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Analysis of the Natural Gas Market during the Period of Deregulation – A Comparison of Selected European Countries

Bachelor thesis

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Abstrakt

Liberalizace trhů s plynem je v Evropské Unii, obzvláště pak v jejích nových členech, aktuálním tématem. Tato práce se věnuje srovnání liberalizačních procesů ve třech středoevropských zemích – České Republice, Slovensku a Polsku. Na úvod práce pojednává o konceptech státních a přirozených monopolů, specifikách trhu s plynem a legislativě Evropské Unie, která je základem liberalizace. Dále se tato práce podrobně zabývá vývojem na jednotlivých trzích těchto třech zemí. Zaměřuje se především na národní legislativy, otevírání poptávkové strany a změny ve struktuře trhu, zahrnující rozdělování společností, nové účastníky trhu a změny dodavatele. V závěrečné kapitole je pomocí koncentrace trhu spočtené Herfindahl-Hirschmanovým indexem zanalyzována a porovnána rychlost uvolňování trhů v jednotlivých zemích.

Abstract

The liberalization of gas markets is in the European Union and especially in its new Member States a current topic. This thesis is devoted to a comparison of the liberalization processes in three Central European countries – the Czech Republic, Slovakia and Poland. The thesis first introduces the concepts of public and natural monopolies, the specific characteristics of gas markets and the legislation of the European Union that underlies the liberalization. Further, the thesis takes a close look at the developments in the gas markets of the three countries. The focus lies mainly on the national legislation, opening of demand side and changes in the market structure, including unbundling, new entrants and supplier switching. The final chapter of the thesis analyzes and compares the progress in liberalization of the individual markets by calculating the market concentrations using the Herfindahl-Hirschman index.

Klíčová slova

zemní plyn, trh plynu, deregulace, liberalizace, rozdělení společností, přístup třetích stran, Herfindahl-Hirschmanův index, koncentrace trhu, Česká republika, Slovensko, Polsko

Keywords

natural gas, gas market, deregulation, liberalization, unbundling, Third Party Access, Herfindahl-Hirschman index, market concentration, Czech Republic, Slovakia, Poland

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Declaration

1. I hereby declare that I have written this thesis independently using only the references and literature listed.
2. I hereby declare that this thesis was not used to obtain another degree.
3. I hereby agree that the thesis will be made available for study and research purposes.

In Prague, 29 July 2011 Barbora Mirková

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Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

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Analýza trhu zemního plynu v době deregulace - srovnání vybraných evropských zemí.

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

V minulosti byla distribuce zemního plynu považována za typický příklad přirozeného monopolu. Společnosti působící na trhu zemního plynu byly vlastněny výlučně státem a celé odvětví bylo silně regulováno. Během 70. a 80. let 20. století však mnohé země díky neefektivnosti daného uspořádání přistoupily k liberalizaci a deregulaci tohoto odvětví. V posledních letech zasáhla deregulace trhu zemního plynu i země střední a východní Evropy.
Cílem této práce bude porovnat trhy zemního plynu několika různých evropských zemí. Důraz bude kladen především na vývoj cen zemního plynu a jeho závislosti na stupni deregulace tohoto odvětví v daných zemích. Analýza bude založena na dostupných údajích o cenách plynu, která budou získána ze statistických a regulačních úřadů, ať už evropských nebo místních, a jiných institucí.

Struktura BP:

Abstrakt

Úvodní část této práce se bude věnovat regulaci a deregulaci veřejných služeb, se zaměřením na zemní plyn. Bude uvedena základní charakteristika těchto pojmů a jejich vývoj v širším měřítku. Druhá část se bude věnovat trhům zemního plynu jednotlivých zkoumaných zemí. Důraz bude kladen na vývoj těchto trhů, jejich deregulaci a současný stav. Další, empirická část bakalářské práce se zaměří na zkoumání vlivu deregulačních opatření jednotlivých vlád na koncovou cenu komodity v jednotlivých zemích, a to na časových řadách pro jednotlivé země. Pokud se podaří obstarat dostatečně kvalitní data mohlo by být možné zkoumat země paralelně formou analýzy panelových dat.

Osnova

1. Úvod do problematiky
2. Charakteristika trhů zemního plynu a jejich deregulace v jednotlivých zemích
3. Vlastní analýza těchto trhů
4. Vyvození závěrů analýzy

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BACHANOVÁ, Veronika. *Regulace a deregulace v ČR v období 1990-2005* [online]. [s.l.] : Centrum výzkumu konkurenční schopnosti české ekonomiky, 2006 [cit. 2010-06-08]. Dostupné z WWW: <http://is.muni.cz/do/1456/soubory/oddeleni/centrum/papers/wp2006-06.pdf>.

BACHANOVÁ, Veronika. *Regulace a deregulace ve vybraných zemích EU v období 1990–2007* [online]. [s.l.] : Centrum výzkumu konkurenční schopnosti české ekonomiky, 2008 [cit. 2010-06-08]. Dostupné z WWW: <http://is.muni.cz/do/1456/soubory/oddeleni/centrum/papers/wp2008-05.pdf>.

BAILEY, Elizabeth E. ; PACK, Janet Rothenberg. *The political economy of privatization and deregulation* . Aldershot : Elgar, 1995. 639 s. An Elgar reference collection , The International Library of Critical Writings in Economics. ISBN 1-85278-831-3.

BRAKMAN, Steven; VAN MARREWIJK, Charles; VAN WITTELOOSTUIJN, Arjen. *Market liberalization in the European natural gas market : The importance of capacity constraints and efficiency differences* [online]. [s.l.] : CESifo, 2009 [cit. 2010-06-08]. CESifo Working Paper Series, Industrial organisationsion, 2697. Dostupné z WWW: <http://ssrn.com/abstract=1433668>.

Český plynárenská svaz. *Plynárenství 1847 - 1997*. Praha : Atypo, 1997. 127 s. ISBN 8090237800.

MACAVOY, Paul W. *Natural Gas Market : Sixty Years of Regulation and Deregulation*. New Haven : Yale University Press, 2001. 159 s. ISBN 9780300083811.

MCCRUDDEN , Christopher. *Regulation and deregulation : policy and practice in the utilities and financial services industries* . 1st ed. . Oxford : Clarendon Press , 1999. 419 s. ISBN 0-19-826881-5.

MEJSTŘÍK, Michal. *Privatizace, regulace a deregulace utilit v EU a ČR : očekávání a fakta* [online]. [Praha] : [s.n.], [2004] [cit. 2010-06-08]. Dostupné z WWW: <http://ies.fsv.cuni.cz/default/file/download/id/1320>.

MRAVEC, Michal. *Understanding the failure (so far) of the liberalization of the Czech market in natural gas: some models*. Prague : CERGE-EI, 2006. 65 s. Discussion paper series.

MRAVEC, Michal. *Understanding the lack of competition in natural gas market: the impact of storage ownership and upstream competition*. Prague : CERGE-EI, 2007. 40 s. Working paper series, ISBN 9788073431419, ISBN 9788073441302. ISSN 1211 3298.

ROBINSON, Colin. *Successes and failures in regulating and deregulating utilities : evidence from the UK, Europe and the USA*. Cheltenham (UK) : Edward Elgar, 2004. 216 s. ISBN 1843762307.

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Abbreviations

a.s.	Akciová společnost (joint stock company)
CEE	Central and Eastern Europe
Coll.	Collection
ERU	Energetický regulační úřad (Energy Regulatory Office of the Czech Republic)
EU	European Union
GDP	Gross domestic product
GmbH	Gesellschaft mit beschränkter Haftung (limited liability company)
GWh	Gigawatt hour
HHI	Herfindahl-Hirschman index
ISO	Independent System Operator
ITO	Independent Transmission Operator
kWh	Kilowatt hour
LNG	Liquefied natural gas
mcm	Million cubic meters
MWh	Megawatt hour
m^3	Cubic meter
n.a.	Not available
No.	Number
OECD	Organisation for Economic Co-operation and Development
PGNiG	Polskie Górnictwo Naftowe i Gazownictwo
RONI	Regulatory Office for Network Industries (Slovakia)
S.A.	Spółka akcyjna (joint stock company)
s.r.o.	Společnost s ručením omezeným (limited liability company)
Sp. z o.o.	Spółka z ograniczoną odpowiedzialnością (limited liability company)
SPP	Slovenský plynárenský priemysel
TPA	Third Party Access
U.S.	United States
URE	Urząd Regulacji Energetyki (Polish Energy Regulatory Office)
USA	United States of America

Conversion factors

1 m^3 = 10.55 kWh

Introduction

The natural gas industry, along with other power industries, is considered to be a vital part of all modern economies. In European countries, the industry had for many years operated in the form of a monopoly and had been for its importance completely controlled by the states. In the late 1980s and at the beginning of 1990s, the opinions of the European countries on the necessity to keep the gas market as a state-owned monopoly began to change. The general opinion started to shift in favor of privatization and deregulation. These thoughts led in 1998 the European Union to adoption of the First Gas Directive that laid down the first steps towards the liberalization of the natural gas market. Since then, the efforts to liberalize the market and to introduce competition at European level have continued and strengthened.

In the Central and Eastern European countries, the gas industry remained in the hands of the states longer than in the more developed countries. Most of them started taking first steps towards the liberalization only in connection with their accession to the European Union. For this reason, the liberalization of gas markets in Central and Eastern Europe is a very current and relevant topic. The process is in these countries still under way and many of them still have a long journey ahead. Unlike the gas market liberalization in the old European Union Member States, the gas market liberalization in Central and Eastern Europe is due to its recent nature not yet well covered in the literature.

The aim of this thesis is to describe the situation in gas markets in the Czech Republic, Slovakia and Poland and to assess and compare their development. The thesis will examine the extent of implementation of the European directives into the national legislations, the advancements in unbundling of the incumbent companies and the progress of the opening of the market and entry of new companies. The Herfindahl-Hirschman index will be used to assess the development of competition and changes in the three national markets.

The first chapter will introduce the theory of public and natural monopolies. It will describe the reasons for the numerousness of such market structures in the history.

The chapter will also bring comments on problems of the theory and the reasons for diversion away from it.

The second chapter will in detail describe the natural gas supply chain. It will describe the general aspects of the natural gas market and explain all of the concepts that are necessary for the later assessment of the liberalization.

The third chapter is focused on the legislation of the European Union that sets the conditions of the functioning of the gas market and lays down the provisions for its liberalization. Besides the description of the relevant directives and regulations, the chapter evaluates the achievements and failures of the individual legislative acts and also includes its most common critique.

The following three chapters will in detail describe the situation in the three individual markets. They will cover the general characteristics of the markets, their legislation and the progress of liberalization of the market. It will specifically focus on the changing structure of the markets, the progress in unbundling of the vertically integrated companies, the entry of new market players, the switching of suppliers and the price regulation.

In the seventh chapter, Herfindahl-Hirschman index will be calculated for each country and year since the beginning of the gradual opening of the markets in these countries. Based on the results, the progress in the introducing of the competition will be assessed and compared between the countries.

The most important outcomes of the thesis will be summarized in the conclusion.

1. Theory of public and natural monopolies

1.1 Network industries as public monopolies

For many years, network industries have operated in the form of public monopolies. Governments have generally three arguments for this (Geradin, 2006): the provision of universal service, the importance of these industries and their natural monopoly character.

Many of the services provided by network industries are considered to be merit goods. It is believed that everybody – including the poor and those living in remote regions - should have an access to such services (Cremer, Gasmi, Grimaud and Laffont, 1998). However, in competitive markets without government interventions, firms are not willing to serve such regions or users, because costs are too high and profits unlikely. It used to be therefore viewed as necessary to have only one state-controlled firm operating the market. Such firm is, in return for being granted a monopoly position, obligated to provide a universal service. Definitions of a universal service vary, but they are all usually based on obligation to provide a service to all costumers at a good quality and affordable price. Uniformity of prices is a frequent additional requirement (Cremer, Gasmi, Grimaud and Laffont, 1998). The provision of a universal service brings on the firms higher cost, but at the same time, their monopoly position allows them to cross-subsidize and (at least) cover losses from unprofitable areas by profits from the more lucrative ones. The necessity of cross-subsidizing has been, however, challenged in the last decades. Recently, a belief that cross-subsidizing is not necessary to maintain universal service prevails. Other methods, such as direct subsidies are considered to be more suitable (Geradin 2006).

The second reason for public monopolies is the importance of network industries. The governments' desire to control these important industries has three aspects – strategic, economic and political. For strategic reasons, governments want to be able to control the utilities in case of war or other crises. The economic aspect is based on the fact that these industries employ a significant portion of workers and create a non-negligible part of the GDP. Last but not least, public monopolies are often closely linked to the state administration (Geradin 2006).

Since the issue of the natural-monopoly character of the network industries has a major influence on their regulation and deregulation, it is worth devoting a separate section to it.

1.2 Energy markets as natural monopolies

Natural monopolies are characterized by large economies of scale and therefore always facing decreasing marginal and average cost curves (Samuelson and Nordhaus, 1995). This means that a market with one firm is the most efficient structure available; more firms in the market would only result in higher costs. For many years, network industries had been considered such monopolies. Mejstřík (2004) says that this had been a common belief until the 1980s. Governments convinced of the natural monopoly character of the network industries found it necessary to regulate them to prevent inefficient duplications. Duplications have been considered inefficient especially in the field of energy distribution, because of the high costs of distribution systems. They are, however, an attribute of competition and are very common in other fields. For example, gas stations are often located by main roads on the edge of a city right next to each other (Dušek, 1998). The costs of production would most likely be lower if there was only one large firm, but the benefits of competition outweigh the higher costs. If they did not, the duplication would be in reality inefficient and the market forces would cause some of the duplications to end or to merger. Since the market is able to deal with inefficiencies by itself, regulations preventing inefficient duplications are unnecessary (Zajíček, 1999).

Regulations are generally redundant in the markets where the theory of natural monopoly applies. From its definition, natural monopolies occur when there are natural barriers to entry, created by the decreasing average costs and high costs of entry. It is therefore unnecessary to create artificial administrative barriers. Natural barriers keep potential competition out of the market only as long as the monopoly keeps its prices low enough not to become attractive for the potential competitors. The risk of new competitors entering the market is for the incumbent such a threat, that they charge prices almost at the level of prices in perfect competition. If, however, administrative barriers to entry are put in place, the monopolists have no reason to keep their prices low. They are the only firm in the market and there is also no potential competition. Thus, it allows them to earn abnormal profit (Dušek, 1998).

According to Dušek (1998) and Zajíček (1999), there are several other problems in the theory of natural monopoly and its regulation. Besides the inefficient duplications and potential competition, both authors talk about the unrealistic premises of the theory. First problematic assumption is that perfect information about the cost and demand functions is available to everybody – the regulated firm, consumers and most importantly the regulator. This is, however, not true. It is only possible to obtain historical average and total costs of the firm at a quantity that has been really produced. Moreover, this is only possible if the company produces just one product, because in a firm with a wider range of produced articles, it is not viable to clearly distinguish costs of individual products[1]. Same problem applies to the production function, from which we are able to identify only the combinations of formerly bought amounts at the regulated price.

Another unrealistic premise is the stability of cost and production functions. Prices of inputs are constantly changing, technologies are developing and supply and demand fluctuate, both expectedly and unexpectedly. In a free market, such changes are balanced by changing prices of the products, but regulators are not capable of substituting the market forces. They cannot keep up with such a number of factors, let alone predicting their developments and setting the prices accordingly.

Cooperative game is the third, hardly achievable, premise. The regulated firm is the most important source of information for the regulator. The theory of natural monopoly regulation assumes that the firm is playing a cooperative game with the regulator, which means that they provide him with complete and truthful information. It is, however, in the firm's interest to adjust and omit some data in order to make their costs seem higher than they really are. Since regulated prices are usually constructed on the basis of average costs to the firm, manipulating with them allows the firms to manipulate with the prices as well.

The last unrealistic assumption is the independence of the regulator. The theory believes that the regulator's decisions will be unbiased, based on the latest scientific knowledge and made with the aim to reach social optimum. This had been disproved already in the 1960's (Dušek, 1998) with the regulatory capture theory. According to

[1] This problem does not apply to the gas market, because gas is a homogenous product and often an only article of the firm.

this theory, every regulator, no matter how good his intentions are at the beginning, will at some point fall under the control of the regulated firms and will start making decisions profiting them. Regulations can profit the regulated firms by disabling competition to enter the market or by ensuring price regulations or subsidies for the incumbent firm. All this can bring an abnormal profit to the firm (Bachanová, 2006). The interest group theory of regulation went even further. It claimed that regulations were even prompted by the firms themselves in order to benefit them. This is opposed to the former belief that regulations were set up in order to prevent the monopolies from the abuse of a dominant position and to protect public interests (Dušek, 1998).

2. Gas markets

The significance of natural gas as a fuel has been increasing in the last few decades. Its share on consumption of primary energy sources in the European Union rose from 15.65 % in 1980 to 25.58 % in 2010 (BP, 2011). The rising popularity of gas often has been attributed to environmental concerns, because gas is not only a very efficient source of energy but one of the cleanest natural resources as well. Its burning produces significantly lower amounts of carbon dioxide and nitrous and sulfur oxide emissions compared to other fossil fuels (Česká plynárenská unie, 2006). Once a transmission and distribution network is built, the gas is also easier and cheaper to transport than for example coal.

There are many uses for natural gas ranging from heating and cooling in residential, commercial and industrial sectors to using the gas as a feedstock for manufacturing in chemical and other industries (The Natural Gas Supply Association, 2010). In all sectors, it is, however, mainly used to produce heat. In almost all of its uses, natural gas competes with other energy sources, mainly with coal, oil and electricity. Although in most cases users can switch from gas to its alternatives, the opposite is often not true. In the short run, this is prevented by high investments into the equipment, but even in long run, there are instances (such as lighting with a light bulb), where gas cannot be easily used as a substitute for other energy sources (OECD, 2000).

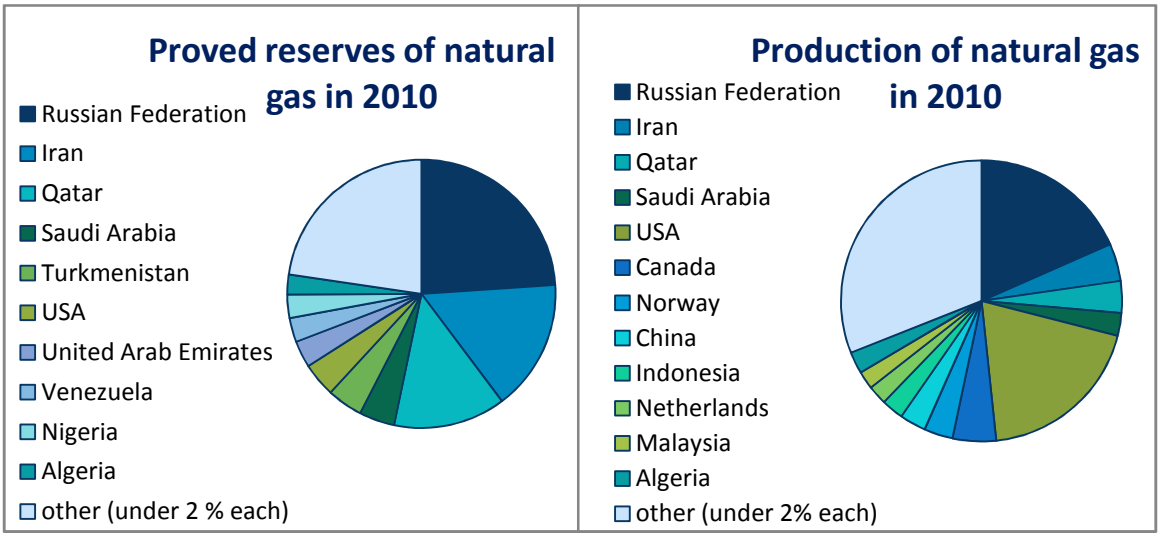
The supply chain of natural gas could be divided into five stages (OECD, 2000; Swartenbroekx, 2007):

- Production
- Bulk transportation
- Distribution
- Storage
- Retailing

2.1 Production

As natural gas is a primary source, its production is located near its reserves. These reserves are, similarly to oil reserves, spread very unevenly around the globe and their majority is concentrated in only few areas. The far largest proven reserves of natural gas are in the Russian Federation. They make up for 23.9 % of world reserves and are followed by the ones in Iran and Qatar with 15.8 % and 13.5 % respectively (BP, 2011). The countries with the largest reserves are however not the largest producers. In 2010, the three countries that produced most natural gas were the United States, Russia and Canada. Iran and Qatar followed after them (BP, 2011).

Figure 1 and 2: Proved reserves and production of natural gas in 2010



Source: Based on BP, 2011

The European Union does not have extensive gas reserves. Currently the two largest producers of natural gas are the United Kingdom and the Netherlands (Egging and Gabriel, 2006). The reserves in the United Kingdom are, however, quickly decreasing and under the current pace of extraction will last only 4.5 years (BP, 2011). The reserves inside of the European Union are not able to cover the EU's high demand. In fact, in 2010 the EU produced only 35.5 % of its consumption (BP, 2011). The European Union is therefore dependent on imports. These come mainly from Russia, Norway and Algeria (Egging and Gabriel, 2006) and their importance will most likely increase in the future, as the EU's reserves will be depleting. Currently, the import dependency is especially high in the new Member States, who are moreover usually dependent only on one main supplier. Unlike the old Member States, who have

diversified their supply over the forty years of major gas industry development, the central and eastern European (CEE) states developed their gas infrastructure in cooperation with the Soviet Union and are therefore still taking most of their gas from this region. While about half of the CEE countries (including Slovakia) is entirely dependent on Russian gas (Kaderják, Cameron and Tóth, 2007), the Czech Republic managed to lower its share to less than 60 %, taking the rest of the gas from Norway and Germany (ERO, 2010). Poland and Hungary have diversified their importers as well and in addition to that produce appreciable amount of gas themselves (Stern, 2002).

2.2 Long-term contracts

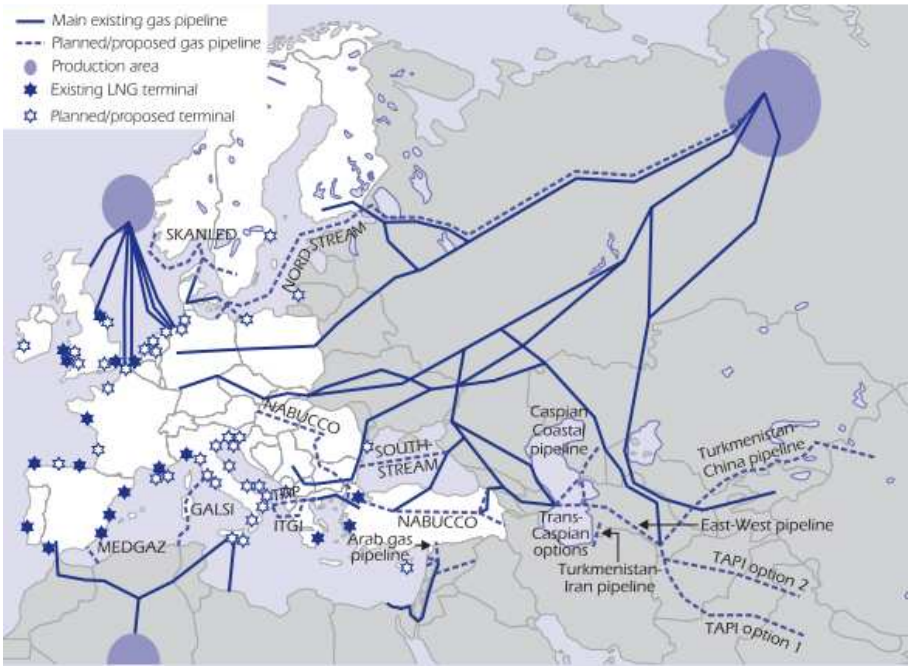
Gas trade requires large investments in the production and transmission facilities. Such investments present a great risk for the investor, because the buyers are likely to act in an opportunistic manner and deprive the investor of his rents (Cretì and Villeneuve, 2004). For this reason, long-term contracts have been used in the natural gas trade, mainly in the form of take-or-pay contracts. These contracts have duration of twenty to thirty years and require the buyer to pay for a specified quantity of gas no matter he uses it or not (Cronshaw, et al., 2008). At the same time, the producer is required to deliver this quantity to the buyer. The contracts often include clauses linking the price of the gas to prices of other fuels. Such long-term contracts split the risks between the buyer and the producer, the first one carrying the volume risk and the other one carrying the price risk (Neuhoff and Hirschhausen, 2005).

2.3 Transportation

Bulk transportation can be split into two components – transportation from the production site to the country of consumption and the national network itself. The former can take a form of transmission of gas through high-pressure pipelines or a transportation of liquefied natural gas (LNG) in tankers (Swartenbroekx, 2007). The significance of LNG for European natural gas market was negligible only few years ago, but it has been sharply increasing in the last few years. Its share rose from only about one tenth in 2004 to about one fifth in 2010. This has been caused by an increase in the capacity of European regasification facilities as well as by larger amounts of LNG available in the world markets (Eurogas, 2011). The transmission through pipelines remains, however, the main method of gas transportation. Since gas is produced only in

a limited number of areas, these pipelines often have to cross several countries before the gas reaches its destination. For the European Union the most important transit countries are the Czech Republic, Slovakia and Poland in the East and Belgium in the West (Swartenbroekx, 2007).

Figure 3: Main supply projects to Europe



Source: International Energy Agency, 2009[2]

The national transmission network consists of high-pressure pipelines that transport gas mainly to the distribution networks, but some large industrial customers and power plants are connected to the transmission network as well. Transmission is followed by distribution, which brings gas via low-pressure pipelines to residential, commercial and small industrial consumers (OECD, 2000).

Both transmission and distribution sectors are often considered to be natural monopolies. This belief is based on the economies of scale or density they exhibit. Transmission is clearly characterized by economies of scale. In the costs of building a new infrastructure, the expenses caused by larger pipe diameter or capacity play only a minor role and are insignificant in comparison to the total costs of construction and obtaining rights of way. Furthermore, with increasing diameter of the pipe, its flow capacity increases significantly more than linearly. The average costs of transmission

[2] Natural gas Market Review 2009© OECD/International Energy Agency 2009, map 6, page 75

are therefore decreasing in the diameter. More economies of scale occur, when the capacity is increased by adding more pipes into one corridor, because the additional cost for construction, security, technology and surveillance are lower and there are no more expenses associated with the right of way (Hirschhausen, Neumann and Rüster, 2007). The existence of the economies of scale is widely accepted, but there are voices claiming that there is no reason for them to cause a natural monopoly character of the transmission sector. For example, Kahn (1988) believes that despite the economies of scale, competition can easily occur in areas between the pipelines or around their junctions. His argument is, however, based on the transmission network in the United States, which is very different from the European one. The production sites in the United States are spread more widely than in Europe and thus enable variety of possible routes for pipelines that could compete with each other, whereas in Europe there are only few directions in which the gas flows. In addition to economies of scale, the distribution networks show economies of density, because once the main pipelines are laid, the costs of connecting another customer in the area are very low (OECD, 2000).

2.4 Storage

Since gas is used mainly for heating, its demand is very seasonal. To smooth the fluctuations, the gas is injected into storage facilities at off-peak times so it can be later used to accommodate the peak demand (Cretì, 2009). Such facilities are for example depleted natural gas or oil fields, aquifers, disused mines and salt caverns. They have each their specific characteristics, but differ mainly in a capacity and withdrawal flow rate. The choice of the type of storage facility is however mainly based on local availability of such sites. By increasing the pressure, the pipelines can serve as storage as well. Such practice is called line-pack and is mainly used to cover daily fluctuations. LNG is stored on surface in cryogenic storage facilities. These are located near LNG reception units (Swartenbroekx, 2007). The storage of gas is an important component of the security of supply as it can provide reserve gas in case of major pipeline accidents or interruption of gas supply for geopolitical reasons (Cretì, 2009). Such situation occurred in January 2009, when disputes between Russian company Gazprom and Ukrainian company Naftogaz over prices and debts resulted in major disruptions of gas supplies that affected several European countries dependent on the Russian gas transported through Ukraine.

3. Legislation of the European Union

The basis for liberalization of the network industries can already be found in the Treaty Establishing the European Economic Community (1957). The Treaty sets a common market as its main goal and requires a freedom of movement for people, services and capital and a gradual removal of all obstacles to these freedoms. A monopoly could be considered one. The Treaty specifically addresses public services in Article 90:

> "Undertakings entrusted with the operation of services of general economic interest or having the character of a revenue-producing monopoly shall be subject to the rules contained in this Treaty, in particular to the rules on competition, in so far as the application of such rules does not obstruct the performance, in law or in fact, of the particular tasks assigned to them. The development of trade must not be affected to such an extent as would be contrary to the interests of the Community." (Treaty Establishing the European Economic Community, 1957)

The later legislation on liberalization of electricity and gas industries proceeds from this thought.

The effort to liberalize the EU energy markets started to take shape in the nineties, when the first directives on electricity and gas were adopted. The First Gas Directive 98/30/EC was adopted on 22 June 1998 with an objective of creating a level playing field for new entrants to the industry. It set rules for all stages of the natural gas supply chain, except for production. It also set rules for organization and the functioning of the industry. The Directive served as a framework and therefore allowed the Member States to transpose the rules into their national legislation in a way that suits the situation in their individual markets best. 10 August 2000 was set as the date by which the transposition needed to be completed (Haase, 2009). There are three major principles included in the Directive: unbundling, access to the network and the opening of the demand side. Unbundling of the undertakings, operating in more sectors of the industry, is viewed as a necessity in avoiding discrimination, cross-subsidizing and

distortion of competition. The Directive, however, requires only separation of accounts. The more advanced stages of unbundling – a legal or proprietary separation - are not specifically mentioned in the Directive and therefore it is up to the Member States, whether they will take the unbundling further or will fulfill only the minimal requirements. The principle of nondiscriminatory access to the network is included in the so-called Third Party Access (TPA). The TPA obliges the owner of the network to allow all producers and retailers to deliver gas to the final customers through their pipelines on conditions that do not favor the incumbents or the undertakings associated with the owner (Polo and Scarpa, 2003). The Member States could have chosen to use one of the two options of the TPA - a negotiated and regulated access - or a combination of both. The negotiated access limited the responsibilities of the Member States to creating a suitable environment for concluding the access and supply contracts by the parties concerned. The prices of access and other terms of use of the system were to be based on voluntary commercial agreements. In case of regulated access, the Member States determined the tariffs and conditions of the access themselves. The network owners were, however, in certain cases granted an option of refusing access to the system. As such case was considered a situation in which the network owner would not have a sufficient capacity or if the access would prevent them from carrying out their public service obligations. The access could have been also denied if there had been a conflict with take-or-pay contracts that would cause the network owners significant economic and financial problems. To gradually open the demand side of the market to competition, the Directive created a concept of eligible customers - customers allowed to freely choose their supplier. The definition of eligibility was not precisely specified in the Directive; the Member States were given a leeway to form their own, based on certain criteria. The eligibility definition had to result in at least 20 % openness of the retail market and had to include all customers consuming over 25 millions cubic meters of gas per year and all gas-fired power generators, regardless of their consumption. The yearly consumption threshold was supposed to be gradually lowered, in order to open 28 % of the retail market by 10 August 2003 and 30 % of the market by 10 August 2018.

The relatively free hand that was given to the Member States in implementing these objectives became the core of the critique of the Directive. Low requirements, number of exceptions in the rules and important topics that were neglected, are often

listed as reasons for unsatisfactory results (Polo and Scarpa, 2003; Thomas, 2005). Particularly the opening of the network proved to be hardly achievable under the First Directive. Only The United Kingdom separated the ownership of transmission operators and three other states (Denmark, Italy and Spain) introduced legal unbundling. The rest of the Member States merely followed the accounting unbundling requirement included in the Directive (Weale and Omahony, 2001). This partial separation did not ensure non-discriminatory access to the network because the integrated company was still able to charge the competitors high prices and thus impede the emergence of competition in other sectors of the market (Polo and Scarpa, 2003). This practice could have been avoided by an implementation of the regulated TPA, since in that case the prices would not be settled by the companies. The Directive allowed, however, for the negotiated TPA as well and therefore enabled the incumbent companies in several states to discriminate the new entrants. Their advantageous position was even strengthened by the possibility to refuse access to the network under certain circumstances (Haase, 2009). A combination of these factors made it very easy for the incumbents to maintain their position and to make the emergence of competition nearly impossible. Critique is also focused on the lack of rules concerning the role of the state in the ownership of the companies, the desirable structure of the market and its appropriate degree of concentration (Polo and Scarpa, 2003). The missing requirement for a sector regulator is criticized as well (Thomas, 2005).

On 26 June 2003, after over two years of heated negotiations (Haase, 2009), the First Directive was followed by the Directive 2003/55/EC. This Directive repealed the Directive 98/30/EC and accelerated the liberalization process. As a main change, the new Directive required each Member State to create an independent regulatory authority that would be responsible for ensuring efficiency and non-discriminatory competition in the market and monitoring all of the aspects of liberalization. The Directive also strengthened the unbundling obligation. The vertically integrated undertakings were required to legally separate their transmission, distribution, LNG and storage activities from the remaining ones as well as to separate its organization and decision-making. Ownership separation was, however, still not mandatory. The Second Directive abolished the negotiated TPA. The access to the network newly had to be based on published non-discriminatory tariffs. These tariffs or their methodologies of calculation had to be approved by the regulator and published prior to their entry into force. The

option of refusing access to the network in case of insufficient capacity or in case of problems with take-or-pay contracts or with fulfilling public service obligation was preserved in the new Directive. The Second Directive significantly sped up the process of opening the demand site. It introduced a new schedule, under which the market should be open for all commercial customers from 1 July 2004 and for everybody, including households, starting 1 July 2007. Newly, the Directive focused on customer protection setting out measures the Member States should take in order to achieve it.

Even though the Second Directive removed many of the imperfections of the First Directive and tightened the rules of liberalization, it still kept some of the weaknesses of the previous Directive. Primarily, the new Directive does not address the issue of integration of upstream (production and import) and downstream (retail) activities and their unbundling. It is also very vague in specifying how far the European Commission and the national regulators should go in breaking up dominant companies (Thomas, 2005). It further lacks any effective provisions on cross border trade (Polo and Scarpa, 2003) and a security of supply.

The security of supply is the subject of the Directive 2004/67/EC adopted on 26 April 2004. The Directive requires the Member States to ensure gas supply for households at least in periods of extremely low temperatures and in case of partial disruption of national gas supplies. It allows the Member States to extend this rule to other customers that cannot switch to other energy sources (especially small and medium-sized businesses) and gas-fired power plants, if they are crucial for the national electricity generation. The Directive provides a list of instruments that can be used to achieve this objective and creates a Gas Coordination Group that should function as a coordinator of security of supply measures.

The process of liberalization of the European gas market continued by the adoption of Regulation 1775/2005 on September 28, 2005. In its preamble the Regulation states that the Second Directive “has made a significant contribution towards the creation of an internal market for gas” (Regulation 1775/2005) and that “it is now necessary to provide for structural changes in the regulatory framework to tackle remaining barriers to the completion of the internal market in particular regarding the trade of gas” (Regulation 1775/2005). In this spirit, the Regulation lays down rules relating to the third party access services, congestion management, capacity allocation

mechanisms, trading of capacity rights, balancing and transparency. It also requires the tariffs of access to the network to be not only non-discriminatory but cost reflective as well.

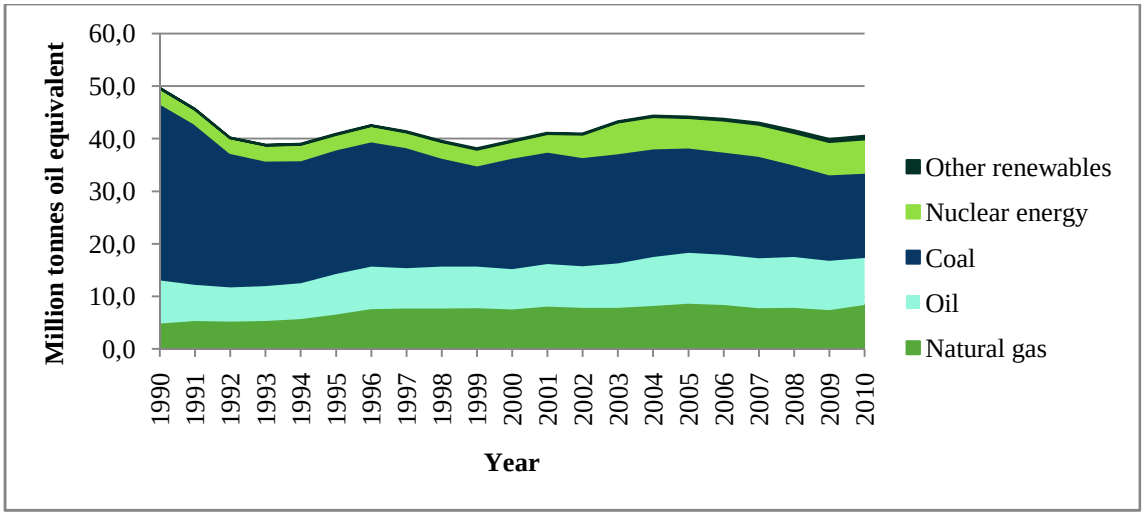
The European Union's effort to liberalize its internal gas market has been so far finished by an adoption of the Third Internal Energy Market Package on 13 July 2009. The Package includes directives on gas and electricity, regulations concerning the access to the gas and electricity networks and a regulation creating the Agency for the Cooperation of Energy Regulators (European Commission, 2011). The Agency for the Cooperation of Energy Regulators was established by the Regulation 713/2009 to replace the European Regulators Group for Electricity and Gas, the independent advisory group founded in 2003 by the Commission. The task of the Agency is to coordinate activities of the national regulators and serve as a regulator at the Community level. It is also supposed to monitor the internal market and inform European or national authorities about its findings as well as to function as an advisor. The Agency was also given the power to develop nonbinding framework guidelines for network codes. The second component of the Third Internal Energy Market Package relevant to the gas market is the Directive 2009/73/EC repealing the Directive 2003/55/EC. The Third Directive brought important changes in the unbundling requirements. Originally, the Commission proposed mandatory ownership unbundling, under which the vertically integrated companies would have to sell off their networks (Eikeland, 2011). This proposal was, however, not well accepted by the Council and therefore the Commission came up with another possibility – the creation of Independent System Operator (ISO) (Havris, 2009). In this case, the integrated company retains the ownership of the transmission system but is not allowed to operate it. This task should be carried out by the ISO. Besides the operation of the transmission system (including managing third party access and collecting access and congestion charges), the ISO is also responsible for investment planning. These investments should be financed by the owner of the system, who, however, does not have a power of decision over them (Directive 2009/73/EC). Not even this less strict ISO model was acceptable for all Member States and therefore a third option had to be included in the Directive (Havris, 2009). Under the Independent Transmission Operator (ITO) model, the ITO is a part of the vertically integrated company but it makes independent decisions on the day-to-day activities, the management of the network as well as on the ten-year plan for

network development. The integrated company keeps, however, some influence over the ITO through a supervisory board that is supposed to make serious financial decisions (Directive 2009/73/EC). The formal separation of the company is often viewed as a not very effective measure. The separation of the decision-making does, however, have a strong influence on the internal environment of the company. As experts in the Czech gas industry remark, such division causes a competition between the managers of the newly separated parts of the company and leads to an inner disintegration. Due to the focus on competition inside of the firm, the company looses its external competitiveness and ability to take action. Such situation plays into the hands of the new entrants and therefore indirectly leads to the increase of competition in the market. Besides the provisions on unbundling, the Third Directive includes rules on customer protection, such as no charges for switching of supplier or access to relevant information, and encourages regional integration of national markets (European Union, 2009b). The third gas-related component of the Third Internal Energy Market Package, the Regulation 715/2009, repealed the Regulation 1775/2005 and established the European Network of Transmission System Operators for gas (European Union, 2009a).

4. Developments in the Czech gas market

Natural gas plays a smaller role in the energy mix in the Czech Republic than in Europe on average. Its share has, however, significantly increased in the past twenty years – from less than 10 % in 1990 to around 20 % in 2010 (BP, 2011). This increase could be explained by the environment-friendly character of natural gas, already mentioned above, as well as by the economic development of the Czech Republic. In the last 15 years, the consumption of gas has been ranging from 8 to nearly 9.8 million cubic meters, peaking in 2001. The year 2009 saw a major drop in the consumption, attributed mainly to the economic recession, rising oil (and therefore also gas) prices and consumer's efforts to save energy (ERU, 2010). The indigenous production of gas is low and has been fairly constant over the past few years. It covers around 1 % of the national demand (ERU, 2010) and the Czech Republic is therefore almost completely dependent on gas imports. Historically, the Czech Republic took all of its imported gas from the former Soviet Union and stayed dependent on Russian gas even after the change of the regime. For a security of supply reasons, the Czech Republic decided to diversify its gas suppliers and in 1997 started to import gas from Norway (Petržilka, 2011). More diversification followed in the last quarter of 2007, when the first gas from Germany arrived in the Czech Republic (ERU, 2008). The supply from these three countries is primarily based on long-term take-or-pay contracts. These contracts pose a conflict with liberalization, because after the entry of new firms into the market, the incumbents may not be able to sell the amounts contracted and may be therefore subjected to fines by the seller. The long-term contracts are, however, for reasons discussed above, necessary for investments into the infrastructure and are therefore dealt with on the European level (Česká plynárenská unie, 2006).

Figure 4: Energy mix in the Czech Republic



Source: Based on BP, 2011

4.1 Legislation

The functioning of the Czech gas market is based primarily on the Act No. 458/2000 Coll., on conditions of the running of a business and state supervision in the power industry, amending selected acts of law, also called the Energy Act. Since 1 January 2001, when the Act entered into effect, eleven amendments have been passed in order to accommodate the Act to the developments in the legislation of the European Union. With the last amendment (No. 158/2009 Coll.), all Regulations and Directives of the First and Second Internal Energy Market Packages have been implemented into the national legislation. Despite its deadline in March 2011, the Third Internal Energy Market Package is yet to be implemented (Havel, 2009). Public notices relevant to the gas market include Public Notice No. 334/2009 Coll. of the Ministry of Industry and Trade, on states of emergency in the gas industry, Public Notice No. 365/2009 Coll. on gas market rules and Public Notice No. 251/2001 Coll. of the Ministry of Industry, laying down the operational rules of transmission system and distribution systems in the gas industry (RWE, 2010).

4.2 Opening of the demand side

As a new Member State acceding to the European Union in May 2004, the Czech Republic was exempted from the requirement of opening the gas market to all commercial customers by 1 January 2004. The new Member States were granted a

transition period until 31 December 2004, but the Czech Republic did not comply with this eased requirement either. The Czech Energy Regulatory Office (ERU, 2005) explains this by the lack of time to transpose the significantly faster timetable of market opening introduced in the Second Gas Directive into the national legislation. The 2004 amendment of the Energy Act included only the provisions of the First Gas Directive and therefore was not able to accommodate to such fast opening. On 1 January 2005, all customers annually consuming over 15 million cubic meters and all electricity generators using cogeneration became eligible customers. This opened about 25 % of the market (ERU, 2005). On 1 January 2006, all commercial customers became eligible. Their consumption together with the consumption of the already eligible customers amounted to over 70 % of total Czech consumption. The opening of the demand side of the gas market was finished on 1 January 2007, when all customers, including households, became eligible customers (ERU, 2007), fulfilling the European Union's requirement to completely open the market by 1 July 2007.

Table 1: Market opening in the Czech Republic

Year	Eligibility criteria (numeric values in mcm)	Market opening (in %)
2005	> 15	25
2006	all commercial customers	> 70
2007	all customers	100

Source: ERU 2005, 2007

4.3 Unbundling and structure of the industry

Until 1994, the gas industry was dominated by a state enterprise Český plynárenský podnik. In 1994, a transmission system operator and eight regional distribution system operators separated from the company. Later, the transmission system operator turned into a separate enterprise Transgas. In 2002 a German company RWE Gas International entered the market, acquiring controlling shares in Transgas and the eight regional distribution system operators (European Commission, 2005). The transmission system operator was unbundled in legal terms and in terms of management and partially accounts on 1 January 2006, creating a new company RWE Transgas Net (later renamed NET4GAS). Distribution system operators with more than 90 000 customers were unbundled in the same extent a year later, on 1 January 2007. All of the

eight distribution system operators formerly part of Český plynárenský podnik fell into this category, while all of the other (circa hundred) licensed distributors stayed unbundled (ERU, 2007). The accounts of the transmission and distribution system operators were fully unbundled in 2008 (ERU, 2009). Ownership unbundling has not been implemented yet. Currently, there are already more importers and suppliers than just RWE Transgas and they are all supervised by the Energy Regulatory Office.

4.4 Market players

In the wholesale market, the incumbent – RWE Transgas, a.s. – plays a dominant role. During the first year after the opening of the market for largest customers, no new company entered the market (ERU, 2006). The first new gas suppliers - Wingas GmbH (owned by a German company Wintershall together with a Russian undertaking Gazprom) and a Czech company Moravské naftové doly, a.s. - started to sell gas in the first half of 2006. Their significance was, however, negligible since they served only four customers at that time. Vemex, s.r.o. (a subsidiary of Gazprom Germania) entered the market at the end of 2006 (ERU, 2007) and during the following year significantly increased its influence, gaining customers mostly in the large offtake[3] category (ERU, 2008). Since 2008, the number of new market players has been increasing. The entrants started to focus not only on the largest customers but on the other categories as well. Vemex strengthened its position as the fastest growing new supplier but RWE Transgas maintained its dominant position (ERU 2009, 2010).

At the beginning of the liberalization, there were eight suppliers in the retail market, all formerly a part of the vertically integrated company. Six of the eight companies – Východočeská plynárenská, Jihomoravská plynárenská, Severomoravská plynárenská, Severočeská plynárenská, Západočeská plynárenská and Středočeská plynárenská – are controlled by the RWE Group. The last three merged in 2009 and created RWE Energie. Another German company, E.ON, has been gradually acquiring majority stakes in the two remaining incumbent companies. By 2007, Jihočeská plynárenská was completely bought by the E.ON group and became a part of the originally electricity-only company - E.ON Energie. The E.ON group also holds a majority stake in Pražská Plynárenská. They directly own 49.35 % of the company's

[3] Offtake - yearly volume of natural gas (either in cubic meters or MWh) withdrawn by the customer from the network.

shares and furthermore hold 49 % interest in Pražská plynárenská Holding who is a majority stakeholder in Pražská plynárenská (ERU, 2008; Pražská plynárenská, 2010). E.ON , however, does not control Pražská plynárenská (ERU, 2009). Even though eight companies operated in the retail market at the beginning of liberalization, there was no competition between them. They each supplied gas only in their respective region and rather than a competitive market, the retail market could have been described as eight small monopolies (ERU, 2006). These eight regional vertically unbundled companies were designated the gas suppliers of last resort, each within their respective service area (ERU, 2010). The emergence of competition in the retail market has been rather slow. Until 2008, no new company gained more than 5 % share of the market. In fact, in 2007 not even the sum of all market shares of the new suppliers exceeded this volume (ERU, 2008). The first company to break this threshold was Vemex in 2008 (ERU, 2009). The following year, the number of active suppliers sharply increased. Particularly successful were Bohemia Energy entity s.r.o., Pragoplyn, s.r.o. (100 % subsidiary of Pražská plynárenská), Lumius, s.r.o., United Energy Trading, a.s., Moravské naftové doly, a.s., Lama Investments, a.s. and ČEZ prodej, s.r.o. (ERU, 2010). The Slovak gas market incumbent Slovenský plynárenský priemysel successfully entered the Czech gas market through his subsidiary SPP CZ, a.s. in 2010.

4.5 Supplier switching

The growth of competition can be also demonstrated by the number of customers switching a supplier and by switching rate. The switching rate is defined as the number of supplier switches divided by the total number of offtake points in a given year. Markets with the switching rate larger than ten percent are considered to be fully liberalized (ERU, 2008). In 2006, only five customers changed their supplier (ERU, 2007). This number increased in the next year to 103, most of it falling into the large-offtake category. Switching ratio in this category was 3.8 % (ERU, 2008), while in the other ones still approached zero. In 2008, the changes of supplier occurred mostly in the low-offtake category, but in view of the total number of supply points in each category, the large customers remained most active in this respect, reaching a switching rate of 6.7 % (ERU, 2009). The following year saw a major jump in the number of households changing their supplier – from only 12 in 2007 and 2008 combined to 28 402 in 2009. The switching rates, however, remained low in comparison to the large-offtake category

(ERU, 2010). This could be explained by the existence of non-zero transaction costs of the switching of supplier that tend to pay off more when larger quantities of gas (and therefore money) are involved. The exact number of supplier switches and the values of switching rates are depicted in Table 2.

Table 2: Supplier switching in the Czech Republic

Category	2007		2008		2009	
	Number of changed offtake points	Switching rate (in %)	Number of changed offtake points	Switching rate (in %)	Number of changed offtake points	Switching rate (in %)
Large-offtake	100	3.8	128	6.7	152	8.7
Medium-offtake	2	0	84	1.2	267	4
Small-offtake	0	0	315	0.2	4 506	2.3
Households	1	0	11	0	28 402	1.1

* The figures do not include supplier switching for reasons caused by the suppliers themselves

Source: Balancing Centre in ERU 2009, 2010

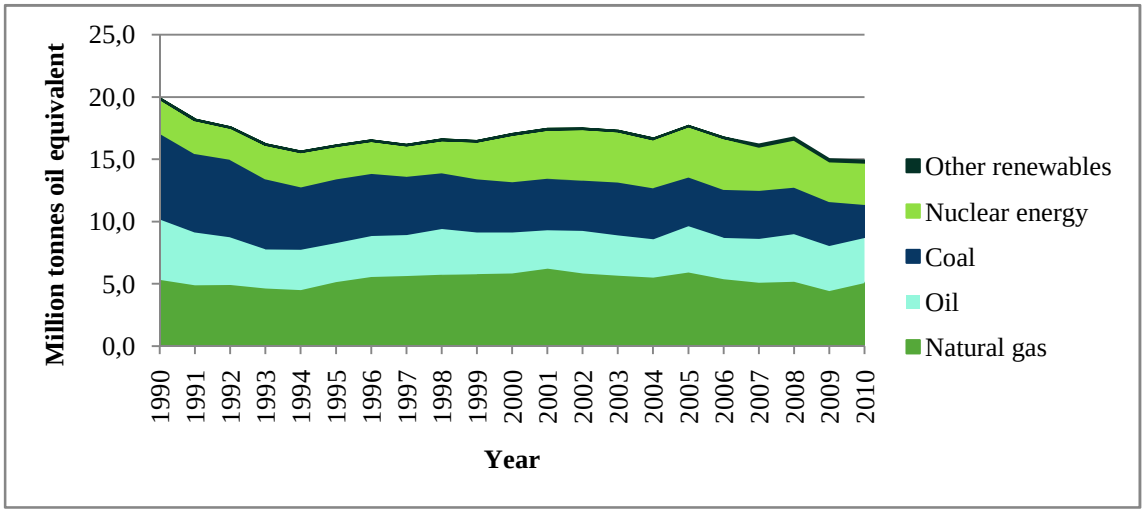
4.6 Price regulation

At the beginning of the liberalization process, the Energy Regulatory Office was responsible for regulating charges for transmission, distribution and line pack and also for the prices of supply to protected customers and of supplies of last resort. The prices of supply to eligible customers and charges for other means of storage than line pack were to be negotiated on the market (ERU, 2005). During the first year of the opening of the market, the Energy Regulatory Office received a number of complaints on the sharply increasing prices of gas and non-transparent policies of the suppliers. Based on these complaints and on an expectation that no new companies will enter the market in the near future, The Energy Regulatory Office decided to restore the regulation of supply and storage prices charged to eligible customers by RWE Transgas, a.s. and on supply prices of companies that buy gas from them (ERU, 2006). The regulation in form of price caps was in effect from January 2006 until 31 March 2007 (ERU, 2007). Since then, of the above-mentioned prices, only transmission and distribution charges have been regulated. In 2010 the price of services of a market operator became regulated (ERU, 2011). The regulated tariffs are issued by the Energy Regulatory Office each year with a possibility of adjusting them every three months.

5. Developments in the Slovakian gas market

The importance of natural gas in Slovakia is significantly higher than in the Czech Republic. The share of natural gas in the energy mix is in Slovakia not only larger than in the Czech Republic but it even noticeably exceeds the European Union's average. It has been increasing in the last twenty years, although not as significantly as in the case of the Czech Republic – from around 26 % in 1990 to 31.5 % in 2010 (BP, 2011). Since 1995, the yearly gas consumption has been fluctuating between 5.7 and 6.9 billion cubic meters with the exception of 2009 when the consumption dropped to 4.9 billion cubic meters. Since its peak in 2001, the demand has had a decreasing tendency that has only been changing in the last year. The Regulatory Office for Network Industries (RONI, 2007) explains this decreasing trend by savings measures that were adopted, increasing energy efficiency and also by switching to other sources of energy such as coal or wood due to rising prices of natural gas. The last reason, however, does not correspond with the data provided by BP suggesting the increasing share of gas in the energy mix. Indigenous production accounts for only about 2 % of the national consumption and it has been slightly decreasing in the last few years (RONI, 2009). Until 2009, Slovakia had been importing all of its gas from the Russian Federation through. This almost complete dependence caused severe problems during the gas crisis in January 2009. Slovakia therefore decided to diversify its natural gas supplies. The Slovakian incumbent company Slovenský plynárenský priemysel, a.s. in addition to prolonging long-term contracts with the Russian company of Gazprom Export signed in 2009 contracts with E.ON Ruhrgas and GDF Suez. Each of these two companies is supposed to supply about a tenth of the amount supplied by Gazprom, none of which needs to be transported through Ukraine (RONI, 2010).

Figure 5: Energy mix in Slovakia



Source: Based on BP, 2011

5.1 Legislation

The liberalization of Slovakian gas market is based on two acts - the Act on Regulation in Network Industries and the Energy Act. The Act on Regulation in Network Industries was passed in 2001 as Act No. 276/2001 Coll. It established the Regulatory Office for Network Industries and laid down new measures for regulating the network industries (RONI, 2005). The Act on Regulation in Network Industries has been amended several times in order to harmonize with the European Union's legislation. The 2007 amendment completely transposed the first two Gas Directives into the Slovakian legislation (RONI, 2007), but few more amendments followed, for the last time in 2010 (Legislatíva, 2011). In 2004 the Energy Act (Act No. 656/2004 Coll.) was passed. The European Commission (2005) claims that in Slovakia there were no efforts to promote competition prior to the accession to the European Union. The adoption of the Energy Act therefore accelerated the harmonization of the Slovakian legislation with the European One. The Energy Act was for the last time amended in 2010 by the Act No. 142/2010 Coll. (Legislatíva, 2011). The Energy Act and the Act on Regulation in Network Industries were complemented in 2007 by the Government Decree of the Slovak Republic No. 409/2007 Coll. laying down rules of gas market operation (Legislatíva, 2011), also called the Gas Market Rules. The Gas Market Rules mainly adjust and specify the provisions of the Energy Act (RONI, 2008) and were amended in 2010 (Legislatíva, 2011). The Third Internal Energy Market Package has

not been implemented yet. According to the spokeswoman of the minister of economy Daniela Piršelová, the Third Package should be transposed to the national legislation during fall 2011 and enter into force at the beginning of the following year (SITA and Havran, 2011).

5.2 Opening of the demand side

Unlike the Czech Republic, Slovakia complied with the European Union's requirements for opening the demand side of the gas market. The first group of customers, composed of customers consuming over 237 GWh per year, became eligible on 1 January 2004. This opened 33 % of the market (RONI, 2005). For the remaining commercial customers, Slovakia utilized the transition period granted by the European Union. They became eligible on 1 January 2005 and brought 73.52 % opening of the market (RONI, 2006). The Slovakian gas market became fully open on 1 July 2007, when households became eligible customers as well (RONI, 2008).

Table 3: Market opening in Slovakia

Year	Eligibility criteria (numeric values in GWh)	Market opening (in %)
2004	> 237	33
2005	all commercial customers	74
2007*	all customers	100

* since 1 July

Source: RONI 2005, 2006, 2008

5.3 Unbundling and structure of the industry

The Slovakian gas industry was historically a state monopoly. The incumbent company - Slovenský plynárenský priemysel, a.s. (hereafter SPP) was partially privatized in 2002 when 49 % of its shares were sold to Gaz de France and E.ON Ruhrgas. The remaining 51 % of the company stayed in possession of the state (Klepáč, 2001). Prior to the Energy Act, the Regulatory Office for Network Industries had issued joint license for transmission and distribution system operators. Since 2005, new licenses have been issued separately but SPP kept the combined one in the first years of liberalization (European Commission, 2005). The transmission and distribution system

operators were at that time unbundled only in terms of accounts and operation (RONI, 2005). The European Commission (2005) criticized the SPP's reluctant approach to full legal and functional unbundling but it also remarked that the Regulatory Office did not impose any pressure on the SPP to do so. The legal unbundling of SPP occurred on 1 January 2006. The transmission and distribution activities were separated from SPP and two new companies were created, SPP - preprava, a.s. (at the beginning of 2008 renamed to Eustream, a.s.) and SPP - distribúcia, a. s., both 100 % subsidiaries of SPP (RONI, 2008). The ownership unbundling has not been implemented yet (RONI, 2010).

5.4 Market players and supplier switching

Even thought the Slovak gas market opened in compliance with the timetable given by the European Union and for non-household customers even sooner than in some other new Member States, Slovenský plynárenský priemysel still strongly holds its monopoly position and the rise of competition is very slow, both in wholesale and retail market. During 2007 and 2008, the number of granted licenses mainly for gas supply and distribution had increased. The companies were, however, not active and no customers switched their supplier yet (RONI, 2005-2009). First competition appeared in the retail market in 2009 when RWE GAS Slovensko, s.r.o., Shell Slovakia, s.r.o., VNG Slovakia, s.r.o. and Lumius Slovakia, s.r.o. started to supply gas. They aimed only at commercial customers and gained together 45 customers from all non-household categories. The switching rate in the wholesale category reached 4.4 %; in other categories, the rate remained negligible. Despite the entry of new competitors into the market, SPP remained until the end of 2009 the only company with market share larger than 5 % (RONI, 2010). This changed in 2010, when RWE Gas Slovensko started to supply natural gas to some of the main industrial customers, especially the largest gas consumer in Slovakia - the chemical company Duslo (RWE Gas Slovensko, 2010). RWE Gas Slovensko was thus the first company to exceed the 5 % threshold.

Table 4: Supplier switching in Slovakia

Category	2009	
	Number of changed offtake points	Switching rate (in %)
Large-offtake	39	4.40
Medium-offtake	14	0.41
Small-offtake	5	0.01
Households	0	0

Source: RONI, 2010

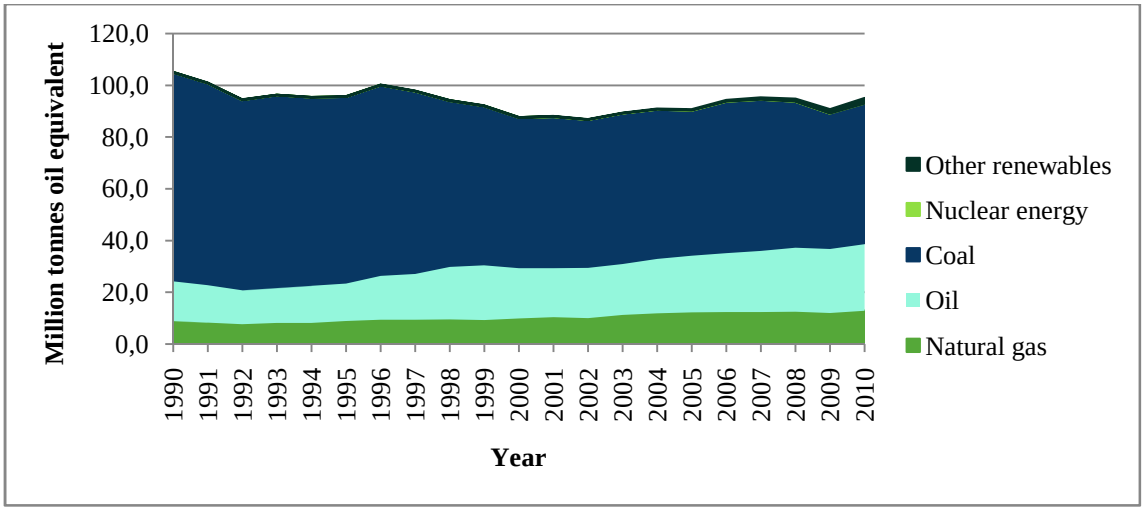
5.5 Price regulation

In the first years of the liberalization the Regulatory Office for Network Industries regulated the prices of connection to the network, access to the network, transmission and distribution. The charges for gas supply to households and for production of heat intended for the households, together with its distribution and supply were also regulated. The charges for supply to eligible customers other than the heat producers were to be negotiated in the market. The prices of gas production and storage were not regulated either (RONI 2005, 2006). A change in the price regulation occurred in 2007 when regulation of provision of ancillary services in gas sector was introduced. The prices of gas supply to households and to the heat producers remained regulated by the Regulatory Office even though the households became eligible customers at the beginning of the year. The charges for supply to households were regulated by the price cap method, which was supposed to serve as protection of the household customers (RONI, 2008). The prices of supply for households and for household heat production became deregulated in 2009 (RONI, 2010).

6. Developments in the Polish gas market

The role of natural gas in the Polish energy mix is very low compared to the average in the European Union. Its share is the lowest of the three countries described and has only been increasing slightly over the past twenty years - from 8.4 % in 1990 to 13.5 % in 2010 (BP, 2011). The low share of gas in the energy mix is caused predominantly by the extensive use of coal as a primary energy source (Pilch, 2011) but according to the Polish Energy Regulatory Office (URE, 2009) the significance of gas is likely to increase in the future, mainly due to its use for electricity generation, the expected growth of its use in combined cycle technology and also due to the growth of end user gas demand (URE, 2009). In the last fifteen years, the total consumption of gas has ranged from 10 to 14.3 billion cubic meters and has been steadily increasing with the exception of 1999 and 2009 when it dropped slightly (BP, 2011). The Polish Energy Regulatory Office (URE, 2010) explains the 2009 drop by a lower gas demand by main industrial customers. As the drop of consumption in 2009 is common to all three countries described, it could be concluded that the economic crisis played a role in this development. The indigenous production of natural gas in Poland fluctuates around 30 % of national demand (BP, 2011). The remaining amount is covered by gas storage and imports. The largest part of the imports is secured by long-term contracts with Russia. Until 2008, Russian gas covered up to 70 % of the imports. This number jumped to 89 % in 2009. The remaining amount is covered by gas supply based on short- and medium-term contracts from central Asian countries (in 2004/2005 mainly Uzbekistan, in 2008/2009 mainly Turkmenistan), Germany and Ukraine (since 2007). Small amounts of gas are imported from the Czech Republic and until fall 2006 gas imports were coming from Norway as well (URE, 2005-2010).

Figure 6: Energy mix in Poland



Source: Based on BP, 2011

6.1 Legislation

The functioning of the Polish gas market is based on the act of 10 April 1997 – The Energy Law Act. The adoption of this Act was one of the major steps in the transformation from command to market economy. The Energy Law Act introduced basic rules of operating the market and established its regulator – The President of the Energy Regulatory Office (URE, 2007). The Act has been amended many times since it came into effect. The amendment of 4 March 2005 fully transposed the second Gas Directive into the national legislation (URE, 2006). The implementation of the Third Internal Energy Market Package is already in progress (The Warsaw Voice, 2011) but has been criticized for its execution. The criticism aims at the excessive regulation of nearly all segments of the market and the methods of regulation that do not lead to promotion of competition (Kaminski, 2011).

6.2 Opening of the demand side

Poland started with opening the demand side of the gas market relatively early. The largest industrial customers (with yearly consumption over 25 million cubic meters) were allowed to choose their supplier already in 2001. The group of eligible customers was enlarged three years later when the market opened for customers consuming over 15 million cubic meters per year, bringing 31.9 % market opening. At the beginning of 2005, all commercial customers became eligible thus opening 72 % of the market

(URE, 2005). The market became fully open on 1 July 2007 when households became eligible customers as well (URE, 2008).

Table 5: Market opening in Poland

Year	Eligibility criteria (numeric values in mcm)	Market opening (in %)
2001	> 25	
2004	> 15	31.9
2005	all commercial customers	72
2007*	all customers	100

* since 1 July

Source: URE 2005, 2006, 2008

6.3 Unbundling and structure of the industry

Historically, the Polish gas industry had a form of a monopoly. The incumbent company Polskie Górnictwo Naftowe i Gazownictwo S.A. (abbreviated as PGNiG S.A.) held a dominant position in all segments of the gas industry and was fully owned by the state. In 1996 the company became a joint stock company (PGNiG, 2009). PGNiG S.A. has been gradually privatized; at the end of the year 2010, the State Treasury held 72.44 % of the company's shares (PGNiG, 2011). On 16 April 2004 PGNiG S.A. established its subsidiary PGNiG-Przesył Sp. z o.o. that was supposed to deal with transmission. In April 2005 the parent company donated all of the shares of PGNiG-Przesył Sp. z o.o. to the Ministry of State Treasury. At the beginning of June 2005 the company was renamed to Operator Gazociągów Przesyłowych Gaz-System Sp. z o.o. and on 1 July 2005 became a transmission system operator (EC, 2005). The transmission system operator is thus unbundled both legally and in terms of ownership and is therefore completely independent of the companies operating in other segments of the industry (URE, 2007). The process of unbundling the distribution system operators has been slower than in the case of the transmissions system operator. In 2003, PGNiG S.A. established six subsidiaries to deal with distribution (URE, 2005). A fist step to their unbundling was a separate auditing introduced in 2005 (URE, 2006). During the following year, the distribution companies became unbundled in terms of accounts, organization and functioning, and were appointed distribution system operators at the end of the year. All distribution system operators that serve yearly more

than 100 000 customers and sell over 100 million cubic meters of gas are required to be legally unbundled by 1 July 2007 (URE, 2007). This rule only applied in the six companies from the PGNiG Capital Group but another company G.EN. Gaz Energia S.A. has recently exceeded the thresholds and is therefore preparing for legal unbundling (Szymczak, 2011).

6.4 Market players and supplier switching

The Polish gas market is strongly concentrated with the companies of the PGNiG Capital Group enjoying a dominant position in nearly all segments of the market. The wholesale market is controlled by PGNiG S.A.; other entities only serve about 2 % of the market. Moreover, a lot of these companies purchase their gas from PGNiG S.A.. The strong position of the incumbent is secured especially by the lack of existence of other significant importers and domestic producers. PGNiG also owns all of the Polish gas storage capacities URE, 2010). The PGNiG Capital Group holds a dominant position in the retail market as well. Until July 2007, in the retail the group was market represented by PGNiG S.A. and the six distribution companies – Greater Poland Gas Company, Pomeranian Gas Company, Mazovian Gas Company, Lower Silesian Gas Company, Upper Silesian Gas Company and Carphatian Gas Company (URE, 2007). As their names suggest, these distribution companies operated on the basis of regions in which they basically had a monopoly power (URE, 2006). After the legal unbundling of distribution system operators on 1 June 2007, the regional distribution companies became distribution system operators and all of the activities connected with gas trading were transferred to PGNiG S.A. (URE, 2008). There are several other companies in the retail market for natural gas but their cumulative share of the market is only about 2 %. A majority of these companies combine the trade and distribution activities and resell gas purchased from PGNiG S.A. (URE, 2010). The largest of the alternative entities active in the market is G.EN Gaz Energia S.A., who has (as mentioned before) recently exceeded the threshold of yearly sales of 100 million cubic meters and will therefore soon separate its distribution and trade activities (Szymczak, 2011). Other active companies include ENESTA S.A., KRI S.A. and CP Energia S.A. (who merged in 2011) and EWE energia SP. z o.o. (URE, 2010; Szymczak, 2011). Despite the presence and activity of the companies outside of the PGNiG Capital Group in the market, until mid June 2011 no customer had switched

their gas supplier nor concluded a separate contract for gas supply and gas transportation (Kaminski, 2011).

6.5 Price regulation

In Poland, gas prices for all customers are regulated by the President of Energy Regulatory Office. The Energy Regulatory Office views this as necessary because the market does not have a competitive structure (URE, 2008). The European Commission, however, does not share this opinion. They (as quoted in Whitehead, 2011) said that "end-user prices set by state intervention put obstacles to new market entrants and therefore deprive consumers and companies of their right to choose the best service on the market." In April 2011, the European Commission sent Poland a reasoned opinion demanding the removal of majority of the regulated tariffs in order to comply with the current European legislation that only allows regulated prices to protect vulnerable customers (Whitehead, 2011).

7. Analysis of the Czech, Slovak and Polish gas market

7.1 Market concentration

The aim of this section is to assess the emergence of competition in the Czech, Slovak and Polish gas markets. To achieve this, the Herfindahl-Hirschman index will be used to calculate the market concentration in the three countries for each year since 2004 – the year in which the opening of the markets started. This index of concentration was for the first time used by Albert O. Hirschman in 1945 in his book *National power and the structure of foreign trade* and was five years later reinvented by Orris C. Herfindahl in his unpublished doctoral dissertation *Concentration in the U.S. steel industry* (Hirschman, 1964). The now so-called Herfindahl-Hirschman index is calculated as a sum of squared market shares of all companies, that is

$$HHI = \sum_{i=1}^{n} (s_i)^2 ,$$

where n is the number of companies in the market and s_i is the market share of company i. The Herfindahl-Hirschman index can assume value from 0 to 10 000. The upper value corresponds to a monopoly market; in perfectly competitive markets, the index approaches zero.

In the following calculations, the market share of a company does not represent its share on the amount of natural gas that has been consumed by customers but it represents the share of the company on total natural gas sales. A reason for this is that the total amounts of gas sold do not always correspond to the amounts consumed by the customers. In some years, the total sales of gas amounted to more than 100 % of the consumption (up to circa 110 %). Such a difference may be caused by the large industrial customers whose gas purchases are sometimes based on take-or-pay contracts. These contracts oblige them to pay for a certain amount of gas, no matter they use it or not. It is possible that the amounts that were not consumed but were paid for are counted by the suppliers as gas sold, while they do not appear in the consumption statistics. Some of the largest customers and gas-fired power generators may also have their own storage facilities and therefore do not have to consume all the gas they

purchase. In some instances, the total sales were, however, not larger but lower than the consumption. This may be again caused by the existence of private storage facilities, from which the gas can be withdrawn. Some of the divergences may also be caused by different techniques of measurement or different coefficients used to convert cubic meters to kilowatt-hours, specification of which is often neglected in the data sources.

The data on the amounts of gas sold by the firms were obtained from their annual reports, websites and from email communication with their representatives. Additional information on market shares and the number of companies active in the markets was acquired from the national reports issued by the regulatory offices of the three countries. Missing information was filled in from newspaper articles and from gas-related websites. A complete list of data sources will be provided at the end of the work. It was, however, not feasible to obtain information about gas sales from some of the smaller companies (for their overview see the appendices). Some of them specifically stated that they do not disclose such information; others did not respond to inquiries. For this reason, in some years it was not possible to directly see the total amounts of gas sold. The total amounts had to be calculated from the data on volumes sold that had been released by some of the companies and their respective known market shares. In several cases, averaging had to be used, because the results varied according to the company on whose sales the calculation was based. From the total amounts of gas sold, market shares of companies with known sales volumes were calculated. An advantage of the Herfindahl-Hirschman index is that it can be used even without knowledge of the market shares of some of the smaller companies. In this case, Hirschman (1980) in his book *National power and the structure of foreign trade* (a later edition of the 1945 book in which he introduced the now so-called Herfindahl-Hirschman index) suggests calculating the upper and lower limit of the index. The upper limit corresponds to a situation when the market share remaining after the known market shares are deducted from a unit belongs to one firm. In that case, the Herfindahl-Hirschman index is calculated as

$$HHI = \sum_{i=1}^{n} (s_i)^2 + p^2 \,,$$

where n is the number of companies with known market shares, s_i is the market share of company i and p is the remaining market share. The lower limit corresponds to a

situation when the remaining market share is equally divided among all the firms whose market shares are not known. In such a situation the Herfindahl-Hirschman index is calculated as

$$HHI = \sum_{i=1}^{n} (s_i)^2 + m\left(\frac{p}{m}\right)^2,$$

where n is the number of companies with known market shares, s_i is the market share of company i, p is the remaining market share and m is the number of the companies with unknown shares. This method was used to calculate the indices of the Czech, Slovak and Polish gas market. To obtain one value for each year and country, the average of the upper and lower limit was calculated.

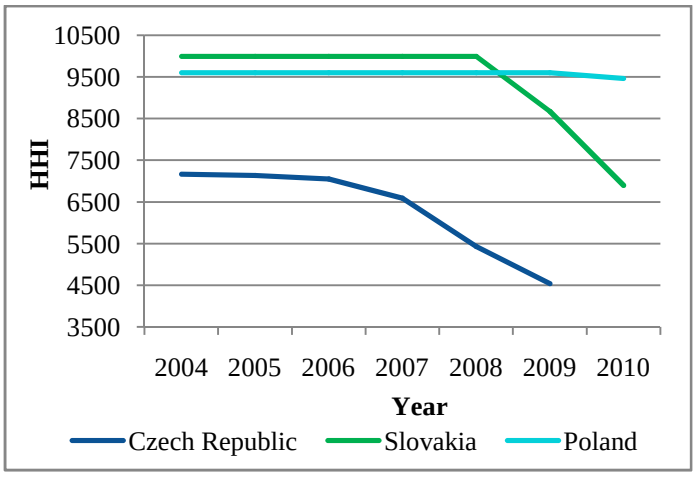
The numbers of companies active in each market were acquired mainly from the national reports. In case of Poland, the data from the national reports had to be, however, extensively supplemented by data from other sources, because the Polish Energy Regulatory Office was not consistent and very thorough in describing the market in their reports. It should also be noted that for the index of the Czech Republic, the market shares of all companies of the RWE Group were combined. The same was done with market shares of Pražská plynárenská and its 100 % subsidiary Pragoplyn. Pražská plynárenská was, however, not combined with E.ON, even though they hold a majority stake in the company, because E.ON does not control it.

The results of the Herfindahl-Hirschman index are shown in Table 6 and Figure 7. For market shares of individual companies and for the upper and lower limits of the Herfindahl-Hirschman index see the appendices.

Table 6: Herfindahl-Hirschman index

	Czech Republic	Slovakia	Poland
2004	7167	10000	9606
2005	7136	10000	9606
2006	7055	10000	9606
2007	6591	10000	9605
2008	5434	10000	9605
2009	4538	8670	9605
2010	n.a.	6898	9470

Figure 7: Herfindahl-Hirschman index



The United States Department of Justice (1997), who uses the Herfindahl-Hirschman index to assess horizontal mergers, considers all markets with the index above 1800 to be highly concentrated. According to this scale, all of the examined markets are clearly very concentrated. To assess the increase of competition in the markets, it is, however, more important to look at the development of the index rather than at its actual value.

A significant progress can be seen in the Czech Republic, where the market concentration has been steadily decreasing over the whole period examined. It was not possible to calculate the Herfindahl-Hirschman index for the year 2010, because one of the incumbent companies had not released the previous year's data by the time of

finishing this thesis. Using the method of calculation of the index described above without information on one of the largest companies would have distorted the results and shifted them far more towards perfect competition than where they really lie. Based on the available data, it can be, however, concluded, that the market concentration continued to decrease, even under a sharper pace. The sales of majority of the new market players have increased noticeably in the last year. The sales of the most successful new supplier - Vemex, s.r.o. - came close to the sales of the third largest market player and even exceeded the 2009 sales of one of the incumbents. Based on the results it can be concluded that the Czech Republic is in a fair way to a truly competitive gas market, especially in the segment of large industrial and commercial customers.

The results of the Herfindahl-Hirschman index in Slovakia show that their market had been truly monopolistic until the end of 2008. After the first new companies started to sell gas in 2009, the market concentration significantly dropped and the fast decrease continued in 2010. The value of the index falls in Slovakia at a faster pace than in the Czech Republic and it can be predicted that Slovakia will catch up with the Czech Republic in terms of the extent of competition in the next few years. This year several new suppliers have already entered the market. Some of them are subsidiaries of companies successful in gas markets in other European countries and it can be therefore assumed that they will do well in acquiring new customers in the Slovakian market as well.

Unlike in the first two countries, the market concentration in Poland has been fairly constant in the past years. The results of the Herfindahl-Hirschman index show a slight decrease in 2010 but since no supplier switching has occurred so far, this drop is likely to be caused by the different source of the used data. As the index shows, the Polish gas market is not a complete monopoly. Several companies have been operating in the market for many years but they only have a few stable customers and have not been noticeably influenced by the opening of the market. The reason behind this may be the regulated prices that do not attract the alternative companies, because they do not allow them to compete for new customers effectively.

7.2 Effects of liberalization on the prices of natural gas

To further examine the markets, it would be interesting to analyze the effects of liberalization on natural gas prices numerically, for both households and industries. The intention was to run regressions with the price of gas as a dependent variable and the various indicators of liberalization along with prices of heating oils as independent variables. From the indicators of liberalization, the focus was supposed to predominantly lie on the extent of market openness and the Herfindahl-Hirschman index. The results of such regressions have, however, proved very insignificant. There are several reasons for this. One of them is that there are many factors that influence the prices of natural gas and the regressors would have only covered a small portion of them. A more severe problem was, however, the extent of the available data. It is not possible to obtain the prices of natural gas on a monthly basis. The prices for industrial customers are subject to a trade secret and are only made available in yearly or semiyearly aggregated statistics. The prices for households have been based on published tariffs for a majority of the period under examination. These tariffs only change few times a year at most and therefore, similarly to the prices for industrial customers, do not provide sufficient data variation. Moreover, these prices are assumed to be less reflective of the changes in the markets due to their long-time regulation and the decision-making processes within the gas companies. The independent variables, except for the prices of heating oils, have proved problematic as well. Similarly to the gas prices, they are available on yearly basis. The volumes of gas sold, that are used for calculation of the Herfindahl-Hirschman index, often fall under the trade secret as well and companies only publish them annually, if at all.

This annual character of the data is a problem especially because the liberalization started in the three countries examined only about seven years ago. Regression based on such a low number of observations cannot give meaningful and statistically significant results. It could be therefore said that it is too early to make conclusions on the impact of the liberalization on the natural gas prices. There is, however, scope for future research on this topic. Current negotiations with some of the incumbents of the three countries discussed above could lead to obtaining monthly data for a reasonable part of particular markets, which would open the door for an extensive

empirical analysis. While it is necessary to take into account that such an approach will always be only a proxy for the true market dynamics description, it can still provide interesting results. This analysis is likely to be a key part of the author's upcoming master thesis.

Conclusion

The aim of this thesis was to describe and compare the liberalization processes in some of the Central and Eastern European countries, whose gas market developments have not yet been sufficiently covered in the literature. The three countries – the Czech Republic, Slovakia and Poland – were chosen because of the proximity of their own not only geographical but historical as well.

Even though these three countries have undergone a similar historical development and their economies were comparable at the beginning of the gas market liberalization, their progress in liberalizing the market has varied substantially. Poland was the first of these countries to introduce new policies focusing on shifting the market towards competition. They started with the opening of the demand side three years before Slovakia and even four years before the Czech Republic. Their progressive steps have had, however, only a small influence on the structure of Polish market. On the other hand, the Czech Republic was late in the implementation of some parts of the European Union's legislation and even received formal warnings, but has been in the liberalization of the gas market far more successful than the two remaining countries.

The Czech Republic is the country in which the largest number of new gas traders has entered the market to good effect. They were successful not only in the industrial sector, where the switching rate reached 8.7 % in 2009, but also in the small commercial and household sector. In the Czech Republic, a clear pattern of new companies increasing their market shares and incumbents loosing customers can be observed. In Slovakia, the new competitors emerged later than in the Czech Republic. Until the end of 2008, the market was fully monopolistic, but since 2009 customers (mainly from the large industrial sector) have been switching their suppliers and the market shares of the new competitors have been quickly increasing. The same cannot be said about Poland. Despite their early opening of the market and the presence of some small companies in the market since the beginning of the liberalization process, the market structure has remained virtually the same over the past six years.

The developments in the markets were assessed based on the Herfindahl-Hirschman index. The calculation of this index confirmed that the Czech Republic is out

of the three countries the furthest in introducing competition. The market concentration based on this index dropped between 2004 and 2009 from 7167 to 4538. While the final value is still considered to represent a highly concentrated market, the improvement is evident. In agreement with the existence of a monopoly in the Slovak gas market until the beginning of 2009, the value of the Herfindahl-Hirschman index was equal to 10 000 between 2004 and 2008. After the entry of four new companies into the market, the market concentration fell to 8670 in 2009 and to 6898 only a year later. The competition has occurred, however, so far mainly in the commercial, especially large industrial, sector. Many of the alternative companies do not offer gas to household customers yet. Unlike in the first two countries, there was practically no development in the Polish gas market. The market concentration had been until 2009 stable at the level of little over 9600. The calculated Herfindahl-Hirschman index has decreased in the last year to 9470 but since no customers have switched their supplier so far, this difference is likely to be caused by a different source of data.

Based on the results of the Herfindahl-Hirschman index, it can be concluded that even though the Czech Republic has so far made the largest progress in introducing the competition, the pace of decreasing the market concentration is faster in Slovakia. It is therefore likely, that Slovakia will soon catch up with the Czech Republic and possibly even exceed it in terms of the extent of competition in the market. The future development of the Polish gas market is uncertain but the competition is likely to remain limited as long as the price regulations are in place.

Because of the short history of liberalization in the three countries and the annual character of the available data, it was not possible to obtain statistically significant results about the effects of the liberalization on natural gas prices. This, however, leaves scope for future research. Negotiations with some of the incumbents about the availability of their monthly prices are underway. If they are successful, they will allow for an extensive empirical analysis of the topic in the future.

Bibliography

Bachanová, V. (2006, June). *Regulace a deregulace v ČR v období 1990-2005*. (Working paper no. 6/2006). Research Centre for Competitiveness of Czech Economy, Brno. Available from: <http://is.muni.cz/do/1456/soubory/oddeleni/centrum/papers/wp2006-06.pdf> [Accessed: 12 May 2010].

BP (2011). *BP Statistical Review of World Energy June 2011 - Workbook*. London: BP. Available from: <http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/spreadsheets/statistical_review_of_world_energy_full_report_2011.xls> [Accessed 12th June 2011].

Cremer, H. Gasmi, F. Grimaud, A. and Laffont, J.-J. (1998). *The economics of universal service: Theory*. Washington, DC: The Economic Development Institute of World Bank. Available from: <http://info.worldbank.org/etools/docs/library/64602/theory.pdf> [Accessed 15 February 2011].

Cretì, A. and Villeneuve, B. (2004). Longterm contracts and take-or-pay clauses in natural gas markets. *Energy Studies Review* [online]. 13(1), p.75-94. Available from: <http://digitalcommons.mcmaster.ca/esr/vol13/iss1/1/> [Accessed 7 July 2011].

Cretì, A. (2009). Gas storage in Europe: Toward a market-oriented approach. *In*: Cretì, A., (ed). *The economics of natural gas storage: A European perspective*, Berlin: Springer, pp.1-12.

Cronshaw, I. et al. (2008). *Development of competitive gas trading in continental Europe: How to achieve workable competition in European gas markets?*. Paris: International Energy Agency. Available from: <http://www.iea.org/papers/2008/gas_trading.pdf> [Accessed 12 June 2011].

Česká plynárenská unie (2006). *Zemní plyn pro Českou Republiku*. Prague. Available from: <http://www.cpu.cz/data/articles/down_119.pdf> [Accessed 6 June 2011].

Dušek, L. (1998). Politická ekonomie 3/1998 Ekonomická teorie regulace a konkurence v energetických sítích. *Politická ekonomie*. 3, pp.400-411.

Egging, R. and Gabriel, S. (2006). Examining market power in the European natural gas market. *Energy Policy* [online]. 34, p.2762-2778. Available from: <http://www.sciencedirect.com/science/article/pii/S0301421505001242> [Accessed 24 October 2010].

Eikeland, P. O. (2011). The Third Internal Energy Market Package: New Power Relations among Member States, EU Institutions and Non-state Actors?. *Journal of Common Market Studies* [online]. 49 (2), p.243–263. Available from: <http://onlinelibrary.wiley.com/doi/10.1111/j.1468-5965.2010.02140.x/abstract> [Accessed 2 July 2011].

ERU (2005). *The Czech Republic's National Report on the Electricity and Gas Industries for 2004*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005> [Accessed 3 June 2011].

ERU (2006). *The Czech Republic's National Report on the Electricity and Gas Industries for 2005*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_En/E06_NR_CzechRep-EN.doc> [Accessed 3 June 2011].

ERU (2007). *The Czech Republic's National Report on the Electricity and Gas Industries for 2006*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_CzechRepublic-EN.doc> [Accessed 3 June 2011].

ERU (2008). *The Czech Republic's National Report on the Electricity and Gas Industries for 2007*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National reporting 2008/NR_En/E08_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

ERU (2009). *The Czech Republic's National Report on the Electricity and Gas Industries for 2008*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%22Reporting%202009/NR_En/E09_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

ERU (2010). *The Czech Republic's National Report on the Electricity and Gas Industries for 2009*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National Reporting 2010/NR_En/E10_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

ERU (2011). *Zpráva o činnosti a hospodaření Energetického regulačního úřadu za rok 2010*. Jihlava. Available from: <http://eru.cz/user_data/files/vyrocni zpravy/VZ_ERU_2010_CZ.pdf> [Accessed 12 July 2011].

Eurogas (2011). *Activity report 2010*. Brussels. Available from: <http://www.eurogas.org/uploaded/EUROGAS Activity Rapport 2010 final.pdf> [Accessed 5 July 2011].

European Commission (2005). *EC - Unbundling of electricity and gas transmission and distribution system operators - Annexes - Country overview*. Brussels and London. Available from: <http://ec.europa.eu/energy/gas_electricity/studies/doc/electricity/2006_03_unbundling_electricity_gas_annex.pdf> [Accessed 1 November 2010].

European Commission (2011). *Energy: Electricity* [online]. Available from: <http://ec.europa.eu/energy/gas_electricity/legislation/legislation_en.htm> [Accessed 2 July 2011].

European Union (2009a). *Natural gas transmission networks (from 2011)* [online]. Available from: <http://europa.eu/legislation_summaries/energy/internal_energy_market/en0015_en.htm> [Accessed 1 July 2011].

European Union (2009b). *Internal market in gas (from March 2011)* [online]. Available from: <http://europa.eu/legislation_summaries/energy/internal_energy_market/en0017_en.htm> [Accessed 1 July 2011].

Geradin, D. (2006). *Twenty years of liberalization of network industries in the European Union: Where do we go now?*. Tilburg: Tilburg University. Available from: <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=946796> [Accessed 11 October 2010].

Haase, N. (2009). *European Gas Market Liberalisation: Competition versus security of supply?*. PhD thesis, University of Twente. Available from: <http://doc.utwente.nl/61558/1/thesis_N_Haase.pdf> [Accessed 28 October 2010].

Havel, L. (2009). *K novele energetického zákona - 158/2009 Sb.* [online]. Available from: <http://www.tzb-info.cz/energetika/5887-k-novele-energetickeho-zakona-158-2009-sb> [Accessed 9 July 2011].

Havris, C. (2009). Competition and regulation in the EU energy market. *Romanian Journal of European Affairs* [online]. 9(4), p.18-28. Available from: <http://www.ier.ro/documente/rjea_vol9_no4/RJEA_2009_vol._9_no_4_Competition_and_Regulation_in_the_EU_Energy_Market_.pdf> [Accessed 3 November 2010].

Hirschhausen, C. Neumann A. and Rüster, R. (2007). *Competition in natural gas transportation? Technical and economic fundamentals and an application to Germany* . (Globalization of natural gas markets working papers 21b). Dresden University of Technology, Dresden. Available from: <http://www.tu-dresden.de/wwbwleeg/publications/wp_gg_21b_hirschausen_et_al_2007_competition_natural_gas_transportation_EFET.pdf> [Accessed July 6, 2011].

Hirschman, A. O. (1964). The paternity of an index. *The American Economic Review* [online]. 54 (5), pp.761-762. Available from: <http://www.jstor.org/stable/1818582> [Accessed 22 July 2011].

Hirschman, A. O. (1980). *National power and the structure of foreign trade*. 2nd. ed. Berkeley: University of California Press.

International Energy Agency (2009). Natural gas market review 2009. Paris: OECD/IEA. Available from: <http://www.oecd-ilibrary.org/energy/natural-gas-market-review-2009_nat_gas_rev-2009-en> [Accessed 6 July 2011].

Kaderják, P. Cameron, P. and Tóth A. I. (2007). Unilateral natural gas import dependence: a new supply security issue for Europe. *European Review of Energy Markets* [online]. 2(2). Available from: <http://www.eeinstitute.org/european-review-of-energy-market/erem5-article-kaderjak> [Accessed 4 July 2011].

Kahn, A. (1988). *The economics of regulation: Principles and Institutions*. Cambridge, MA: MIT Press.

Kaminski, M. (2011). Implementation of the EU III Energy Package in Poland. *In: 4th Central European Gas Congress*, 15-17 June, 2011, Budapest. Available from: <http://www.gazkonferencia.eu/dl/share/mp_gk_Kaminsky_Marek_ENG.pdf> [Accessed 14 July 2011].

Klepáč, J. (2010). Security of natural gas supply in Central Europe - Case study: Slovakia. *In: World Energy Congress*, 11-16 September 2010, Montréal. Available from: <http://www.worldenergy.org/documents/congresspapers/338.pdf> [Accessed 14 June 2011].

Legislatíva (2011) [online]. Available from: <http://www.energoforum.sk/sk/energetika/legislativa> [Accessed 14 July 2011].

Mejstřík, M. (2004). *Privatizace, regulace a deregulace utilit v EU a ČR: očekávání a fakta*. (Working paper no. 57). Institut ekonomieckých studií, Prague. Available from: <http://ies.fsv.cuni.cz/default/file/download/id/1320> [Accessed 3 November 2010].

Neuhoff, K. and Hirschhausen, C. (2005). *Long-term vs. short-term contracts: A European perspective on natural gas*. (Cambridge working papers in economics 0539). University of Cambridge, Cambridge. Available from: <http://www.dspace.cam.ac.uk/bitstream/1810/131595/1/eprg0505.pdf> [Accessed 7 July 2011].

OECD (2000). *Promoting competition in the natural gas industry*. Available from: <http://www.oecd.org/dataoecd/34/23/1920080.pdf> [Accessed 15 May 2011].

Petržilka, O. (2011). Gas Market in the Czech Republic. *In: 4th Central European Gas Congress*, 15-17 June, 2011, Budapest. Available from: <http://www.gazkonferencia.eu/dl/share/mp_gk_Petrzilka_Oldrich_ENG.pdf> [Accessed 8 July 2011].

Pilch, B. (2011). Prospects of using the natural gas in production of electricity in Poland. *In: 4th Central European Gas Congress*, 15-17 June, 2011, Budapest. Available from: <http://www.gazkonferencia.eu/dl/share/mp_gk_Pilch_Bogdan_2_ENG.pdf> [Accessed 14 July 2011].

Polo, M. and Scarpa, C. (2003). *The liberalization of energy markets in Europe and Italy*. (Working Paper n. 230). Innocenzo Gasparini Institute for Economic Research - Università Bocconi, Milano. Available from: <ftp://ftp.igier.uni-bocconi.it/wp/2003/230.pdf> [Accessed 3rd November 2010].

Polskie Górnictwo Naftowe i Gazownictwo (2009). *Polish Oil and Gas Company (PGNiG) is a leader in the natural gas market in Poland* [online]. Available from: <http://www.pgnig.pl/pgnig/216> [Accessed 19 July 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2011). *Annual report 2010*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=25054> [Accessed 19 July 2011].

Pražská plynárenská (2010). *Výroční zpráva 2009*. Prague. Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2009.pdf> [Accessed 10 March 2011].

RONI (2005). *National regulators' annual report to the European Commission*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005/NR/E05-REP-01-03V_NATIONAL REPORTS_QU-SK.DOC> [Accessed 12 July 2011].

RONI (2006). *National report 2006*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_En/E06_NR_Slovakia-EN.doc> [Accessed 12 July 2011].

RONI (2007). *National report 2007*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_Slovakia-EN_V2.doc> [Accessed 12 July 2011].

RONI (2008). *National report 2008*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20reporting%202008/NR_En/E08_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RONI (2009). *National report 2009*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202009/NR_En/E09_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RONI (2010). *National report 2010*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202010/NR_En/E10_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RWE (2010). *Přehled platné legislativy* [online]. Available from: <http://www.rwe.cz/cs/legislativa/> [Accessed 9 July 2011].

RWE Gas Slovensko (2010). *RWE Gas Slovensko získala 25% tržní podíl v segmentu velkých průmyslových zákazníků*. Press release, issued 17 March 2010. Available from: <http://www.rwe.cz/cs/tiskove-zpravy-4456/> [Accessed 25 July 2011].

Samuelson, P. and Nordhaus, W. (1995). *Ekonomie*. Translated from English by Mejstřík, M. et al. Praha: Nakladatelství Svoboda.

SITA and Havran, M. (2011). Tretí energetický balíček implementujú do konca roka. *24hod.sk* [online], Available from: <http://www.24hod.sk/treti-energeticky-balicek-implementuju-do-konca-roka-cl165125.html> [Accessed 14 July 2011].

Stern, J. (2002). *Security of European Natural Gas Supplies: The Impact of Import Dependence and Liberalization*. London: Royal Institute of International Affairs. Available from: <http://kms1.isn.ethz.ch/serviceengine/Files/ISN/99313/ipublicationdocument_singledocument/315574fd-888e-40f0-9061-32337aa1b236/en/3035_sec_of_euro_gas_jul02[1].pdf> [Accessed 4 July 2011].

Swartenbroekx, C. (2007). *The gas chain : influence of its specificities on the liberalisation process*. (122). National Bank of Belgium, Brussels. Available from: <http://aei.pitt.edu/11014/1/wp122En.pdf> [Accessed 17 February 2011].

Szymczak, M. (2011). *Annual reports*. Email to: B. Mirková. 13 July 2011, 15:36. Personal communication.

The Natural Gas Supply Association (2010). *Uses of natural gas* [online]. Available from: <http://naturalgas.org/overview/uses.asp> [Accessed 24 July 2011].

The United States Department of Justice (1997). *Horizontal Merger Guidelines*. Washington, DC. Available from: <http://www.justice.gov/atr/public/guidelines/hmg.pdf> [Accessed 22 July 2011].

The Warsaw Voice (2011). *Polish energy law compliant with EU Directives - EconMin* [online]. Available from: <http://www.warsawvoice.pl/WVpage/pages/article.php/16308/news> [Accessed 18 July 2011].

Thomas, S. (2005). *The European Union gas and electricity directives*. (Discussion Paper). PSIRU - University of Greenwich, London. Available from: <http://www.psiru.org/reports/2005-10-E-EUDirective.pdf> [Accessed 25 June 2011].

URE (2005). *Annual report to the European Commission*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005/NR/E05-REP-01-03T_NATIONAL REPORTS_QU-PL.PDF> [Accessed 16 July 2011].

URE (2006). *Annual report to the European Commission 2006*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_nl/E06_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2007). *National report 2007*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_Poland-EN_V2.doc> [Accessed 16 July 2011].

URE (2008). *National report 2008*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20reporting%202008/NR_En/E08_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2009). *National report 2009*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202009/NR_En/E09_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2010). *National report to the European Commission 2010*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202010/NR_En/E10_NR_Poland-EN.pdf> [Accessed 16 July 2011].

Weale, G. and Omahony, G. (2001). *Report of the European Commission Directorate General for Transport and Energy to determine changes after the opening of the Gas Market in August 2000 – Volume I: European Overview*. DRI-WEFA. Available from: <http://ec.europa.eu/energy/gas_electricity/studies/doc/gas/2000_08_opening_market_gas_volume1.pdf> [Accessed 25 June 2011].

Whitehead, P. (2011). *EC urges Italy, Poland, Romania to change regulated power, gas prices* [online]. Available from: <http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/8755783> [Accessed 19 July 2011].

Zajíček, M. (1999). Teorie v síťových odvětvích. *In*: *Konkurence v českém plynárenství*, Prague: Liberální institut, pp.70-88.

Legislation of the European Union

Council Directive 2004/67/EC of 26 April 2004 concerning measures to safeguard security of natural gas supply

Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC

Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas

Regulation (EC) No 1775/2005 of the European Parliament and of the Council of 28 September 2005 on conditions for access to the natural gas transmission networks

Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators

Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005

Treaty Establishing the European Economic Community, 25 March 1957

Data sources

Alternatívni dodávatelia plynu (2011) [online]. Available from: <http://www.dodavatelia-plynu.sk/alternativny-dodavatel-plyn-alternativni-dodavatelia.php> [Accessed 21 July 2011].

Bohemia Energy (2011). *Zprávy o hospodaření* [online]. Available from: <http://www.bohemiaenergy.cz/domacnosti-o_spolecnosti-zpravy_o_hospodareni> [Accessed 23 July 2011].

Caliński, M. (2011). *Request for data for a thesis*. Email to: B. Mirková. 29 March 2011, 20:44. Personal communication.

ERU (2005). *The Czech Republic's National Report on the Electricity and Gas Industries for 2004*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005> [Accessed 3 June 2011].

ERU (2006). *The Czech Republic's National Report on the Electricity and Gas Industries for 2005*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_En/E06_NR_CzechRep-EN.doc> [Accessed 3 June 2011].

ERU (2007). *The Czech Republic's National Report on the Electricity and Gas Industries for 2006*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_CzechRepublic-EN.doc> [Accessed 3 June 2011].

ERU (2008). *The Czech Republic's National Report on the Electricity and Gas Industries for 2007*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National reporting 2008/NR_En/E08_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

ERU (2009). *The Czech Republic's National Report on the Electricity and Gas Industries for 2008*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%22Reporting%202009/NR_En/E09_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

ERU (2010). *The Czech Republic's National Report on the Electricity and Gas Industries for 2009*. Jihlava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National Reporting 2010/NR_En/E10_NR_CzechRep-EN.pdf> [Accessed 3 June 2011].

EWE (2011). *Wyniki działalności* [online]. Available from: <http://www.ewe.pl/ewe-energia/o-nas/o-firmie/wyniki-dzialalnosci?cl=pl> [Accessed 25 July 2011].

E.ON Energie (2008). *Výroční zpráva 2007*. České Budějovice. Available from: <http://www.eon.cz/file/cs/investors/annual_reports/EON_Energie-Vyrocni_zprava_2007-CS.pdf> [Accessed 24 January 2011].

E.ON Energie (2009). *Výroční zpráva 2008*. České Budějovice. Available from: <http://www.eon.cz/file/cs/investors/annual_reports/EON_Energie-Vyrocni_zprava_2008-CS.pdf> [Accessed 24 January 2011].

E.ON Energie (2010). *Výroční zpráva 2009*. České Budějovice. Available from: <http://www.eon.cz/file/cs/investors/annual_reports/EON_Energie-Vyrocni_zprava_2009-CS.pdf> [Accessed 24 January 2011].

Fišer, R. (2011). *JCP - prodej plynu - VZ 2005*. Email to: B. Mirková. 6 April 2011, 07:27. Personal communication.

Jihočeská plynárenská (2006). *Výroční zpráva 2005*.

Jihomoravská plynárenská (2006). *Výroční zpráva 2005*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/vyrocni_zprava_2005_cj.pdf?jis=20110722231035> [Accessed 11 March 2011].

Jihomoravská plynárenská (2007). *Výroční zpráva za rok 2006*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/vyrocni_zprava_2006_cj.pdf?jis=20110722231035> [Accessed 11 March 2011].

Jihomoravská plynárenská (2008). *Výroční zpráva 2007*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/RWE_JMP_VZ_07_CZ_final.pdf?jis=20110722231035> [Accessed 11 March 2011].

Jihomoravská plynárenská (2009). *Výroční zpráva 2008*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/RWE_JMP_Vyrocni_zprava_2008.pdf?jis=20110722231035> [Accessed 11 March 2011].

Jihomoravská plynárenská (2010). *Výroční zpráva 2009*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/VZ_2009_JMP_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Jihomoravská plynárenská (2011). *Výroční zpráva 2010*. Brno. Available from: <http://www.rwe.cz/cs/media/jmp/VZ_2010_JMP_CZ_aktiv.pdf?jis=20110722231035> [Accessed 31 May 2011].

Juřica, R. (2011). *Prosba o data pro bakalářskou práci*. Email to: B. Mirková. 12 April 2011, 16:33. Personal communication.

Lipnička, R. (2011). *Prosba o data pro bakalářskou práci*. Email to: B. Mirková. 18 April 2011, 23:08. Personal communication.

Ludvík, M. (2011). *Prosba o poskytnutí dat pro bakalářskou práci*. Email to: B. Mirková. 6 June 2011, 16:03. Personal communication.

Neumanová, M. (2011). *Údaje pro bakalářskou práci*. Email to: B. Mirková. 1 June 2011, 07:42. Personal communication.

Polskie Górnictwo Naftowe i Gazownictwo (2006). *Annual Report 2005*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=2227&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 24 January 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2007). *Annual Report 2006*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=2217&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 24 January 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2008). *Annual Report 2007*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=2192&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 24 January 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2009a). *Annual Report 2008*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=11339&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 24 January 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2009b). *Sprzedaż gazu* [online]. Available from: <http://www.pgnig.pl/pgnig/sd/oim/sg/?r,article,Id=1083> [Accessed 20 July 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2010). *Annual Report 2009*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=18454&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 24 January 2011].

Polskie Górnictwo Naftowe i Gazownictwo (2011). *Annual Report 2010*. Warsaw. Available from: <http://www.pgnig.pl/binSrc?docId=25054&paramName=BINARYOBJ_FILE&index=0&language=EN&forceSave=yes> [Accessed 20 July 2011].

Pražská plynárenská (2006). *Výroční zpráva 2005*. Praha . Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2005.pdf> [Accessed 10 March 2011].

Pražská plynárenská (2007). *Výroční zpráva 2006*. Praha . Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2006.pdf> [Accessed 10 March 2011].

Pražská plynárenská (2008). *Výroční zpráva 2007*. Praha. Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2007.pdf> [Accessed 10 March 2011].

Pražská plynárenská (2009). *Výroční zpráva 2008*. Praha. Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2008.pdf> [Accessed 10 March 2011].

Pražská plynárenská (2010). *Výroční zpráva 2009*. Praha . Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2009.pdf> [Accessed 10 March 2011].

Pražská plynárenská (2011). *Výroční zpráva 2010*. Praha. Available from: <http://files.ppas.cz/o-nas/spolecnost-ppas/vyrocni-zpravy/ppas-vyrocni-zprava-2010.pdf> [Accessed 23 July 2011].

RONI (2005). *National regulators' annual report to the European Commission*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005/NR/E05-REP-01-03V_NATIONAL REPORTS_QU-SK.DOC> [Accessed 12 July 2011].

RONI (2006). *National report 2006*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_En/E06_NR_Slovakia-EN.doc> [Accessed 12 July 2011].

RONI (2007). *National report 2007*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_Slovakia-EN_V2.doc> [Accessed 12 July 2011].

RONI (2008). *National report 2008*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20reporting%202008/NR_En/E08_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RONI (2009). *National report 2009*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202009/NR_En/E09_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RONI (2010). *National report 2010*. Bratislava. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202010/NR_En/E10_NR_Slovakia-EN.pdf> [Accessed 12 July 2011].

RWE (2011). *Annual report 2010*. Praha. Available from: <http://www.rwe.com/web/cms/mediablob/en/543512/data/110822/4/rwe/investor-relations/financial-reports/Annual-report-2010-PDF-Download-.pdf> [Accessed 20 July 2011].

RWE Energie (2010). *Výroční zpráva 2009*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/energie/VZ_2009_RWE_E_CZ_.pdf?jis=20110722231035> [Accessed 27 March 2011].

RWE Energie (2011). *Výroční zpráva 2010*. Ústí nad Labem.

RWE Transgas (2010). *Výroční zpráva 2009*. Praha. Available from: <http://www.rwe.cz/cs/media/transgas/RWE_TG_Vyrocni_zprava_2009.pdf?jis=20110723230831> [Accessed 27 March 2011].

Severočeská plynárenská (2005). *Výroční zpráva 2004*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/scp/VZ_SCP_04_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severočeská plynárenská (2006). *Výroční zpráva 2006*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/scp/VZ__SCP_05_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severočeská plynárenská (2007). *Výroční zpráva za rok 2006*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/scp/VZ_SCP_06_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severočeská plynárenská (2008). *Výroční zpráva 2007*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/scp/RWE_SCP_VZ_07_CZ_full.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severočeská plynárenská (2009). *Výroční zpráva 2008*. Ústí nad Labem. Available from: <http://www.rwe.cz/cs/media/scp/RWE_SCP_VZ08_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2005). *Výroční zpráva 2004*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/vz_2004_cz.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2006). *Výroční zpráva 2005*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/vz_2005_cz.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2007). *Výroční zpráva 2006*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/vz_2006_cz.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2008). *Výroční zpráva 2007*. Ostrava. Available from: < http://www.rwe.cz/cs/media/smp/RWE_SMP_Vyrocni_zprava_2007.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2009). *Výroční zpráva 2008*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/RWE_SMP_Vyrocni_zprava_2008.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2010). *Výroční zpráva 2009*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/RWE_SMP_Vyrocni_zprava_2009.pdf?jis=20110722231035> [Accessed 11 March 2011].

Severomoravská plynárenská (2011). *Výroční zpráva 2010*. Ostrava. Available from: <http://www.rwe.cz/cs/media/smp/RWE_SMP_Vyrocni_zprava_2010.pdf?jis=20110722231035> [Accessed 31 May 2011].

SIME Polska (2010). *O firmie* [online]. Available from: <http://simepolska.pl/ofirmie.html> [Accessed 25 July 2011].

Slovenský plynárenský priemysel (2005). *Výročná správa 2004*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2004_SK.pdf> [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2006). *Výročná správa 2005*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2005_SK.pdf > [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2007). *Výročná správa 2006*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2006_SK.pdf> [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2008). *Výročná správa 2007*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2007_SK.pdf> [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2009). *Výročná správa 2008*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2008_SK.pdf> [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2010). *Výročná správa 2009*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2009_SK.pdf> [Accessed 10 February 2011].

Slovenský plynárenský priemysel (2011). *Výročná správa 2010*. Bratislava. Available from: <http://www.spp.sk/download/vyrocne-spravy/SPP_VS_2010_SK.pdf> [Accessed 1 June 2011].

SME.sk (2011). SPP si vlani udržal 82-% podiel na trhu s plynom. *SME.sk* [online]. Available from: <http://ekonomika.sme.sk/c/5890077/spp-si-vlani-udrzal-82-podiel-na-trhu-s-plynom.html> [Accessed 24 July 2011].

Středočeská plynárenská (2006). *Výroční zpráva 2005*. Praha. Available from: <http://www.rwe.cz/cs/media/stp/VZ_STP_2005_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Středočeská plynárenská (2007). *Výroční zpráva za rok 2006*. Praha. Available from: <http://www.rwe.cz/cs/media/stp/VZ_STP_2006_CZ.pdf?jis=20110722231035> [Accessed 11 March 2011].

Středočeská plynárenská (2008). *Výroční zpráva 2007*. Praha. Available from: <http://www.rwe.cz/cs/media/stp/RWE_STP_Vyrocni_zrava_2007.pdf?jis=20110722231035 > [Accessed 11 March 2011].

Středočeská plynárenská (2009). *Výroční zpráva 2008*. Praha. Available from: <http://www.rwe.cz/cs/media/stp/RWE_STP_Vyrocni_zprava_2008.pdf?jis=2011072223103 5> [Accessed 11 March 2011].

Szymczak, M. (2011). *Annual reports*. Email to: B. Mirková. 13 July 2011, 15:36. Personal communication.

Takácsová, A. (2010). Vlani zmenilo dodávateľa plynu 45 odberateľov. *Webnoviny.sk* [online]. Available from: <http://www.webnoviny.sk/ekonomicke-spravy/vlani-zmenilo-dodavatela-plynu-45-odbe/149831-clanok.html> [Accessed 21 July 2011].

United Energy Trading (2009). *Výroční zpráva 2008*. Praha. Available from: <http://www.uet.cz/download/38/vyrocni_zprava_UET_2008_Czech%5Bdot%5Dpdf> [Accessed 14 March 2011].

United Energy Trading (2010). *Výroční zpráva 2009*. Praha. Available from: <http://www.uet.cz/download/91/vyrocni_zprava_UET_2009_Czech%5Bdot%5Dpdf> [Accessed 14 March 2011].

United Energy Trading (2011a). *United Energy Trading snížila na letošní rok ceny elektřiny o 10 %*. Press release, issued 5 January 2011. Available from: <http://www.uet.sk/30-article-united-energy-trading-snizila-na-letosni-rok-ceny-elektriny-o-10> [Accessed 21 July 2011].

United Energy Trading (2011b). *United Energy Trading za loňský rok zvýšila tržby na 7,8 miliardy Kč*. Press release, issued 5 April 2011. Available from: <http://www.uet.cz/34-article-united-energy-trading-za-lonsky-rok-zvysila-trzby-na-7-8-miliardy-kc> [Accessed 21 July 2011].

URE (2005). *Annual report to the European Commission*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2005/NR/E05-REP-01-03T_NATIONAL REPORTS_QU-PL.PDF> [Accessed 16 July 2011].

URE (2006). *Annual report to the European Commission 2006*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2006/NR_nl/E06_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2007). *National report 2007*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/NR_2007/NR_En/E07_NR_Poland-EN_V2.doc> [Accessed 16 July 2011].

URE (2008). *National report 2008*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20reporting%202008/NR_En/E08_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2009). *National report 2009*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202009/NR_En/E09_NR_Poland-EN.pdf> [Accessed 16 July 2011].

URE (2010). *National report to the European Commission 2010*. Warsaw. Available from: <http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202010/NR_En/E10_NR_Poland-EN.pdf> [Accessed 16 July 2011].

Vemex (2010). *Výroční zpráva 2009*. Praha.

Vemex (2011). *Výroční zpráva 2010*. Praha. Available from: <http://www.vemex.cz/pdf/vemex-vyrocni-zprava-2010-cs.pdf> [Accessed 1 June 2011].

Východočeská plynárenská (2005). *Výroční zpráva 2004*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/VCP_vyrocni_zprava_2004.pdf?jis=20110722231035> [Accessed 11 March 2011].

Východočeská plynárenská (2006). *Výroční zpráva 2005*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/VCP_vyrocni_zprava_2005.pdf?jis=20110722231035> [Accessed 11 March 2011].

Východočeská plynárenská (2007). *Výroční zpráva 2006*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/VCP_vyrocni_zprava_2006.pdf?jis=20110722231035> [Accessed 11 March 2011].

Východočeská plynárenská (2008). *Výroční zpráva 2007*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/VCP_Vyrocni_zprava_2007.pdf?jis=20110722231035> [Accessed 11 March 2011].

Východočeská plynárenská (2009). *Výroční zpráva 2008*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/RWE_VCP_Vyrocni_zprava_2008.pdf?jis=20110722231035 [Accessed 11 March 2011].

Východočeská plynárenská (2010). *Výroční zpráva 2009*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/RWE_VCP_Vyrocni_zprava_2009.pdf?jis=20110722231035> [Accessed 11 March 2011].

Východočeská plynárenská (2011). *Výroční zpráva 2010*. Hradec Králové. Available from: <http://www.rwe.cz/cs/media/vcp/RWE_VCP_Vyrocni_zprava_2010.pdf?jis=20110722231035> [Accessed 31 May 2011].

Západočeská plynárenská (2006). *Výroční zpráva 2005*. Plzeň. Available from: <http://www.rwe.cz/cs/media/zcp/2005zcpcz.pdf?jis=20110722231035> [Accessed 11 March 2011].

Západočeská plynárenská (2007). *Výroční zpráva za rok 2006*. Plzeň. Available from: <http://www.rwe.cz/cs/media/zcp/2006zcpcz.pdf?jis=20110722231035> [Accessed 11 March 2011].

Západočeská plynárenská (2008). *Výroční zpráva 2007*. Plzeň. Available from: <http://www.rwe.cz/cs/media/stp/RWE_STP_Vyrocni_zrava_2007.pdf?jis=20110722231035 [Accessed 11 March 2011].

Západočeská plynárenská (2009). *Výroční zpráva 2008*. Plzeň. Available from: <http://www.rwe.cz/cs/media/stp/RWE_STP_Vyrocni_zprava_2008.pdf?jis=20110722231035> [Accessed 11 March 2011].

Žižka, J. (2011). *Množství prodaného plynu*. Email to: B. Mirková. 14 March 2011, 10:46. Personal communication.

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Appendices

Appendix 1: Market shares and Herfindahl-Hirschman index in the Czech Republic

	PP & Pragoplyn	JČP - E.ON	RWE Group	Vemex	Bohemia Energy	Lumius	United Energy Trading	Lumen Energy	ČEZ	SPP CZ	Wingas
2004	11,91	4,39	83,7027								
2005	12,00	4,40	83,5000								0,0500
2006	11,84	4,34	83,04	0,1408							0,3196
2007	11,21	4,18	80,2400	2,7862			0,0050				0,3158
2008	12,28	4,09	72,23	5,86		0,3797	0,0911	0,0124			0,7224
2009	15,28	3,70	64,8800	8,5400	0,5700	1,6100	1,2700	0,0400	0,0400	0,2200	0,0300

	MND	LAMA Investments	Česká plynárenská	Energie Bohemia	Conte	VNG Energie Czech		HII lower limit	HII upper limit	HHI average
2004								7167	7167	7167
2005	0,0500						0,1000	7136	7136	7136
2006	0,3196						0,6392	7055	7055	7055
2007	0,3158	0,3158	0,3158			0,3158	1,5788	6590	6592	6591
2008	0,7224	0,7224	0,7224	0,7224	0,7224	0,7224	5,0567	5423	5445	5434
2009	1,1500	1,0900	0,3400	1,1600	0,0600	0,0200	0,0200	4538	4538	4538

values given or calculated directly from sales volumes without averaging

values calculated using averaging from given sales volumes

a combination of the above (PP - given a Pragoplyn - calculated using averaging)

estimates for the lower limit of HHI

estimates for the upper limit of HHI

* PP - Pražská plynárenská
JČP - Jihočeská plynárenská
MND - Moravské naftové doly
HHI - Herfindahl-Hirschman index

Appendix 2: Market shares and Herfindahl-Hirschman index in Slovakia

	SPP	RWE Gas Slovensko	Lumius Slovakia	Elgas	VNG Slovakia	Shell Slovakia	Vaša Energia		HII - lower limit	HII - upper limit	HHI average
2004	100								10000	10000	10000
2005	100								10000	10000	10000
2006	100								10000	10000	10000
2007	100								10000	10000	10000
2008	100								10000	10000	10000
2009	93	3,8502	0,1838		1,4830	1,4830		2,9661	8668	8673	8670
2010	82	13,0014		0,5276	1,4903	1,4903	1,4903	4,4710	6898	6898	6898

values given or calculated directly from sales volumes without averaging
estimates for the lower limit of HHI
estimates for the upper limit of HHI

* SPP - Slovenský plynárenský priemysel
HHI - Herfindahl-Hirschman index

Appendix 3: Market shares and Herfindahl-Hirschman index in Poland

	PGNiG	G.EN Gaz Energia	KRI	SIME Polska	EWE	ENESTA	Media Odra Warta	CP Energia
2004	98	0,2510	0,3498				0,3498	
2005	98	0,2473	0,2504				0,2504	0,2504
2006	98	0,5215	0,2112				0,2112	0,2112
2007	98	0,5851	0,1769		0,1769	0,1769	0,1769	0,1769
2008	98	0,6324	0,1709		0,1709	0,1709	0,1709	0,1709
2009	98	0,6878	0,2214	0,1476	0,5203	0,0846		0,0846
2010	97,3	1,1000	0,3000		0,9000			0,3000

	ANCO	Avrio Media	P.L. Energia	GAZ technologia i energia		HII lower limit	HII upper limit	HHI average
2004	0,3498		0,3498	0,3498	1,7490	9605	9607	9606
2005	0,2504	0,2504	0,2504	0,2504	1,7527	9605	9607	9606
2006	0,2112	0,2112	0,2112	0,2112	1,4785	9605	9606	9606
2007	0,1769	0,1769	0,1769		1,4149	9605	9606	9605
2008	0,1709	0,1709	0,1709		1,3676	9605	9606	9605
2009	0,0846	0,0846	0,0846		0,4230	9605	9605	9605
2010	0,1000					9470	9470	9470

values given or calculated directly from sales volumes without averaging
estimates for the lower limit of HHI
estimates for the upper limit of HHI

* PGNiG - Polskie Górnictwo Naftowe i Gazownictwo
HHI - Herfindahl-Hirschman index