech Republic. [online]. The Czech Geological Survey. Available on: <http://www.geology.cz/extranet-eng/geology-for-all/geological-localities>

Regionální portréty. [online]. 2005. CZSO. Available on: <http://www.czso.cz/csu/2004edicniplan.nsf/p/1362-04>

Veřejná databáze - Zaměstnanost a nezaměstnanost od roku 1993. [online]. 2014. CZSO. Available on: http://vdb.czso.cz/vdbvo/tabparam.jsp?voa=tabulka&cislotab=PRA1010CU&&kapitola_id=3

Dovoz černého uhlí do Česka raketově roste, ale klíčový zůstává vývoz. [online]. 2011. ČTK. Available on: <http://byznys.ihned.cz/c1-50348540-dovoz-cerneho-uhli-do-ceska-raketove-roste-ale-klicovy-zustava-vyvoz>

ELS, F.: *CHART: Oversupply pushes thermal coal price to 2009 levels.* [online]. 2013. Available on: <http://www.mining.com/thermal-coal-heading-for-97298/>

World Energy Outlook 2010 [online]. 2010. France: IEA PUBLICATIONS, 2010. Available on: <http://www.worldenergyoutlook.org/media/weo2010.pdf>

Czech Republic Mining Laws and Regulations Handbook: Strategic Information and Basic Laws [online]. 2013. Int'l Business Publications, 2013. Available on: <http://books.google.cz/books?id=dW-8AAAAQBAJ&printsec=frontcover&hl=cs#v=onepage&q&f=false>

Využití uhlí. [online]. Institut geologického inženýrství, VŠB - Technická univerzita Ostrava. Available on: http://geologie.vsb.cz/loziska/suroviny/vyuziti_uhli.html

Modern Coal Related Technology [online]. 2007. Kentucky Foundation. Available on: http://www.coaleducation.org/technology/modern_equipment.htm

Těžba českého uhlí klesla za posledních deset let na polovinu (1999). [online]. 2008. Lidové noviny. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/minulost/tezba-ceskeho-uhli-klesla-za-poslednich-deset-let-na-polovinu-1999/>

Paleozoic Era: Facts & Information. [online]. 2013. Available on: <http://www.livescience.com/37584-paleozoic-era.html>

MICHL, J.: *Jak cinká uhlí.* [online]. 2001. Euro. Available on: <http://euro.e15.cz/jak-cinka-uhli-819185>

The collection of yearly reports *Mineral Commodity Summaries of the Czech Republic* between 1993-2013 [online]. Ministry of the Environment of the Czech Republic. Available on: <http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries>

Surovinová politika České republiky. [online]. 2012. Ministerstvo průmyslu a obchodu. Available on: <http://www.spov.org/data/files/surovinovapolitika072012.pdf>

Coal preparation plant flowsheet. [online]. Available on: <http://www.mine-engineer.com/mining/coal/coalflow.htm>

Teplárenství - Zdroje. [online]. MojeEnergie.cz. Available on: <http://www.mojeenergie.cz/cz/teplarenstvi-zdroje>

Trhy práce v regionech v roce 2011. [online]. 2014. Národní vzdělávací fond. Available on: <http://www.budoucnostprofesi.cz/trhy-prace-v-regionech/regiony2011.html>

FAQs. [online]. 2014. New world resources. Available on: <http://www.newworldresources.eu/en/media/faqs>

The Environment. [online]. 2012. OKD, 2012. Available on: <http://www.okd.cz/en/the-environment>

Surface phenomena in the course of exploitation [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/the-environment/surface-phenomena-in-the-course-of-exploitation>

How coal is mined in OKD. [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/coal-mining/how-coal-is-mined-in-okd>

Reclamation. [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/the-environment/reclamation>

About us. [online]. 2012. OKD, a. s. Available on: <http://www.okd.cz/en/about-us>

Definition of natural resources in English. [online]. 2014. The Oxford Dictionaries, 2014. Available on: http://www.oxforddictionaries.com/us/definition/american_english/natural-resources

BOYCE, G.: Howard Weil Annual Energy Conference. [online]. 2013. Peabody Global Analytics, World Steel Association. Available on: <http://www.peabodyenergy.com/mm/files/Investors/IR%20Presentations/PeabodyEnergy-HowardWeilConference031813.pdf>

The Past and Present of Mining Brown Coal in Northern Bohemia. And the Future...? [online]. 2007. Available on: <http://www.allforpower.com/clanek/378-the-past-and-present-of-mining-brown-coal-in-northern-bohemia-and-the-future/>

Předpis 115/1995 Sb. [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=115&r=1995>

Předpis 192/1995 Sb. [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=192&r=1995>

Předpis 560/1991 Sb. [online]. Parlament České republiky, Poslanecká sněmovna. Available on: <http://www.psp.cz/sqw/sbirka.sqw?cz=560&r=1991>

Kandidát Mládek byl u Zemana. Ten mu prý dával otcovské rady. [online]. 2014. Available on: <http://www.parlamentnilisty.cz/arena/monitor/Kandidat-Mladek-byl-u-Zemana-Ten-mu-pry-daval-otcovske-rady-301117>

PEREZ, A.A., Soto-Viruet, Y. et al.: The collection of yearly reports *Minerals Yearbook* between 1994 - 2011 [online]. U.S. Department of the Interior, U.S. Geological Survey. Available on: <http://minerals.usgs.gov/minerals/pubs/country/europe.html#ez>

EU Energy in figures: Statistical pocketbook 2010 [online]. 2010. Luxembourg: Publications Office of the European Union, 2012. Available on: <http://bookshop.europa.eu/en/eu-energy-and-transport-in-figures-pbKOAB10001/>

EU Energy in figures: Statistical pocketbook 2012 [online]. 2012. Luxembourg: Publications Office of the European Union, 2012. Available on: http://ec.europa.eu/energy/publications/doc/2012_energy_figures.pdf

EU Energy in figures: Statistical pocketbook 2013 [online]. 2013. Luxembourg: Publications Office of the European Union, 2012. Available on: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf

RŮŽIČKA, J.: *Elektrárna Opatovice si koupila povolenky a spaluje méně kvalitní uhlí.* [online] 2014. iDNES.cz. Available on: http://pardubice.idnes.cz/elektrarna-opatovice-emise-siry-povolenky-f2h-/pardubice-zpravy.aspx?c=A140129_173028_pardubice-zpravy_mt

SVOBODOVÁ, H.: *Trh práce ČR: Nezaměstnanost – základní pojmy.* [online]. Pedagogická fakulta, Masarykova univerzita. Available on: <http://is.muni.cz/do/rect/el/estud/pedf/js13/geograf/web/pages/03-trh-prace.html>

Vliv hlubinného dobývání na životní prostředí. [online]. 2011. Available on: <http://tezba-a-vyuziti-cerneho-uhli.webnode.cz/vlivy-hlub-dobyvani-na-ziv-prostredi/>

TRAXLER, J. *Jak vydělat na uhlí.* [online]. 2011. Available on: <http://www.finez.cz/odborne-clanky/oborove-analyzy/jak-vydelat-na-uhli>

Průmyslové dějiny Ostravska. [online]. 2011. Available on: <http://tezba-a-vyuziti-cerneho-uhli.webnode.cz/historie/prumyslove-dejiny-ostravska/>

Overview data for Czech Republic. [online]. 2013. U.S. EIA. Available on: <http://www.eia.gov/countries/country-data.cfm?fips=EZ&trk=m>

Rising Asian demand drives global coal consumption growth. [online]. 2011. U.S. EIA. Available on: <http://www.eia.gov/todayinenergy/detail.cfm?id=4390>

International Energy Statistics - Total Oil Supply [online]. U.S. EIA. Available on:
<http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=53&aid=1&cid=ww,&syid=2008&eyid=2012&unit=TBPD>

Total Energy: Annual Energy Review. [online] 2012. U.S. Energy Information Administration, 2012. Available on:
<http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0709>

International Energy Outlook 2013. [online]. 2013. U.S. EIA. Available on:
<http://www.eia.gov/forecasts/ieo/>

Energy & Mining. [online]. 2014, The World Bank Group. Available on:
<http://data.worldbank.org/topic/energy-and-mining>

Coal Information. [online]. World Coal Association. Available on:
<http://www.worldcoal.org/coal/>

What is Coal?. [online]. World Coal Association. Available on:
<http://www.worldcoal.org/coal/what-is-coal/>

Útlum českého hornictví. [online]. 2008. Available on: <http://www.zdarbuh.cz/dejiny-hornictvi/soucasnost/utlum-ceskeho-hornictvi/>

Důl Paskov. [online]. 2009. Available on: <http://www.zdarbuh.cz/reviry/okd/dul-paskov/>

Vývoj uhelného hornictví v ČR v 90. letech. [online]. 2009. Available on:
<http://www.zdarbuh.cz/dejiny-hornictvi/minulost/vyvoj-uhelneho-hornictvi-v-cr-v-90-letech/>

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Appendix 1: The bituminous coal

Indicator	Unit	2007	2008	2009	2010	2011
Number of enterprises		12	10	9	8	7
Number of employees		17 423	16 729	14 568	13 716	13 351
Sales	mill. CZK	40 021	51 166	31 223	44 464	44 991
Value added	mill. CZK	18 145	26 742	14 595	20 170	21 545
Sales per employee	ths. CZK/ employee	2 297	3 058	2 143	3 242	3 370
Mining total = 100%	%	90%	109%	95%	125%	122%
Labour produktivity based value added	CZK/ employee	1 041 427	1 598 525	1 001 855	1 470 521	1 613 761
Mining total = 100%	%	116%	156%	107%	136%	128%
Hourly labour produktivity	CZK/ working hour	651	978	622	890	972
Mining total = 100%	%	123%	164%	111%	139%	131%
Average salary	CZK/ employee	28 157	33 276	29 856	34 517	36 445
Mining total = 100%	%	112%	121%	112%	120%	122%
(Value added - salaries) per employee	CZK/ employee	1 013 270	1 565 249	971 998	1 436 004	1 577 316
Mining total = 100%	%	116%	157%	107%	136%	128%

Indexes	11/07	07/08	09/08	10/09	11/10
Number of enterprises	-42%	-17%	-10%	-11%	-13%
Number of employees	-23%	-4%	-13%	-6%	-3%
Sales	12%	28%	-39%	42%	1%
Value added	19%	47%	-45%	38%	7%
Sales per employee	47%	33%	-30%	51%	4%
Labour produktivity based value added	55%	53%	-37%	47%	10%
Hourly labour produktivity	49%	50%	-36%	43%	9%
Average salary	29%	18%	-10%	16%	6%
(Value added - salaries) per employee	56%	54%	-38%	48%	10%

Appendix 2: The brown coal and lignite

Indicator	Unit	2007	2008	2009	2010	2011
Number of enterprises		6	15	7	8	5
Number of employees		13 366	13 405	10 844	10 206	9 523
Sales	mill. CZK	26 609	30 849	29 574	26 559	26 513
Value added	mill. CZK	14 561	17 082	16 377	13 511	15 382
Sales per employee	ths. CZK/ employee	1 991	2 301	2 727	2 602	2 784
Mining total = 100%	%	78%	82%	121%	100%	101%
Labour produktivity based value added	CZK/ employee	1 089 399	1 274 288	1 510 218	1 323 745	1 615 250
Mining total = 100%	%	122%	125%	162%	122%	128%
Hourly labour produktivity	CZK/ working hour	668	762	915	801	982
Mining total = 100%	%	126%	128%	163%	125%	132%
Average salary	CZK/ employee	24 478	27 581	28 858	28 917	30 108
Mining total = 100%	%	98%	100%	109%	100%	101%
(Value added - salaries) per employee	CZK/ employee	1 064 921	1 246 707	1 481 360	1 294 827	1 585 141
Mining total = 100%	%	122%	125%	163%	123%	129%

Indexes	11/07	07/08	09/08	10/09	11/10
Number of enterprises	-17%	150%	-53%	14%	-38%
Number of employees	-29%	0%	-19%	-6%	-7%
Sales	0%	16%	-4%	-10%	0%
Value added	6%	17%	-4%	-18%	14%
Sales per employee	40%	16%	19%	-5%	7%
Labour produktivity based value added	48%	17%	19%	-12%	22%
Hourly labour produktivity	47%	14%	20%	-12%	23%
Average salary	23%	13%	5%	0%	4%
(Value added - salaries) per employee	49%	17%	19%	-13%	22%

Source: MSC, 2012¹⁰⁰

¹⁰⁰ MSC and their calculations according to Ministry of Industry and Trade and Czech Statistical Office data

Appendix 3: The branch of employment in the Czech Republic by regions (2011)

Region	The branch of employment																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
ČR	3.1	0.9	26.3	1.2	1.1	8.8	12.2	6.5	3.9	3	2.5	0.9	4.1	2.4	6.6	5.9	6.7	1.7	1.8	0.4	0
MSK	1,9	3,8	30,3	1,5	0,9	7,6	11,4	5,8	2,8	2,8	2,3	0,7	2,9	2,9	6,3	5,3	7,2	1,2	1,7	0,8	0
ZLK	3,2	0,1	36,5	1,2	0,9	10	12,2	4,8	3,3	1,3	1,3	0,5	2,7	2	4,5	5,4	6,8	1,7	1,7	0	0
OLK	3,8	0,4	29,5	0,7	1	8,5	13	6,3	3	1	2,1	0,7	3,2	2	9,1	5,6	8	0,8	1	0,3	0
JHM	2,9	0,5	24,8	1,1	0,8	8,3	11,9	6,9	3,4	2,9	2,8	0,8	6	2,4	7,2	6	7,7	1,6	1,6	0,4	0
VYS	5,8	0,5	34,7	1,3	1,1	8	10,5	5,2	3,5	0,9	1,9	0,1	2,7	2	6,8	5,6	6,9	1,1	0,9	0,3	0,1
PAK	4,7	0,2	34	0,7	1,2	8,8	12,5	5,8	3	1,7	2,5	0,4	3,7	1	4,5	5,9	6,7	0,6	1,3	0,9	0
HKK	4,4	0,2	30,4	0,9	1,1	8,7	10,1	7	4	2,3	1,8	0,3	3,7	0,9	6,6	7,2	7,1	1,6	1,6	0,3	0
LBK	2,3	1	37,4	0,8	0,9	9,2	10,2	5	3,7	1,6	1,5	0,5	3,7	1,5	6,2	4,9	6,6	1,7	0,9	0,2	0,2
ULK	2,8	2,1	26,4	1,5	1,9	11,4	10,5	7,3	3,2	2,2	1,6	1,2	2,6	2,6	6,5	5,6	7,1	1,2	2	0,1	0
KVK	2,8	4,2	24,4	1,4	1,4	8,7	12,5	7	5,8	0,6	1,2	0,9	2,6	2,7	7,2	5,4	7,4	2	1,1	0,6	0,1
PLK	4,9	0,7	29,7	1,4	1,7	9,4	11,8	5,4	3	1,5	2	0,6	2,9	1,6	6,9	5,8	6,4	1,6	2,4	0,3	0
JHC	5,5	0,2	28,3	1,7	1	11	11,8	5,9	4,5	2,1	1,5	0,4	2,7	2,2	5,7	5,7	5,5	1,9	1,7	0,8	0
SČK	2,9	0,3	24,3	1,2	1,1	8,7	13,4	8,8	4,2	3,5	3,1	1,1	4,3	2,4	6,2	5,2	5,5	1,5	2,2	0,1	0
PHA	0,3	0	7,6	0,9	0,7	7,6	14,9	6,9	6,3	8,6	5,2	1,9	7,9	4	7,4	7,8	5,8	3,7	2,4	0,1	0

Source: <http://www.budoucnostprofesi.cz>¹⁰¹, table made by author

Agriculture, forestry, fishing (A)

Mining and extraction (B)

The construction industry (C)

Electricity, gas, heat (D)

Water, waste and redevelopment (E)

Construction (F)

Trade (G)

Transportation and storage (H)

Accommodation and food services (I)

Information and communication activities (J)

Financial and insurance activities (K)

Real estate activities (L)

Professional, scientific and technical activities (M)

Administrative and support service activities (N)

Public administration and defense (O)

Education (P)

Health and social care (Q)

Cultural and entertainment and recreation activities (R)

Other activities (S)

Activities of households (T)

Extraterritorial organizations (U)

¹⁰¹ Trhy práce v regionech v roce 2011. [online]. 2014. Národní vzdělávací fond. Available on: <http://www.budoucnostprofesi.cz/trhy-prace-v-regionech/regiony2011.html>

Appendix 4: The regions of the Czech Republic



Source: <http://www.budoucnostprofesi.cz>¹⁰²

¹⁰² Trhy práce v regionech v roce 2011. [online]. 2014. Národní vzdělávací fond. Available on: <http://www.budoucnostprofesi.cz/trhy-prace-v-regionech/regiony2011.html>