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RENEWABLE ENERGY SOURCES AS A BARRIER TO THE EU'S COMMON ENERGY POLICY – ON THE EXAMPLE OF POLAND AND GERMANY

ODNAWIALNE ŹRÓDŁA ENERGII JAKO BARIERA WSPÓLNEJ POLITYKI ENERGETYCZNEJ UNII EUROPEJSKIEJ – NA PRZYKŁADZIE POLSKI I NIEMIEC

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Summary: The main objective of the EU is to achieve a high rate of economic development. High rate of economic growth can be achieved, inter alia, by increasing economic cohesion. In the last period, the Community put special emphasis on the creation of a single electricity market. This market has led to lower prices, provided more secure supplies and facilitated the optimization of production plants based on renewable sources and thus their development. The aim of this article is a synthetic presentation of the problems that transmission system operators have with unscheduled electricity flows as a consequence of the production of renewable energy, which is difficult to predict. Solving this problem is crucial to the integration of the electricity market in the EU and thereby economic cohesion.

Keywords: cohesion policy, energy policy of EU, international power transmission systems.

Streszczenie: Głównym celem UE jest osiągnięcie wysokiego tempa rozwoju gospodarczego, poprzez m.in. zwiększenie spójności gospodarczej. W ostatnim okresie szczególny nacisk Wspólnota położyła na utworzenie jednolitego rynku energii elektrycznej, co ma spowodować obniżenie cen i zapewnienie bardziej bezpiecznych dostaw oraz ułatwić optymalizację produkcji elektrowni opartych na odnawialnych źródłach i tym samym ich rozwój. Celem artykułu jest syntetyczna prezentacja problemów, jakie mają operatorzy systemów przesyłowych z nieplanowanymi przepływami energii elektrycznej, będącymi skutkiem trudnej do przewidzenia produkcji OZE. Rozwiązanie tego problemu będzie bowiem decydowało o integracji rynku energii elektrycznej w UE i tym samym o realizacji polityki spójności gospodarczej.

Słowa kluczowe: polityka spójności, polityka energetyczna UE, międzynarodowe systemy przesyłania energii.

1. Introduction

The European Union has set priorities for the perspective 2014-2020 which concern electrical energy sector. On the one hand, there is a need to reduce carbon dioxide emissions in order to prevent climate change and limit environmental damage. On the other hand, the goals are intended to develop European territorial cooperation by increasing the diversity of energy sources and transmission routes [European Commission 2015]. In terms of economic cohesion, the European Community wishes to combine currently separated national electrical power systems into a single overarching grid. It assumes that an EU-wide electrical power system will be more sustainable, competitive and secure in comparison to individual, national systems. Moreover, a unified system will:

- increase energy efficiency,
- increase the share of renewable energy sources,
- decrease pollution caused by coal power plants [European Commission 2012].

The aim of this article is to summarise some of the key problems that Transmission System Operators (TSOs) encounter due to unplanned power flows caused by renewable energy sources. A change in electricity supply in one EU country has a negative impact on electrical power systems in many other countries and means that the TSO as well as the country as a whole has to bear additional costs. Therefore, an argument was made that the negligence of this problem will result in a limitation of cross-border electricity trade and thereby hinder the creation of a unified energy market or even lead to its failure. It will also have negative influence on development of renewable energy sources and the economic cohesion process within the EU. In order to illustrate the problem, unscheduled power flows from Germany to Poland were presented as an example.

2. General information about electricity transmission grid in Poland and Germany

PSE S.A. acts as the transmission system operator in Poland. At its disposal are extra-high-voltage transmission lines of a total length of 14.069 km, including 7.971 km of 220 kV lines and 5.984 km of 400 kV lines (as at 31 December 2015). Furthermore, the company also owns an overhead line with an unusual voltage level of 750 kV, connecting the Polish and Ukrainian power systems, that is currently out of operation. Also of interest is an under-sea 450 kV DC cable connection with Sweden. Alongside transmission lines, PSE's assets also include 106 extra-high-voltage stations.

In most cases, there is only one transmission system operator in each European country (like in Poland). The exception is in Germany, where there are four operators:

- 50Hertz,
- TenneT,

- Amprion,
- TransnetBW [Berkel 2013].

50Hertz is responsible for the north-eastern part of the country. Its grid is directly connected with the Polish power system. Although 50Hertz's geographic area covers 109.558 km² (consisting of 31% of Germany), which is around one-third the size of Poland (312.679 km²), it has extra-high-voltage transmission lines of a total length of more than 10.000 km and 77 stations [50Hertz 2016]. This means that 50Hertz's grid (as well as those of other German TSOs) is much denser than the Polish grid, with a larger number of stations per square kilometre. Along with Poland, 50Hertz's transmission grid is also connected to the Czech Republic and Denmark, and has several additional interconnectors linking it with TenneT.

In recent years, Germany has invested extensively in grid expansion. In 2015 alone, the four German TSOs spent combined €2.3 billion on transmission grids [Monitoringbericht 2015]. This amount is comparable to planned investment in Polish transmission grid for the next several years. Nevertheless, the progress of German grid development has not been rapid enough to transport all the renewable energy from where it is produced to the centres of consumption. A similar situation also exists in other EU countries, where grid infrastructure is obsolete (30-40 years old on average[1]) and not adapted to the requirements of renewable energy sources. Even the Projects of Common Interest (PCI) will not change it in the near future. This is a list of key energy infrastructure projects drawn up by the European Commission in order to integrate the European internal energy market and reach the EU's other energy policy objectives. There are 195 projects on the latest list (2015) that will receive financial support totalling €5.35 billion from the Connecting Europe Facility (CEF) in the period 2014-2020 [European Commission 2015]. Among these key projects are investments undertaken by the Polish TSO, such as an interconnector with Lithuania which was put into operation in December 2015, phase-shifting transformers in Mikułowa station that are in the process of being built, and the new Eisenhüttenstadt – Plewiska line between Germany and Poland that is currently in the early planning phase.

Financial support provided to PSE by CEF is proof that the Polish transmission grid is very important in terms of European energy market integration. Even though Poland already possesses interconnectors with neighbouring countries (Lithuania, Sweden, Germany, the Czech Republic, Slovakia, and Ukraine), their transmission capacity is insufficient, which means that the possibility for international exchange is limited.

[1] In Poland 82% of 220kV lines and 25% of lines 400kV lines are over 30 years old [Jankiewicz 2015].

3. Unplanned power flows from Germany to Poland

The European TSOs calculate (taking into account the transmission system security standards) cross-border transmission capacities for respective profiles (e.g. the Polish-German profile). These capacities are provided to electricity traders operating under market-based rules issued by the Joint Allocation Office (JAO), who conducts the auction procedures. Details regarding these rules are described in following documents: *Allocation Rules for Forward Capacity Allocation* and *Rules for Daily Capacity Allocation on borders of CEE region and borders Croatia-Hungary and Croatia-Slovenia* [JAO 2015]. The above-mentioned congestion management procedure is necessary because technical transmission capacity between countries is not sufficient to transport the entirety of the electricity volumes that market participants would like to trade with. For this reason it was essential to establish a procedure that would both enable international trade and maintain transmission system security at the same time. Germany and Austria connected their electricity markets several years ago, and today share one common German-Austrian bidding zone. This means that electricity prices are the same in both countries and the common German-Austrian bidding zone is excluded from the coordinated European cross-border congestion management procedure. The high volume of commercial flows between Germany and Austria influences the volume of unplanned flows passing through the neighbouring grids. Polish regulatory authority URE (Urząd Regulacji Energetyki) defines unplanned flows as "cross-border power exchange that was not reported to a TSO in the form of cross-border schedules, and was excluded from market-based mechanism for allocation of transmission capacity" [URE 2015].

Unplanned power flows across the German-Polish border are already well known and have occurred consistently for several years (and their incidence continues to increase). The real-time flow from Germany to Poland was around 1137MW higher on average in 2014 (hourly values were even higher) than the flow resulting from trade volume between those two countries. It is an increase of 42% on the previous year [URE 2015]. In comparison, the average unplanned flow during the period 2011-2012 was 899MW. It is no coincidence that the values of unplanned flows from Poland to the Czech Republic and Slovakia are almost the same as those from Germany to Poland. This occurs because Poland is only a transit country for German electricity being transported to customers in southern Europe (including southern Germany). In periods when German electricity is cheap, and especially at times of high wind power production in the northern part of the country, Austria imports this electricity either for consumption or storage purposes. As mentioned above, this import is excluded from cross-border congestion management procedure. For this reason the unplanned flows from Germany to Poland are especially high during windy days. Germany does not limit wind generation to suit the technical capacity of its transmission grid, instead uses the grids of neighbouring countries for transportation. This state of affairs was

confirmed in a report prepared by TSOs from the Czech Republic, Hungary, Poland and Slovakia [ČEPS, MAVIR, PSE, and SEPS 2012]. The report paid particular attention to the correlation between unplanned flows and commercial Germany-Austria exchanges. Similar arguments are presented in a report by URE [URE 2015]. It appears that Germany sells more electricity to Austria than the transmission lines of both countries are able to transport. One particularly good example of this behaviour is 2 December 2011, when Germany sold 8500 MW of power to Austria but only 4000 MW was transported southward via the German grid. The rest was transported by using the grids of neighbouring countries: 2000 MW via the Czech grid, 1500 MW via the Polish grid, and 1000 MW via the Dutch grid.

Unplanned power flows cause negative consequences for the transit country. Firstly, they reduce the security of transmission system operation [Jankiewicz 2015, pp. 209-223; Bania, Mierzejewski 2014, pp. 9-36]. They lead to the violation of reliability criteria in the Polish system, such as the so-called "n-1" criterion, which is an analysis that determines whether a system would still be secure following the failure of one of its elements. Secondly, this phenomenon decreases cross-border capacities available to the participants of the Polish energy market. This happens because interconnectors are permanently overloaded, which prevents market players from being able to trade. This leads to decrease in Polish capabilities to import as well as export electricity, such as occurred in the period 2011-2014. Alongside the loss for Polish traders and the Polish economy, we can also observe an increasing export from Germany to Austria, who has a privileged access to cheap German electricity thanks to neglecting technical problems with the grid. This is an example of unequal treatment of market participants.

In November 2014, URE took legal steps in reaction to unplanned flows and requested the ACER's (Agency for Cooperation of Energy Regulators) opinion on whether current cross-border congestion management procedure in CEE region (with the exclusion of the German-Austrian border) is in accordance with Regulation (EC) No 714/2009[2]. According to URE, the exclusion of the German-Austrian border from the coordinated European cross-border congestion management procedure does not comply with Regulation (EC) No 714/2009, which sets out the basic rules for cross-border exchanges in electricity and with Regulation (EC) No 1222/2015[3].

ACER published its opinion on 23 September 2015, calling for the introduction of coordinated capacity allocation procedure on the German-Austrian border [ACER 2015]. This would decrease unplanned flows and relieve the permanently overloaded interconnectors between Poland and Germany. Unfortunately, the relevant TSOs did not implement ACER's recommendation, and appealed against it.

[2] Regulation (EC) No 714/2009 of the European Parliament and the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No. 1228/2003.

[3] Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management.

Meanwhile, the installed capacity of German wind and photovoltaic energy sources has continued to increase. The German regulatory authority reported growth of about 22 GW in the period 2011-2014 (from 54.6 GW to 76.5 GW respectively) [EEG 2014]. Further increases in renewable energy capacity in Germany will lead to even higher unplanned flows through Poland.

4. Conclusion

The above example of Poland and Germany shows how difficult it has been to establish integrated energy market in Europe. The central problem is the rapid development of renewable energy sources concentrated in some regions as well as the difference in infrastructure conditions in respective countries. Germany began the transition to renewable energy some years ago and periodically produces large amounts of electricity from renewable sources (its share of overall consumption was 28% in 2014). Because the German grid is not extended enough to transport such large volumes, this electricity has to be transported using grids in other countries, which threatens the system security of neighbouring TSOs and increases their operational expenses. For this reason, Poland is striving to stem unplanned power flows from Germany. Alongside legal action, this includes the construction of phase-shifting transformers on the German-Polish border. These are specially-designed transformers that make it possible to control load flows in the grid [Vereinbarung... 2014]. PSE is responsible for the construction of phase-shifting transformers on the Hagenwerder-Mikułowa connection, while 50Hertz is required to build them on the Krajnik-Vierraden connection. Construction on the Polish side will be finished in the middle of 2016, while 50Hertz reports that its section should be finished in October 2017. It is important to mention that the operation of phase-shifting transformers will not stem unplanned flows completely but merely reduce them. This is also true of other commonly-used remedial actions, such as DC loopflow and cross-border redispatching.

It is also worth noting that the costs of remedial actions are partially covered by Polish energy consumers.

The countries of the European Community plan to significantly extend their renewable energy capacity in the next decade. Several years ago, the EU decided that it wants to achieve at least 20% energy from this type of sources by 2020 [European Commission 2010]. Germany's goal is to produce at least 35% of its energy from renewable sources by 2020. As a result, the problems with unplanned power flows will continue to increase. If a solution to this problem is not found on the EU level, affected countries will begin to isolate their systems, leading to a failure in the integration of the European energy market. This will also make the implementation of economic cohesion policy more difficult. The European Community should take measures to establish a legal framework concerning cross-border unplanned power flows. In the face of rapid development of wind and photovoltaic sources, greater

financial support for grid extension is needed as well as investment in generation units that would balance volatile production from renewable energy sources.

This situation across Poland and Germany exposes some obstacles that lie in the way of an integrated European energy market. Bearing in mind the desire to achieve many various goals at the same time, it is clear that achieving some of them (e.g. greenhouse gas reduction, increase in the production of renewable energy) comes at the cost of failing to reach others. The overproduction of electricity in some regions makes the whole system unsustainable, and the transportation of electrical energy over a huge distance via several countries and in volumes higher than technical grid capability reduces the security of the European system.

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