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Daniela Vojiková

Table of Contents

1. Abstracts

1.1. English

Energy markets in Czech and Slovak Republic in the context of liberalization

Despite of a decade of market liberalization in Europe, final electric energy prices did not drop significantly in recent years in Czech Republic or Slovakia and continue to be one of the highest among European Union member states. This thesis aims to capture and explain the drivers behind the recent price development in the context of liberalization and integration of markets. Liberalization should enable alternative providers of electricity (including producers of energy from renewable sources) to access the energetic grid, which was not the case in the past and prevented them to compete with the traditional monopolies at the national markets. Market structure is identified as one of the decisive factors determining industry dynamics in Czech Republic and Slovakia, especially engagement of the state as the controlling shareholder of the dominant market players. An assessment of market power based on market share of subjects and switching behavior of customers is delivered in order to determine whether what is observed are competitive market prices. Following a comprehensive market structure characterization the thesis analyzes price components – deregulated and regulated part – separately. In wholesale prices trading is essential which was facilitated by the establishment of a common day-ahead market, i.e. market coupling in the third quarter 2009. We analyze hourly market data to evaluate the level of effectiveness with which market coupling operates and find that while wholesale markets are efficient, regulated fees were set incorrectly with distribution fees accounting for largest difference in prices and constitute the main reason for price differential in the examined region.

Keywords: electricity markets, liberalization packages, market coupling

1.2. German

Energiemärkte in Tschechien und der Slowakei im Kontext der Liberalisierung

Obgleich die Liberalisierung in Europa bereits seit einem Jahrzehnt fortschreitet, sinken die Preise für Elektrizitätsversorgung in Tschechien und Slowakei nicht, sie gehören sogar zu den teuersten unter den Mitgliedstaaten der Europäischen Union. Diese Arbeit identifiziert und erklärt Treiber der letzten Preisentwicklung im Kontext der Liberalisierung und Integration von Energiemärkten. Im Zuge der Liberalisierung sollte sich auf für alternative Energieversorger (einschließlich Erzeuger von Elektrizität aus erneubaren Quellen) ein freier Zugang zum Markt verstehen. Diese simple Gleichung fand in der Praxis jedoch bisher keine Umsetzung mit einem eingeschränkten Wettbewerb auf dem Energiemarkt. Marktstruktur wurde als einer der entscheidenden Faktoren identifiziert, vor allem die Beteiligung des Staates in Energiekonzernen in Tschechien und der Slowakei, wodurch die Industrie stark geprägt wird. In der vorliegenden Arbeit wurde eine Evaluierung der Macht auf den Märkten vorgenommen, wobei die zu untersuchenden Objekte anhand ihres Marktanteil und Konsumentenverhalten untersucht wurden. Dadurch kann festgestellt werden, ob die beobachteten Preise dem freien Marktpreis entsprechen. Des Weiteren wurde eine zweiteilige Analyse durchgeführt die sich im ersten Teil auf den nicht regulierte und im zweiten Teil auf den regulierten Teil des Preises fokussiert. Für Großhandelspreise ist ein transparenter und funktionierender Markt essenziel, was durch die Einführung von ‘market coupling’ im dritten Quartal von 2009 sichergestellt wurde. Eine weitere Datenanalyse bietet einen Einblick auf die Effektivität des Market-couplings und stellt fest, dass der deregulierte Teil des Preises mit dem freien Marktpreis konvergiert. Im Gegensatz, die Gebühren, welche den Endpreis bilden sind ineffektiv fixiert und sind für die beobachteten Preisunterschiede verantwortlich.

Schlüsselworte: Elektrizitätsversorgung, Energiepreise, Liberalisierung, Market-coupling

2. Introduction

In the past decade there have been several strong initiatives that forced electricity markets to undergo major structural changes. Formerly vertically integrated monopolies were split into legal entities to ensure separation of transmission and distribution from production and trade. These changes follow one ultimate goal which is higher competition in electricity markets that would dilute market power of incumbents, lead to higher energy efficiency in production and competitive prices for the customers. Through this long term social benefits could be achieved where a proper part of these benefits would be shared with end consumers[1]. The competition can be intensified and market power of dominant players decreased by extension of the respective markets due to which creation of internal European energy market was commenced. Integrated energy markets across the European Union would translate into the freedom of customers to choose from suppliers not only on domestic markets but internationally as well without losing power supply security.

Liberalization in Czech Republic and Slovakia proceeded somehow unequally despite similar starting position. Both countries went from planned economy with regulated prices to the market model and underwent waves of privatization in the electricity sector. These two countries also share a special position within European Union since they used to be a single state and even after separation in 1993 enjoyed superior economic cooperation. In addition to that their transmission network was built as one and therefore there should be sufficient transfer capacity on the cross-border profile, enabling efficient trading and price arbitrage that would under optimal circumstances lead to price equalization. Nevertheless the statistics on household prices show significant differences between these two historically and economically interconnected countries.

There are several aspects that would explain this features. One explanation would be that Czech Republic was more successful in the process of liberalization, has a more open market with higher competition that pressures the profit margins down which in turn means cheaper electricity price for households. Secondly, this difference could suggest that Czech Republic in general is able to produce cheaper electricity by utilization of their endowments like coal or nuclear energy and the differences in price reflect the diverse structure of energy mix of these

[1] Joskow, 2008, 11

countries. On the other hand, differences could also result from different stages of market liberalization that were actually achieved. Finally, price difference between these countries could also suggest that the international electricity trading is insufficient, suffering from congestion or exercise of market power which disables arbitrage and following equalization of prices.

This thesis wants to provide more insight on whether the current situation in Czech Republic and Slovakia corresponds with the principles of liberalizes market and identify the major differences that impact final household electricity prices. The two, very connected research questions of this master thesis are as follows:

- What factors cause the differences in final household electricity prices between Czech Republic and Slovakia?
- What country-specific factors determine the development of prices?

In this thesis and analysis of wholesale electricity prices and the market structure is conducted in order to identify the sources and reasons behind different household electricity prices, focusing mainly on the assumptions made above. The data used for the research are publicly available data from regulatory offices, transmission network operators and official short term market operator in Czech Republic, unless stated otherwise.

The first chapter provides a summary of the most important concepts related to liberalization and describe the process on the example of Czech Republic and Slovakia. Next the thesis provides an overview on market structure and energy mix in respective countries. Chapter five evaluates the concentration of the industry and potential for market power based on market share of market subjects, identification of incumbents, independence from the state and analyses switching behavior of customers in order to determine their responsiveness.

In the next part focus is on prices. In chapter six creation of wholesale prices is explained, including intra-state and cross-border trading. It explains and lists in praxis observed cases of assignment of transfer capacity and goes on to explain market coupling and congestion management in Czech Republic and Slovakia. With the help of descriptive statistics we examine empirical data in order to confirm or refuse hypotheses based on which we determine the level of efficiency of market coupling. In chapter eight we calculate based on the information provided by energy regulators and subsequently analyze regulated fees and charges in respective

countries. We compare them in order to explain price differences between the examined countries. At the end of the thesis we provide a conclusion and a short summary of our findings and the answer to our research question.

3. Key concepts

3.1. Liberalization

Liberalization in Europe did concentrate on market openness rather than on complex design of electricity markets. The electricity liberalization in Europe drifted away from the textbook model mainly due to more difficult coordination on European level among all member countries. The focus here was on retail competition[2] meaning the freedom of customers to choose their supplier. However as it was recognized, a meaningful degree of retail competition cannot be achieved, unless there is a well functioning wholesale market, network access and pricing institution that would enable customers to take advantage of this freedom. The end result of the ongoing process should be efficient retail and wholesale markets with distribution and transmission remaining regulated as legal monopolies[3]. Liberalization alone does not necessarily need to result in lower prices. In some countries the regulated prices were inefficiently low and therefore the actual prices after liberalization should be high enough to encourage investments and discourage wasteful consumption[4]. On the other hand open markets should foster competition which dilutes market power of incumbent, in result of which the price-cost margin should decrease benefits the final customer.

Liberalization in Europe is a top down process. Member states follow directives of the European Union in form of so called "liberalization packages" which describe a group of Directories and Policies that are to be adapted on national level. Then the member states are obliged to change their legislation accordingly, so that it corresponds with the principles of the European policies. The first wave of liberalization – the first liberalization package - in 1998 aimed to unite the energy legislation of member states and lay the basis for further integration.

The second liberalization package (Directives of 2003) required the legal and functional unbundling of distribution system operators (DSOs) with more than 100,000 customers and transmission system operators (TSOs) by 1st of July 2007[5]. The legal unbundling should prevent inter-company subsidies that would also impede fair competition. The new role of DSOs was to serve as a neutral market facilitator of retail competition, which should ensure non-

[2] Ibid., 20
[3] Ibid., 11
[4] Ibid., 15
[5] http://www.euractiv.com/en/energy/liberalising-eu-energy-sector/article-145320

discrimination access to networks that broke down the entry barrier for retail suppliers and foster competition.

Third party access should have led to more market entries and more providers. Realization of this goal automatically suggests more competitive environment and as a result of this lower electricity prices for consumers. This step, along with the right energy policy should also lead to more alternative providers and a higher share of renewable resources of energy in the energy mix of the country. Retail competition is supposed to allow customers to choose among retail service providers the one who best meets their price/service requirements[6]. Before, protected customers (individuals or companies) had the right to access to a distribution system and to electricity supplies of certain quality for regulated fees. After liberalization entered into effectiveness, protected customers became authorized customers, who had by law the right to enter into contract with an electricity supplier of one's choice.

The third liberalization package whose implementation was supposed to finish not later than in the beginning of March 2011 but was postponed by all member states, aims to amend the rules to achieve better coordination and cooperation between member states. The third package implements physical unbundling where the ownership of distribution grid becomes independent from final supply entities. There are several possibilities how to achieve this and member states have the freedom to choose the form of this separation.

3.1.1. Implementation in Czech Republic

In the past, before market liberalization, energy prices were determined by the Czech regulator the Energy regulatory office. Liberalization turned a "protected customer" into an "entitled customer" who has the right and responsibility to choose his or hers electricity supplier. The liberalization of electricity market in Czech Republic follows the European initiative and preceded step-wise:

- From 1.1. 2002 – customers with yearly consumption from 40 GWh
- From 1.1. 2003 – customers with yearly consumption from 9 GWh
- From 1.1. 2004 – all industrial customers with automatic meter reading

[6] Joskow, 2008, 11

- From 1.1. 2005 – all industrial customers except households
- From 1.1. 2006 – all customers including households

As of 2011 all end users have the possibility to switch their supplier of electricity free of charge.

3.1.2. Implementation in Slovak republic

On January 1st, 2005 the Act no.: 656/2004 Coll. set the legal framework for liberalization, which also meant that companies became "authorized customers" and the market started to open. Households could change to their supplier of choice from July 1st 2007 which de facto meant liberalization of the market.

3.2. Creation of integrated European electricity market

The current initiatives of European Union aim to gradually create an open and integrated European electricity market. It would mean that while national competition is being encouraged by open markets, the potential market power of national incumbents is threatened and mitigated by foreign competition. Therefore a successful interconnection management is needed, along with cooperation of cross-border congestion management among countries. The basic argument here is that an integrated market would give companies the possibility to benefit from economies of scale on one hand and decrease the concentration and market power potential on the other hand[7]. Also, customers would not be locally restrained but could freely choose a supplier – whether national or foreign. The effects of integrated markets could be summarized into:

- equalization of prices
- exercise of market power is hindered[8]

Simply put, in order to integrate the European electricity market, regional markets must be integrated as well. There are several regions in which markets are fairly integrated: e.g. Nordpool – the oldest and best known example of electricity markets integration in the Nordic countries.

[7] Bergman, 2009, 10
[8] Ibid., 12

Gradually more regions follow the example of Nordpool, namely Benelux countries, Germany and Denmark, Spain and Portugal and most recently Czech Republic and Slovakia.

Market coupling in Czech Republic and Slovakia can be perceived as the next step towards internal energy market and a mean of competition development. In the ideal case companies are not locally restricted as neither are customers, prices converge and effective location of production results. The achievement of these goals remains vague. To which extent are the above mentioned effects present on Czech and Slovak markets along with necessary market structure will be evaluated in detail in the following chapters. Whether integration of Czech and Slovak electricity markets succeeded is an important factor in the price determination and could explain observed differences in prices.

4. Market structure

4.1. Czech Republic

4.1.1. Legal framework

Electricity market in Czech Republic follows the Act No. 458/2000 Coll. on business conditions and public administration in the energy sectors and on amendment to other laws (the "Energy Act")[9]. The Act is based on directives of the European Union, mainly Directive No. 2003/54/ES concerning common rules for the internal market in electricity.

4.1.2. Market subjects

1) Generation – power plants

Czech Republic has two nuclear power plants, one in Dukovany and one in Temelin, both are operated by the Czech state-controlled utility giant ČEZ, a.s.[10]. ČEZ is at the same time the largest electricity generator on the market, with a share of 75% in electricity generation in 2010[11]. State owns 69.78% (in 2010) of all equity[12], which makes the Czech government the majority shareholder. There is a very low ownership on the account of foreign investors, larger shareholders are banks – Unicredit Bank Czech Republic with 9.4% shares followed by Citibank Europe Plc with 5.35% and CSOB with 3.5%. Aside from ČEZ there are local Czech generators, Dalkia, E.On and RWE are present on the market as well.

2) Transmission system operator

The role of TSO in Czech Republic is executed by ČEPS, which is fully state owned company[13]. Formerly it was established as a 100% daughter company of ČEZ, but due to legislation changes

[9] http://www.eru.cz/dias-browse_articles.php?parentId=202&deep=off&type=
[10] http://www.cez.cz/cs/vyroba-elektriny/jaderna-energetika.html
[11] http://www.energostat.cz/velka-majetkova-transakce-na-energetickem-trhu-cr.html
[12] http://www.cez.cz/en/cez-group/cez/structure-of-shareholders.html
[13] CEPS Annual Report 2010, 25

went under the ownership of Czech ministries. Its main role is ensuring electricity transmission, balance of the system and maintenance and development of the network[14].

3) Distribution system operators

Czech Republic is divided into three distribution regions, each of these regions is assigned to one distribution company. Distribution companies ensure operations of the network and distribute electricity to customers. They also direct the physical flows of electricity, measure consumption and have further competencies in order to ensure stability of the network. There are three primary distribution companies that were founded by incumbent electricity suppliers[15]:

- E.ON Distribuce, a.s., serves southern regions
- PREdistribuce, a.s., serves the area of Czech capital Prague
- ČEZ Distribuce, a. s., serves the largest area, predominantly north and west regions

Due to the ownership relations to their mother companies – who operate as final electricity suppliers – they are able to provide distribution tariffs for their mothers with lower profit margins than to alternative electricity suppliers. In this way they have certain power to make it more difficult to alternative suppliers to compete with incumbents. Aside from these conventional distributors, local distribution companies exist, predominantly in the proximity of larger industrial areas.

4) Retailers

Retailing companies are responsible for electricity supply to end customers. They can buy electricity directly from generators, via bilateral contracts or on the wholesale markets, e.g. Power Exchange Central Europe, European Energy Exchange in Leipzig. The biggest retailer remains to be CEZ, with 45% market share[16]. Prazska energetika (PRE) remains to be dominant in the Prague region, subsidies of European utility concerns of E.on and RWE are also present, along with alternative suppliers, e.g. Centropol Energy, BohemiaEnergy.

[14] http://www.ceps.cz/indexen.asp
[15] ERU, Price Decision 2010
[16] http://www.cez.cz/cs/pro-media/otazky-odpovedi/3.html

5) Short term electricity market operator

Short market operator OTE is state owned and state-established company that is responsible for processing and reporting business balances of electricity. Furthermore it operates and balances short-term market in cooperation with the TSO, engages in market coupling, settles imbalances through regulating energy and also serves as the administrator of registry for greenhouse gas emission allowances trade.[17]

7) Regulator Energy regulatory office

Energy Regulatory Office issues licenses for restricted period of time for businesses in energy sector (distribution, retailing, buyer), oversees the activities of TSO, approves regulated fees such as transmission and distribution tariffs, sets limits for losses in transmission and distribution lines. It main objective is to create and foster an environment that is close to competition while not handicapping end-customers. It also manages, administrates and controls utilization of renewable sources of energy. Its correct operations are essential in order to ensure functioning of those spheres of energy sector where natural monopoly is still in place.

4.2. Slovak Republic

4.2.1. Legal framework

The legislation concerning electricity markets and prices is very complex and defined on several levels. Directives of European Union provide the legal basis that is common for all member states, this is amended by national legal norms. Most important are these:

- Act No. 656/2004 on energy sector
- Act No. 276/2001 on regulation of network industries
- Regulation of the Government of the Slovak Republic No. 317/2007 Coll. determining the Energy Market rules effective from June 1, 2010 (market rules).

[17] http://www.ote-cr.cz/about-ote/main-reading

There is a specific provision in §14 of this Regulation that states that if an alternative electricity provider is incapable of fulfillment of its contractual responsibilities (e.g. electricity supply), the conventional retailer is to take over its responsibilities. This provision should ensure electricity supply security for households and industrial customers and should also contribute to better competitive environment.

4.2.2. Market subjects

1) Generation

The market is dominated by single generation company - Slovenske elektrarne, former state-owned monopoly. Slovenske elektrarne (SE), the biggest generation company in Slovakia with market share close to 84%, owns and manages a variety of power plants including both nuclear power plants and the biggest hydro power plant. National Property Fund of the Slovak Republic (representative of the state) with a share of 34% and by Enel, SpA of Italy holding a majority share of 66%[18]. Unlike in Czech Republic, the state in this case does not hold the controlling majority and therefore does not unilaterally decide about the running of business. Historically there have been three regional electricity suppliers, who went through legal unbundling and the generating entities of these companies still own and run several power plants.

2) Transmission system operator and market operator

Since it is not rentable to build or operate multiple electricity grids distribution and transmission remain natural monopolies. The single transmission system operator (TSO) who manages and owns the transmission lines (high voltage 220 and 400kV) is a state-owned company Slovenská elektrizačná prenosová sústava, a.s. (SEPS).

SEPS also executed the role of short-term market operator until the end of 2010, when its daughter company OKTE overtook the responsibilities for clearing and market organization from 1.1.2011[19].

[18] Slovenske Elektrarne, Annual Report 2010, 13
[19] SEPS, Annual Report 2010, 27

3) Distribution system operators

In the distribution system (medium voltage 110 kV and lower) there are three regional companies operating: ZSE – Distribúcia a.s. (western Slovakia), SSE – Distribúcia a.s. (central Slovakia) and Východoslovenská distribučná a.s. (eastern Slovakia), that were established as a result of unbundling of conventional electricity suppliers.

4) Retailers

Suppliers to end customers buy electricity from producers, or on wholesale markets and provide it to end customers. Conventional retailers who spawned from incumbents: ZSE – Energia a.s., SSE a.s., VSE a.s. are state-owned (with 51% of all shares), while remaining shares and voting rights were acquired by German E.ON Energie AG, French EDF and German RWE respectively. Aside from the dominant regional retailers there are minor or alternative electricity suppliers that entered the market as a result of liberalization efforts. The largest is ČEZ Slovensko, a subsidiary of the ČEZ - market leader in Czech Republic mentioned in the previous section. Others are for example Magna E.A., Lumius, Korlea Invest, Slovakia Energy, Coal Energy and A.En Slovakia.

5) Regulator

The regulatory institution in Slovak Republic is the Regulatory Office for Network Industries (URSO). ÚRSO overlooks the market conditions, regulates access to the network, determines the conditions, approves transmission and distribution fees, as well as fees for loses and system operation tariff in order to create and maintain a competitive environment.

There are several similarities between electricity markets since their legislation is strictly following directives of the European Union. The structure is almost identical with the exception of short term market organizer. Slovak republic did not have a short term market until the introduction of market coupling in September 2009. Another difference is in the presence and influence of the state in the industry. In Czech Republic the state is still the controlling shareholder of CEZ, which along with its daughter companies dominates several spheres of electricity markets from generation to distribution and end supply. A subsidy of CEZ in Slovakia is also the biggest alternative supplier. In Slovakia, the state is still controlling all distribution

companies, however has mild influence on the biggest generating company where the majority owner is a foreign investor – Italian utility giant Enel SpA. This ownership structure would suggest that while in both countries state remains the single most influence on business in electricity sector, in Czech Republic the state is directly more present than in its eastern neighbor.

The markets differ significantly in size. The market in Czech Republic is roughly double the size than Slovakia which is documented by statistics on net electricity consumption (see Table 1) Czech Republic is also a traditional exporter of electric energy whereas Slovak Republic is dependent on imports of electric energy in order to cover consumption. This state is projected to change in the future due to ongoing installments of capacity so that Slovak Republic could achieve a positive balance of production.

Table 1: Annual net consumption

Czech Republic									
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Consumption net	53581	54781	56388	57664	59421	59752	60478	57112	59255
Slovak Republic									
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Consumption net	28674	28892	28682	28572	29624	29632	29830	27386	28761

Source: based on annual reports of regulatory offices

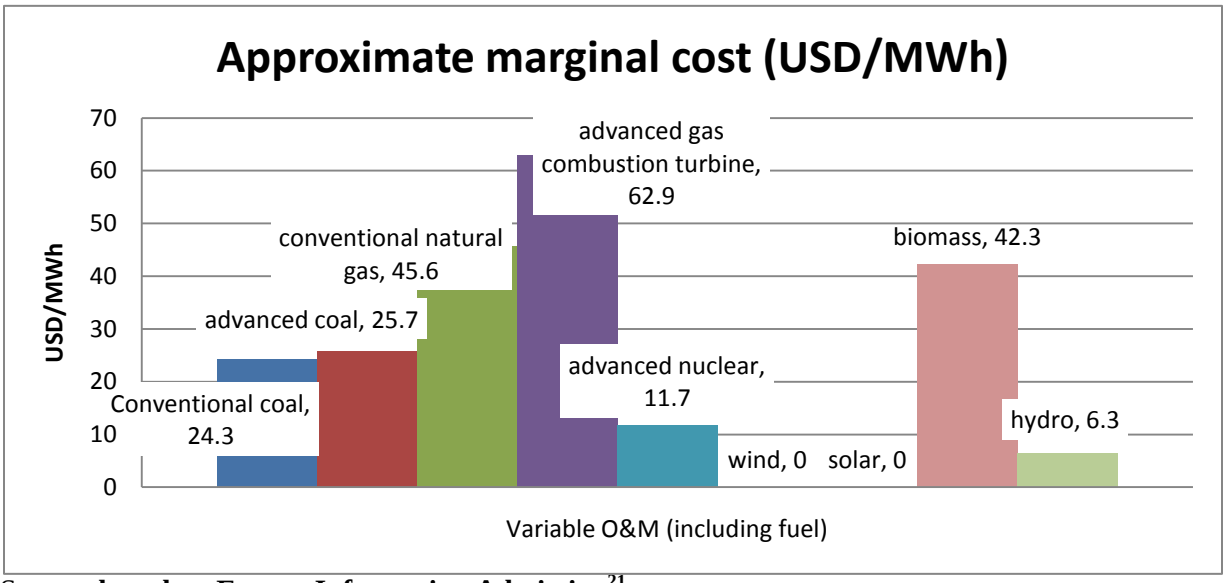
4.2. Energy mix

There are also relatively significant differences in the energy mixes of both countries. The schemes representing energy mixes of the countries and their development over time can be found in *Appendix 1* and *Appendix 2*. The differences in marginal costs of electricity production vary significantly, as illustrated in the graph below which represents variable costs of new generation sources in year 2016, as published by American Energy Information Administration[20]. Although these data are simply for illustration the differences in production costs of various fuels in energy mix could help explain and grasp the prices differences in

[20] http://www.eia.gov/oiaf/aeo/electricity_generation.html

between Czech Republic and Slovakia, given they in fact use remarkably cheaper energy sources.

Figure 1: Approximate marginal of power generation by fuel



Source**: based on Energy Information Admission**[21]

Czech Republic unlike Slovakia disposes of relatively large coal stocks and relies heavily on coal power plants. Coal power plants are the leading source of electric energy in the production. Coal power plants are cheap but produce relatively high carbon dioxide emissions. Slovakia has gradually moved away from the use of coal power plants as primary energy source and replaced them with gas and nuclear power plants[22]. Currently nuclear energy is the dominant source. The share of nuclear energy in the energy mix fluctuated around 55% in the past ten years. Such energy mix can be largely problematic for the future because of strong opposition from other European countries like Germany – who in connection of recent events in Japan and the nuclear catastrophe in Fukushima decided to shut down its nuclear plants - and also from neighboring Austria who is well-known opponent of nuclear energy. With the exception of hydro power both countries have relatively small share of renewable energy resources. Slovakia however is able to benefit from its water resources and produces approximately 20% in 2010 from large-scale hydro energy (see Appendix 2 for the representation of energy mix). From the point of CO_2 emission

[21] Ibid.
[22] http://www.iea.org/papers/security/slovak_republic_2011.pdf, 4

production has Slovakia a relatively better position than Czech Republic since it uses more hydro energy and relies less on fossil fuels. Nuclear energy also does not significantly contribute to CO_2 emissions. Under the new environmental legislation coal becomes continually more expensive over time and less beneficial. This is why is Czech Republic considering further construction of additional units around nuclear power plant in Temelin after which should the share of nuclear energy rise from current 30% to approximately 50-60%[23].

Another major difference is the energy dependency of both countries. Slovakia is 100% dependent on the supplies of gas from Russia and other primary energy resources, which negatively influences the energy dependency. In regards to produced electric energy Slovak republic was a net exporter since 2007 but as a part of EU admission process it committed itself to decommission two reactor units of the nuclear power plant in Jaslovske Bohunice[24] as of 31.12.2008. Although the nuclear reactors adhere to safety and longevity criteria this decision was made under strong international political pressure. This decision translated into a need for electric energy import, mainly from Czech Republic, influenced the growth of high voltage prices and triggered issues with reserve power for grid[25]. Depending on the development of national consumption, Slovakia could acquire the exporting position again in the future. Further units of the nuclear power plant in Mochovce are planned to by installed and another installation of a power plant in strategic cooperation with ČEZ should take place in the future. The projects should be finished and connected to the power grid by 2013 and 2020 respectively. Czech Republic is a net exporter but due to projected shut downs of obsolete and nuclear units is expected to lose its position around 2014 to 2019[26]. Energy dependency calculated as imports divided by total consumption is 64% for Slovakia and 28% in the case of Czech Republic[27] which reflects current situation.

[23] http://www.energia.sk/clanok/jadrova/podiel-jadra-v-cesku-by-sa-mal-zvysit-nad-50/2993/
[24] http://www.worldenergy.org/documents/congresspapers/310.pdf, 10
[25] Ibid., 10
[26] Ibid,, 4
[27] http://www.energy.eu/

4.3. Renewable sources of energy

4.3.1. Czech Republic

Both countries have a relatively small percentage of renewable energy source (hereinafter "RES") in their energy mix[28] which reaches approximately 8%[29].Wind energy has gradually gained importance and weight in share of renewable energy sources in Czech Republic. Wind energy represents approximately 50% of RES followed by photovoltaic sources. According the recently published press report[30] there has been a major increase in the amount of installed photovoltaic capacity, mainly due to the promotional efforts from the government and relatively higher price for electrical energy coming from this source. At the end of February 2011 the total installed capacity of photovoltaic sources was 1900 MW, which accounts for a rapid increase of 1400MW from 2009. Czech Republic also employs energy sources from biomass, these however have minor share (103MW) on total production.

4.3.2. Slovakia

The situation is quite different in Slovakia where hydropower remains to be the mostly used RES. Biomass – although it has relatively high potential that has yet not been tapped – and wind energy constitutes a very small share of the whole portfolio. The legislative has been perceived as relatively hindering with the price of energy from RES still remaining a factor[31]. Another obstacle were concerns for the stability of electricity grid since energy from wind and solar power is more difficult to predict. With the change of government and similarly as in Czech Republic a boom of solar collectors could be observed along with the favorable government policy for this kind of resource. In Slovakia the installed capacity of photovoltaic as of mid 2011 is 480 MW which already exceeded the strategic energy plan of 300MW for Slovakia[32]. Wind energy and use of biomass still remain underdeveloped.

[28] Ibid.
[29] http://www.energia.sk/clanok/obnovitelne-zdroje/obnovitelne-zdroje-su-v-cesku-na-vzostupe/2702/
[30] http://www.worldenergy.org/documents/congresspapers/310.pdf
[31] Ibid., 15
[32] http://www.energia.sk/clanok/solarna-energia/instalovany-vykon-fotovoltaickych-elektrarni-na-slovensku-je-480-mw/3824/

5. Competitiveness of markets

Current debate widely recognizes the need of competition in historically monopoly-operated energy sector. While certain attributes of electric energy – distribution and transmission – are due to high construction and coordination cost still considered natural monopolies, European Union member states encourage competition in generation and retail market. New market entrants can compete thanks to their flexibility[33] that enables them to purchase cheaper base load electricity. In addition to that they operate with lower overhead costs which translate into cheaper electricity for end customers.

Energy sector is very specific due to high entry costs and price inelasticity of customers. High entry cost were targeted by the second and third liberalization package, that gradually required functional, legal and finally physical unbundling. Under this legislation alternative providers of electric energy have under certain cases guaranteed access to energy grid. Distribution networks are now operated separately and can therefore be also sourcing energy from minor energy generators. Despite this arrangement incumbents remain dominant. The structure of energy markets still resembles oligopoly[34] which proves certain improvement towards perfect competition. In generation incumbents tend to be protected by high entry barriers, in retail markets are these rather insignificant.[35] End consumers typically do not have the relevant information in real time and also are rather rigid in electricity consumption, especially in the short term. Retailers are therefore usually protected by the immobility of customers who are reluctant due to perceived switching cost. In perfect competition the margin between wholesale and retail prices would reflect only the cost of distribution metering, billing and general services to retail customers[36]

5.1. Measures of market power

As previously mentioned liberalization failed if market power of incumbents did not decrease in the process. This part of the thesis provides an analysis of the market structure with respect to the potential of market power.

[33] Ibid, 2
[34] Küpper et. al, 2007, 43
[35] Bergman, 2009, 20
[36] Ibid., 14

There are several indicators of potential market power. One of the measures is Residual Supply Index which measures "to what extent the competitors of a given generator, as a group, can meet the current demand[37]." If these generators are able to supply 100 percent and more of the demand, the examined generator is not pivotal and does not have market power. However if the cumulative capacity of the rest of the industry is not sufficient to meet the demand, the generator in question can influence market prices. Another measure is Herfindahl-Hirschman index (HHI) which is defined as "the sum of the squares of the market shares, in percent, of all firms in the market."[38]

The goal of this section is not to calculate the relevant indexes due to the unavailability of relevant data. However the following analysis will use criteria that are relevant for above mentioned measures with the focus of concentration in the industry. It also must be noted that high degree of concentration is sufficient for market power problems to arise, however these can be present also when small generators are pivotal to the market. Although purely company's size is not necessarily decisive factor, it is - along with market share of conventional providers - the best approximation for market power potential. Furthermore the number of changes of suppliers and the presence of alternative providers is considered a sign of functioning liberalized market and price competition.

5.2. Concentration of industries

5.2.1. Czech Republic

There are no official data publicly available for Czech Republic. The web site of CEZ lists the market share of 45%[39] The CEO of Prazska energetika (PRE) listed the market share to be "around 11%[40]". The distribution area of PRE is mainly the area of Czech capital Prague and surroundings, where the company services 80% of the market[41]. E.on lists the market share to be 20%[42]. The most recent available information from 2007 say that these traditional companies

[37] Ibid., 6
[38] Ibid., 7
[39] http://www.cez.cz/cs/pro-media/otazky-odpovedi/3.html
[40] http://zpravy.e15.cz/nazory/online-rozhovory/12-ptejte-se-generalniho-reditele-pre-pavla-elise
[41] http://www.pre.cz/data/sharedfiles/PRE/Nezavisle-na-segmentu/Nase-spolecnost/Pro-investory-a-akcionare/vyrocni-zprava-2010.pdf, 80
[42] http://www.cenyenergie.cz/elektrina/katalog-dodavatelu/21-e-on-energie.aspx

service 95% of final customers' total consumption; in the case of small customers which includes households, their share is more than 99%[43]. Up to date there are 21 suppliers of electric energy total, which is almost double the amount from 2007. CEZ is a former monopoly which is also currently owned by state. European commission is conducting an investigation for alleged competition hindering practices, as of August 2011[44]. Judging from the concentration of the Czech electricity market, incumbent suppliers remain very strong which would implicate market power potential. Data on supplier changes are analyses next in order to gain more insight in the degree of competitiveness of markets.

5.2.2. Slovakia

Markets share of incumbents (ZSE, SSE, VSE) is sinking, as the report of URSO regulator shows. In 2008 their cumulative market share reached 57,7%, 56,4% in 2009 and 52,1% in 2010[45]. In this regard the unbundling and liberalization was effective in dilution of market concentration since almost 50% of the market in Slovakia is serviced by alternative suppliers. More problematic is the structure in generation where Slovenske elektrarne (SE) maintain 84% market share, with numerous small, predominantly local generators. However there is relatively large share of hydropower in Slovak energy mix. Hydropower is specific in the aspect, that it is storable to certain level. This feature decreases the probability of market power exercise[46] since it can be supplied to energy grid during peak hours when the generation is running at its full capacity.

5.3. Customer behavior – switching

5.3.1 Czech Republic

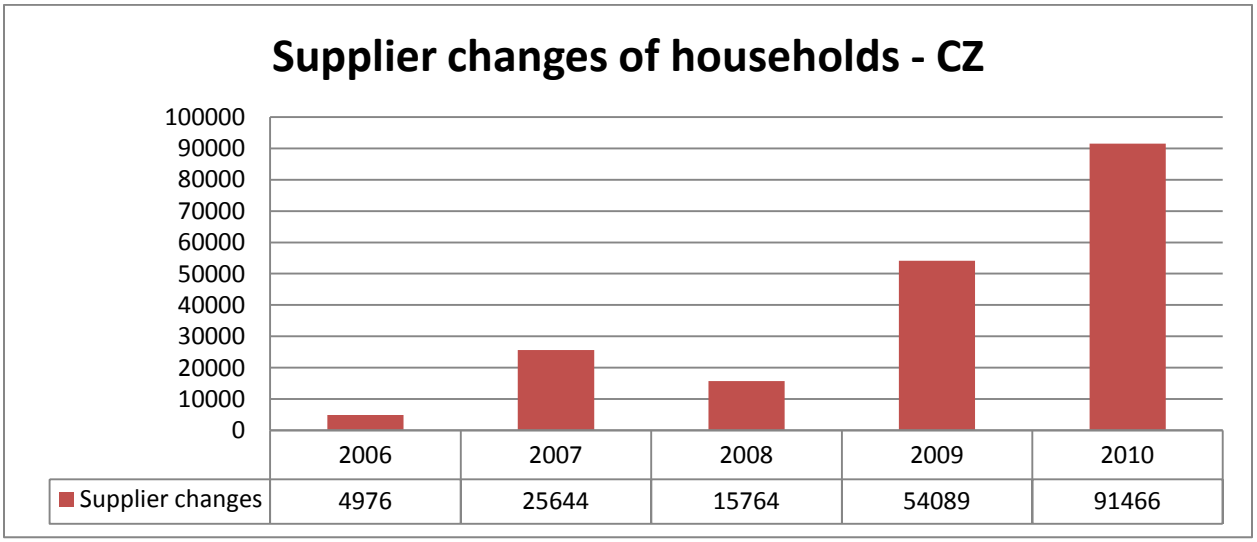
In Czech Republic it was possible for households to switch their energy provider from the beginning of year 2006, however only relatively small amount of households – 4,976 – did so in the same year. Switching of households rose gradually and soared in 2010 where nearly 91,466 households changed their supplier. Industrial customers were more numerous, switched earlier

[43] http://ec.europa.eu/energy/energy_policy/doc/factsheets/market/market_cz_en.pdf
[44] http://www.energia.sk/clanok/elektricka-energia/europska-komisia-opat-presetruje-konanie-cez-u/4095/
[45] SEPS, Annual Report 2009 and Annual report 2010
[46] Bergman, 2009, 12

and more in the sum. Taking into account the number of private households in Czech Republic, as officially stated in EUROSTAT (Number of private households 4,216,085) this corresponds to a switching rate of 5.9%. The numbers of 2011 are preliminary (published as a news release by the market operator OTE), however report an exponential growth that is represented by double the amount of customers switching their supplier in the first six months of 2011 than in the previous year. In Czech Republic, customers' reaction is relatively slow coming 4 years after the first introduction of the possibility of switching, which can be connected to resolution of issues and higher presence of alternative providers.

Although legally there is no switching fee, in reality some alternative suppliers charge a so called "activation fee" which depends on the company, chosen tariff and annual consumption[47]. It can be as high as 600 KC[48] (approx. €25). In order to balance this fee out, they provide special offers where for example there is a fixed price for electricity from 1.1. to 31.12. of the respective year, or a floating price which linked to prices on wholesale markets and changes on monthly basis. ČEZ offers a possibility to purchase electricity for a whole year ahead[49].

Figure 2: Total annual changes of supplier – households in Czech Republic



Source: annual report of Energy Regulatory Office[50]

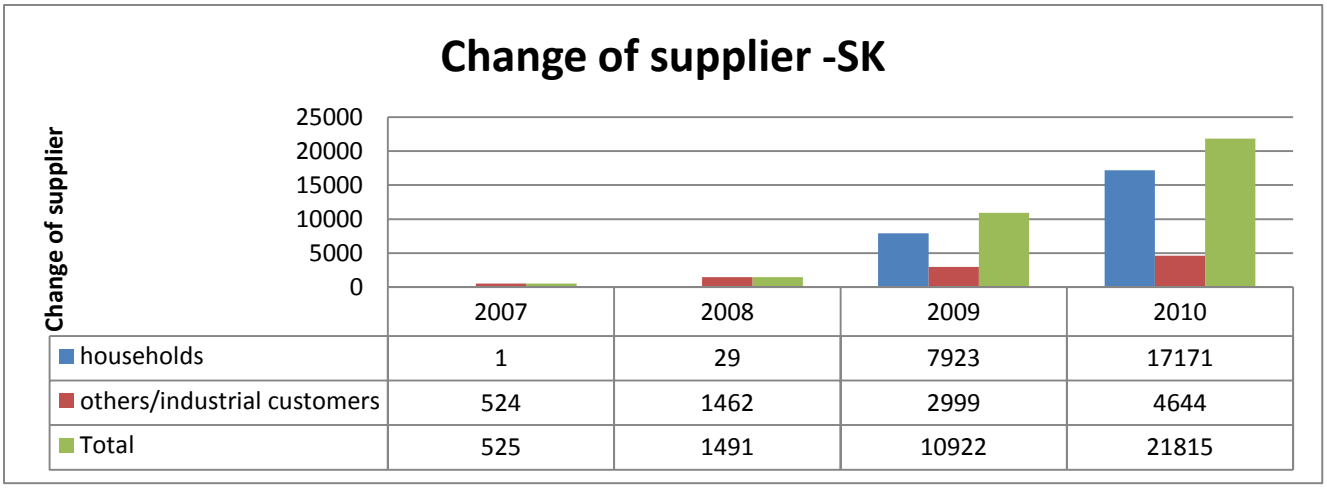
[47] http://www.cenyenergie.cz/elektrina/clanky/aktivacni-poplatek-za-zmenu-dodavatele-muzete-zaplatit-i-tisic-korun.aspx
[48] KC stands for "Korun ceskych", Czech Crowns
[49] http://liberalizace.nycor.cz/text/liberalizace-trhu-s-elektrinou-v-cr.html
[50] ERU, Annual report 2010, 20

5.3.2. Slovakia

From 1st of July 2007 every customer has the freedom to choose their electricity supplier, with price being one of the important factors. The reaction in Slovakia was even slower than in its western neighbor when in the first year of fully liberalized markets only 1 household changed its supplier. Consumers started to respond to this possibility in larger extent two years later, while the numbers in 2010 reached double the level from previous year.

There have been several issues from the beginning and remain negatively influencing the willingness of customers to switch their supplier. One of the main concerns of customers, which explain why most customers remain with their supplier, is energy supply stability, lack of service quality, payment and technical competencies, overall riskiness and rating, flexibility of amount, capacity, customer and technical service etc.

Figure 3: Total annual changes of supplier by type of customer - Slovakia



	2007	2008	2009	2010
households	1	29	7923	17171
others/industrial customers	524	1462	2999	4644
Total	525	1491	10922	21815

Source: Based on annual reports of the regulatory office (URSO)

5.3.3. Reasons for a change

Customers consider several aspects when switching, besides electricity price also quality of customer service (consulting, approach, individual offer, term conditions, complex supply and distribution services etc.). The regulatory office believes that majority of firms have set their

tariffs inefficiently and incompatibly[51], which generates addition costs and makes firms less competitive.

5.3.4. Best practices of liberalized markets

The best case can be currently observed in Norway[52]. The features of the policies that contributed to high level of competition in the retail market are as follows:

• Free entry on the supplier side
• Low degree of supplier concentration
• Transparent prices and conditions for electricity offered
• Free choice of supplier and contracts
• No charge for switching supplier

The design of Czech and Slovak retail market is very similar. The entry on the supplier side is only hindered by initial capital costs, but is not restricted which can be also documented by the switching rate and rise of alternative providers. Information on prices is publicly available (on power exchange in Prague), there are several online calculators that make it easy and quick to compare available offers and calculate the cost. There is no charge for switching supplier, although one fraction to this prerequisite is the activation fee in Czech Republic. Regarding supplier concentration both in Czech Republic and Slovakia there are regionally present incumbents who remain strong. In order to further support effective functioning of electricity markets, it is necessary that[53]:

- the process of supplier change is kept simple
- suppliers adhere to technical standards since there have been repeated problems with their competencies and readiness as well as problems with electrical data exchange
- prevent from misuse of dominant market position, false advertising and dishonest practices of direct selling, when the sales force uses inaccurate information in effort to sign as many customers as possible
- availability of information of customers is sufficient

[51] URSO, Report on gas and electricity markets 2010, 15
[52] Bergman, 2009, 13
[53] URSO, Report on gas and electricity markets 2010, 15

Liberalization in Czech Republic and Slovakia meant privatization of former state owned monopolies whereas these were acquired by foreign investors. In the case of Slovak distribution companies, these are partially owned by foreign investors (RWE, E.on, EDF), who hold 49%. Enel SpA also controls the dominant generator Slovenske Elektrarne. The Czech provider ČEZ is dominant in domestic market and increasing in importance in the Slovak. Although numbers show that incumbents were losing market share the possibility of foreign investors to acquire shares enabled the biggest energetic companies to extent their portfolio and penetrate markets that were up to that point completely closed and serviced by national monopolies. In fact, as the market share in the relevant national market decreases the presence of energetic giants across the internal European market increases making them more influential in the whole European market.

The concentration is a good approximate for market power. However it is highly vague to conclude, whether the potential for market power exercise really leads to distortion of market competition. Market power can be beneficial under certain circumstances. The structural characteristics alone, "indicate potential market power rather than the actual exercise of market power". Concentration of sellers must be accompanied by entry barriers for the incumbents to be able to exercise of market power over long periods and low price elasticity of demand. We have seen that Czech and Slovak customers are slow in reaction and do not respond immediately to rising prices by change of supplier. However market competition does not necessarily have to be hindered if concentration increases but small generators are able to compete. By definition lower competition leads to higher mark-ups, which in turn attract more market entries. If the entry costs are low enough, in long term period the concentration should decrease.

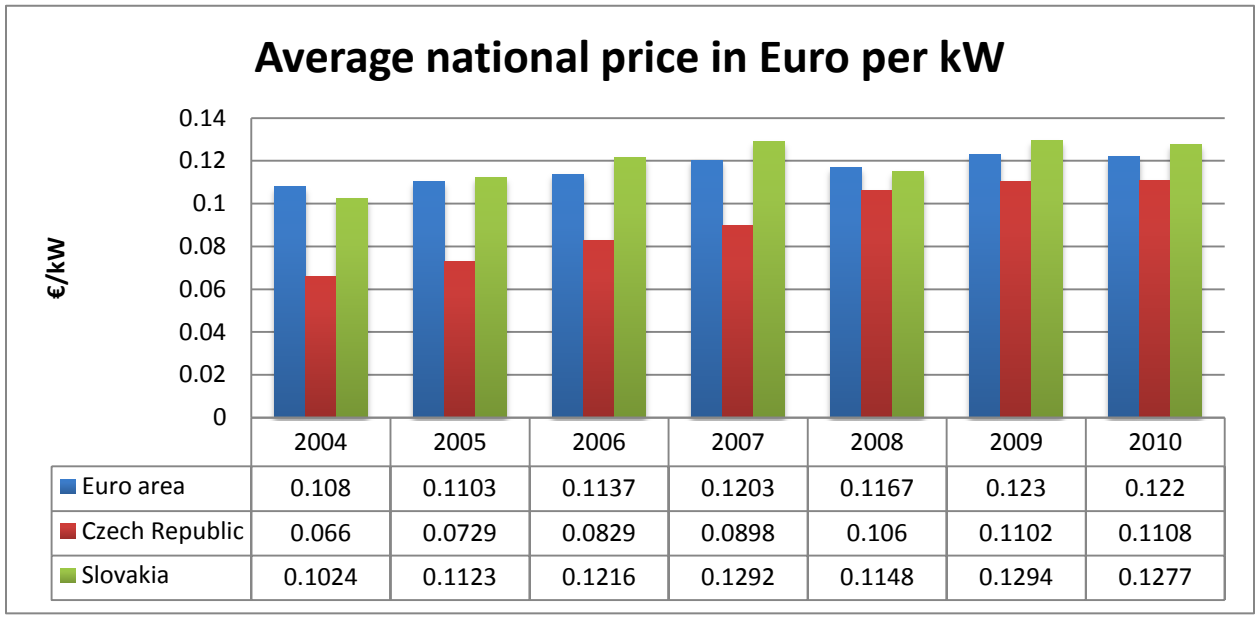
Although the structure in both countries is very similar the major difference lies in the role of state / government in the industry. In Czech Republic CEZ remains to be state owned and controlled with largest distribution area (which is also disproportional to the other distribution areas) and therefore major influence on the market. As previously mentioned, market power can be exercised if there is not sufficient capacity for cross border trading, elimination of domestic competition alone is not sufficient. However this relates only to wholesale prices which are determined by the market. Regulated fees – mainly fees for distribution which constitute the largest part of regulated fees - are determined by governmental offices and therefore are intact by

competitive environment In this case the engagement of the state in the industry, where it also controls e.g. fees for distribution which are strictly local, plays a significant role. In the next chapter we will analyze the data on electricity prices, including regulated fees and deregulated prices of active energy in order to identify crucial factors that determine different electricity prices for households.

6. Electricity price

The prices of electric power in Czech Republic and Slovakia have been different. There are differences in the retail price for end customers as well as in the wholesale price on the spot market. The data represented in the Figure 4 below refer to average electricity prices free of value added tax for households with average annual consumption between 2500 MWh and 5000 MWh, as reported by EUROSTAT. Most statistics available in the annual reports by Czech and Slovak regulatory offices and annual report of their TSOs use a model household with lower annual consumption of below 2500 MWh. While Czech Republic does not reach the price level of Euro area, Slovak prices have exceeded the European average in year 2005 and have been copying this trend also in the following years.

Figure 4: Average national electricity price for households (annual consumption 2500-5000MWh)



	2004	2005	2006	2007	2008	2009	2010
Euro area	0.108	0.1103	0.1137	0.1203	0.1167	0.123	0.122
Czech Republic	0.066	0.0729	0.0829	0.0898	0.106	0.1102	0.1108
Slovakia	0.1024	0.1123	0.1216	0.1292	0.1148	0.1294	0.1277

Source: EUROSTAT

Prices in both countries are continually rising despite ongoing liberalization of energy markets whereas this trend is copying the development of primary resources prices, like oil and natural gas on world markets. What is surprising is the price difference, which is somewhat significant, between historically connected economies of Czech Republic and Slovakia. In the following chapters author aims to target and explain the difference of prices based on analysis of

generation costs (energy mix) influencing wholesale prices, fees and surcharges for transmission and distribution influencing retail prices and competitiveness of markets which influences the final mark-up.

The final price of electricity for the customer consists of what can be divided into two very specific parts[54]:

1) the price of active energy – including generator's profit margin, also considered the wholesale price – which is not regulated and depends on cost of generation (therefore are influenced by energy mix and naturally type of source used).

In Czech Republic this accounts for 40-60% of final price of electricity supply (depending on yearly consumption and customer category). In Slovakia this is approximately 50% of the final price[55]. Base load electricity is traded on wholesale markets (like Power Exchange Central Europe– PXE - or EEX in Germany) and responds to demand and supply at the markets. The final suppliers (either traditional or alternative) are able to buy their electricity either directly from the generator on contractual base, or to buy it on wholesale markets, like PXE. There are several possibilities how to set up a tariff. There can be a single tariff where the electricity price for customer stays the same throughout the whole day. Another possibility is to have different time of day tariff: different tariff during day (peak) and during night (off- peak); low or high tariff etc.

2) regulated fees and charges, that are on yearly basis determined by the regulatory offices – ERU in Czech Republic and URSO in Slovakia. The structure of fees is rather complex and although very similar for both countries, it differs in the principle by which the fees are grouped into charges paid by the final customer for electricity supply.

In this regard, the market is liberalized. The only exception from market price creation were in year 2010 customers with annual consumption lower than 30MWh. In this case the Regulatory Office for Network Industries set the final price[56].

[54] ERU, Annual Report 2009, 20

[55] http://www.finance.gov.sk/Components/CategoryDocuments/s_LoadDocument.aspx?categoryId=7857&documentId=5677, 2

[56] http://www.euractiv.sk/energetika/clanok/ceny-elektriny-v-europe-odolavaju-chladnemu-pocasiu-016434

7. Wholesale prices

Electric energy is very specific due to the lack of storability. This feature calls for strong coordination among market subjects and increases the complexity of challenges the liberalization of European markets faces[57]. The overall goal of EU is to create one internal electricity market. This would mean that any customer is free to choose her supplier and is not limited by location or the country borders, which delivers higher variation and more choice between offers. This arrangement would mean higher cross border competition, higher cross border trading[58]. Ultimately, it facilitates arbitrage which leads to equalization of prices and fosters production efficiencies.

Integrated European market is facing several challenges with one being the physical constraints on cross boarder transmission capacity. In most cases were these capacities designed to ensure stability of transmission network in respective countries and security of delivery. The very restricted possibilities of electricity storage also mean that there must be equality between produced and consumed electric energy and any given point in time. For this, existence of spot markets are essential, where residual electricity can be traded and regulating energy purchased, in order to keep balance between generation and load. Market prices then contain information and serve as a clearing tool.

7.1. Power exchanges

There are two power exchanges that are relevant for wholesale prices in Czech Republic and Slovakia – Power Exchange (hereinafter "PXE") in Prague and more liquid German European Energy Exchange (hereinafter "EEX"). Power exchange in Prague is 100% subsidy of Prague stock exchange and was established in January 2007. The trading with Czech electricity started more than half a year later in July 2007. Under liberalization and integration tendencies, Slovak electricity began to be traded in October 2008 followed half a year later by Hungarian electricity[59]. PXE remains to be the reference framework for wholesale prices in the Central European Region. Except physical assets there are also financial assets – financial futures –

[57] Oggioni, 2010, 3
[58] http://www.marketcoupling.com/market-coupling/Benefits%20of%20market%20Coupling
[59] http://www.pxe.cz/dokument.aspx?k=Co-Je-PXE&language=english

being traded as of February 1st, 2010. Futures remain to be the most significant product traded on PXE – in 2010 amount of traded futures reached 24.3 million MWh, whereas the spot market accounted for only 83.8 thousand MWh[60].

The German European Energy Exchange is based in Leipzig, Germany and is a reference exchange for wholesale electricity prices for PXE and central European region. It was established in 2002 after merger of exchanges in Leipzig and Frankfurt in an effort to create a single marketplace[61]. Currently electricity (day ahead and intraday trading), natural gas, emission rights (day-ahead trading) as well as respective financial derivates (futures and options) are being traded on EEX.

Short term electricity markets can be divided into[62]:

- Block market[63] involves trading blocks of different types: base (0:00–24:00), peak (8:00–20:00) and off-peak (0:00–8:00; 20:00–24:00). The trading starts 5 days before delivery and closes at 13:00 one day before the delivery (which corresponds with the deadline for closing bilateral trading.). Enables continuous trading.

- Day-ahead market – market subjects trade on day D-1 or D-2 capacity or volumes for day D. The shortest trading period in Czech Republic is one hour – this enables market subject to trade for each hour of the days which translates into 24 markets.

- Intraday market – usually after closing day ahead markets for the respective day, intraday market opens (in Czech Republic as of 2009 this trading opens at 3 p.m. the day before[64]) which enables the market subjects to trade anonymously volumes for the same day. Intraday market closes latest hours or minutes before realization of the contract (e.g. delivery of electric energy, in Czech Republic the deadline is 1.5 hours ahead).

[60] Annual Report Prague Stock Exchange 2010, 36
[61] http://www.eex.com/en/EEX/EEX%20AG
[62] Chemisineč, 2010, 45
[63] OTE, Technical Report 2010, 57
[64] OTE, Technical Report 2008, 30

In Czech Republic, following trading tools are used[65]:

- Bilateral trading (including exchange intra-state contracts)
- Organized short-term market
    - block market
    - day-ahead spot market
    - intra-day market

In 2010 more than 97% of electricity was traded in form of bilateral contracts[66], these include traditional and exchange intra-state contracts, as well as contracts for import and export. The role of market operator is exercised by OTE a.s. There has been a significant increase in traffic especially on the intraday market in connection with the increase of unpredictable RES in the energy share. OTE reports[67] that trading volume from January to March 2011 increased 5 times in comparison with the same period of previous year. This indicates development of the market, more activity among market subjects, increasing transparency, information value, relevance and liquidity.

In Slovakia, the trade with electricity is very similar and can take these forms[68]:

- over the counter bilateral trading – non-public,
- brokerage platforms, mostly anonymous internet platform e.g. TFS, ICAP, GFI, Spectron or SPX
- power exchange (EEX in Leipzig or less liquid PXE in Prague)
- auction system – Czech Republic and Slovakia use market coupling to connect their day markets

In 2010 approximately 8% of electrical energy was traded on wholesale market[69] and fluctuates around 10% of total production. This numbers reflect the volatility of production from

[65] Ibid. 30
[66] Ibid, 30
[67] http://www.ote-cr.cz/about-ote/OTE_news/petinasobny-mezirocni-narust-obchodu-na-vnitrodennim-trhu-s-elektrinou-ote
[68] URSO, Report on gas and electricity markets 2010
[69] SEPS, Annual report 2010, 132

hydropower and possible interruptions in production of other sources in the region.[70]. Until recently, there has been no organized marketplace in Slovakia. On 5.11.2008[71] the transmission system operator SEPS was appointed to organize the short term and remained in this position until 1.1.2011 when a newly established entity OKTE took over. Because of the size and struggle with liquidity of the Slovak market daily import and export is inevitable.[72] The market operator is also responsible for imbalance clearing. Imbalance is defined as the difference between the commitment supply electricity to the system and the commitment to take electricity from the system[73]. This is done in order to keep the system in balance at every given point in time. In case there is a negative imbalance (lack of energy), regulation electricity is supplied to the system by system operator. The cost of such additional energy is then born by the inflictor of negative imbalance. In case of positive imbalance, residual electricity that is not subjected to annual bilateral contracts is being traded on short term basis on intra-state spot market, foreign markets, mainly via brokerage platforms. The day-ahead market with electricity functioning as market coupling should be expanded to involve Hungarian market as well and connect with the regionally integrated market of Western Europe in the future.

7.2. Cross border trading

Although relatively small percentage of electricity in Czech Republic and Slovakia is being traded on exchanges, this practice is essential for further development of competition and fair prices for end customers. The best practice in order to enable more competitive environment is to integrate regional markets that increase the geographical extent of the relevant market as previously seen in Nordic countries[74] which in turn decreases concentration. More importantly it facilitates arbitrage and therefore price convergence, it enables market subjects to operate more efficiently. Especially for markets in Slovakia and Czech Republic the integration enables a trivial thing – profiting from economies of scale and availability of natural resources that are limited in the other country. European Market Coupling Company (EMCC), company operating in central Western Europe that allocates cross border capacities in implicit auctions, states that

[70] URSO, Report on gas and electricity markets 2010, 5
[71] SEPS, Annual report 2010, 125
[72] Ibid., 6
[73] OTE, Technical Report 2010, 23
[74] Bergman, 2009, 10

the benefits of cross-border competition [75] to be the maximization of total economic surplus of all participants. Since prices are based on where demand meets supply, fair and competitive prices serve as signaling tools to both customers and producers and enhances efficient consumption and production.

Arbitrage takes place when there are price differences in participating countries. While arbitrage is highly desirable, it can have counterproductive effects as well. By definition it only increases welfare if the incumbent does not significantly restrict supply, which is not the case of electricity markets because of the restricted transmission capacity.[76] In this particular case it allows the arbitrageurs to trade electricity from the low-price region to the high-price region which improves the allocation efficiency among end users but decreases production efficiency since it shifts production to the high-price region[77]. Ability of incumbents to exercise market power plays a decisive role in determination, whether market coupling really leads to better allocation of resources and increase in welfare. Similar results are concluded by a study based on simulation of already partially integrated electricity markets in Benelux[78]. The question is which one of these effects – increase of allocation efficiency among customers or decrease of production efficiency prevails. To summarize the findings of previous studies this implies two important prerequisites for efficient arbitrage:

1) market power of incumbent is broken down at least in one of the two markets[79],
2) interconnector capacity is large enough to allow arbitrage (via cross border trading) that would equalize the prices in adjacent countries[80]

Due to condition number (2), the reduction of physical bottlenecks remains a necessary condition for market integration[81].

[75] http://www.marketcoupling.com/market-coupling/Benefits%20of%20market%20Coupling
[76] Küpper, 2007, 42
[77] Ibid, 42
[78] Hobbs, 2005, 29
[79] Ibid., 43
[80] Bergman, 2009, 8
[81] Oggioni, 2010, 20

7.2.1. Explicit auctions

Since the physical capacity of cross-border lines is very scarce the first attempt to assign this capacity in a transparent manner, in line with the principles of liberalization were explicit auctions[82]. These auctions were based on bilateral or multilateral agreements among neighboring transmission system operators (TSOs), where market subjects can auction off the available daily or hourly capacity. The disadvantage of explicit auction is that the market subjects must auction off the transmission capacity separately from the marketplace where actual electricity is bought/sold. In practice bids for the capacity auction are submitted before energy prices are posted on the stock exchange[83]. This practice results in separation of information about the prices on spot markets and can lead to inefficient utilization of the connectors when the acquired transmission capacity does not correspond with the actual physical cross border flow.

7.2.2. Implicit auctions

This is the reason why implicit auctions were introduced where the market subject auction off the transmission capacity along with respective volumes of electric energy. There are several forms of implicit auctions implemented currently discussed below.

7.2.2.1. Market splitting

If there is only on power exchange handling implicit auctions for all participating countries we describe this arrangement as market splitting. Market splitting is currently executed in e.g. Spain and Portugal (Iberian peninsula)[84] and Nordpool[85]. In the Nordic region the transmission capacity is auctioned off on a day-ahead basis with the results incorporated in the following spot prices and trading. Main advantage of this arrangement is that there is only one entity managing the marketplace with one set of rules eliminating the risk of price or volume discrepancies, increasing information efficiency and social welfare. Because of these it is expected that European market, especially national markets who implemented price coupling, may evolve towards market splitting.

[82] Chemisineč, 2010, 148
[83] Hobbs, 2005, 27
[84] http://www.omel.es/en/inicio
[85] http://www.npspot.com/PowerMaket/The-Nordic-model-for-a-liberalised-power-market/Implicit-auction/

7.2.2.2. Market coupling

Further possibility is market coupling. Market coupling is currently executed in Netherlands-Belgium-France, with plans to include Germany and Luxemburg in the near future. This form of implicit auction was implemented in September 2009 between Czech Republic and Slovakia[86].

We differentiate price coupling and volume coupling. Under market coupling respective markets are handled by respective market organizers cooperate in organization of implicit auctions. Market operators use a market coupling algorithm. There are various mathematical approaches used in calculation of the optimal outcome and assignment of capacities. The more participant, the more complicated algorithms are being used

Price coupling includes all data and rules of participating exchanges and delivers volumes and flows between bidding areas based on the prices. Market splitting is commonly recognized and a form of price coupling[87]. The results of volume coupling are however only volumes and cross border flows between bidding regions. This information is then forwarded to the marketplace operator that calculates the prices and volumes for the respective part of the market. This method is associated with relatively higher risk. It takes certain amount of time when the market is waiting for the results of the first auction, the risk of price or volume discrepancies is higher which is accompanied by the risk of incorrect cross border flows.

Effective arbitrage allowing markets clear energy and transmission rights simultaneously at spatial level, however this is not the case currently in Europe[88]. Market coupling is considered the best approximate for such organization of markets, however embodies a major drawback. It provides a simplified representation of the electricity grid, based on which national power exchanges clear multi-national energy markets. This in turn creates incomplete market, since the traded volumes do not necessarily correspond with physical capacity. TSOs then, if any overflows arise, undertake counter-trading operations in order to rebalance the whole system

[86] http://www.energia.sk/clanok/elektricka-energia/cesko-slovensky-spotovy-trh-s-elektrinou-existuje-uz-rok/0650/
[87] Chemisineč, 2010, 150
[88] Oggioni, 2010, 3

which is one way of dissolving the resulting congestions[89]. Within this means TSOs perform an arbitraging function.[90]

7.2.2.3. Market coupling in Czech and Slovak Republic

Market coupling between Czech Republic and Slovakia is a response of the initiative of European market coupling company (hereinafter "EMCC") and is fully in line with European legislation ((Regulation ES 1228/2003 and policy 2005/89/ES) [91]. The energy trade between these countries has been historically very intense, with companies operating in both countries and with Czech Republic having the position of net exporter of electrical energy. The necessary condition for market coupling was the existence of marketplaces in both countries. While Czech Republic had established market organizer – OTE, a.s., in Slovakia the transmission system operator SEPS (Slovenská elektrizačná prenosová sústava) initially was authorized to exercise this role. The connection of Czech and Slovak markets is first of its kind in central and eastern European region.

The main improvement the established cooperation brings is the opportunity of market subjects to buy and sell electricity on both national markets. Resulting benefits from this organization of market is higher daily liquidity, higher accessibility, lower risk from trading electricity and transmission capacity separately. Slovak market subjects also acquire access to spot market with stabile levels of liquidity. The ultimate goal is to secure stability and security of both electricity markets. As a result there is one market price for electricity for both countries, taking into account the cross border transmission capacity. If there is not enough transmission capacity the prices on the market can differ.

The main expected advantages of market coupling are:

- Better utilization of cross border capacities,
- Higher liquidity and transparency of spot markets, more clarity about price setting for customers,
- Convergence of prices and lower volatility

[89] Ibid., 5
[90] Hobbs, 2005, 11
[91] Ibid.

- Elimination of speculative market operations
- Elimination of risk resulting from separate bidding for electricity and for transmission rights (vacant capacity)

7.2.2.4. Congestion management – CZ/SK profile

As previously mentioned allocation between Czech Republic and Slovakia runs via implicit auctions in cooperation with operators of the day-ahead electricity markets. Since 1. 1. 2010 the transfer capacity between these two countries were not allocated on annual/monthly basis but exclusively via auction. Market subject could submit their offers until 10 a.m. 2 days before the day of delivery[92]. The capacity of CZ/SK interconnector is sufficient for trading (transfer capacity 3x400kV and 2x220kV lines) however import to Czech Republic is limited due to bottlenecks within Czech network[93]. Congestion management is an integrated part of market coupling, however the interconnector itself does not seem to hindering cross border trading. One explanation is the fact, that the transmission network in Czech Republic and Slovakia was initially built as one single network, since these two countries used to be one state (until the split in 1993). Secondly, Kirchhoff's laws imply that flows will be split between parallel paths. Due to this the actual electricity flow will always be lower than the physical capacity enables[94].

Czech Republic, as major exporter of electric energy previously experienced congestions on German and Austrian border. Capacity on the ČEPSAPG (Austria) interconnector was allocated on a bilateral basis. The transfer capacity of other interconnectors is being auctioned off in Central Allocation Office in Freising, Germany. The Office organizes coordinated auctioned for five TSOs in the central European region: 50Hertz and transpower/TenneT (both in Germany), PSE Operator (Poland), SEPS (Slovakia) and ČEPS (Czech Republic)[95].

[92] SEPS, Annual Report 2010, 126
[93] http://www.sepsas.sk/seps/TlacSprava2009_8_18_en.asp?Kod=125
[94] Hobbs, 2005, 10
[95] CEPS, Annual Report 2010

7.3. Empirical evidence on market coupling in Czech Republic and Slovakia

Despite market coupling final electricity prices in examined countries differ. Under market coupling, wholesale day-ahead trading yields one price for Slovak and Czech market. The only situation where prices differ is the case of congestion. In case that the result of market coupling for Czech and Slovak markets is a physical flow of electricity that is insufficient, markets decouple: each market is evaluated separately with highest possible level of optimizing. In this case two different prices result with the higher price assigned to the importing region in respective period. The price difference times the total flow of electricity is then divided between system operators as a fee for management of bottlenecks[96]. The intuition behind different prices then would be that Slovakia, as importing country is experiencing higher prices during congestion periods which would explain the differences of final prices for customers.

Czech Republic and Slovakia should be able to benefit from the fact that while these two used to be one country – Czechoslovakia – in the past, the transmission lines were built as for one state. Reserved capacity according to the data from Czech market operator as high as 3100 MW, however as SEPS reports, the interconnector itself is strong enough and the physical flows in 2009 were well beyond its capacity[97]. Nevertheless, actual data will be analyzed in order to determine how often "decoupling" followed by different prices appears, as result of insufficient cross-border transfer capacity.

We examine three hypotheses:

Hypothesis Nr.1: Congestion on the CZ/SK interface is rare, therefore markets can work effectively, cross border trading and resulting arbitrage is enabled

Hypothesis Nr.2: Price volatility decreases after introduction of market coupling, since the relevant markets are extended, as a result liquidity increases.

Hypothesis Nr.3: Considering market coupling Czech Republic is a net exporter of electrical energy to Slovakia.

[96] SEPS, Annual Report 2010, 125

[97] http://www.sepsas.sk/seps/TlacSprava2009_8_18_en.asp?Kod=125

7.3.1. Data

The data used for this purpose are publicly available data on prices and volumes published by the by Czech market organizer, OTE, a.s. on the official web site http://www.ote-cr.cz/statistics/yearly-market-report?set_language=en. Available are hourly data on prices, volumes, prices, assigned and utilized cross-border capacity and profile price (in EUR/MWh) from 1.1.2009 to 30.7.2011. Also another set of data from the same source is used for computation of descriptive statistics for year 2008.

7.3.2. Method

First, we will find out, how often market decoupled by identifying such events in the sample, when assigned capacity was fully utilized, although not necessarily resulted in different prices on Czech and Slovak markets. We compare data on "assigned capacity" with "utilized capacity" in Microsoft Office Excel program. The results should either confirm or refuse hypothesis #1.

Furthermore descriptive statistics will be used in order to find evidence of efficiently functioning of the markets and verify hypothesis #2. One of the assumptions that we want to verify is whether price volatility decreased after trading was extended to larger geographical area and involved larger number of market participants. Volatility is calculated as standard deviation of respective daily average prices. Although we have hourly data available, we use daily averages in order to avoid bias since electricity prices are strongly seasonal (price electricity is lower at night, when the demand is usually very low and higher during day).

Similarly we use descriptive statistics to verify hypothesis #3. We determine hours and assign the characteristic – exporter or importer to respective country. We then determine which characteristic is prevailing for each country, based on the data from market coupling. Furthermore we examine average and total volumes traded and calculate the share of both countries on total trade. This will enable us to determine whether Czech Republic plays the role of electricity exporter also on the short term organized market.

7.3.3. Findings

Observable market decoupling

Based on the available data, the assigned capacity was fully used 12 times (which translates to only 12 hours) in 2009, 30 times in 2010. This state did not occur in the first six months of 2011. Despite the insufficient capacity and market decoupling, different prices were recorded only in 2 cases out of 12 (in 2009) and 21 cases out of 30 (in 2010). Such situation can arise when the marginal price is determined based on the last accepted offer, with no follow up offer exists that would shift the price (in comparison to the price is exporting area). The results are summarized in *Appendix 3*. Judging from this evidence, market coupling does not suffer from physical constraints of cross-border interconnectors and contributes to efficient functioning of the markets. Hypothesis #1 can be confirmed. Market coupling between Czech Republic and Slovakia functions without any significant problems due to lack of capacity, arbitrage is enabled and fostered in this situation.

Volatility

Further we tried to verify the hypothesis #2 that market coupling leads to lower volatility in prices. We calculated standard deviation of average daily spot prices. In 2009 we divided the sample into 2 parts. Part one (noted 2009/1 in the table below) comprises before market coupling time period from January until August. Part two (noted 2009/2) comprises months September until December, when market coupling is already in effect. The results are summarized in the table below. We also analyzed available data for current year 2011 which comprises months January until June.

Table 2: Standard deviation of market prices (volatility)

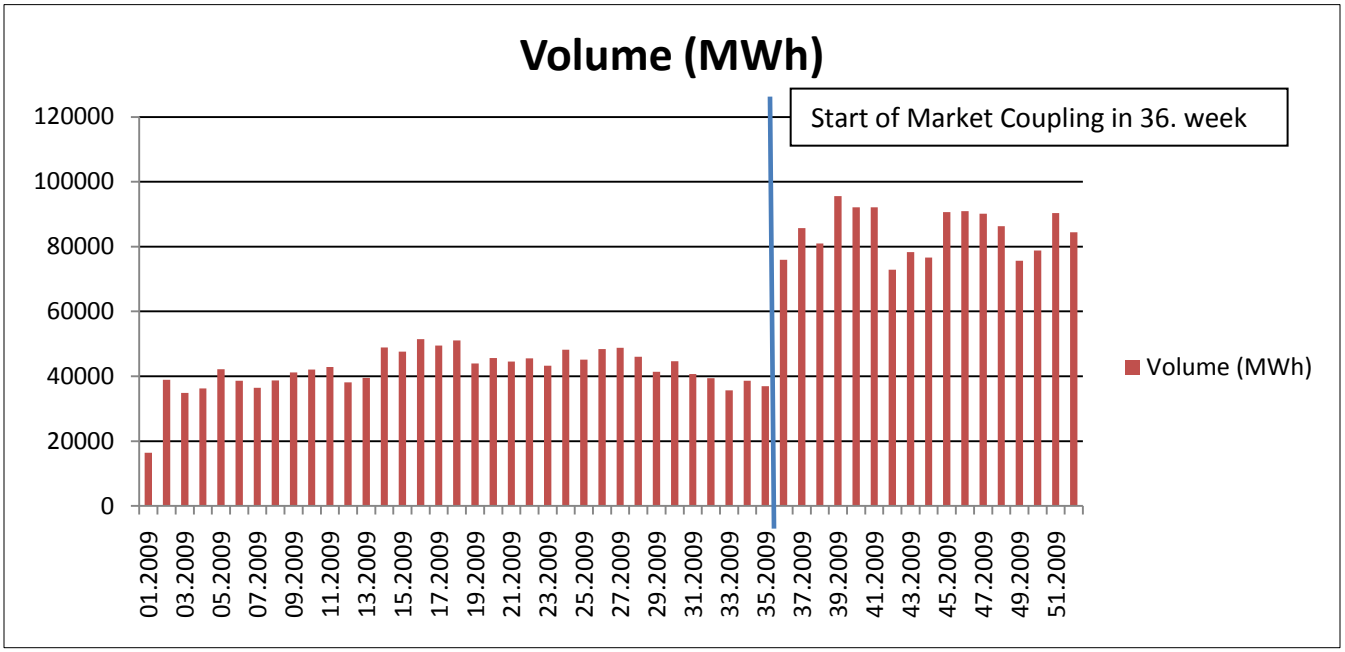
	2008	2009/1	2009/2	2010	2011/1
Czech Republic	18.4	10.71	10.02	8.92	7.6
Annual decline		41.79%	45.54%	10.98%	14.80%
Slovakia	n/a	n/a	10.59	8.88	7.6
Annual decline	n/a	n/a	n/a	16.15%	14.41%

Based on the evaluation of results, we can confirm hypothesis #2. Volatility declined by 45.54% in Czech Republic in the first three months of market coupling, compared to the previous year's level. The slight differences in the price volatility of both countries can be explained by different prices as a result of congestion and following market decoupling.

Liquidity

The impact of market coupling on the market is observable also in the increase of traded volume on the Czech day-ahead market and immediate liquidity. Market coupling became effective in the 36. week of 2009 which corresponds to the jump in the traded value, as depictured on the graph.

Figure 5: Liquidity of day-ahead market as traded volume in MWh



Source: based on OTE a.s. data

The increase in liquidity is also apparent from the data on average hourly volume traded. While before market coupling the average hourly traded volume for the first 35 week was 253.95MWh, after introduction of market coupling the same characteristic climbed to 503.24MWh which corresponds to an increase of 49.53%. The entry of Slovak market subject was accompanied by

further entry of other market participants – on Czech side as well as a direct result of market coupling, following higher liquidity, higher information value and credibility.

Cross-border flows

In hypothesis #3 we were attempting to establish one of the countries as a net exporter and validate Czech Republic as an exporter also in short term market – although it represents a relatively small fraction of the total electricity market. We identified following criteria:

- Total volume traded, volume exported by Czech Republic, volume exported by Slovakia (since it is market coupling Czechs export to Slovakia only and vice versa)
- Hours in which one country was a net exporter (also dominance on the market)

The results are summarized in Table 3 below. By analyzing the data on cross border flows the exporting position of Czech Republic could be confirmed. From the point of traded volumes, approximately 73% of traded electricity is being traded in the area of Czech Republic in 2009, with 58% in 2010 and almost 76% in the first half of 2011. This confirms the dominant position of Czech Republic in the common market and dependence of Slovakia on electricity import.[98].

Table 3: Data on importing/exporting position of the respective countries

		2009	2010	2011
Volume	Amount traded (MWh)	532,601.50	1,702,249.3	1,157,169.3
	Czech Republic - exporting	72.79%	58.31%	75.86%
	Slovak Republic - exporting	27.21%	41.69%	24.14%
Hours	Hours traded	2,902	8,759	4,343.0
	Czech Republic - exporting	66.64%	58.65%	66.94%
	Slovak Republic - exporting	33.36%	41.35%	33.06%

The prevalence of Czech export becomes apparent also by looking at the data that determine how often (meaning on which trading hours) did the country took the exporter position. In 2009 and 2011 – who are years when the data available are only for parts of the years (2009 from

[98] OTE, Technical Report 2010, 59

September and in 2011 until June which is documented also in the column "hours traded" in the Table 3) – Czech Republic is exporting in 2/3 of cases, leaving the exporting position to Slovakia in 1/3 of all cases. In 2010 Czech Republic is still a dominant exporter but the difference is relatively smaller compared to the other two years.

Czech Republic is also trading higher volumes and contributes therefore with larger weight to the short term market. The average hourly cross border flow from Czech Republic is significantly larger than in the case of Slovakia – see Table 4 below.

Table 4: Average cross border flows

Average cross border flow - respective country exporting to the later country in MWh			
	2009	2010	2011
Czech Republic	132.4	113.3	202.1
Slovak Republic	49.5	81	64.3

Hours in which respective country was a net exporter			
	2009	2010	2011
Czech Republic	1,934	5,137	2,907
Slovak Republic	968	3,622	1,436

The efficient functioning of market coupling can be supported by further evidence: number of market participants is increasing (from 22 in 2009 to 33 in 2010[99]) and the amount of traded volume in Slovak republic is significant - 8% of total consumption. Although establishment of a functioning market coupling in a rather short time could be considered a success, more investment in the network capacity is needed in order to extract all potentially positive effects[100] over long term.

Price convergence

Since one price for both geographical areas is a sign of effective market coupling we will use another set of data on prices from the Power exchange Central Europe in Prague in order to determine whether price convergence takes price. The data we analyze here are publicly available daily data on 1-year electricity supply futures that are traded on Power Exchange

[99] URSO, Report on gas and electricity markets 2010 12
[100] Küpper, 2007, 64

Central Europe in Prague (www.pxe.cz) from January 2nd 2009 until July 29th 2011. The price in question is a price in Euros per MWh.

The price difference should under the assumption of efficient markets facilitation arbitrage reflect only the transportation cost associated with cross-border transmission. We compare the prices of electricity 1-year futures for Czech Republic and Slovakia in order to determine, whether they converge, whether there is an improvement after introduction of market coupling in September 2009 and whether the price difference reflects the implied transportation costs.

The results are summarized in the Table 5 below. The calculated average price differential decreases significantly after the introduction of market coupling, influencing the prices of 1-year futures on the Power Exchange in Prague. The price differential decreased in absolute terms but also the price equalized more often after market coupling was introduced in September 2009. Prices differed:

- in 164 days out of 168 in the first part of 2009
- in 77 cases out of 82 in the second part of 2009 after introduction of market coupling.
- in 107 cases out of 251 in 2010
- 3 times out of 148 in the first part of 2011 (until July 27th 2011, latest available data)

Table 5: Price convergence – average price differential in €/MWh and its occurrence

	2009/1	2009/1	2010	2011
Average price differential (€/MWh)	1.019881	0.231111	0.034891	0.02195
Occurrence	97.62%	93.90%	42.63%	2.03%

Prices converge on more accounts after market coupling. The effect is not as significant in the second part of 2009 (which refers to the 4 months with market coupling). The delay can be explained by the fact that the futures in question have a relatively longer maturity – 1 year maturity and are therefore slightly more rigid. The occurrence of price differential is almost insignificant in 2011 when on almost 98% of all trading days are prices identical. Furthermore the respective correlation coefficient calculated from the daily prices for Slovakia and Czech Republic is 0.975 which speaks of high level of association among these two sets of prices.

7.3.4. Conclusion

Proposed hypothesizes could be confirmed on the data sample examined. The evidence found supports the assumption that market coupling between Czech Republic and Slovakia is functioning efficiently, without frictions which is enabled by sufficient cross-border capacity. Also dominant exporting position of Czech Republic based on the data from short term market could be confirmed. It exports twice as much electricity to Slovakia than in imports. Regarding the data we could find evidence of majority of the criteria of best practices mentioned above including lower volatility, higher liquidity and better utilization of transfer capacity. The intuition that higher prices in Slovakia result from higher wholesale prices due to the fact that markets decouple and Slovakia as importing country suffers from resulting higher prices could not be confirmed. Therefore we need to look for explanation of the price difference in the second part of electricity price – regulated fees and charges.

8. Regulated fees and charges

Regulated fees and charges are fully in control of the national regulatory offices - Energy Regulatory Office in Czech Republic and Regulatory Office for Network industries. The objective of regulatory policies is to create a competitive environment but to protect investors and customers at the same time. Therefore the fees and charges should be reasonable and reflect the real costs and investments of all participants, enforcing effective utilization of their assets. The end customer is charged in principle the same fees which are grouped and named differently in respective countries. In the following section we list and examine data on fees as stated in the annual reports of respective regulators: ERU and URSO. In reality fees differ based on annual consumption and tariff therefore we use the average. Also calculated price for active energy differs from wholesale prices since the active price includes profit margin of the electricity supplier. Regulated fees and charges include several fees discussed below.

8.1. Transmission

The transmission system is operated by fully state owned TSOs - CEPS and SEPS, Czech Republic and Slovakia respectively and includes high voltage lines: 220kV and 400kV. The fee covers charges for transmitted electricity, losses and reserve capacity[101] and therefore reflects the electricity price on wholesale markets which is purchased to cover for the losses. Transmission was slightly but not significantly more expensive in Czech Republic where it covers larger area and the length of transmission lines is larger in absolute terms.

8.2. Balancing services

TSOs are responsible for keeping the transmission system in balance, meaning the amount of electricity consumed must equal the amount of electricity fed into the system at any given time. System operators therefore purchase supporting services from several providers that basically do not primarily supply electric energy to customers but function as reserve generators in case there are sudden and unpredicted events either in electricity consumption or production. These events can include extreme weather conditions (temperatures, wind, rainfall influencing production in

[101] SEPS, Annual Report 2009, 79

wind, hydro and photovoltaic power plants), technical difficulties and other events requiring regulatory interventions. In Slovakia and similarly Czech Republic these are covered by production from conventional energy sources – mainly fossil fuels[102]. The fee covers the costs for such purchased services.

The fee was during observed years from 2008 until 2011 higher in Slovakia by 30% to 43% and may refer to lower competition among service providers and the constitution of energy mix of respective countries. Fossil fuels especially coal is more available in Czech Republic whereas Slovakia has relatively larger share of gas turbines, that rank amongst the most expensive energy sources.

8.3. Distribution fee

The distribution fee is has the largest weight in the structure of regulated fees and significantly influences the final electricity price. This is documented by the share on the final price of approximately 30%-35% in Czech Republic and 36% - 41% in Slovakia.

The fee distribution consists of two parts:

- fixed price for reserved capacity (€/month),
- variable price (€/kWh) according to actually distributed amount of electricity

Distribution fees differ in both countries among regions where distribution companies are active. In both countries there are three distribution areas. Czech Republic is divided into north and south, plus much smaller area of the capital Prague, in Slovakia distribution regions are more equal in regards to the area they are covering with the country divided into west, center and east.

The distribution fee is determined by different cost of operation[103], investments into network development and repairs, with factors like number of customers, used capacity/km, type of distribution lines (air, land or cable profiles), total amount of electricity distributed along with technical specifications. The price of distribution the end customer is paying is then regionally bound, but also depends on the tariff and the total annual consumption.

[102] URSO, Report on gas and electricity markets 2010, 16

[103] http://www.cenyenergie.cz/ceny-elektriny-2011-za-distribuci-plati-v-praze-o-650-kc-mene.aspx

The fee is constructed in order to cover the costs plus a reasonable profit margin. Regulatory office determines the maximal share of losses during distribution[104]. The costs associated with losses include also unregistered access and illegal electricity consumption.

The average fee for distribution has been significantly higher for Slovak household than Czech with the difference reaching 28% in 2008 which in absolute terms means a difference of €16.65/MWh. This appears to be one of the main factors of different household electricity prices between Czech Republic and Slovakia. Interestingly, the distribution fees, including the fee for distribution losses has been decreasing in Slovakia, with a very opposite trend observed in Czech Republic. In fact, the total fee for distribution including losses is projected to break even in 2011, with a slightly higher average costs for Czech households. This development corresponds with the shrinking of the price differential recorded by EUROSTAT statistics presented in the beginning of this chapter, where it is becoming apparent that while Slovak prices stagnate, Czech are coming closer to Slovak level.

8.4. Short term market operator fee

Since in Slovakia is this fee included in the system operator tariff since and exists in this form only in Czech Republic, a separate comparison cannot be made. Instead we include this fee to the fee for renewable energy sources in Czech Republic in order to enable comparison.

8.5.A Electricity tax

Newly stipulated electricity consumer tax – introduced in 2008 in Czech Republic, with Act. No. 261/2007 Coll., also called ecological tax. It is fixed at CZK 28.30/MWh (€1.16/ MWh) and is equal for everybody, paid by the electricity supplier to the Customs Administration in bulk for all customers. It has insignificant impact on final electricity price.

8.5.B Fee for nuclear decommissioning fund and disposal of burn-up nuclear fuel

Slovak Republic introduced a surcharge effective from 2011 the Ordinance of the Government no. 426/2010 Coll. which imposes a fee for levy into the National Nuclear

[104] URSO, Report on gas and electricity markets 2010, 19

Decommissioning Fund and Disposal of Burn-up Nuclear Fuel and Radioactive Waste in the amount of €3/MWh[105]. This is due to the ongoing decommissioning of nuclear power plant Bohunice.

8.6. Support of renewable sources of energy and system operator tariff

There are two terms for describing in principle one fee, depending on the country. In Czech Republic the subsidies in form of a feed-in-tariff are simply called "Support of RES", in Slovakia they are covered with one System operator tariff that also includes the fee for short term market operator OKTE, 100% daughter company of the Slovak TSO. This is included since 2010, before this date Slovak TSO was responsible for accounting activities and organization of short term market. Furthermore, the system operator tariff includes not only support of electricity buyout from RES, so called feed-in-tariff, but also coal mining subsidies[106]. Controversially, all customers pay a fee subsidizing non-ecological coal mining and renewable resources of energy.

Table 6: System operator tariff in €/MWh

	2008	2009	2010	2011
Czech Republic	1.55	2.15	6.77	15.39
Slovakia	2.81	2.72	6.30	14.85

In the comparison above, the fee for Czech Republic is a sum of the RES fee and short term market operator fee which correspond structure-wise to the Slovak system operator tariff. In this way they can be compared. It becomes clear from the overview that in 2008 the fee was almost double in Slovakia, however the difference to Czech Republic is insignificant in absolute terms, ranging from €1.26/MWh in 2008 to €0.47/MWh in 2010.

[105] URSO, Report on gas and electricity markets 2010, 22

[106] http://www.energia.sk/weekly-energy-review/vsetky-sekcie/electricity-price-in-slovakia-is-one-of-the-highest-in-the-eu/2251/

8.6.1. Feed-in-tariff

The development of renewable energy sources (hereinafter "RES") proceeds in line with the overall target for 2020 when the share of RES in final energy consumption is set at 14% for Czech Republic and 13% for Slovakia[107]. The main support tool for private investments into RES is so called feed-in-tariffs. It describes prices for which are electricity grid operators (who are distribution companies in the examined countries) by law required to buy electricity produced from privately (either by individuals or companies) owned generators at prices that are determined by long term contracts. The price is set by the respective regulatory office and therefore is fixed for mid-term period.

Table 7: Feed-in-tariffs, prices valid for April 1st, 2010 in €/kWh

Member state	wind power	solar PV	biomass	hydro
Czech Republic	0.108	0.455	0.077 - 0.103	0.081
Slovakia	0.05- 0.09	0.27	0.072 - 0.10	0.066 - 0.10

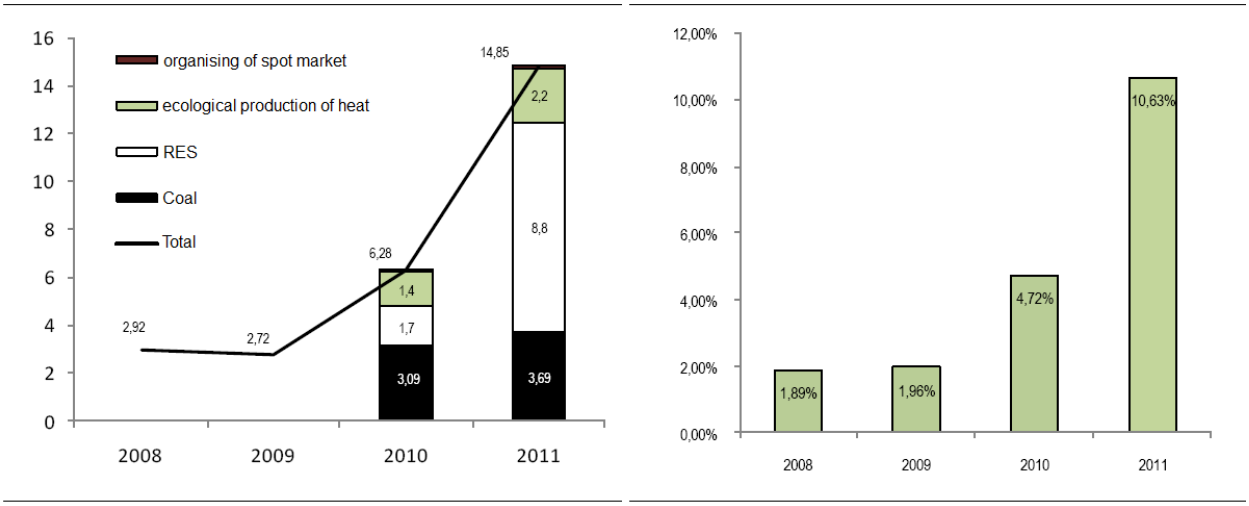
Source: www.energy.eu

Czech Republic implemented a feed-in tariff by act of law no. 180/2005 for wide range of renewable sources in 2005[108]. Slovakia introduced a very similar act of law, (No. 309/2009 Coll. on the Promotion of Renewable Sources of Energy and High-Efficiency Cogeneration) effective from September 1st, 2009. The feed-in-tariff is a premium payment, therefore by definition higher than the price paid for energy from conventional sources. In Germany, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety published a study that shows that this system of subsidies results in an increase of costs for German households[109]. The reports of respective ministries in Czech and Slovak republic show similar results. In Slovak republic the total projected amount paid by customers in year 2011 is as high as €322 million, which is almost triple the level of 2010 when the tariff amounted to €137 million total. Since the majority of these subsidies flows to private investors, this kind of arrangement raises controversy. It is said that without these subsidies the electricity prices would have dropped in

[107] http://www.energy.eu/
[108] http://www.renewableenergyworld.com/rea/news/article/2005/05/czech-republic-passes-feed-in-tariff-law-30844
[109] http://www.bmu.de/files/pdfs/allgemein/application/pdf/brochure_electricity_costs.pdf, 21

2011[110]. At the same time, this is the most rapidly growing part of regulated fees - they rose significantly from 1.7€/MWh in 2010 to 8.8€/MWh in 2011 which represent an annual increase of 517%.

Figure 6: System operator tariff and its share on final price of electricity in €/MWh



Graph A: Transmission operation tariff

Graph B: Share of transmission operation tariff on final price of electricity

Source: Ministry of Finance, Slovak Republic[111]

The total cost of RES subsidies in Slovakia is broken down demonstrated in Figure 7 below. Based on this information it possible to conclude two statements valid for Slovakia:

1. Total cost of RES subsidies rose in 2011 to almost 5 times the level of previous year.

2. The increase is cause predominantly by photovoltaic energy resources that accounted for more than 60% of the total costs.

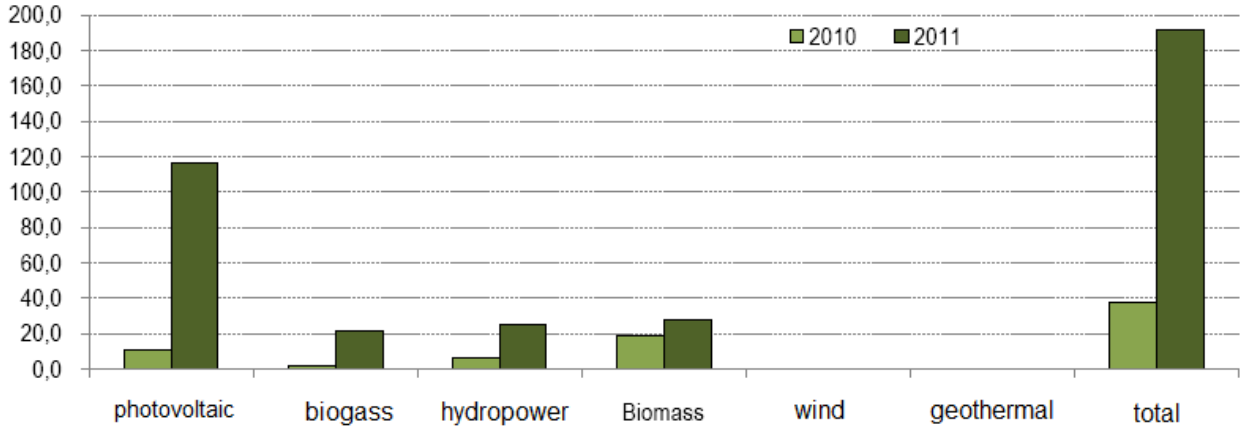
This suggests that feed-in-tariffs for photovoltaic energy were set too high which would explain the boom in reported installed capacity of photovoltaic energy sources. As mentioned above, the total installed capacity in first half of 2011 already exceeded the target for 2020 by 50%. In

[110] http://www.finance.gov.sk/Components/CategoryDocuments/s_LoadDocument.aspx?categoryId=7857&documentId=5677

[111] http://www.finance.gov.sk/Components/CategoryDocuments/s_LoadDocument.aspx?categoryId=7857&documentId=5677

addition to that production costs of photovoltaic energy have been constantly decreasing and it is estimated that the costs of photovoltaic energy will reach the level of conventional energy resources by 2015[112]. In some cases this has already been reached.

Figure 7: Support of renewable energy sources in Slovakia in millions of EUR



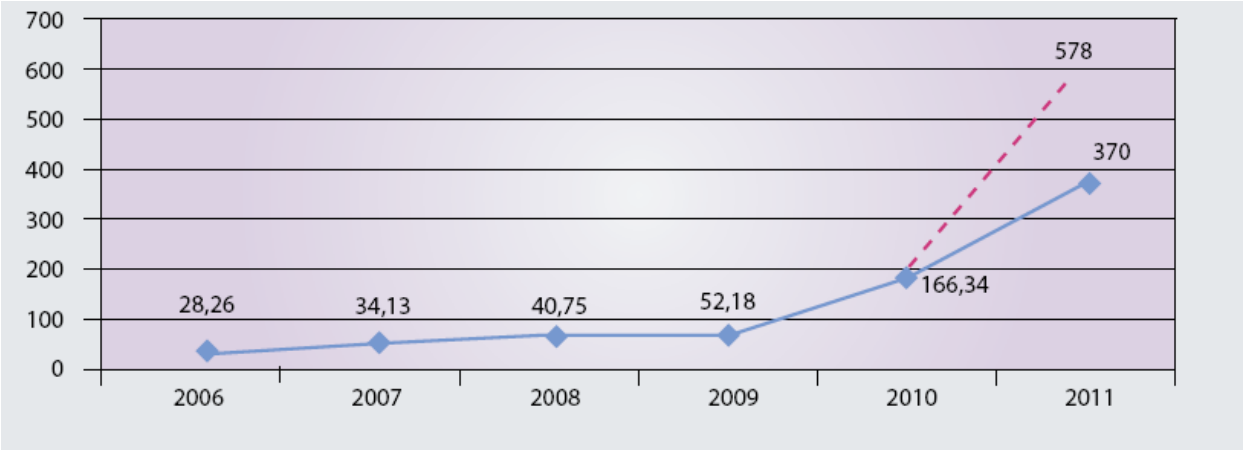
Source: Ministry of Finance, Slovak Republic

A similar situation to Slovakia was experienced in Czech Republic a year earlier when the boom of photovoltaic power plants along with a simultaneous drop in construction costs inflated estimates of electricity price increase to as high as 18% annually[113]. Analysis of the Czech regulator concludes that if the subsidies in Czech republic remained at the level from 2010, electricity prices would have sunk by 1.4%-3.8%[114]. Due to this information, the Czech government responded quickly in the form of an addendum that stopped subsidies of solar power plants altogether and in addition to that introduced a 26% tax on revenues from this resource which should be effective retrospectively on solar panels installed since year 2009[115]. Nonetheless support for renewable resources remains a part of regulated fees. The Czech regulator estimates that it will cost 32 Mld. Czech crowns (1.32 Mld. Euro) as opposed to 8 Mld.

[112] http://www.finance.gov.sk/Components/CategoryDocuments/s_LoadDocument.aspx?categoryId=7936 &documen tId=6283, 2
[113] http://www.energia.sk/clanok/solarna-energia/ministerstvo-priemyslu-cr-fotovoltaika-zvysi-cenu-elektriny-o-8-percent/0893/
[114] ERU, Annual Report 2010, 22
[115] http://www.energia.sk/clanok/solarna-energia/vaclav-klaus-umozni-prijat-kladivo-na-fotovoltaiku/1412/

Czech crowns (330 million Euro) in 2010[116]. The number was lowered through a subsidy from the government, which in turn lowered the fee charged to the end customer.

Figure 8: Renewable energy sources support tariff in Kc/MWh



Source: Energy regulation office[117]

In July 2011 the responsible Slovak ministry expressed the intention to change the current policy and the amount of feed-in-tariffs as a result of the boom in photovoltaic energy sources[118]. In the future it would be reasonable to target resources with greater potential (e.g. wind or biomass) and avoid booms and jumps in the process of achieving targets for 2020. Ideally, the progress should be linear in order to avoid overinvestment into most pricey resources. The fact that feed-in-tariffs were recognized as the major reason for price increases due to incorrectly set feed-in-tariffs through regulatory policies overshadows a potential positive impact renewable energy sources can have on wholesale prices over long term. The price dampening effect RES in energy mix can have on wholesale prices is referred to as the merit order effect.

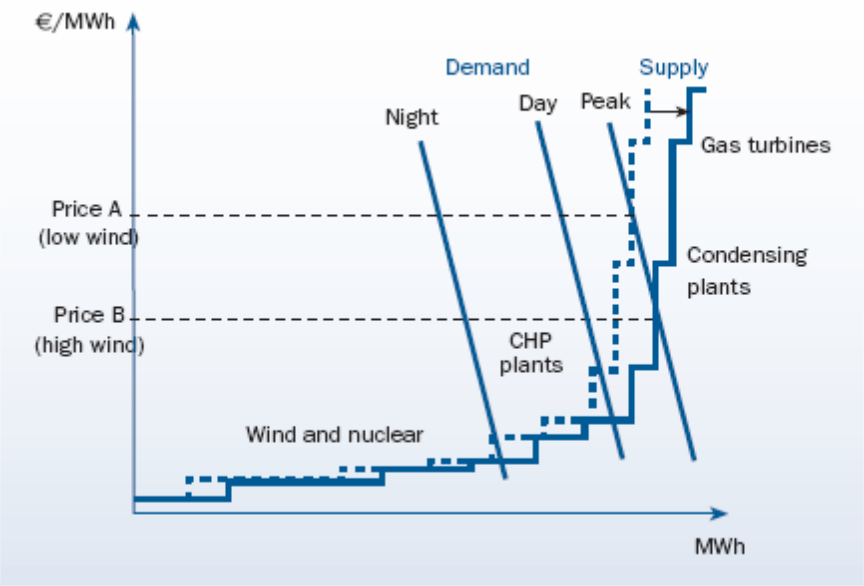
8.6.2. Merit order effect

Merit order refers to the pecking order in power supply where energy sources are used accordingly to their marginal costs: the cheapest energy sources like nuclear and wind energy are used first, followed by more expensive sources like coal and heat power plants, with the most

[116] ERU, Annual Report 2010, 22
[117] Ibid., 23
[118] http://www.energia.sk/clanok/solarna-energia/instalovany-vykon-fotovoltaickych-elektrarni-na-slovensku-je-480-mw/3824/

expensive – gas turbines – used during peak hours. Figure 9 demonstrates a typical example of demand and supply curves, where the supply curve is usually called merit order curve.

Figure 9: Demonstration of merit order curve



Source: Wind energy and electricity prices[119], available under ww.ewea.org

Despite the fact that feed in tariffs are being blamed for increasing electricity prices, in theory higher share or RES in energy mix can have a direct and indirect price dampening effect. The direct effect refers to the constitution of supply curve. When more energy resources with low (almost zero) marginal cost like wind or solar energy are employed, this shifts the supply curve to the right. Since demand is inelastic, little changes in supply result in major price changes as can be seen in the figure above where price during peak hours decreases from level A to level B[120]. Furthermore there may be congestion issues during high wind periods which results in reduction in production of power plants at the end of the merit order curve. This in most cases leads to lower price in the market. However the impact of wind or solar energy depends on the time of the day – the impact is highest when the steepness is highest and vice versa. Moreover

[119] http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/MeritOrder.pdf, 10

[120] Ibid., 11

variability of residual demand and instability of wind energy supply remain important factors[121]. There have been several studies trying to quantify the impact of merit order effect targeting mostly Germany, Denmark and Benelux, regions with relatively high share of wind power in energy mix. The estimates of price effect vary, from €3/MWh in Germany to €23/MWh in Benelux[122]. In addition to this, a higher share or RES can influence prices indirectly. If ecological technologies replace CO_2-intensive technologies, the demand for certificates that are needed in order to comply with EU targets decreases resulting in overall savings.

The studies referenced here targeted countries where wind energy has a remarkable share in the production mix. In Czech Republic and Slovakia wind energy is not significant from the view of total production, therefore the presence of merit order effects in these observed countries remain highly questionable. In order to be able to observe and examine positive impact of RES in this form, wind energy must be far more developed than currently is.

With regards to the list above, a customer can influence his electricity cost only through certain extent. The only not regulated part of electricity price is the base load price. In our overview, the price for active electricity for households includes profit margin, is therefore typically higher than for industrial customers and is different from the price on wholesale markets. Depending on whether the electricity is being purchased based on long term contracts or on day-ahead markets, the distributor is able to purchase electricity for lower or higher prices. In addition to that several parts of the regulated fees are determined by the wholesale prices, e.g. distribution fee serves to cover losses, which is positively correlated with base load prices, since the system operator has to purchase electricity in real time in order to balance the whole system – the costs associated with such intervention are then born by distributors and charged to end customers. If the wholesale prices sink, than the fees can also be lowered in the next period. The ability of suppliers to purchase cheaper electricity increases their competitiveness in the market and depends on the production costs of the generator, which in turn are determined by energy mix used.

[121] Ibid., 20
[122] Ibid., 16

8.7. Overview

The total fees and charges were in 2010 the highest amongst observed countries[123] and it is understood that current status quo ranks Slovakia among countries with the highest surcharges in Europe. Too high fees can impede competition if they elevate prices that would in turn discourage new entries. Regulated fees are determined by a variety of technological and economical aspects. Regulatory offices take into consideration the situation from previous years and estimates for the current year which makes it irresponsive and inflexible. Regulated fees were increasing in absolute terms during the observed period, with the exception of 2009, which reflects positive development on wholesale electricity markets. Wholesale prices had a decreasing tendency from 3. quarter of 2008[124] due to which operators were able to purchase electricity for losses coverage in distribution and transmission at lower costs. Larger production from photovoltaic sources is accountable for the notable increase in regulated fees from year 2010 on, which is a failure of regulatory policies in both countries. Also the level of fees reacts to lower total consumption in previous years. Lower total consumption in year 2009[125] translates into higher costs per unit for the following year - costs are being divided into lower number of units.

Figure 10: Comparison of regulated fees total: Czech Republic and Slovakia

CZ				
	2008	**2009**	**2010**	**2011**
Regulated fees total	55.04	54.48	64.03	79.82
SK				
	2008	**2009**	**2010**	**2011**
Regulated fees total	72.35	69.43	73.00	80.72
	2008	**2009**	**2010**	**2011**
Difference	17.31	14.95	8.97	0.90
Difference in %	23.93%	21.53%	12.29%	1.12%

[123] http://www.energia.sk/weekly-energy-review/vsetky-sekcie/electricity-price-in-slovakia-is-one-of-the-highest-in-the-eu/2251/
[124] ERU, Annual Report 2009, 25
[125] URSO, Report on gas and electricity markets 2010, 7

The difference in fees explains the household price difference between these two countries. Aside from more liquid market, in Czech republic currency exchange rate also plays a role, since this country kept its currency – the Czech crown after entry to EU in 2004. Czech currency (towards Euro) was especially strong in year 2007 and 2008[126] and is in general terms a stronger currency than the Slovak crown, which was in validity until 1.1.2009 when Slovakia adopted Euro as it's official currency. Czech Republic was also able to benefit in the past from significantly lower distribution costs – the difference in the distribution fee of €16.65/MWh in 2008 represents 96.16% of the total difference in regulated fees for that year. Similarly for year 2009 the share of difference in distribution fee was 77.44% and 86.48% in 2010. In 2011 projected regulated fees are almost equal with no significant differences. This is due to the fact that while distribution costs in Czech Republic rose significantly, Slovak regulator was able to lower these, including a lowering in costs for distribution losses. In fact, in 2011 every item of the regulated part increased in Czech Republic, while Slovakia was able to lower transmission fee, balancing service fees and above mentioned distribution including losses.

[126] http://www.ecb.int/stats/exchange/eurofxref/html/eurofxref-graph-czk.en.html

9. Conclusion

The analysis conducted in previous chapters leads to several conclusions. When it comes to market structure and concentration in the industry, there has been certain progress towards perfect competition but neither of the markets achieved a respectable level of competiveness that would resemble perfect competition. In Czech Republic the state remains an important player with a controlling share in the largest generation company – ČEZ and through its daughter company also the distribution network. ČEZ – distribution company operates on the largest area among the distribution regions and enables the Czech state to intervene not only through regulatory policies but also in the business sectors via direct strategic business decisions.

Although Slovak government does hold only a minor share in the largest national electricity generator – SE – it is controlling all three distribution companies. Through different distribution tariffs for alternative and conventional electricity suppliers it is possible for the state to impede or facilitate competition. The number of alternative electricity providers is rising, with ČEZ Slovakia (a subsidy of ČEZ operating in Czech Republic) being the strongest competitor by number of customers. Although this subsidy dilutes market share of Slovak incumbents it increases an overall presence of this utility giant in the region. The documented customer behavior seems rather reluctant in both countries, with Czech Republic being slightly more advanced. Customer switching is very slow due to perceived issues with supply security and reliability of alternative producers.

The descriptive statistics for wholesale electricity price data suggest that wholesale markets work efficiently. Market coupling between Czech Republic and Slovakia rarely experiences congestion which is supported by the results of the analysis of data on market coupling. From the beginning of market coupling in September 2009 until June 2011 the markets decoupled only in 42 cases which corresponds to 42 hours. Only in 23 cases the market decoupling resulting in different prices. Therefore the price difference could not be explained by an analysis of wholesale prices. We also concluded that the interconnector capacity is overall sufficient for trading and facilitates arbitrage.

Finally we analyzed regulated fees and charges in respective countries. Czech Republic and Slovakia have a very similar, almost identical fee structure. The only exception is the fee for nuclear decommissioning fund and disposal of burn-up nuclear fuel in Slovakia. Czech Republic,

unlike their eastern neighbor, imposed an ecological tax on electricity. The data also showed that regulated fees were significantly higher in Slovakia- by 24% n 2008, 21.5% in 2009 and 12.3% in 2010. The projected difference in regulated fees is rather insignificant for year 2011, though because the year 2011 is not finished yet, we cannot compare this to the real data and electricity prices for this year.

The conclusion we made above provides us with the answer to the research question: What factors cause the differences in final household electricity prices between Czech Republic and Slovakia? The decisive factor were higher regulated fees in Slovakia. We identified the fee for distribution to be the main reason for difference in final household prices. The difference in distribution fee alone is responsible for 77% to 96% of the total difference in regulated fees. Based on the available data we conclude that feed-in-tariffs contained in the system operator tariff is responsible for the increase in final price for years 2010 and 2011. If the contribution of the customers to renewable sources of energy stayed at the level from previous year, electricity prices for households in Czech Republic would have decreased, we can project the same outcome for Slovakia. The advantage of decreasing electricity prices on wholesale market, where regulating electricity is purchased for coverage of losses in transmission and distribution was cancelled out by increasing fees which in total resulted in higher prices.

The market structure in Czech Republic suggests that the distribution company CEZ with the largest distribution area is being influenced significantly by its owner – the Czech state who also determines fees the company can charge for distribution. Moreover, CEZ is being investigated by the European Commission on charges of competition hindering practices, as previously mentioned in the chapter on market structure. In Slovakia the state does not exercise such an influence, with more equally assigned distribution areas. With distribution fees being significantly lower in Czech Republic and accounting for almost the whole difference in final household electricity prices it becomes apparent, how important the presence of the Czech government as the controlling shareholder of CEZ is.

Implications for further policies can be derived from the experience from Czech and Slovak markets. In order to foster competitive environment the so called activating fee has to be relieved in Czech Republic. This fee is de facto a substitute of a switching fee and decreases the willingness of customers to change their supplier in response to more beneficial offer. Regarding international electricity trading, further investment into the development of electricity grid is

needed in order to ensure sufficient interconnector capacity with neighboring countries. Although it was not the objective of this thesis to examine, there is evidence on congestion between Czech Republic and Austria and Czech Republic and Germany.

What is Czech Republic and Slovakia experiencing right now is a boom in installed capacity of photovoltaic power plants. This can be blamed on too high feed-in-tariffs. Therefore more accurate setting of feed-in-tariffs is needed. In addition to that the regulator should enforce more control over the installed capacity of supported RES to ensure an adequate response in the case of need. The fulfillment of targets for 2020 of share of renewable energy sources in the electricity production should proceed more linear and avoid booms and steep price increases as a result of it.

Czech Republic and Slovakia remain to have a specific position within Europe and through introduction of market coupling became leaders in the central and eastern European region. For future fulfillment of the goals of European Union – creation of a free and integrated European electricity market – gradual integration of neighboring countries like Hungary or Poland is essential. A free and liberalized market gives more possibilities to the customers. At the same time the customer carries more responsibility to stay informed, react to more beneficial prices and incentivize all market subjects towards higher efficiency. In addition to that regulatory institutions should continue to create a competitive environment, eliminate market failures and support cross-border coordination and trading.

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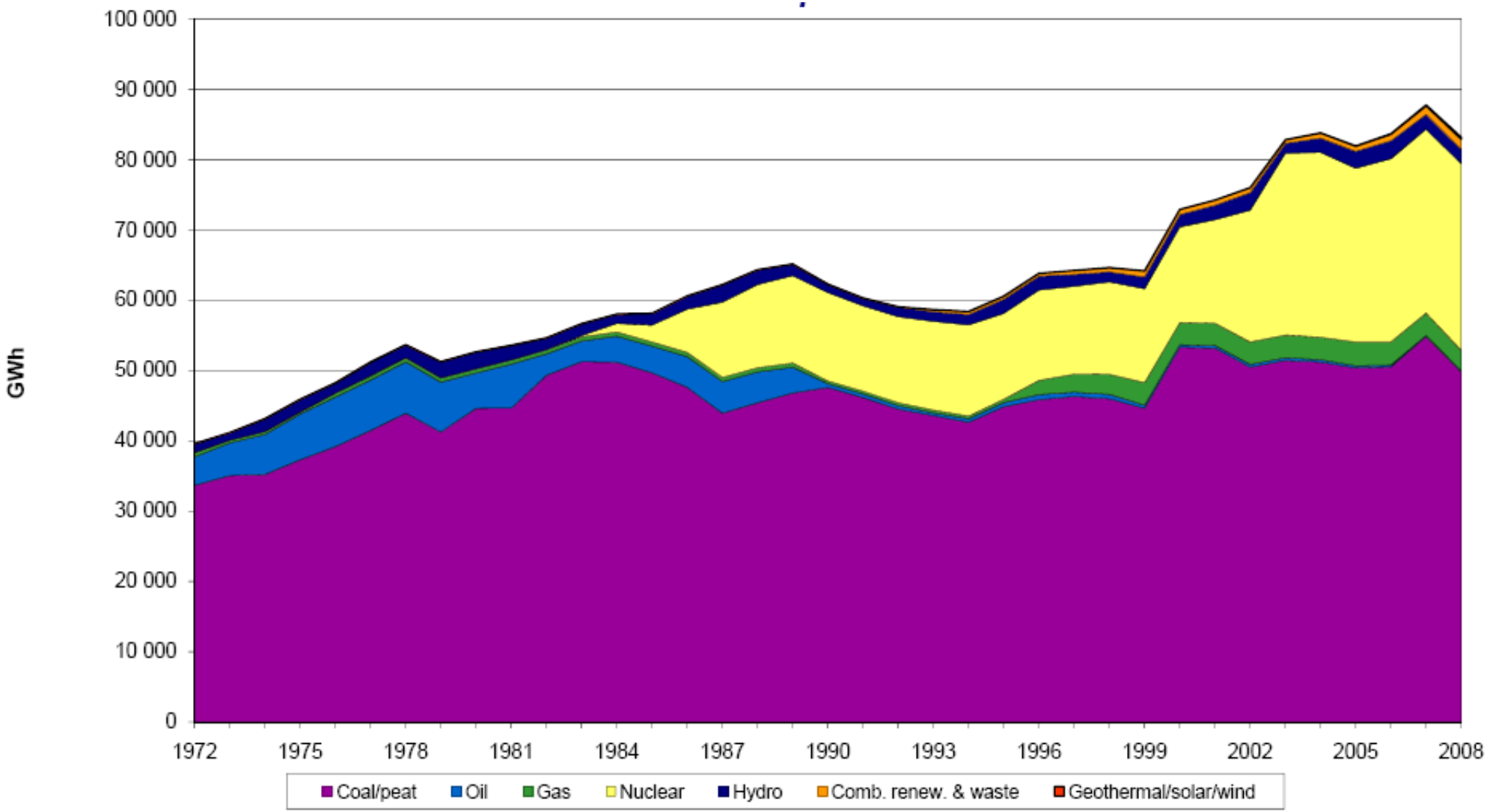
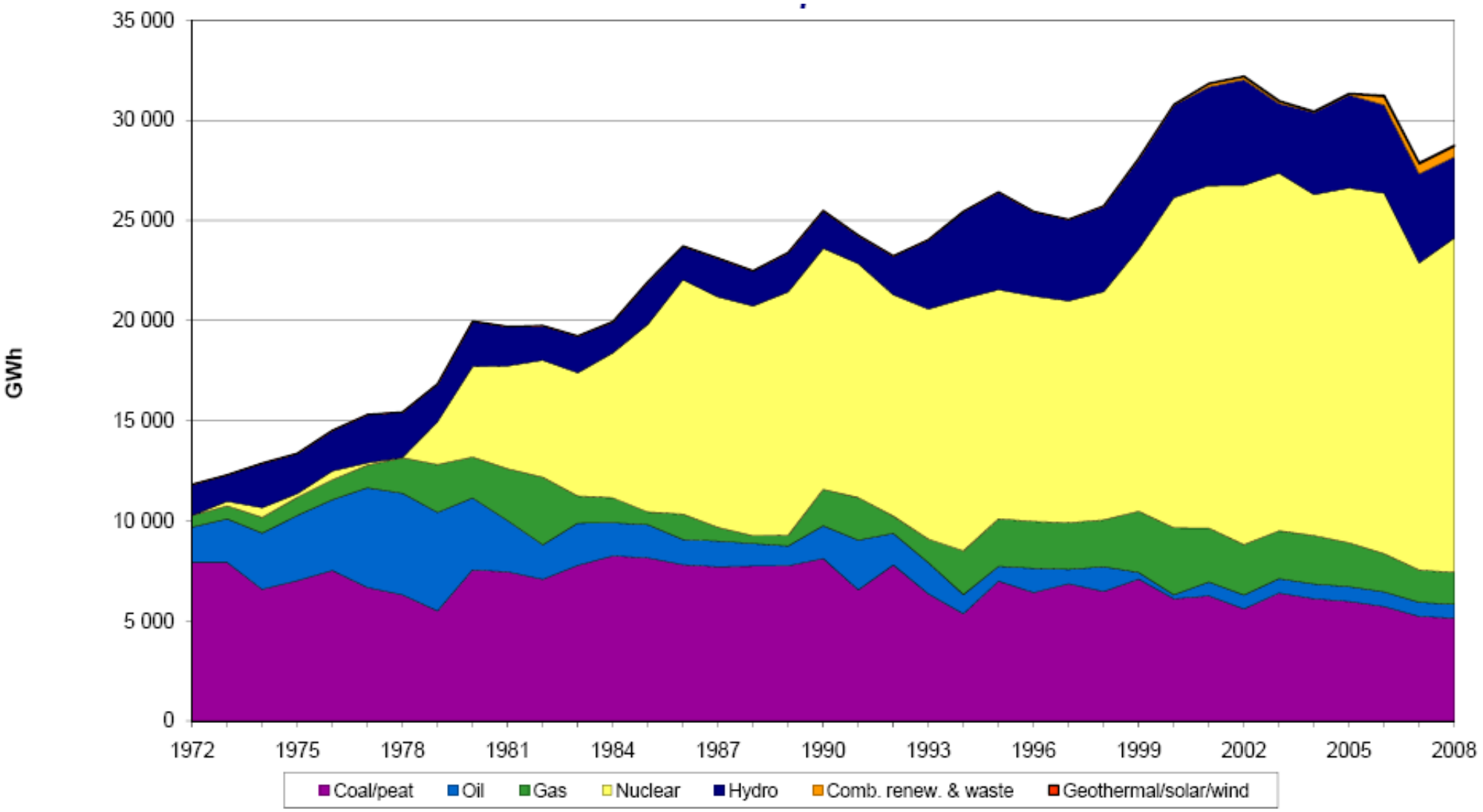
Appendix 1: Electricity generation by fuel – Czech Republic



Source: IEA, http://www.iea.org/stats/pdf_graphs/CZELEC.pdf

Appendix 2: Electricity generation by fuel – Slovak Republic



Source: IEA http://www.iea.org/stats/pdf_graphs/SKELEC.pdf

Appendix 3: Results of Market Coupling – decoupled hours

Date	Hour	Available capacity ČR->SR (MW)	Available capacity SR->ČR (MW)	Used capacity (export) ČR->SR (MW)	Used capacity (import) SR->ČR (MW)	Price for profile CZ/SK (EUR/MWh)
07.01.2010	2	1,199.0	846.0	0.0	846.0	1.00
07.01.2010	4	1,224.0	820.0	0.0	820.0	0.00
07.01.2010	5	1,223.0	838.0	0.0	838.0	0.00
03.06.2010	3	1,805.0	495.0	0.0	495.0	15.00
03.06.2010	4	1,813.0	487.0	0.0	487.0	9.20
03.06.2010	5	1,812.0	488.0	0.0	488.0	10.82
07.06.2010	3	2,182.0	118.0	0.0	118.0	0.99
22.07.2010	12	151.0	2,749.0	151.0	0.0	0.00
22.07.2010	13	149.0	2,751.0	149.0	0.0	0.00
22.07.2010	14	126.0	2,774.0	126.0	0.0	0.00
22.07.2010	15	146.0	2,754.0	146.0	0.0	0.00
22.07.2010	16	117.0	2,783.0	117.0	0.0	0.00
22.07.2010	17	127.0	2,773.0	127.0	0.0	0.00
22.07.2010	22	147.0	2,753.0	147.0	0.0	0.00
25.11.2010	2	2,264.0	836.0	0.0	836.0	14.99
26.11.2010	2	2,424.0	676.0	0.0	676.0	14.99
04.12.2010	4	2,366.0	684.0	0.0	684.0	32.04
09.12.2010	4	2,696.0	404.0	0.0	404.0	22.00
11.12.2010	1	2,787.0	313.0	0.0	313.0	21.99
11.12.2010	2	2,745.0	355.0	0.0	355.0	21.99
11.12.2010	3	2,756.0	344.0	0.0	344.0	17.99
11.12.2010	4	2,684.0	416.0	0.0	416.0	4.99
11.12.2010	5	2,610.0	490.0	0.0	490.0	15.99
17.12.2010	1	2,819.0	281.0	0.0	281.0	37.81
17.12.2010	2	2,832.0	268.0	0.0	268.0	37.81
17.12.2010	3	2,792.0	308.0	0.0	308.0	37.81
17.12.2010	4	2,787.0	313.0	0.0	313.0	37.81
17.12.2010	5	2,847.0	253.0	0.0	253.0	41.99
17.12.2010	6	2,779.0	321.0	0.0	321.0	44.99
17.12.2010	7	2,560.0	540.0	0.0	540.0	3.17

Appendix 4: Overview of regulated fees and charges

CZ	2008			2009			2010			2011		
	%	CZK	EUR	%	CZK	EUR	%	CZK	EUR	%	CZK	EUR
Active power	55	1686.09	67.62	57.5	1949.06	73.69	42.27	1666.16	65.90	45.40	1612.24	66.22
Market operator	0.2	4.63	0.19	0.13	4.75	0.18	0.12	4.75	0.19	0.13	4.75	0.20
Balancing services	4.8	147.15	5.90	4.16	141.01	5.33	3.94	155.38	6.15	4.38	155.40	6.38
RES	1.3	34.13	1.37	1.539	52.18	1.97	4.22	166.34	6.58	10.40	370.00	15.20
Dec.vyroba	0.3	9.20	0.37	0.271	9.21	0.35	0.19	7.49	0.30	0.30	10.65	0.44
Transmission	3	91.97	3.69	3.1	105.08	3.97	2.88	113.52	4.49	3.10	110.09	4.52
Distribution	**35.4**	**1085.23**	**43.53**	**33.3**	**1128.76**	**42.68**	**29.00**	**1143.09**	**45.21**	**35.60**	**1264.22**	**51.92**
Ecological tax	0	0.00	0.00	0	0.00	0.00	0.72	28.30	1.12	0.80	28.30	1.16
TOTAL		3058.40	122.66		3390.04	128.17		3285.04	129.93		3555.66	146.03
Exchange rate (CZK for 1 EUR)			24.933			26.45			25.284			24.348

SK	2008			2009		2010		2011	
	%	SKK	EUR	%	EUR	%	EUR	%	EUR
Active power	43.07	1811.00	57.88	49.28	67.46	45.20	60.23	42.69	60.10
System operator tariff	2.09	88.00	2.81	1.99	2.72	4.73	6.30	10.54	14.84
Balancing services	6.97	293.00	9.36	6.84	9.36	7.21	9.60	6.35	8.95
Transmission incl. losses	0.00	0.00	0.00	2.26	3.09	3.10	4.13	4.64	4.07
Distribution excl. losses	44.78	1883.00	60.18	27.48	37.62	31.51	41.97	28.15	39.63
Distribution losses	3.10	130.23		12.15	16.64	8.26	11.00	7.61	10.71
Distribution total	**44.78**	**1883.00**	**60.18**	**39.63**	**54.25**	**39.76**	**52.97**		**50.34**
TOTAL		4205.23	130.23		136.89		133.23		138.30
Exchange rate			31.291						

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- Administration von Sachbezügen

07/2008 bis 09/2008

Angestellte der Rezeption (**Hotel Clarion**, Hampton, VA, USA)

06/2007 bis 06/2008

HR Assistentin, Teilzeit (**Siemens**, Bratislava)

- Unterstützung von Recruiting

Fremdsprachen

Englisch: fließend; Deutsch: verhandlungsfähig, Slowakisch: Muttersprache; Tschechisch: verhandlungsfähig

Sonstiges

Präsidentin der Umweltkommission in der lokalen und landesweiter Runde von **Model European Parlament, 2005**

Teilnahme an verschiedenen Workshops mit dem Thema Umweltschutz und Nachhaltigkeit (INEX 2011)