of alternative network balancing methods (demand flexibility, energy storage).

Traditional sources will thus be less utilized, on average. They will be active for fewer hours and generate less electricity over the course of a year. This will of course be reflected in their returns, particularly for those sources which financially rely on continuous operation and on low variable costs which compensate for the high initial investment. The ongoing, profound changes also increase the financial risk related to the long-term planning of and investments in the sources with long construction periods.

5. IMPACT OF ENERGIEWENDE ON THE CZECH POWER SECTOR

5.1 Energy security and unscheduled electricity flows

An additional imminent issue complicates the relations between Germany and the Czech Republic. The unscheduled flow of electricity streaming from Germany through the Czech network (as well as those in Poland and other states) complicates the security and economic situation of the transmission system operator, the company ČEPS.

5.1.1 Scheduled vs. unscheduled electricity flows

Cross-border electricity transit is nothing new in Europe. First, it serves as a way to balance deviations, which is cheaper than production/consumption regulation and investments in backup capacities. Second, because of the different electricity prices in the neighbouring states, business opportunities arise. Building a common European energy market has strengthened these (predominantly) business trends.

The main complication in smooth cross-border trade is the current, in some cases insufficient, physical capacity of the cross-border networks.[25] This therefore increases the impor-

[25] The cross-border capacities were developed primarily for the purpose of deviation balancing and national grid security, not for the purposes of trading large volumes of electricity. Despite the growing investments made by the network operators, the development pace for the missing connectors is slow.

tance of the mechanisms used to determine how the cross-border profiles are distributed during periods of excess demand. These mechanisms differ for various models of market integration and there are intensive negotiations on the European level about their final shape (typically setting the network code of Capacity Allocation and Congestion Management CACM).

If the flows of traded electricity are very high and the capacity allocation mechanism fails for any reason, the contracted electricity flows along a different route than intended, along the physical path of least resistance in the line.

5.1.2 German-Czech electricity flows

The described problem is, in the case of Germany, accentuated by the following facts:

1) Unequal distribution of the production and consumption capacities. Because of the favourable climate conditions in the north of Germany, there is an increase in the development of off-shore wind farms and it is necessary to transport the electricity from there to the more southern industrial centres.
2) Germany's insufficient domestic network is unable to transport the required electricity volumes.
3) Germany's growing export caused by stable or slightly decreasing consumption and increasing production. Electricity is increasingly exported both to the West and to Austria, as well as to the Balkan countries.
4) German-Austrian bidding zone. The zone was established by Germany and Austria at the beginning of the common EU energy market construction with the aim of strengthening competitiveness and liquidity. The bidding zone is a geographically defined area in which the participants can trade electricity without the cross-border capacity allocation. In other words, this is an area in which there are no expected weak points which would hinder the transmission of electricity. The individual bidding zones (traditionally the individual states) have mechanisms for the distribution of otherwise limited cross-border capacities.

   A problematic situation arises when trading large volumes of electricity from the north of Germany to Austria and beyond. Germany and Austria made 28 % of all Central and East Europe (CEE) transactions in 2012, for example. (Strnad, 2014, p. 316) Due to the existence of the aforementioned bidding zone, the transport calculation does not reflect the fact that the north-south networks do not have sufficient capacity and, from a business perspective, the electricity transport through different routes has not been resolved. To be more precise, there is no capacity re-allocation mechanism in the common bidding zone of Germany and Austria and problem-free electricity transmission between these two countries is expected. If the flow is in reality higher than the cross-border capacity, the electricity starts to flow along the line of the least resistance. In other words, electricity is transferred through the networks of the neighbouring countries.

Whereas the green arrows show the planned, agreed and expected electricity flows, the red arrows show the real situation. These flows are problematic from two perspectives:

Security perspective. The unplanned flows jeopardise network stability. There are technical limits for network stability and these flows are approaching them.

Financial perspective. When allocating the cross-border capacity, network operators (in this case ČEPS) keep a portion of the transport capacity in case of unforeseen circumstances. The growing share of unplanned flows forces them to keep this reserve rather high, but this reduces the amount of capacity available for trading. Other financial costs arise because of the more complicated network stabilization. The figures for the specific costs are not available, but a certain frame is provided by the fact that from December 2014 to January 2015, during a period of extremely high wind source production in Germany which resulted in overflow to the Czech Republic, ČEPS spent CZK 60 million for remedial actions. This is approximately 2.5 times the costs for the entire 2012/2013 year.

From the point of view of the CR, the short-term solution for the whole problem is based on the installation of phase-shifting transformers in Hradec u Kadaně, located near the German border. A similar facility is being built at the Röhrsdorf distribution point by the company 50Herz, the operator of the adjoining German network. From the end of 2016, when they are expected to go online, the transformers will serve to protect the Czech network, deterring the most significant electricity overflows.

One long-term business-regulatory solution would be (from the point of view of the Czech network operator Čeps a.s. and its Slovak, Polish and Hungarian counterparts) the dissolution of the German-Austrian bidding zone and its incorporation into the models and trade rules which are being created on the EU level in order to create a common EU electro-energy market (Flow-based market coupling model, Network Complex NC CACM and one other).[26] Preservation of the common zone is seen by the aforementioned operators as the fundamental obstacle to further market integration in the region.

If the problem is not resolved on the regulatory level it will be necessary to wait until the German domestic network is sufficiently developed. The development of high voltage lines which are able to transport large electricity volumes across Germany is crucial for the success of the EW itself. The exigency increases with the approaching shutdown of the remaining nuclear sources in 2022 (these sources are generally located in the central and southern parts of Germany).

The Power Grid Expansion Act (EnLAG – Energieleitungsausbaugesetz), adopted in 2009, identifies 23 lines of extra

[26] Another option would be the implementation of a capacity re-allocation mechanism inside the zone. The zone would externally remain unified but in fact it would be integrally divided.

high voltage,[27] the development of which is absolutely crucial for EW and therefore should be sped up. This represents a total of 1855 km of lines.

The development pace is significantly slower than planned. By the third quarter of 2014, only 438 km had been built. By the end of 2016, 40 % of the total volume is supposed to be built. (Bundesnetzagentur, 2014b, p. 62)

In 2011, an amendment to the Energy Act (EnWG – *Energiewirtschaftsgesetz*) established new procedures for network expansion. Since 2012, all four German TSOs are obliged to prepare plans specifying future network development and reconstruction, and these plans are subject to federal inspection.

Germany is aware of the exigency of the domestic network issue and the pressure for development is apparent. Lengthy permission procedures and public resistance, rather than the financial requirements, are the problem. Also for this reason, it can be expected that development will remain slower than planned.

5.2 Price signals

The Czech electricity market is significantly interconnected with the German market. With respect to the size of both markets, the German market defines prices and business flows in the region – the Czech market is perpetually the recipient of the German price. In addition to the assumption that price and price expectations are the main factors based on which electricity producers in the liberalised markets (such as the Czech market) make decisions regarding the future of their portfolios, this means that German Energiewende's impact on German prices directly influences which sources will be profitable to build, operate or shut down in the Czech Republic.

[27] One of them was later removed because it was not necessary.

Tab. 8: Electricity production in 2013 (TWh)	
Czech Republic	81
Slovakia	27
Hungary	28
Romania	54
German-Austrian bidding zone	662
Source: (Eurostat, 2015)	

5.2.1 Market interconnecting and price convergence

Today, the Czech electro-energy sector is far from being an energy island, isolated from neighbouring markets. The transmission grids of the region are mutually interconnected and this results in the sensitivity of the individual markets to developments which take place in other markets. Czech electricity trade is influenced by two regional groupings in particular: the formalised intra-day market interconnection of four Central-European states (the "4M MC") and the German-Austrian bidding zone prices which the Czech Republic adopts.

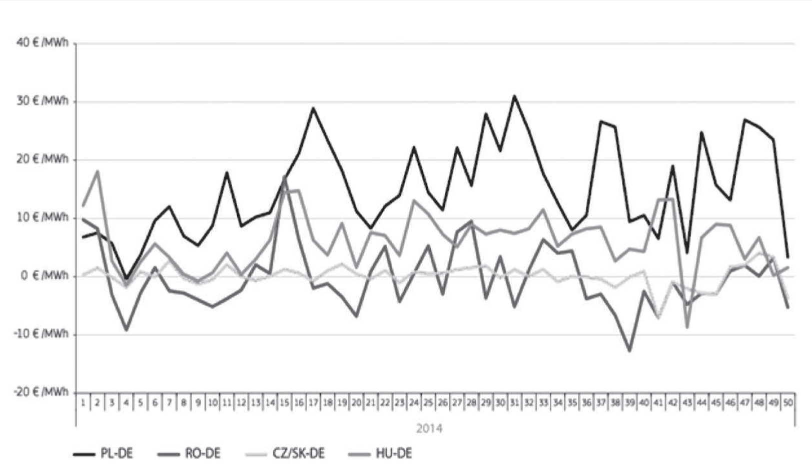
The 4M MC is formally finished day-ahead coupling[28] of markets of the Czech Republic, Slovakia, and Hungary and, since 19 November 2014, of Romania as well. Interconnection of these markets is based on the principle of implicit allocation of cross-border capacities. On the intra-day market, the participants from CR, SR, HU, and RO can purchase or sell electricity for the following day in all four market areas without the necessity to independently seek a cross-border transmission capacity for their transactions.

The sufficient capacity of the physical interconnection then allows the electricity to flow from one market to another in relation to the price differences. If the price in the Czech Republic is higher than in Germany, the Czech market attracts cheaper German electricity. This causes an increase of electricity supply against the demand and the scarcity of electricity on the Czech market, and thus also a decrease in electricity price. The flow of German electricity and consequent price fall will last until the price difference between Germany and the Czech Republic is balanced and continued exchange loses its economic attractiveness. Of course, this applies vice versa – a lower price level in the Czech Republic motivates merchants to purchase in the Czech Republic and to sell in Germany until the demand on the Czech market is weakened by this behaviour to such an extent that the price increases to the German price level. In practice, due to the physical capacity permitting these flows, the prices in Germany (and Austria) and the Czech Republic (and Slovakia, which is connected through the same mechanism to the Czech Republic)[29] are in fact the same.

[28] Market coupling is the term for one of the steps when forming integrated regional markets. Based on the coordinated calculation of prices and electricity flows between the countries, it optimizes the process of cross-border capacity allocation. The basis is represented by an implicit auction where the market subjects receive both the electricity offer and the cross-border capacity for transit of this electricity; thus the market subject is not forced to organize these two components of the cross-border trading separately. Market coupling leads to more efficient utilization of (now scarce) cross-border capacities and therefore to an increase of cross-border trade, liquidity in the given region and reduction of the differences between the electricity prices of participating countries as well. At the same time, this mechanism indicates possible insufficient cross-border capacity and thus sends the price signals to create it.

[29] Slovakia is also interconnected with the Czech Republic by the formalized 4M MC which makes the trade between both countries easier. The reason for the divergence in the Czech-Slovak price and the Hungarian or Romanian price is the insufficient capacity of the interconnection between Slovakia and Hungary which limits the trading volume below the level which would ensure a full price convergence. Electricity price on the intra-day market for the 4M MC states fully converge only during hours in which electricity demand is generally lower and cross-border capacity is relatively more important with respect to the total volume consumed – typically during weekends and at night.

Fig. 39: The price difference against the German market, weekly base load



Source: (European Commission, 2015, p. 21)

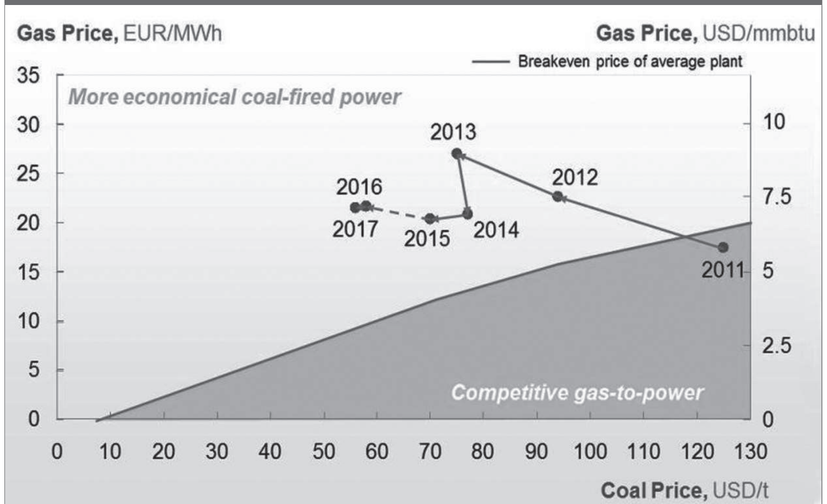
In the part of Central Europe which is influenced by Germany, wholesale electricity prices remain low. The low prices are the result of two simultaneous phenomena: the dramatic increase of the capacity of RES which, with its zero fuel costs, push the conventional sources out of the market (merit order effect, see chapter 2.1); and low coal prices.

In the environment where conventional sources predominate this would mean a “seasonal deviation” – the low prices would put a halt to the investments into new sources and would prod the shutdown/conservation of those sources which are unprofitable in the long term; this would lead to a decrease in supply and to an increase in price. This already happens on the German market, but nevertheless it cannot be expected that these shutdowns will significantly influence price. The state supported development of RES is not intended to shut down the conventional power plants but rather to replace them with the renewable sources. In other words, the current German policy does not target the insufficient supply on the domestic market which would bring a rise in prices, but exactly the opposite: the EEG,

reformed in 2014, expects a growth of 5 GW in the maximum annual production capacity from photo voltaic and on-shore wind power plants and the development of 1 GW from off-shore wind power plants by the end of 2014, increasing to 6.5 GW in 2020 and 15 GW in 2030. Thus, we can theoretically expect up to 90 GW of newly installed capacity from wind and solar power plants by 2030.

This alteration of the production portfolio will probably keep the electricity price rather low in the coming years. Its growth to pre-crisis levels (interval 50–90 €/MWh spot, 70–95 €/MWh Phelix baseload year futures) cannot be expected, at least for the period in which the electricity price on the German (and continental) market correlates with the price of coal, which fuels marginal power plants. Coal prices are currently kept low due to the overproduction on the North American market and low prices of coal substitutes (namely natural gas). From this point of view, three future development scenarios brought about by increased electricity price can be identified: (1) The downturn of natural gas production in the USA which results in higher

Fig. 40: Competition between natural gas and coal.



Source: (McKinsey, 2015)

prices and the subsequent increased demand for an alternative – in this case, coal. (2) The downturn of German coal fired power plants forced by the regulation will, according to merit order, push a different fuel into the role of marginal source; in Germany this would be natural gas which, in fact, is unable to compete with coal in the European environment (see Fig. 40). (3) The price of emission allowances will increase or some other tool for the valorisation of carbon dioxide emissions will be introduced.

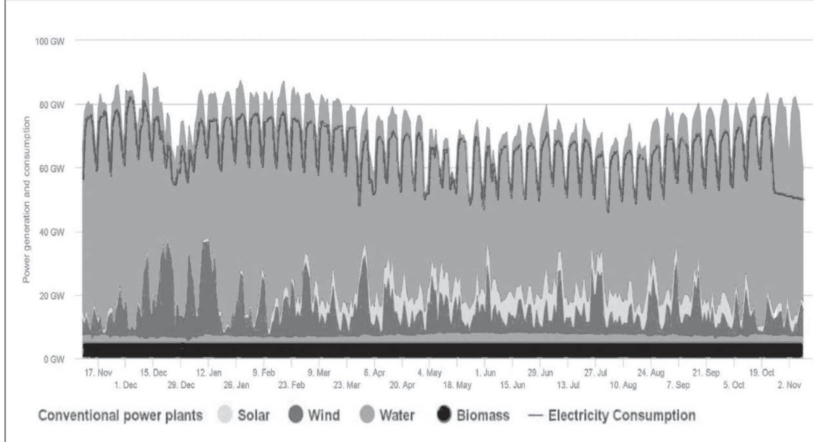
5.2.2 Price volatility

Advancing penetration of the RES into the system also means the transformation of the price schemes of the electricity markets. The schemes were traditionally build on two basic categories of sources: *base load* sources with low variable costs, providing almost continuous electricity supply; and cutting-edge *peak load* sources with high variable costs used to cover time limited periods of higher consumption.

With the advent of RES, this model has been questioned. The base load sources are heavily utilized, in particular due to their low variable (fuel) costs. The renewable sources have zero variable costs – they only produce electricity when natural or technical conditions permit.[30] At the same time, the continuing trend of RES development will mean that these sources will be able to satisfy an increasing portion of electricity demand (for a certain part of the day) – the current per hour record of RES electricity production is 78 %, and during daytime peaks the values are typically around 20 to 30 %, with minimum daytime production at 10 to 20 % (see Fig. 41).

[30] Exceptions to this can be situations where the RES are supported, for example, by the feed-in premium system, the market electricity price is negative and at the same time the state subsidy is not sufficiently high to compensate for these prices.

Fig. 41: The share of conventional and renewable sources in total electricity production (11/2014–11/2015)



Source: (Agora Energiewende, 2015)

At first glance it may seem that the variation of 10–30 % also provides enough space for the current conventional sources to fully satisfy the demand, as there is still at least 70 % of the production capacity which is not covered by the renewable sources during an average day. Nevertheless, with the changeable production curve and zero variable costs (meaning that the RES would be turned on whenever physically possible, regardless of the presence/absence of the legally imposed priority purchase), both the real time demand for the capacity which supplements RES production and the price of this supplementary electricity will change.

Let us note that the above mentioned figures apply only to situations in which the RES share of electricity production in Germany stays between 20–25 %. Higher RES utilization will further strengthen the current trend of emphasising the flexibility of conventional sources (the ability to quickly increase or decrease the output to balance the variations of RES production). The more flexible the source, the longer it will be able to earn toward its fixed and variable costs and to generate profit.

At the same time, this model will direct investors toward sources with low capital costs. Lower price predictability and lower electricity demand will discourage investors from developing expensive (and thus risky) sources. Investments which require minimal initial investment will be preferable, even if there are higher variable costs.

Both these consequences will threaten the position of the nuclear industry in particular. The flexibility of nuclear power plants is low and the initial investments are high. In a model where conventional power plants can earn toward their operation for only a limited part of the day, it will be very difficult for the nuclear plants to compete. Even now, when nuclear plants produce electricity almost continuously with only small technical interruptions, it is very hard for investors to find enough means to operate them.

Gas and (flexible) coal fired sources will fare better. Their low investment costs lower investment risk and the possibility of quick production adjustment allows investors to take advantage of price increases during decreased RES production.

5.3 Compatibility of the Czech energy strategy with the new market situation

The energy strategy of the Czech Republic as defined in the updated State Energy Policy from 2014 (SEP) reflects the traditional focus of the Czech energy sector on self-sufficiency, nuclear energy and long-term planning. This is primarily seen in the proposed development of two to four new reactors in Temelín and Dukovany, one or two in each of these traditional sites. This is not a new idea; there was a call in the Czech Republic for the construction of two blocks in the Temelín nuclear power plant which was cancelled in 2014 because of doubts about the profitability of the project. The National action plan for nuclear energy has returned to the idea, which is also supported by the SEP. According to the SEP, it is necessary to "Support and accelerate the process of negotiating, preparing and implementing

new nuclear units at existing nuclear power plant sites with a total output of up to 2,500 MW, or annual production of approximately 20 TWh by the years 2030–2035, including the steps necessary for international discussion of the issue." (Ministry of Industry and Trade, 2014, p. 62)

The Ministry of Industry and Trade, the main "driver" of nuclear development in the CR, has three alternatives for resolving the problem of investors' unwillingness to participate in such a project. The first would be based on the possibility that electricity prices will increase in the future to a level where the project will become commercially viable. The second alternative relies on public support for the power plant, for example in the form of a "contract for difference" where the difference between the market price and the price necessary to cover the costs of the power plant is paid to the operator probably by the consumer through an increase in the regulated part of the end-user electricity price. The third option is the establishment of a state owned company which would build the power plant, regardless of the economics of its operation, using state funds. According to Minister Jan Mládek, "such a company could be simply ordered by the government to build the reactors". (Lukáč & Trejbal, 2015)

The justification for such an invasive state intervention into the energy sector is based on the idea that the currently low price of electricity does not provide sufficient incentive for the construction of the new sources necessary for future energy security. The Czech Republic could see a shutdown of a significant part of the existing capacity due to low electricity prices, although new capacities would not yet have been built. According to Minister Mládek, "To be able to maintain the energy self-sufficiency and security of our country it is necessary to commence the construction of one nuclear block in the Dukovany area and one block in the Temelín area, with the possibility of a further extension to two blocks in each locality". (Czech television, 2015)

Considering the significant changes taking place on the regional market, this strategy seems inappropriate and unsustainable.

5.3.1 Compatibility with EU law

From the perspective of European law, the idea of public financing for new nuclear power plants is controversial. The Czech Republic, being integrated into the European market, is not allowed to provide direct subsidies to a producer or a power plant, as the EU law sees that as state aid distorting the market.

For this reason, the contract for difference support scheme is being widely discussed among energy officials. In such a case, the state would initiate an increase in the regulated part of the retail electricity price and transfer this income to the plant operator to foster the plant's competitiveness (similar to how it currently deals with the renewable energy sources).

Nevertheless, it is not clear whether the contract for difference scheme does comply with the EU law either. When approving the scheme for the British Hinkley Point C NPP, the European Commission made it clear that its decision should not be perceived as precedent for similar ventures elsewhere in the EU. (Černoch, Zapletalová 2015) Moreover, since electricity can be freely traded between the Czech Republic and its neighbours, the benefits of the new, competitive source of supply would be shared among all the regional power consumers, while the costs of making these sources competitive would be carried solely by those in the Czech Republic.

Another question is, to what extent is the objective of the state support of nuclear source development compatible with other priorities of the SEP, such as:

> Promote a highly competitive environment in the electricity market, the regional integration of the electricity market and regulatory power and energy, harmonization of the market rules, price-setting and tariff mechanisms and simplification of access to the market.
>
> Promote market mechanisms that negate the significant influence that market distortion (subsidies, administrative restrictions and barriers) has on the price of electricity. If any form of capacity mechanism is introduced in Europe, promote a coordinated approach that minimises the final burden on the consumer and does not place the Czech energy sector at a disadvantage within the Framework of the internal electricity market. (Ministry of Industry and Trade, 2015a, p. 61)

5.3.2 Self-sufficiency as an objective

There is a nearly universal rule in the Czech debate that energy self-sufficiency and energy security are synonymous. According to the Supplementary analytic material of the SEP, Czech energy strategy is built on three strategic objectives: security, competitiveness and sustainability (Ministry of Industry and Trade, 2015b, p. 6) and this reflects the most common definition of energy security as a reliable energy supply for a reasonable price, while respecting environmental sustainability. The SEP defines "security" as follows:

> Ensuring essential energy supplies for consumers in normal operation and, in the case of step changes, in external conditions (supplies outages of primary sources, market price fluctuations, malfunctions and attacks) in the context of the EU; the aim is to guarantee the rapid restoration of supply in the case of outages and also to guarantee full provision of supplies of all forms of energy to the extent necessary to keep the economy functioning in "emergency" mode and to keep the population supplied in any emergency situations. (Ministry of Industry and Trade, 2015a, p. 33)

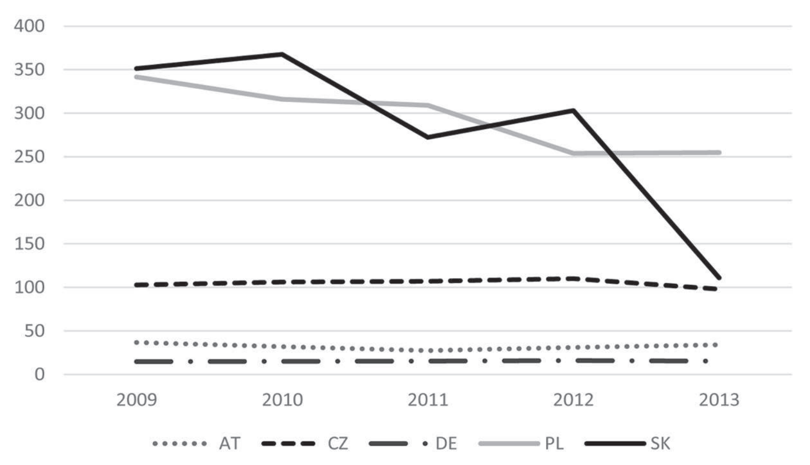
The Supplementary analytic material of the SEP then outlines the following indicators for monitoring the progress toward the strategic objectives:

1) Emergency reserves of the primary energy sources
2) Development of the expected capacity reserve
3) Diversification (of primary energy sources, import, gross energy production)
4) Import share of the particular primary fuels

5) Import dependency (the share of net import on the consumption)
6) Self-sufficiency in the electricity supply

From these indicators only (1), (2) and (3) relate to energy security in terms of the security of supply as defined in the SEP. The suitability of indicators (4), (5) and (6), which are related to self-sufficiency/import dependency, for the measurement of the "energy security" can be, in the Czech environment, justified only with difficulty. Yet, self-sufficiency itself does not guarantee secure supply. On the contrary, the import of electricity from the countries with better supply security statistics can eventually be more reliable than the supply provided by domestic production. This can be seen in Poland, for example, where there was a serious blackout threat during the summer of 2015 when the country experienced above-average temperatures.

Fig. 42: Unplanned supply interruption in the distribution network (SAIDI, minutes)

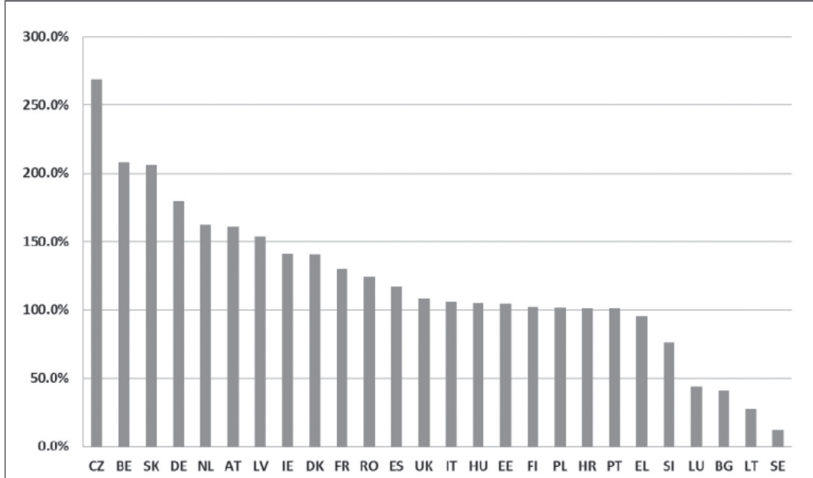


Source: (CEER, 2015, p. 27)

Just as self-sufficiency does not mean security, import dependency does not automatically mean a security risk. This is

probably best seen in the gas industry, as the following example demonstrates. Let's imagine a European country with the following characteristics: a 30 % share of natural gas in total energy consumption, 94 % natural gas import dependency, the only supplier is a former colonial power which remains influential in the country, and gas is transported only by two parallel pipelines with a single cross-border point. Such characteristics intuitively correspond with the countries of the former Eastern bloc where there is a strong tendency to consider dependency on Russian gas import to be a security problem. But in this case, the country is Ireland. Based on the general indicators of dependency, Ireland thus has significantly worse parameters than the majority of Central and Eastern Europe states; yet no document exists which considers Ireland's one-sided import dependency (on Great Britain) to be a security problem.

Fig. 43: Compliance with N-1 formula (2013)



Source: (European Commission, 2014, p. 8)

Czech Republic is the exact opposite of Ireland. Despite the facts that the greatest gas crises of the recent decades (2006 and 2009) did not affect the Czech Republic in any way, that the capacity of direct interconnection with Germany as one of the Europe's biggest markets exceeds multiple times the Czech Republic's consumption, and that the Czech Republic scores the highest at the N-1 supply security standard among European countries, in the Czech Republic natural gas is a symbol of dependency, unreliability and security risk.

The fear of import dependency makes even less sense in the power sector. Because of the laws of physics and the physical and regulatory market interconnection (see chapters 3.1, 3.2 and 5.2.1) the Czech electricity market is an integral part of a larger regional market. This means that the electricity generated in the Czech Republic is physically present and as well as traded in other states, just as foreign produced electricity is present and traded in the Czech Republic (see chapter 5.2.1). Interconnecting the networks and markets has the indisputable security benefit in balancing and maintaining network stability. This is easier to achieve in larger, well connected systems (as, after all, the positive impact of German TSO integration on the stability of transmission network in Germany has shown, see Chap. 1.5.6).

Directive 2005/89/EC identifies the following decisive factors of electricity supply security: sufficient interconnection of the member states' networks, generation adequacy and the balance between supply and demand. (European Commission, 2013, p. 25) The mentioned case of the Polish electro-energy sector in summer 2015 shows that the real threats of supply security are the combination of insufficient generation adequacy and an insufficiently developed network, or insufficient interconnection with the neighbouring markets. Generation adequacy (which, in tandem with cross-border exchange, establishes supply security) should not be confused with self-sufficiency.

The ENTSO-E has applied the same approach to the assessment of generation adequacy. This is defined as *Remaining Capacity minus Adequacy Reference Margin as a part of Reliably Available Capacity*. It also adds a regional analysis which takes into account available interconnections and cross-border exchange. These are defined as *Remaining Capacity minus Adequacy Reference Margin*. In ENTSO-E Scenario B,[31] based on the best available information on the future development of consumption and production capacities, the predictions for individual countries are diverse. States such as Austria or Romania will have a more than 20 % reserve of reliably available capacity, whereas the block of states comprised of France, Belgium, Switzerland, Germany, Denmark, Czech Republic, Poland and Slovakia will lack the reliable available capacity to cover peak consumption in the same period. But if we consider cross-border trade, only Switzerland, Germany, Denmark and Czech Republic will be in deficiency and transferring[32] the missing capacity from the surplus neighbouring markets is possible. According to ENTSO-E:

Fig. 44: Generation adequacy per ENTSO-E member country/Regional analysis of generation adequacy; both in January 2025, Scenario B

Source: (ENTSO-E, 2014, pp. 79, 82)

[31] From the variants presented by ENTSO-E, Scenario B predicts the most critical values of generation adequacy in the region for January 2015.

[32] The prediction is based on the expected employment of the cross-border profiles and not only on its ordinary nominal capacity.

> According to the results, the block of Denmark, Germany, Czech Republic and Switzerland may simultaneously require import in the winter period under the assumptions of Scenario B in 2025. Import from all countries directly connected to the aforementioned group is foreseen, with Germany possibly requiring the most import. The total of the Remaining Capacity in the four countries is -10.3 GW, whilst there is ample import capacity available on the external borders of the group to cover this amount. (ENTSO-E, 2014, p. 82)

It is quite surprising how strongly the Czech energy strategy emphasises production self-sufficiency, especially when the SEP itself states that "*The operability of energy sources is also almost entirely dependent on broad international cooperation between transmission system operators and a flexible cross-border trade mechanism,*" (Ministry of Industry and Trade, 2015a, p. 120) and as the main objectives of the particular areas determine, for example, the following:

> Create a regional electricity and gas market in the region of Central Europe, or in the EU, providing fully open, barrier-free access to the market for end customers. In compliance with the European Council conclusions, complete the integration of the internal energy market in the EU and eliminate all barriers between member states and regions.
>
> Support the rapid integration of the electricity market on the principle of implicit auctions throughout the Central and Eastern Europe (CEE) region and its connection with north-western Europe; support the development of the electricity, services and financial instruments market to ensure the stability of the electricity market. Owing to its geostrategic position in the region, support the Czech Republic's role in market integration and the creation and coordination of market mechanisms and institutions.

> Ensure the full implementation of directives and regulations on the internal market in all EU countries. Particularly as regards non-discriminatory access to cross-border capacities and respecting cross-border influences.
>
> Integrate network development (including involvement in planning the development of European transmission infrastructure and the construction of Electricity Highways). (Ministry of Industry and Trade, 2015a, pp. 85, 98)

5.3.3 Long-term planning

Probably the biggest weakness in the Czech energy strategy is that its rigid long-term planning is in direct conflict with both current and expected electricity market uncertainty. The SEP itself acknowledges this and states, for example, that:

> One of the most significant characteristics of the current trend in energy on the global scale is the high degree of uncertainty concerning future political and economic development, the development of technology and the requirements concerning environmental and climate protection.
>
> The European electricity market is currently at a crossroads. Further development will focus either on completion of the internal market and a return to the "Energy-Only Market" by eliminating market distortion, or on dividing the energy market and capacities and creating a separate a mechanism providing signals for investment. It is not currently clear what the future model will be like. If this change comes to pass, it will be the third market model implemented during the last 20 years and will not necessarily be definitive for the next 20 years.
>
> The fundamental problems of the energy market are the high risks associated with rapid changes in European legislation and unstable market signals generated by a num-

ber of distortions in the market and the promotion of political objectives. (Ministry of Industry and Trade, 2015a, pp. 4–5)

To reduce the uncertainty, the SEP uses scenario analysis – a method which facilitates decision making in complex and continuously changing systems (such as the energy sector). A scenario analysis is typically a set of possible future scenarios which attempt to anticipate all possibilities of future development (one of which will likely occur) with a certain rate of reliability. This approach does not offer predictions, however, and probability is not included in the scenario design process as this would limit the diversity of the scenarios. Thus, scenario analysis is valuable for decision makers because it provides enough different future alternatives to both aid in the development of strategies which will lead to the preferred scenario and to adapt to the situations outlined in the other scenarios. The scenarios are constructed by: (1) identifying the key factors in examined phenomena, (2) determining the factor values in the target year/period, (3) arranging the values into coherent scenario sets, (4) analysing consequences of the actualized scenario for a given phenomenon in relation to its definition.[33]

[33] Thus, for example, scenarios of global oil market development (the examined phenomenon) can be formulated in which we focus on the market horizon e.g. 10 years. The key input factors will be the factors which influence the supply and demand (investment cycle), favourable or unfavourable regulation of oil exploration and production, technological progress, etc., or economic growth, individual car transportation demand, alternative fuels development in the transportation sector, etc. The result of values arrangement will be four scenarios – two for market balance (high supply + high demand and low supply + low demand), one for a buyer‘s market (high supply + low demand) and one for a seller‘s market with market tension features (low supply + high demand). The value of such a scenario set is that it covers all variants and allows regulators to plan the related policies with respect to the real development of the issue and the expected consequences of the particular scenarios.

The scenarios suggested by the SEP fail in doing so. Their main weak point falls in the first step of the analysis: the identification of the input factors (the SEP labels them “prerequisites”). The scenarios have the following components: electricity consumption, nuclear based production, coal based production, RES based production, and trade balance (electricity import/export). Interestingly, apart from electricity consumption, these are more output than input factors, which directly opposes the SEP’s ambition to determine the desirable shares of individual sources in electricity production – the SEP states that “*[T]he result is the specification corridors that define the acceptable direction to be taken in the development of the mix of primary energy sources and gross electricity production in the Czech Republic. The corridor concept is therefore a means of quantifying the possible variability of the results of the model, depending on the predefined value of the input parameters in the variant.*” (Ministry of Industry and Trade, 2015a, p. 6) The SEP therefore follows the circular argumentation pattern, as it firstly sets the input parameters (the prerequisites) which are the amounts of electricity produced from the individual sources (and therefore also their shares of the final production), and then it calculates the outputs, which are the shares of the individual sources on the final production represented by the corridors.

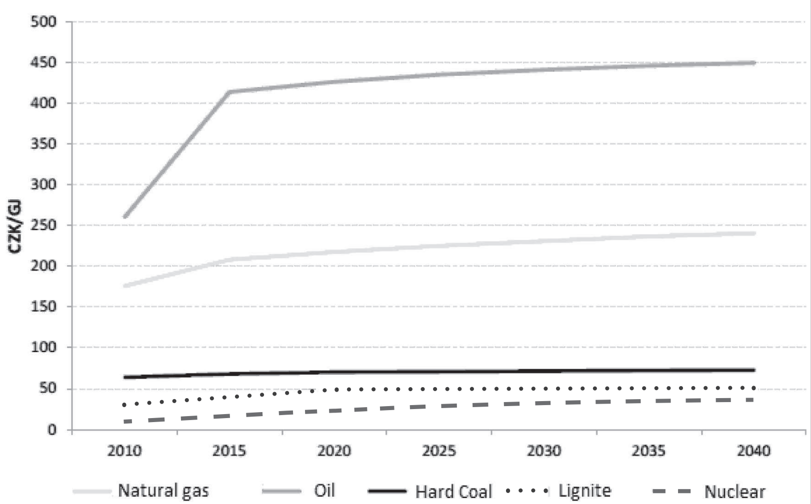
In terms of the validity of the SEP, it is important to look at the selection of input factors. Surprisingly, the SEP only works with internal factors (those originating in the Czech energy policy) while external factors are omitted. These external factors are, for example, the price of energy commodities and emission allowances, the shape of the European and German electricity markets (not only the Energy Only Market versus the capacity market but also the subject of trading – see chapter 4.2.2), or the share of renewable sources in German electricity consumption.

Tab. 9: Reflected and missing input factors in the SEP scenarios

Factors reflected in the SEP	Factors missing in the SEP
Electricity consumption	Price of energy commodities
Nuclear based production	Price of emission allowances
Coal based production	RES share on German electricity consumption
RES based production	German electricity market design
Trade balance (electricity import/ export)	EU electricity market design

The listed external factors will significantly influence the Czech energy sector, however they are completely missing in the SEP. Only the price of energy commodities is mentioned, although in total contradiction with the prerequisites of the applied method, these prices are held constant in all of the scenarios.

Fig. 45: Energy commodity price according to the SEP



Source: (Ministry of Industry and Trade, 2015a, p. 135)

Even if we accept such a reduction, the prices indicated by the SEP remain questionable. This is due to two reasons. First, when converted into internationally accepted units[34] we find that between the years 2010 and 2015, according to the SEP, the price of oil should have risen from US $74 a barrel to US $119 a barrel, and then in the period 2015 to 2040, prices remain between US $119–128 a barrel. Of course, it is impossible to credibly make such a prediction, as the data from the period 2010 to 2015 clearly show: in 2010 the average price of Brent[35] oil was US $79 a barrel; it then rose to US $110 a barrel where it stayed until 2013. In 2014, it fell to US $99 a barrel and in 2015 it dropped to the average of US $52 a barrel (World Bank, 2016), i.e. US $67 a barrel less than predicted.

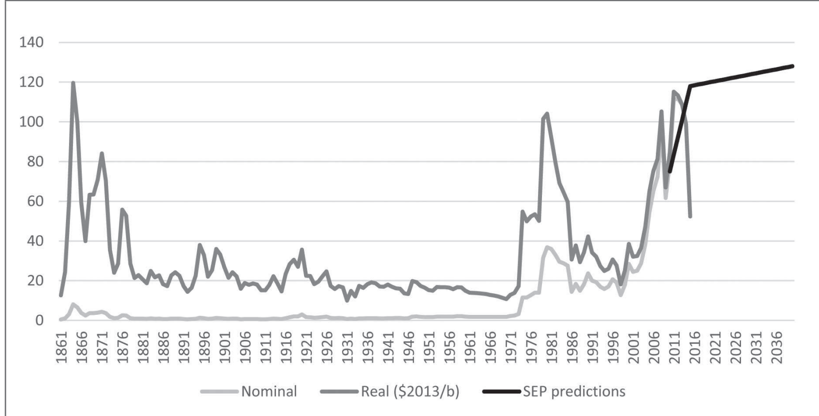
Second, when we look at the history of oil prices adjusted for inflation, we find that since 1864 oil prices have reached the interval of US $119–128 a barrel only once. This was in 2008 when it rose from US $115 a barrel in the beginning of May to US $147 a barrel in the second half of July. This was followed by a sharp drop to US $34 a barrel at the end of December. Thus the average price for 2008 reached US $98 a barrel. There have been two other instances during the past 150 years when oil prices even approached the expected interval: during the second oil shock in 1979 and between years 2011–2013 when Arab Spring revolutions, the imposition of sanctions on Iran, and the economic recovery in the United States all coincided. In that period, however, the representatives of OPEC, and in particular Saudi Arabia, presented the price of US $100 a barrel as the "fair price". (Business Insider, 2015) In other words, the price was high enough to reflect the market situation and support the investments into new production capacities but not too high as to prod the transition to other fuels and thus threaten OPEC

[34] Applied average exchange rate for 2014 was 20.75 CZK/US$.

[35] Until 2009, the prices of the Brent and WTI benchmarks differed only minimally. In relation to the development of domestic production, between 2009 and 2014, WTI oil was sold cheaper than Brent; since autumn 2014, the prices have again returned to approximately the same level.

business interests. Thus, just as oil prices cannot be expected to remain at US $30 a barrel (as they were at the end of 2015), prices also cannot be expected to be significantly higher than US $100 a barrel over the long term.

Fig. 46: Oil price history according to the SEP prediction (US$/b), 1950–2015



Source: (BP, 2015), (World Bank, 2016), (Ministry of Industry and Trade, 2015a, p. 135)

As was indicated above, the other factors are not reflected in the SEP at all. The SEP itself admits the limited variability: "*During the preparation of this document, a range of possible alternative scenarios were explored on the basis of a balance model in order to outline the future development of the energy sector in the Czech Republic. These scenarios are based on the change in the input parameters (although not axioms) of the balance model*. [...]" (Ministry of Industry and Trade, 2015a, p. 6) Thus, more than anything else, the SEP scenarios represent possible Czech reactions to one static image of the European and regional energy sectors in the interval between the years 2015–2040. And finally, these alternative reactions are not left very open: even if we considered "rigid external factors development + variability of Czech response" to be legitimate, we also find that the corridors, designed to provide variability of Czech response, in fact do not offer much flexibility.

Tab. 10: Power production corridors by 2040	
Nuclear fuel	46–58 %
Renewable and secondary sources	18–25 %
Natural gas	5–15 %
Brown and black coal	11–21 %

Source: (Ministry of Industry and Trade, 2015a, p. 46)

In comparison with the current situation, the share of the nuclear sector will definitely grow, even at the lower value of the respective corridor. According to the SEP, therefore, the new nuclear units must be built, coal-based production must be reduced and the remaining load divided between the renewable sources and gas. The SEP states that "*State Energy Policy must provide not only a long term focus, but also the necessary flexibility to promote new technical and economic development*." (Ministry of Industry and Trade, 2015a, p. 4) It provides, however, only a very inflexible long-term outlook.

5.3.4 Focus on nuclear energy

5.3.4.1 *Nuclear power plant investment risk*

Investment risk related to the construction of new nuclear power plants is based on two factors: the future cost structure of the sources as outlined in the SEP, and the high investment requirements of the nuclear industry itself in combination with the uncertainty of future price levels.

Cost structure

The nuclear industry, in comparison with all other fuel-based conventional sources (see chapter 2.1), shows a specific cost division between the fixed and variable costs. Whereas in the case of the other conventional sources, fuel is the most important component of the variable and, subsequently, total costs, the fuel share of the total costs is, in the case of the nuclear industry, only several percent. It is important to note that whereas fuel is a primary commodity for the other sources, nuclear fuel is a highly sophisticated engineering product. In the nuclear fuel production cycle there are at least five individual technology steps (uranium mining, conversion to fluoride, enrichment, conversion to oxide, cell fabrication), many of which are both expensive (in absolute figures) and time consuming: for example, the George Besse II enrichment plant in Southern France is powered by four reactors built only for the purposes of the plant. Also, nuclear fuel wear/consumption is, in comparison with the fossil fuels, significantly less dependent on changes in power plant output. Therefore, nuclear fuel has the following specific characteristics:

- It is a technology, not a primary commodity.
- The fuel production process is time consuming and, in absolute figures, also investment intensive.
- Fuel consumption depends less on the power plant output variation.

It can be deduced from these characteristics that nuclear power plant fuel costs are fixed rather than variable. Variable costs themselves are, in fact, close to zero and therefore all costs can be seen as fixed.

This, finally, gives the nuclear industry a certain competitive advantage over other sources. This is because the source employment merit order mechanism used to satisfy the current demand reflects the production costs per energy unit as determined by the variable costs. In the other words, the zero variable costs mean that nuclear power plants are always dispatched first and that the electricity price margin needed to operate the plant is very low. Therefore in reality the nuclear power plants (price takers) accept the prices formed by the variable costs of the marginal sources (in continental Europe, including the Czech Republic, this is typically coal). The price taker role is common for the nuclear industry and renewable sources.

The SEP expects that in 2040, 43.2 TWh and 20.2 TWh of the total 88.5 TWh of gross electricity generation will come from nuclear and renewable sources, respectively.

Tab. 11: Structure of gross electricity generation (GWh), 2010–2014

	2010	2015	2020	2025	2030	2035	2040
Black coal	6052.0	5832.4	4198.4	4134.3	2824.0	2745.0	1989.1
Brown coal	42936.1	40389.6	36951.3	29167.5	27947.7	23366.2	13497.2
Natural gas	1125.7	3624.6	3914.4	3973.4	4043.5	4126.6	7101.1
Other gases	1080.4	1130.5	1130.5	1130.5	1130.5	1130.5	1130.5
Nuclear	27998.2	31495.1	31495.1	30384.2	31495.1	41177.9	43204.5
Other fuels	814.8	848.6	917.4	1294.5	1446.3	1446.3	1446.3
RES	5902.8	10122.3	11548.8	13742.0	15125.6	17638.7	20173.0
Total	85910.0	93443.2	90156.0	83826.4	84012.7	91631.2	88541.7

Source: (Ministry of Industry and Trade, 2015a, p. 122)

Thus, the cumulative share of the price takers (nuclear + RES) increases between 2010 and 2040 from 39 % to 72 % of gross electricity generation (the source development corridors of the SEP work with an interval of 64–83 %). The price takers will put pressure on the sources with significant variable costs, just as they do in Germany today. In the event that there is a delay in the planned withdrawal from the coal energy industry (the amount of brown and black coal based electricity production is supposed to decrease from 49.0 to 15.5 TWh), there will be no room left in the energy mix for the gas fired sources which would otherwise play the role of marginal producer pushing the price higher. The SEP expects that coal and gas prices are to remain constant in the period 2010–2040, and when this expectation is realised (see chapter 5.3.3), coal will be traded on the German exchange for US $80–100 a ton. With coal as the marginal source, this would correspond to electricity prices of €40–55/MWh. As a reminder, the SEP expects a 23 % (corridor 18–25 %) RES share in the energy mix in 2040; this is equivalent to the situation in Germany in which more competitive RES, atomic, and coal fired sources put the gas sources out of business. If the shutdown of the coal fired power plants does not correspond with the construction of the new nuclear blocks and RES development, it will be impossible to reach a price level which would compensate for the construction of the new nuclear units.

Price level

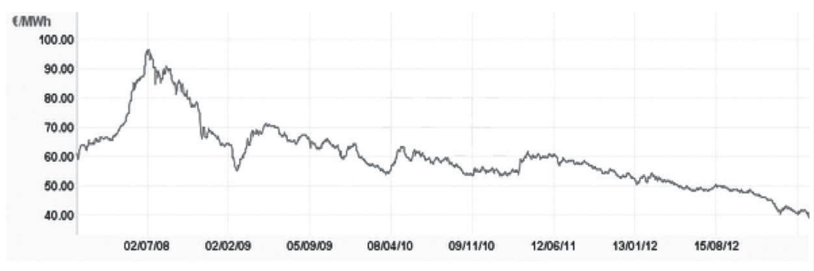
Additionally, even in the event that the power industry were to develop exactly as the SEP has planned, the profitability of the new blocks is very uncertain. The SEP itself expects the following development of the electricity wholesale price: the price will stay at CZK 1000/MWh in 2020 (€36/MWh according to the average CZK/€ exchange rate in 2014); in 2025, the price will climb to CZK 1500/MWh (€54/MWh), and in the period from 2030 to 2040 the price will stay within the interval CZK 1700–2000/MWh (€61–72/MWh). (Ministry of Industry and Trade, 2015a, p. 136)

These prices would be too low to commercially build a nuclear plant. Daniel Beneš, ČEZ CEO, mentions €100/MWh as the "not unreal" contract for difference price; during conference interviews, ČEZ representatives have often quoted the interval at €90–100/MWh. This price level approximately corresponds with the 10 % profitability of the new blocks. To achieve 7–8 % profitability, a standard for the regulated industries such as transmission or distribution, the new units would require around €75–80/MWh. (Investiční web, 2013)

It is again worth noting that during recent decades base load electricity prices have only reached a "not unreal" level once. This was in June 2008, when concerns over future energy insufficiency caused by the dramatic growth in demand in South-East Asia culminated. These concerns were accompanied by many records, such as a $147/barrel oil price. This came to an end with the economic crisis and development of unconventional natural gas and renewable electricity sources. For the rest of the monitored period, the prices remained constantly below

the regulated profitability level (€75–80/MWh) and considerably under the €90–100/MWh "not unreal" benchmark defined by ČEZ.

Fig. 47: Prices of electricity (Phelix Baseload Year Futures, EEX, €/MWh)



Source: (Energy Transition, 2013)

This means that the electricity price only reached the level demanded by ČEZ during a period of both extreme market tension and expectations of increased demand surplus over supply. In other words, the determination of the strike price at the level demanded by ČEZ (€90–100/MWh) would mean the fixation of the purchase price at the level typical for a crisis period. Thus, the Czech energy sector replaces current and expected electricity price uncertainty with the certainty of high price: again, the SEP itself expects wholesale electricity prices of €61–72/MWh.

Furthermore, in the case of possible contract for difference, the specific strike price would be determined based on the negotiations between the state and the company assigned to building the new blocks. This, in fact, would surely be ČEZ. The state would be put in a schizophrenic position, striving on one hand to ensure the electricity supply for a price which would not burden the economy, and on the other hand, not harming ČEZ, of which the state is the majority owner. The statement made by the Minister of Finance, Andrej Babiš, on the decision to breach the so called mining limits and continue with coal production in North-western regions gives a certain indication of the possible price level on which the state and the state majority owned

ČEZ would agree. "Our political movement and I have finally decided to trust the analysis of the semi-state owned company ČEZ which expects that the coal supply for small consumers and heating plants will be in danger as early as in 2022." (Patria online, 2015) The ČEZ position toward the completion of the nuclear power plant is then hardly surprising: "Completion of the third and fourth blocks of JE Temelín ensures the reliable coverage of the growing electricity consumption in the Czech Republic after 2020." (ČEZ, n.d.)

5.3.4.2 Electricity consumption and generation adequacy

An increase in electricity consumption is expected by the SEP as well. This growth of gross consumption, from a little less than 71 TWh in 2010 to nearly 85 TWh in 2040, could justify the construction of the new nuclear units. The greatest growth is expected in the industrial sector: whereas the other sectors will stagnate or develop at a rather slow pace, industry will grow from 34 TWh in 2010 to 44 TWh in 2040, or by nearly 13 %.

Tab. 12: Electricity consumption structure (TWh)

	2010	2015	2020	2025	2030	2035	2040
Industry	34.1	34.9	37.2	40.2	42.1	43.3	44.0
Entrepreneurs	8.4	8.3	8.9	9.6	10.0	10.3	10.5
Households	15.0	14.3	14.3	14.6	14.7	14.5	14.4
Electro-mobility	0.0	0.0	0.1	0.4	1.2	2.3	3.4
Gross consumption	70.9	71.1	73.8	77.6	80.7	83.3	83.8

Source: (Ministry of Industry and Trade, 2015a, p. 122)

But this does not correspond with the development of electricity consumption to-date, specifically, industrial sector energy consumption. During the last 15 years, industrial electricity consumption has remained stable at between 22 and 26 TWh

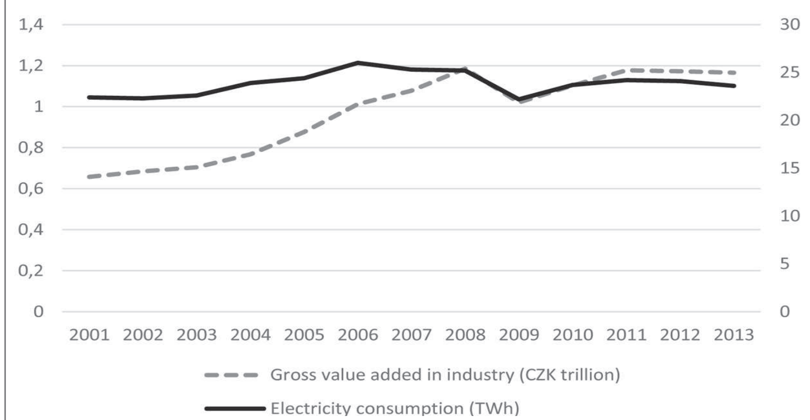
per year,[36] both during the 2001–2006 growth period and the 2006–2013 recession.

Tab. 13: Electricity consumption, total energy consumption and Czech industrial energy intensity (2001–2013)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Electricity consumption (TWh)	22.4	22.3	22.6	23.9	24.4	26.0	25.3	25.2	22.2	23.7	24.2	24.1	23.6
Energy consumption (TWh)	NA	NA	111.6	115.1	112.8	112.8	109.3	104.7	95.4	100.0	98.9	94.4	NA
Energy intensity (kWh / CZK thousand	189.2	178.9	177.8	164.7	146.7	126.1	119.1	100.1	93.3	103.5	89.7	87.1	NA
Industry GVA (CZK trillion)	0.6	0.7	0.7	0.8	0.9	1.0	1.1	1.2	1.0	1.1	1.2	1.2	1.2

Source: (ERÚ, 2014, p. 9), (Eurostat, 2014, p. 83), (Cenia, n.d.)

Fig. 48: Industry GVA vs industry electricity consumption



Source: (ERÚ, 2014, p. 9), (Eurostat, 2014, p. 83), (Cenia, n.d.)

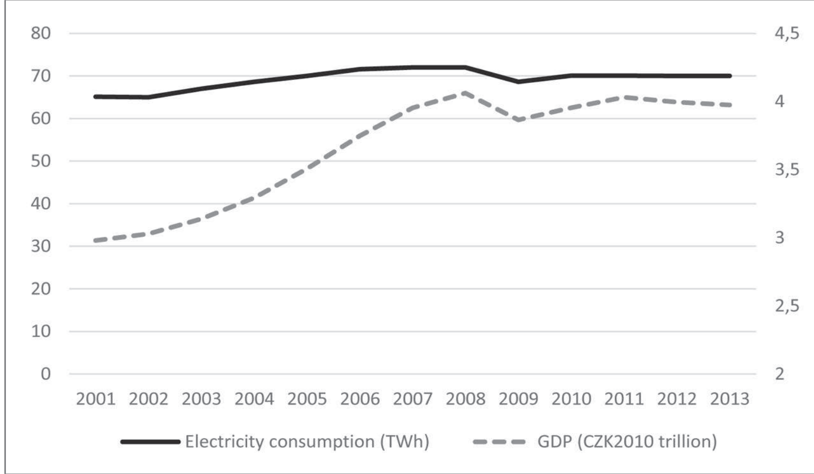
[36] The data difference of the SEP and ERO is mainly the result of the different definitions of consumption categories.

Total industrial energy consumption has shown a decreasing trend following the decrease of the industrial energy intensity: between the years 2001 and 2012, energy intensity decreased by 55 % while at the same time the industry GVA increased by 84 %. Energy intensity thus decreased by half, whereas the added value almost doubled. (Cenia, n.d.) According to the SEP, this trend will continue: the energy intensity of gross added value creation (of the whole economy) should decrease by 45 % between the years 2010 and 2040. Electro-energetic intensity should, according to the SEP, decrease more slowly, but also considerably: by 25 % in the same period. (Ministry of Industry and Trade, 2015a, p. 132) Also for the same period, the SEP sets the growth of industry electricity consumption at 13 %; this would imply the growth of industry GVA to a not unrealistic CZK 1.7 trillion in 2040. Taking into consideration the receding economic crisis, it is very difficult to foresee the situation – the present consumption decrease can to a large extent be assigned to the crisis and only the long-term recovery of the economy will show how the growing GDP influences growth in electricity consumption. The trend of delinking economic (industrial) performance and energy consumption which is typical for most of the developed world remains the main uncertainty. While this widely applies for the total Czech energy intensity, electric power intensity decreases more slowly as the cost-saving measures are, to a certain extent, compensated for by increasing industry electrification. However, as soon as the electrification process reaches its limits, the electrical power intensity of the Czech economy will most likely follow the same path as the overall energy intensity.

Concerning the electricity supply security issue, electricity consumption is closely related to the issue of generation adequacy. Generation adequacy refers to capacity which is available to cover consumption in all circumstances, including seasonal peaks.

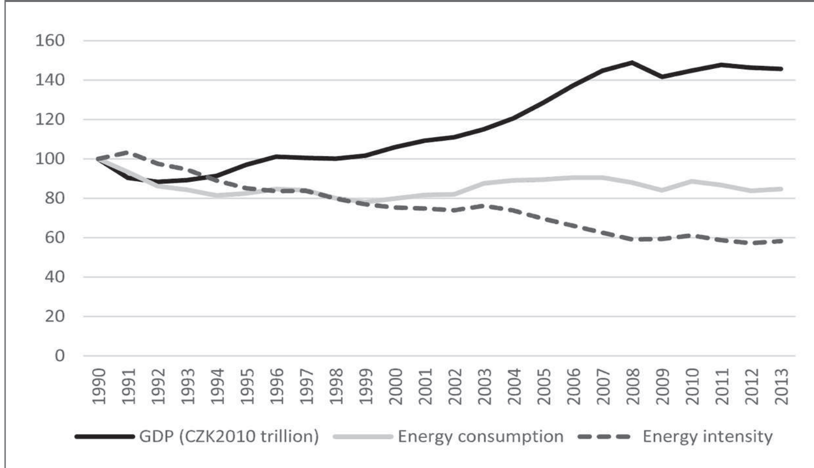
In predictions of the future generation adequacy, the SEP relies on, among other sources, the analysis of ENTSO-E: "*The ENTSO-E report warns that only the scenario that counts on the economic profitability of new sources can lead to a surplus*

Fig. 49: Electricity consumption vs GDP development, CR, 2001–2013



Source: (kurzy.cz, 2015), (ERÚ, 2014)

Fig. 50: Energy consumption and GDP development, CR, 1990–2013 (index 1990 = 100)



Source: (Cenia)

power balance in compliance with the SOAF requirements. If no new system base load sources were to be built beyond those *now under construction, after 2030 the Czech Republic would lose its ability to cover domestic consumption through domestic generation.*" (Ministry of Industry and Trade, 2015b, p. 133)

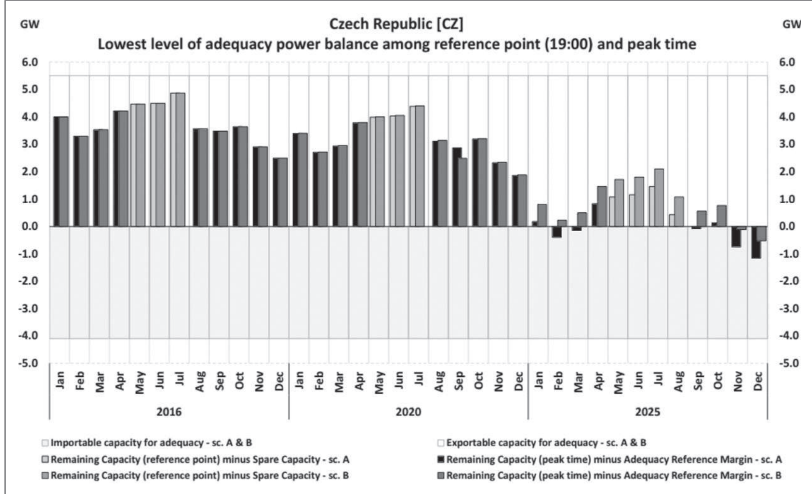
This argument has two substantial shortcomings. First, the ENTSO-E report works with two bottom-up scenarios in which it derives future generation adequacy based on current information on production capacity development and shut down. Scenario A reflects only those sources which are under consideration by the ENTSO-E members (the particular TSOs); these are the sources which have already been approved or constructed. Scenario B works with sources which are not yet confirmed but which can, when considering market development, be reasonably expected. Therefore it is not surprising that in the longer time horizons for which no confirmed sources are thus far available, ENTSO-E expects insufficient output capacity (Scenario A). Second, the ENTSO-E scenarios only reach 2025. In addition to the scenarios, ENTSO-E works with four electro-energy market "visions" for the year 2030. These are envisaged as the possible alternatives of market development based on currently identified factors such as consumption development, cooperation and market integration, R&D investments, RES employment and the price of carbon. ENTSO-E emphasises that these are not prognoses and they do not predict generation adequacy. ENTSO-E also does not assign probability to these scenarios. The ENTSO-E scenarios merely conceptualize several different ways of integrating the European energy industry objectives for 2020 and 2050. It is possible to anticipate that one of them will occur with an acceptable level of probability. (ENTSO-E, 2014, p. 128)

This means that the ENTSO-E report, referred to in the SEP, states that by 2025 it will be necessary to build other sources apart from those which had been approved or were under construction by June 2014. This is not surprising. More important is the fact that, because of the high level of uncertainty, the ENTSO-E report does not analyse generation adequacy for the year 2025 and beyond. Thus it is not possible to state that "based on this study, after 2030 the Czech Republic would lose

its ability to cover domestic consumption through domestic generation."

According to ENTSO-E, this will happen in both the A and B Scenarios as early as 2020, after which it will be possible to import enough electricity to cover all peak consumption. Also according to ENTSO-E, the necessity for new production capacities will emerge during that time.

Fig. 51: Generation adequacy in the ENTSO-E scenarios for CR



Source: (ENTSO-E, 2015, p. 43)

The new production capacities will of course result from any current market situation where coal, gas and renewable sources are under consideration. It will be impossible to build nuclear facilities in such a short time (see chapter 5.3.3). The shortest possible construction time for a nuclear plant, including the approval procedure, is estimated at 15 years. For a coal fired power plant, approval and construction take about seven to eight years, and four years for a gas fired power plant. (Drábová, 2007, p. 59) The SEP itself, when expecting the launch of the first newly constructed nuclear units in 2032, works with an optimistic prediction which challenges the 15 year approval and construction period of a nuclear plant. (Ministry of Industry and Trade, 2015a, p. 118) Conservative estimates of the complete process of nuclear power plant construction are about 20 to 22 years in the Czech environment. Renewable source facilities, on the other hand, are possible to construct in approximately 6 months to a year, including the approval process. They therefore remain at the other end of the construction time spectrum.

If in the middle of the next decade the generation capacity of the Czech power industry decreases, the gap will probably be filled by other sources or by increased import. In this way, the nuclear sources planned for 2032 to approximately 2038 will start up shortly after the investment wave in the 2020s and will face increased market competition which will further jeopardise their return on investment and increase the likelihood that power from the new units will end up being exported. After all, the same situation occurred after finishing the first two Temelín units. A shortage that occurred between the plant's FID and its launch was covered by the sources with more operative construction times. Since Temelín's launch, the Czech Republic power exports are nearly equivalent to the plant's production.

At this point it is important to realise that the long-term aspect of the nuclear energy industry results not only from its unprecedented long approval and construction time but also from its financing. The British nuclear power plant Hinkley Point C received state support in the form of contract for difference for a period of 25 years. In the Czech environment, this would mean a guarantee of purchase price for ČEZ until 2057 at the very least (with a start date of 2032). Realistically, with a start date of 2038, the guarantee would last until 2063. The German market, with which the Czech market is bound, expects an increase in the renewable sources share of consumption from 50 % in 2030 to 65 % in 2040 and to 80 % in 2050. At such values, it will be very difficult to maintain such a large, inflexible source on the market, especially given the fact we do not really know how the market is going to look.

5.3.5 Summary

It can be concluded that the present Czech energy strategy represented by the SEP is not a suitable instrument for determining the direction of Czech energy sector development in the coming decades. This is caused mainly by inappropriately identified driving factors and partial input assumptions, insufficient reflection of uncertainty and fundamental internal inconsistency.

The SEP relies on the outdated premise of self-sufficiency which it freely confuses with supply security. In doing so, the SEP often makes reference to ENTSO-E analyses, which, nevertheless, define supply security using a combination of generation adequacy and cross-border capacity and thereby emphasise the importance of international exchange rather than self-sufficiency. Generally, it does not make much sense to stress self-sufficiency while at the same time participating in the creation of common European gas and electricity markets (chapter 5.3.2).

The SEP implicitly expects that the Czech state has full control over the Czech energy industry and therefore it dares to predict both wholesale and retail electricity prices in the Czech Republic for the 2015–2040 period as if prices were to be determined by some already known governmental regulation. Surprisingly, the same applies to the prices of internationally traded commodities – all SEP scenarios fix the price of oil at US $119–128 a barrel. Remarkably, this price level has only occurred once since 1864, and only for one three month period, definitely not for a whole year; additionally, such a price level is considered undesirably high even by the OPEC countries themselves. The comparison made for the year 2015 in which the real and SEP predicted average prices differ by US $67 a barrel proves that it is not possible to credibly make such predictions (chapter 5.3.3), not to mention using them as a model for the state's future energy needs.

Furthermore, in an environment characterised by essential uncertainty, the SEP ignores the fundamental rules of responsible planning and risk balancing. The scenarios which should prepare Czech decision-makers for the uncertain future completely ignore the factors which will surely influence the Czech energy sector: for example, the shape of the European and German electricity markets or the share of renewable sources in German electricity consumption (chapter 5.3.3). Despite this, the SEP uses these scenarios as to support their decision to base future Czech power production on nuclear sources, regardless of lengthy licensing and construction times and public funding requirements (chapter 5.3.4.1). The selected course, due to its rigidity, puts the Czech power industry at significant risk (chapter 5.3.3); it is the least compatible with the regional market situation (chapter 5.2.2) and potentially contradicts European law (chapter 5.3.1). At the same time, this approach ignores the fact that the market (onto which the new nuclear units are planned to be placed in 2032 and which will be held with state support until at least 2057) will probably be totally different than either today's market or the market of the first decade of the 21st century (chapter 5.2).

The bottom line is that these weaknesses represent logical flaws (such as justifying the need for new nuclear units planned for 2032 by an ENTSO-E study whose predictions do not reach beyond 2025) and fundamental internal inconsistencies. The Czech energy strategy often contradicts itself – on one hand, it urges opening and integrating power markets as much as possible and supporting international exchange, and on the other hand, it considers power imports, including those from countries that reach far better scores in supply reliability than the Czech Republic, as a security risk. On one hand the SEP is against state support and other market distortions, and on the other hand, the Ministry of Trade and Industry, the collective author of the SEP, calls for public subsidies for nuclear energy.

6. EUROPEANISATION OF ENERGIEWENDE

Energiewende is primarily a German project. Nevertheless, its implementation does not happen in a vacuum; the German energy sector is a part of European Energy Policy (EEP) and it both influences and is influenced by this policy.[37]

The important fact is that, so far, the German public and political elites have primarily focused on EW implementation in Germany itself. The EU dimension – implementing the policy in the European context – has been left aside. This is also demonstrated by the limited progress in this area. Although the number of sources pointing out the need to integrate EW and the EEP have been increasing,[38] the priorities and instruments of implementation are described only very generally.

Instead of starting with specific and clearly defined interests which are, in relation to EW, declared by Germany at the European Union level, we first have to define these interests. We will use the materials and knowledge from the previous chapters and

[37] From a formal perspective, since the Treaty of Lisbon, the EEP belongs to the shared policies. But this Act has only codified the long-term practice in which the energy policies of member states are created in relation to the European Energy Policy.

[38] See: Buchan, D. *The Energiewende – Germany's gamble*. (2012). OIES.; Fischer – Geden. *Moving Targets*. (2014). SWP Research Paper.; Fischer – Geden. *Die Deutsche Energiewende europäisch denken*. (2011). SWP Aktuell; Kwiatkowska-Drożdż *et al. Germany's Energy Transition. Difficult Beginnings*. (2013). OSW Report. Governmental documents: BMWi. *Die Energiewende in Deutschland*. (2012).; BMWi *10-Punkte-Energie-Agenda des BMWi*. (2013).; CDU, CSU, SPD. *Deutschlands Zukunft Gestalten – Koalitionsvertrag*. (2013) et al.