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DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin

Tel. +49 (30) 897 89-0
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Beyond the "Grid-Lock" in Electricity Interconnectors

The Case of Germany and Poland

Lidia Puka [a]

Kacper Szulecki [b]

Abstract

The common European electricity market requires both market integration and transmission grid expansion, including trans-border interconnectors. Although the benefits of increased interconnectivity are widely acknowledged, expansion of interconnectors is often very slow. This paper gathers insights on the reasons behind this "grid-lock" drawing on the study of the German-Polish border. Although two interconnectors already exist, the trade is blocked by unplanned electricity loop flows. A third interconnector has been discussed for years, but saw little progress in spite of declarations of support on both sides. Drawing on the existing literature on the topic of grid expansion we identify four hypotheses for the grid-lock: inadequate financing; diverging interests; governance and administration problems; and different actors' motivations, trust and security perceptions. We evaluate them using the empirical material gathered through document analysis and stakeholder interviews conducted in Germany and Poland. None of the hypotheses on its own can explain the "grid-lock". However, while financing has not been a major obstacle, divergent interests had an impact on the project delay, administrative and governance problems are a great hindrance on the technical level, while motivations influence interstate political relations and policy shaping. EU support and closer bilateral cooperation provide opportunities to address these challenges.

Keywords: Electricity interconnectors; the European Union; loop-flows

JEL: N7, N74, Q4, Q48

[a] Polish Institute of International Affairs (PISM), Warsaw

[b] Hertie School of Governance, Friedrichstrasse 180, 10117 Berlin and Visiting Fellow DIW Berlin, kacper.szulecki@gmail.com

1. Introduction

The idea of an Internal Energy Market (IEM) dates back to the European Commission's (EC) policy proposal from 1988. More than two decades later, in March 2011 the European Council finally envisaged a common energy market (for power and gas) already by 2014, to enhance economic performance, increase security of supply, and facilitate the transfer to a low carbon economy. While the actual shape of the common market for electricity is being developed with framework guidelines and grid codes, most of the attention so far is on the alignment of trading rules and system operations (Majchrzak et al. 2012). This approach is necessary albeit not sufficient, as for a functioning common market we also need a robust electricity grid with more interconnectors and thus – an increased exchange capacity between the member states. This is emphasised in the European Union's (EU) financial and regulatory support.[1] The minimal envisaged exchange capacity is indicated at 10% of national generation capacity. While this level is still far from optimizing the synergies between national systems, it is already difficult to achieve for many member states. On the borders between the EU states, such as between France and Spain or Germany and Poland, projects are effectively stalled.

At the same time, various benefits have been recognised, as accompanying the grid development.

They include increased system stability and enhanced security of supply (General Electric and E3G, 2013). Furthermore, transmission grid expansion is the cheapest way to integrate high shares of renewables and makes the power system more resilient (Ecofys 2013). Finally, in the light of the growing generation from scattered and intermittent RES, grid management faces new challenges such as unplanned energy flows (Spiecker and Weber, 2014), and

[1] I.e. the European Energy Infrastructure Package, European Energy Programme for Recovery, selection of the Projects of Common Interests, and the recent Connecting Europe Facility.

interconnectors are one of the necessary components of achieving efficiency (Neuhoff et al., 2011). Finally, a case study of a Japan-Korea interconnector reveals significant cost-effectiveness of interconnection and increased efficiency of the regional decarbonisation strategies compared to individual efforts. (Kanagawa and Nakata, 2006).

In the light of the above, it is difficult to understand the low progress in grid development. This study analyses the reasons for low progress in construction of a third interconnector between Germany and Poland as an illustrative case of this EU-wide problem. The next section introduces data gathering method, followed by the different theoretical approaches to the problem of grid expansion, and distils four hypotheses that can explain that "grid-lock". The third section provides an introduction to the German-Polish case, departing from the differences between the two countries' energy systems, the history of interconnectors expansion, the currently salient question of "loop flows" and the mapping of key stakeholders. In the fourth section, the hypotheses derived from the literature review are contrasted with the empirical material, and each hypothesis is evaluated. The conclusions include ideas to improve the conditions for interconnector expansion and unlocking potential synergies of EU-wide significance.

2. Methods

We use a qualitative single case study method to provide in-depth insights on the "grid-lock" in interconnector expansion. While some of the findings from such a case study can be generalized, there is an understandable degree of case-specific factors in play. Data gathering involved a wide document and secondary literature query, including legislative documents, reports and parliamentary proceedings. We have also conducted a number of expert and stakeholder semi-structured interviews with selected interviewees in Poland and Germany.

These included the transmission system operators, regulators, representatives of ministries, energy exchanges, the European Commission, as well as the expert community – universities, think-tanks, and NGOs.

2.1 Hypotheses

The reasons behind the little progress on transmission grid development in general, and even less in interconnectors, have been subjected to a various research. Below we consider four possible explanations present in the literature and/or expert discourse.

2.1.1 Financing

According to Accenture estimates (2013), as much as €25 billion might be needed for grid expansion in Germany alone, hence the financial constraints appear the simplest explanation for stalled investment. An insufficient financing model can be a hindrance to investments, and also result in a lack of interest in construction of merchant lines. Under current trends in the evolution of transmission tariffs, Henriot (2013) argues, only half the volumes of investment currently planned could be funded, and only a very significant increase in tariffs would get us where we need to be for a really integrated system. On the other hand, with appropriate regulatory framework, the financial risk of long-term strategic infrastructure investments is generally low and helps acquire sufficient finance (Battaglini and Liliestam, 2010, p. 2).

2.1.2 Interests of stakeholders

The stall in construction can be caused by either contradictory interests or disinterest on one of the sides. In the light of general investment uncertainty, the actors on both sides – the operators, regulators, producers, exchanges, EU-agencies, NGOs and governments – follow individual, potential and perceived cost-benefit calculations. Studies indicate that the political economy of the energy sector and different interests of the neighbouring countries can indeed

be a hindrance (General Electric and E3G, 2013, p. 8). De Nooij (2011) claims that current interconnector and transmission investment decisions in Europe are unlikely to maximize social welfare. Last but not least, under a country-wide regulatory model, "interconnection development that provides long-term economic benefits to one country but fewer benefits to the neighbouring country, is unlikely to be constructed and congestion at the border will increase" (Battaglini and Lilliestam, 2010, p. 3).

2.1.3 Governance and administrative processes

A large body of literature indicates that not harmonized, complicated processes on the domestic level are the most visible problem for transmission grid development. When coordination across borders is required, the process faces a grid-lock. Different problems fall under this category: administrative, legal, societal etc. An insufficient regulatory framework, and inefficient allocation of planning and authorization competences can be a problem (Battaglini et al,. 2012; Steinbach, 2013), worsened still by a general lack of public acceptance of infrastructure projects, including new grids (Kogdenko, 2013). The length of procedures is also a very important barrier. Depending on the legal context, permitting and building can take up to 20 years, and the process can be stopped arbitrarily by the administrative authorities at any point (ENTSO-E, 2010).

2.1.4 National "energy security" and trust

Different levels of system reliability may result in attempts to implement different generation security standards, as well as restrictions of trade across interconnectors (General Electric and E3G, 2013). Individual security concerns can arise from resource availability, import dependence, and market development. Thus, the lack of political support can stem from different paradigms of energy security and views on the electricity markets, and can block interconnector projects at different political levels – including the highest. This can be

combined with mistrust between the actors operating in an uncertain environment. If that is the case, the question remains whether the difference in perception is shared across all governance levels.

3. Results

3.1 Significance of the case study: German-Polish interconnectors

The case of Germany and Poland allows us to observe the interplay of different factors: political, administrative, social and economic – that together influence grid expansion. Moreover, the countries serve as an example of the ongoing processes of regional EU market integration. Thus, the study can add to the understanding of the EU role as a driver of infrastructure projects. Further, Germany and Poland in the recent years have been seen symptomatic for wider categories of EU member states. While Germany likes to be perceived as progressive in its energy policy (having embarked on its national energy transformation – *Energiewende*), Poland has been a vocal supporter of conventional generation, especially coal, but also nuclear. This particular case is interesting also because of the historical background (see 3.3).

3.2 Energy systems: an overview

The German-Polish border divides two different traditions of energy governance or "energy cultures" (Pronińska 2013). Although neighbours, Poland and Germany operate in very different settings. German generation and consumption of electricity is roughly 4 times bigger than the Polish one. Germany is also a well interconnected, transnational energy hub, and part of the most developed European electricity market. It is a part of most of the European regions: Central-Southern, Central-Eastern, and Northern-Western (the latter being the biggest pending project of integration). Meanwhile, Poland remains the European electricity system's Eastern border-state – the links with Ukraine and Belarus are only active with a direct link to

one dedicated power station, and progress on the construction of an interconnector with Lithuania is slow. Poland is a part of the Central Eastern and Northern-Western European regions (the latter limited to the connection with Sweden). Progress of coupling with the Eastern countries (Czech Republic, Slovakia, and Hungary) was slow but might now gradually progress with signing on 15. January 2014 of the Memorandum of understanding of on the implementation of the day-ahead congestion management target model between the TSOs, power exchanges, and National Regulatory Authorities of the the CEE region, and ACER. However, major conceptual questions remain to be answered, as the short gate closure time envisaged in market coupling under gate closure is difficult to align with the liquidity requirements for a secure operation of the Polish system.

Germany has been an electricity exporter and transfer country for the last decade, with the exchange capacity of around 10% of its generation, while in ideal conditions Poland's exchange capacity is below 5%. In 2011, total German export of electricity equalled 1/3 of the whole Polish consumption. Main German export markets are Austria, Switzerland and the Netherlands. In the second quarter of 2013, Germany commercially exported 14 350 GWh and imported 13 797 GWh, while Poland's commercial flows were at 891 and 286 GWh respectively – a twenty-four fold difference in aggregated flows (DG Energy 2013). This situation visibly influences the perceptions of trans-border electricity trade. In Germany this is a sphere of normal business operations, whereas for Poland, this is a question of structural transformation and security.

Both countries are facing an insufficient internal grid development. Grid density and distribution in Germany is twice as big as in Poland, this, however, merely reflects the population density in the two countries. Poland is suffering from energy infrastructure decapitalization, visible both in generation and transmission. Many lines are quite aged and

require retrofit – a problem shared by Germany. In the EU, the estimates of the investments needed in high voltage grids development between 2013-2020 round €140 bln (European Commission, 2012). The Polish TSO plans to spend €5.8 bln on grid investments by 2025, of which € 2.4 bln between 2013-2017 (PSE 2013). In Germany, the estimated costs of the grid investments between 2012 and 2022 vary between €5 bln in the minimal scenario to €20 and €30 bln in the favoured grid expansion scenarios. The German Grid Development Plan 2013 projects the investment need at € 22 bln (Groebel, 2013; NEP 2013). Additional distribution grid investments are even higher (IEA, 2013b, p.13).

3.3 Emergence of German-Polish interconnectors

With the end of the Cold War and the collapse of Eastern European communist regimes, Poland found itself interconnected into the eastern UPS/IPS electricity system. With a similar rationale as the NATO and EU membership applications, both filling the apparent 'security vacuum' and realising the political elite's vision of reaffirming a European identity, the decision to interconnect with the Western European system was quickly taken and implemented. In October 1995 the Polish system was switched and became part of the Union for the Coordination of Transmission of Electricity (UCTE) (Kasprzyk 2006). To date, two interconnectors operate between the German station in Vierraden and the Polish station in Krajnik in the northern part of the border, and between Hagenwerder and Mikułowa in the southern part. The third interconnector between the German station at Eisenhüttenstadt and the Polish one at Plewiska has been discussed by the transmission system operators (TSOs) since 2008, without much progress.

3.4 Poland as prospective electricity importer

Germany's generation, despite the nuclear phase-out, has been increasing, while Poland faces a generation deficit, and may eventually become a market for German power. The Ministry of

Economy estimates that in 2017, the capacity production deficit might reach 1.1 GW (Ministry of Economy, 2013, p.78-9). The estimations of the Polish TSO, go even further - by 2020 Poland might need to close as much as 6.4 GW of capacity (Majchrzak, 2013). This is related both to infrastructure age and to enforcement of the EU air pollution regulations which will require some coal-fired plants to be taken off-grid from 2016 (Industrial Emissions Directive, 2010).

At the same time, the electricity consumption of Poland has been increasing in recent years, and is projected to increase by more than a third by 2030, compared to 2012 (Ministry of Economy, 2013, p.78). Today it is still half of per capita German consumption (3864 GWh/pc to 7000 GWh/pc), though measured per GDP, it is twice as high as in Germany. Germans, contrarily, since 2010 consume less, while producing more electricity (increase by 1.4% between 2012 and 2011) (IEA, 2011; 2013a; 2013b).

3.5 Negotiations on a third German-Polish electricity interconnector

Although the installation of the interconnectors on the Polish-German border in the 1990s has reduced the political incentive for further integration, the technical cooperation between the TSOs has proceeded. In 2003, following black outs linked insufficient coordination of system operation at European level, the topic of interconnector appeared on the agenda in a security context. With increasing deployment of intermittent renewable energy sources international coordinated system operation receives further relevance, for example to address cross-border impact on the neighbouring systems. To improve the situation, and to avoid the risk of a unilateral disconnection, some alternatives were proposed: grid enhancement, new interconnectors, and installation of phase shifting transformers on the existing lines.

The role of the third interconnector, and the challenges for its development have been identified already in 2006 by the European Commission, and later in May 2008 in Berlin by the TSOs – the Polish national PSE Operator and the then eastern German operator – Vattenfall Europe. The cooperation has been strongly supported by the EU as well as the expert community. The Polish government joined the initiative, concerned about unplanned cross-border flows, hoping that the European Network of Transmission System Operators for Electricity (ENTSO-E) would address the coordination problems. On that basis, the EU Energy Coordinator appointed by the EC, Władysław Mielczarski (supported by Georg Adamowitsch) set up semi-annual meetings of the representatives of governments, regulators, and TSOs, between 2008-2010 (Mielczarski, 2010, p.9). These meetings resulted in recognition of the third interconnector between Germany and Poland as a regional priority project in the Baltic Energy Market Interconnection Plan (CESI, 2009).

Still, the progress was slow. A participant of the bilateral negotiations has underlined that "the German stakeholders did not see it necessary to create a joint venture of the TSOs to prepare for the investment", a sign of "not enough political will on the German side".[2] Instead, a priority was given to grid enhancement, while the installation of phase shifters was also discussed. In April 2010 the TSOs have signed the agreement on the cooperation in the enhancement of the transmission capacity of the existing power lines. The plan included an upgrade on Krajnik-Vierraden line to 380 kV by 2013-2014 (Mielczarski, 2010) and installation of phase shifting transformers in substations Krajnik and Mikulowa. It was assumed that the latter measure will enable a power exchange capacity of 1700 MW in both directions until 2020. The high voltage upgrade of Krajnik-Vierraden has been completed, however, it is not in operation, as the necessary additional investments in Germany are due by 2015 (Majchrzak 2012a).

[2] Telephone interview, source to remain anonymous, 20 Aug. 2013.

The construction of additional interconnector between Eisenhüttenstadt (5-10 km from the border) and Plewiska (ca. 270 km into Poland), was agreed in a General Agreement between the TSOs in March 2011, and included in the BEMIP Action Plan. It was assumed that it could further increase the transmission by 1500 MW in import to Poland, and export by 500 MW (Majchrzak, 2012, p. 283). Nevertheless, the progress in new grid development and installation of phase shifters was slow; their importance increased in 2012, triggered the increasing "loop flows" problem.

3.6 Loop flows

The problem of *loop flows* – unplanned electricity flows, a kind of unexpected electricity "transit" – has recently been visibly politicized. Large volumes of electricity originating in Germany and Denmark are passing through Poland and other neighbouring countries, significantly limiting the possibilities of trade and undermining grid stability (Majchrzak et al. 2012).

Although coal remains the basic source of electricity generation in both countries, the deployment of the intermittent renewable energy sources is on the rise. Currently, wind and solar generation capacity in Germany is double the size of the whole Polish system. However, Polish generation and transmission capacity in the north-west of the country is too week to balance these large scale physical flows. Moreover, insufficient grid development and inadequate market design,[3] result in unplanned electricity flows (IEA 2013b, p.13). Contrarily, more interconnectors, installation of phase shifters, early information and effective

[3] Day-ahead trading has difficulties in foreseeing actual RES generation due to unreliable weather forecasts. What is more, market bidding zones are created according to administrative/political divisions and do not gridt structure and physical flows. In this case, high RES supply in north-eastern Germany is met with high demand in remote south-west of the country. Furthermore, Germany and Austria are a single bidding zone, which assumes full interconnectivity, while in reality much of physical flows from Germany to Austria pass through Poland, Czech Republic, Slovakia and even Hungary (cf. ČEPS, MAVIR, PSE, SEPS, 2013).

grid management would minimize the risk of black-outs, and expand trans-border exchange capacity.

Some media and policymakers on both sides indicate that loop flows come at a *cost*. In Germany, it is the cost of "sending electrons to Poland for free" and "subsidising the Polish energy consumers",[4] whereas in Poland it is the cost of "grid damage" done supposedly by "green electricity".[5] None of these is justified. Under the European obligatory compensation mechanisms, i.e. Inter-TSO Compensation, the Polish TSO received €3.7 mln euro in 2011 and €5.6 mln euro in 2012 for transmission loss, as well as €2.6 mln euro in 2011 and €3.3 mln euro in 2012 for infrastructure use. The transmission loss compensation was recognized as "adequate to factual costs" (Tomczykiewicz, 2013).

What is more important, however, is a negative influence of loop flows on the stability of the grid and, more recently, entire cancellation of transmission capacity available for cross-border trade (Skånlund et al. 2013, p. 28).[6] The trend - on increase since 2008 - reached critical conditions on 7 December 2011 when more than a half of the 5.3 GW scheduled exchange between Germany and Austria actually flew through the Polish network (Ratz 2012). This led to an agreement between PSE and 50 Hertz on technical solution – installation of phase shifters (PS). In a letter of intent from December 2012 the TSOs agreed to arrange first a "virtual phase shifter" – an emergency mechanism of coordination and capacity re-dispatching – and later to coordinate the work on constructing physical phase shifters. The

[4] Quote from the German environment minister Peter Altmaier speaking in the panel discussion "Energiewende: Wie wird der Kraftakt zum Erfolg?", 13 March 2013, Hertie Schol of Governance, Berlin.
[5] Quote from the parliamentary interpellation to the Polish ministry of economy, by Dariusz Piontkowski MP, 17 April 2013, Białystok.
[6] The available transmission capacity offered by the Polish TSO in terms of exports has been continuously falling, while the import capacity in the recent years has been non-existent. Interview and subsequent e-mail communication with representatives of the Polish Regulator, URE, L. Kukuła, A. Ratyńska and J. Szymanowski, 18 Jul. 2013, Warsaw.

virtual phase shifter, however, proved insufficient.[7] The TSOs from Poland, Czech Republic, Slovakia and Hungary have issued a report on loop flows and moved the issue into the ENTSO-E forum (ČEPS, MAVIR, PSE, SEPS, 2013). The current sketched agreement envisages that one phase shifter will be financed and installed on the German side and the other on the Polish side, and they will be paid for by the respective TSOs. In the summer 2013, 50Hertz has issued a preliminary tender to assess the approximate cost range.[8] However, the details on financing (ca. €100mln) and management are still being negotiated.

4. Discussion

4.1 Explaining the "grid-lock": empirical study of the German-Polish case

Bearing in mind the negotiations and frequent contacts between the TSOs in relation to the loop flows problem, it is justified to look at the reasons behind the very slow progress with the third interconnector. While a third interconnector would not be a sufficient response to the overall needs of better coordination of system operation, we focus our analysis on this tangible component as an illustration of the overall development.

In this section, we confront the theoretically derived hypotheses (see: 2.0) with evidence gathered through document analysis and interviews. Before moving to the analysis, we sketch the current state of investment on the German-Polish border and institutional arrangements between the TSOs, and list the stakeholders relevant for the process – both directly and indirectly.

[7] This has been acknowledged by our interviewees representing both TSOs as well as the Polish regulator.
[8] Interview and subsequent e-mail communication with 50 Hertz representatives, 30 Aug. 2013. Berlin.

The third interconnector is included in both grid development plans of the TSOs (50 Hertz 2012). However, national deadlines for the realisation differ from those set in the Ten Year Network Development Plans of ENTSO-E. The official Plan from 2012 with its Monitoring Assessment confirm 2020 as deadline for the completing the interconnectors (ENTSO-E 2013, 2012, 2010). In the national plan, the Polish TSO, PSE, assumes that the interconnector would be completed in 2022-2025. On the German side, the Bundestag declared that the project of the third interconnector was urgently needed already in in the Energy Line Extension Act (EnLAG) of 2009. The interconnector is also featured in the national grid development plan of 2012, adopted by the Federal Government as a federal requirement plan. 50 Hertz has initiated the spatial planning procedure on 14 January 2013 (at Eisenhüttenstadt); however, the planning and approval procedures might take several years to complete and require cross-border coordination (50 Hertz 2013).

The major stakeholders involved in the planning and development process are the two TSOs: the Polish national PSE Operator and its counterpart, private owned 50Hertz; the national regulators: Agency for Energy Regulation (URE) in Poland and the Federal Network Agency (BNetzA); the two national governments, with the largest involvement of the respective economic and foreign ministries. Another group of stakeholders that are affected by an interconnector are the energy producers, including major utilities, and the energy exchanges – Polish Power Exchange (TGE) and the German based European Energy Exchange (EEX) and French based European Power Exchange (EPEX Spot) covering wholesale spot trading. The academics, professionals, and NGOs, not least, the European Commission and other European institutions are the policy stakeholders.

4.2 Why financing is not a major impediment

Although it is often easy to explain the lack of investment through lack of capital, based on our research, funds and financing have not been a major hindrance in this process. Both TSOs have a stake in building new grids – new investment is in many ways their *raison d'être*. Each new project is based on a set rate of return agreed with the national regulator and recovered from consumer tariffs. In Germany, additionally, they are higher than on existing lines and constitute a significant source of revenue for the TSOs. Hence, the burden of the investment is transferred to the consumers who will pay for the grids through tariffs. The problem of societal acceptance is addressed in more detail in section 4.3.

It could be claimed that the interconnectors are not in the TSOs interest, as the TSOs benefit from auctioning scarce transmission capacity between countries and thus benefit from congestion and price *differences* between the markets. (Battaglini and Lilliestam, 2010, p. 3).Additional interconnection could reduce these differences. However, EU regulation requires that such congestion revenue is used to fund for example new transmission investment and should thus not provide direct financial incentive. Moreover, the currently observed *full congestion* on the German-Polish border effectively eliminates the possibility of trade, and congestion rents benefits.

However, constructing several major lines at the same time can cause exhaust project development and management capacity. Both TSOs are focused on several such projects. 50Hertz is prioritizing the South-West corridor in Germany (although progress there is slow due to local opposition), and PSE Operator has to cope with general modernization and the politically crucial link with Lithuania (requiring large scale investment also in north-eastern Poland). Thus while financing constraints are unlikely to explain the lack of progress on the third interconnector to date, they might constitute a challenge that has to be considered more carefully as the overall investment volume in grids increases.

Infrastructure projects of both countries are also on the EU list of the Projects of Common Interest (PCI), which provides both for streamlined administrative procedures for regulatory approval and potential financial support (European Commission 2014). The EC will evaluate the project progress and the PCI status every second year. Further cooperation between the TSOs and an agreement on cost sharing is thus required to maintain the status, and receive the financial support from the Connecting Europe Facility mechanism (the first call to be established in May 2014).[9] This is important especially for the Polish side, where ca. 250 km of grid needs to be constructed, compared to only 5-10 km in Germany. The estimated cost is € 1 mln per kilometer of transmission line.

The semi-public, regulatory financing model seems to be the only viable option in the present situation. In theory a merchant model, financing of the transmission line by a third party which then charges for its use, is also possible (cf. Van Koten 2012). The idea of constructing the third interconnector was discussed in autumn 2012. A private investor, EnercoNet, expressed interest in creating a merchant line between Plewiska and Eisenchuttenstadt by 2017; however, PSE considered the project to be already in progress (WNP, 2012). Battaglini and Lilliestam (2010, p. 3) also point out that a major incentive for constructing merchant lines can be exploiting significant price difference between two zones. In the German-Polish case long-term price differences are difficult to assess. In the unlikely event of a long-term, visibly lower price in Poland, still, the generation deficit would make exports difficult. Additionally, former problems with road infrastructure investments in public private partnership model in Poland could obstruct bank financing. External guarantees and EU support could help regain the trust.

[9] Interview with Marija Mrdeza, DG Energy, 23 Jan. 2014. Brussels

4.3 The complex web of stakeholder interests

As the previous section indicated, both TSOs, who are major stakeholders in the process, express an interest in the construction of a new interconnector, provided that immediate security concerns are addressed by installing physical phase shifters on the existing links (cf. Majchrzak et al. 2012), or the internal German grid is developed (Skånlund et al. 2013, p. 18). Only then can the concerns of PSE for the functioning of the Polish system be addressed.[10] The 2012 Memorandum between the TSOs has opened the path for that. In late summer 2013 first steps were made in the tender procedures regarding the construction of PS at Vierraden and Mikułowa, though the financing and management are still negotiated. There is also a visible focus of the TSOs on electricity prices, and market coupling.

There is a clear difference in the pressure the congestion and lack of coordination on the German-Polish border inflicts on both sides. While for the Polish stakeholders loop flows are a matter of great concern, it is much less pressing for the German TSO. 50Hertz cannot in any way be economically punished for not building the third interconnector, beyond the fixed compensation measures (i.e. re-dispatching as part of virtual phase shifter and payments under Inter TSO Compensation mechanism). Moreover, **s**ome Polish stakeholders, including the European Energy Coordinator,[11] note the former delays in negotiations on the German side.

The interests of other parties involved are much more difficult to assess. The current levels of wholesale electricity prices might suggest that Polish industrial consumers could benefit from commercial imports, because spot wholesale prices in Germany, mostly due to renewable generation, can be lower than in Poland. In the long run, however, a comparison of average wholesale base load prices on the EPEX and TGE exchanges shows, that the two behave

[10] Personal communication, 2 Jul 2013.
[11] Telephone interview, 13 Aug. 2013.

similarly and remain close, while at the end of 2013 the prices were on exactly the same level. However, there remains an acute need on the Polish side related to the need to balance the generation gap resulting from decommissioning of several power coal power stations from 2016 and rising electricity consumption. Current plans of electricity import interconnectors, however, are not likely to address this gap, as most of them are planned for 2020 and beyond (with Germany, Lithuania, Belarus). The plan of opening the connection with Ukraine alone (2x 600 MW) although could see completion in 2015, will not fill the generation gap (Ministry of Economy, 2013, p.77). Instead, in the short term, the TSO plans different means of intervention (such as decrease in demand on request, or cold reserve intervention) to avoid load shedding Ministry of Economy, 2013, p.55).

Long-term information on the impact of the third interconnector on prices is not available, and the modelling at this stage is highly unreliable (De Nooij, 2011). The pace of market coupling is also uncertain, although it may have some impact on energy prices. Since February 4, 2014, Germany is a part of the integrated, North-Western European implicit market coupling zone, which Poland meets only on the connection with Sweden). Germany's central position will likely make it a "joint link" between the North-Western, Central-Eastern, and Central Southern zones.[12] Already now, these regions together account for approx. 60% the whole wholesale power trade in the EU (European Commission 2013, p.6), and with the current political momentum, they will be the driver of market integration across the EU. Poland's market coupling efforts have brought limited impact. The coupling with North Western European zone through SwePol Link, over the 3.5 years of its operation has seen trade volume as low as 5.7 TWh – much too small to allow for any price convergence.[13]

[12] Communication with energy exchange representative, 27 Aug. 2013.
[13] E-mail communication with a representative of the Polish Energy Exchange (TGE), 21 Aug. 2013.

The European Commission analyses show economic benefits of market coupling already at this stage. Despite the decreasing electricity consumption in the EU (0.7% on a year to year basis), the day-ahead power contracts on the EU trading platforms rose (by 9%, and cross-border physical power flow rose by 6%). Furthermore, the European Semester recommendations for Poland and for Germany underline that interconnectivity expansion between the countries would have a positive impact on their economic performance (Council of the European Union 2013, p.8). It is important to emphasize that the TSOs calculate benefits on the basis of expected flows, not price differences. Thus in principle, also Germany is interested in market coupling with its CEE neighbours based on a flow based mechanism.[14]

Observing the process of negotiations, one can argue that at some stages Germany has had a limited interest in the construction of a third interconnector, and was reluctant to engage in discussions on unannounced loop flows. This game was hard to be played further, as the risk of political and technical escalation of the loop flow problem could make Germany face a physical disconnection from Poland (a threat the Czech TSO has used). Such a disconnection, though contrary with existing grid-operation rules, would reduce the capacity of both the Polish and German system and the system security benefits of the larger integrated system. Using "national" frames in this context is, however, debatable if we keep in mind that the "German" TSO is in fact a privately owned company with Australian and Belgian capital, interested mostly in business operation, rather than foreign policy.

Also when analysing the discourse of Polish policymakers, one can get the impression that Poland is disinterested in the third interconnector, as it would supposedly "destabilize the grid".[15] On the other hand, though, the Polish expert community and specialized

[14] Interview with Federal Ministry of Economics and Technology representative, 30 Aug. 2013, Berlin.
[15] Personal communication with an employee of the Polish Embassy, 28 Aug. 2013, Berlin.

administration (the regulator and TSO) sustain the need for a third link for exactly the opposite reason – system stability. Furthermore, the Polish TSO has a strong interest in moving the project forward and acquiring external assistance, as the interconnector requires some 250 km of domestic grid, which would connect some important urban areas with high voltage lines and prepare Western Poland for the growing RE generation which is being constructed there.

4.4 Administrative processes – a scape goat or the real challenge?

A major obstacle pointed out by different stakeholders is the lack of coordination in *governance* and the complex and time consuming *administrative processes.* While the centralisation of governance improves the strategic, system-wide planning of construction, entrenched interests at different governance levels constitute a major obstacle. While centralisation helps push the investments forward, the questions of land tenure, compensation of the land owners, or environmental concerns remain on the grassroots level. Germany's "Law Concerning Measures to Accelerate the Expansion of the Electricity Grids" (*NABEG*) is an attempt to reconcile centralised grid development with responsiveness to local dissent through mechanisms of democratic supervision, thus legitimising the grid investments. We briefly go through all the aspects of the administrative/governance problems.

Lengthy procedures, regarding permitting, case by case negotiations, public consultations, and land tenure issues, are definitely a problem, and most interviewees point in that direction as the major obstacle for infrastructure development. On the other hand, centralized decision making seems, actually, not to be the major problem. In fact, we are seeing more centralization, and pooling of grid governance in the European level institutions (ENTSO-E, TEN-E, ACER). With funding available (i.e. through Connecting Europe Facility), this might be a path to follow in the future. But centralization alone does not solve the problem (cf.

Steinbach 2013). What seems to be an issue is the lack of communication between the highest level of decision-making and local governance level as well as the general population. This problem used to be especially stark for the TSOs in Germany, where societal protest for grid development blocked i.a. the strategic line in Thuringia. Recent legislative change and dialogue involving TSOs, societal groups and NGOs raises hopes that this can be resolved.

On the other hand, communication also has its limits. Instead of idealistically foreseen deliberation and persuasion, one might actually see cases of self-interest pursuit and a not-in-my-back-yard (NIMBY) attitude. If either the municipalities, or TSO or landowners stand firmly by their egoistic interest (i.e. demanding compensation at the level of eight times the nominal land value, which takes place) it is difficult to progress in the name of a wider, societal, national or European common good. In Germany, to avoid this case, expropriation of land is possible.

Although awareness and resistance to infrastructure financing is generally low, some specialized watchdog organizations raised this problem in relation to domestic grid expansion. These as well as grassroots organizations have pointed out that some new investments are not always necessary and while financially benefitting the TSOs and making their operation easier, they would constitute a burden for consumers. The opposition has an additional environmental angle. Some local interest groups, while supporting the energy transition and expansion of grids in principle, argue that some transmission lines are built primarily to transfer conventionally (e.g. brown coal) generated electricity or to facilitate trade. These two points can become a fundament of contention in the case of interconnectors.[16]

[16] Interview with NGO representative, 13 Aug. 2013, Berlin.

This sphere is largely shaped by national level legislation, which is currently in need of reform in the face of large scale infrastructure investments necessary in the near future. Both Germany and Poland are either testing or working on new legislation, which gives both an opportunity for learning and policy diffusion (cf. Ancygier and Szulecki 2013).

Germany has begun reforming its legislation first. The process, laid down in the German Energy Act (ENWG), starts with drafting annual long term energy scenarios by the four TSOs, which are then confirmed by the regulator (BNetzA), after public consultations. First set of scenarios was prepared in 2011. The next step is the national network development plan in which the TSOs identify prospective generation at different points in the system, and which nodes of the grid are likely to suffer from bottlenecks. Their plans are again handed over to the regulator, published and subject to consultations. Thirdly, based on the approved network development plan a Federal Requirement Plan is prepared and voted on by the Bundestag (first such vote took place in 2013), creating the basis for specific permit granting procedures. Fourthly, for part of the projects, the TSO prepares an application for a specific corridor (500-1000m wide) and alternatives, which it hands over to BNetzA, who then organizes a public conference and announces the plans. Based on consultations, the regulator has 6 months to issue a final decision. Lastly, the TSO prepares a proposal for the exact route of the project, and the competent planning authority carries out a last set of consultations linked to an environmental impact assessment (Rottmann 2013: 23-6). It is yet to be seen how this new legislation functions in handling real-life grid development projects and if reducing lengthy permit granting procedures and increasing participation can indeed be achieved at the same time.

One can argue that the German model evolved towards a more participatory and legitimate formula (Buras 2012; Steinbach 2013). On the other hand, grid-development within Germany

is actually as much "grid locked" as are the interconnectors. There seems to be a visible short-term trade-off between effectiveness and legitimacy, which, according to theories of *good governance*, should not obscure the fact that in the longer run a more legitimate system renders results that are closer to both welfare optimum and societal preference (cf. Rosenau 2000; Hertie School of Governance 2013) It is also argued that increased transparency and public participation can maintain the legitimacy of the process without compromising its effectiveness (Rottmann 2013). What remains a major problem for governance, is however, that "costs (in terms of landscape, nature, impact on communities) remain at the local level whereas the benefits (e.g. lower electricity prices, integration of renewables, grid stability) go either to someone else or remain very abstract".[17]

On the other side of the border, the much needed Polish "Corridors Act" – streamlining investment and permitting procedures for all types of infrastructure in strategic "corridors", is still not in place. The list of problems that need to be regulated is vast and recognized by the TSO (Majchrzak 2013, pp 27-28). It ranges from land ownership (private, public), land status (available for construction, forest, agrarian, or not regulated), different rights to construct, and compensation (negotiated individually, often involving lengthy court proceedings)[18]. The "Corridors Act" aims at regulating all line investments in one act – thus can be considered too big to succeed. Another question is regulation of compensation for the transmission right, which will have far reaching consequences into the existing factual relations and will be binding on the infrastructure built back in the days of communist centrally-planned economy (WNP 2014).

[17] E-mail communication with former NGO representative, 9 Feb. 2014.
[18] Telephone interview with M. Rypina, lawyer at Kancelaria Wierzbowski i Partnerzy, 5 Aug. 2013.

A separate set of governance and administration issues is related to the supra-national, EU level. The scope, and feasibility of transition towards the European market target model, is hard to predict. The integration of different regional initiatives is also uncertain. In such a regulatory setup incentive for trade on that border are lower. However, the role of energy exchanges who are a major driver of market coupling, in infrastructure projects is very limited. Both energy exchanges - EPEX Spot trading in Germany (which is already a big hub) and TGE in Poland (owned by the Warsaw Stock Exchange, trading both spot and long-term contracts) have the incentive to increase trade volumes.

Increased governance coordination on the European level, that could require a pan-European TSO and regulator (not merely discussion for a like ENTSO-E and ACER), could be an option (cf. Gawlikowska-Fyk 2012). This, however, would require the prioritization of the IEM over national sovereignty regarding energy policies and mixes. At the moment, the Member States reluctance for pan-European integration is visible, which slows the integration. However, economic considerations and market coupling could change the situation in the next couple of years. Coordinated EU-level governance could further help in selecting EU-wide infrastructural priorities (such as PCIs), acceleration of procedures and additional financial support.

4.5 Motivations, negotiation dynamics and discourse matter

Finally, the varying domestic perceptions of *national energy security* as well as *insufficient trust* between the two partners make negotiations more difficult. It can be noted that in Germany, a country long relying on vast imports and exports of energy sources, energy – including electricity – is perceived as a commodity and thus remains largely in the realm of economy. Even so generation adequacy calculations are still pursued at the national level – e.g. trade is only to optimize production. At the same time Poland, still largely self-sufficient

and perceiving energy imports as dependency (although Poland in fact imports oil, gas and growingly – coal), electricity supply becomes securitized in the language of national security (cf. Goldthau, 2012; Świątkiewicz-Mośny and Wagner, 2012). The German 'energy as business' perception is further enhanced by the way unbundling was conducted and the domestic energy system governance functions – with four generally private-owned TSOs, while in Poland, there is a single, all-national and state-owned TSO.

"We cannot think of the energy sector only in terms of economic calculation. That kind of thinking will result in importing electricity from abroad. The state has to secure supply stability. Energy security is key", claimed an analyst of the Krakow-based Jagiellonian Institute (2013), expressing a view widely shared by Poland's policymakers and experts. This was also confirmed by the Prime Minister Donald Tusk, who called energy independence the fundamental task for any government.[19] The value of high energy independence is underlined in national strategies (RCB 2013). While German stakeholders are treating the issue as an element of regular economic relations, the president of the Polish Energy Exchange argues that "negotiations with Germany are tough, and this is a matter of energy security of the State".[20]

Apart from those deeply engraved differences in perceptions of energy security and energy relations, the question of trust in bilateral relations also played a role. During the course of the negotiations, a different area of the energy sector saw major shifts that put neighbourly relations to a tough test. Between 2005 and 2009 the interstate consultations over the Nord Stream pipelines took place. The pipeline, transferring Russian natural gas directly to Germany under the Baltic Sea – bypassing Poland – was perceived as a major blow to

[19] Compare for example the statement made during Miner's Day celebrations, 4 Dec. 2013. Available at: http://wiadomosci.onet.pl/slask/tusk-do-gornikow-jestescie-polsce-bardzo-potrzebni/engf3 (last accessed 2 Feb. 2014).
[20] Personal communication, 17 Jul. 2013, Warsaw.

Poland's energy and economic security, and a severe breach of energy solidarity on the part of Germany (Ćwiek-Karpowicz et al., 2013). It visibly deteriorated the bilateral relations, especially in the energy sector. Furthermore, a general pragmatist logic represented by the German authorities (and confirmed by interviewees from both countries) clearly states that the interests of the German industry are the interests of Germany. Combined with the loop flows issue, this explains the reluctance of Polish stakeholders to engage in joint projects.

Loop flows – having clearly asymmetrical impact on the German and Polish systems, were depicted as an example of Germany's cynicism. European incentives did not seem to matter. The question remains open over how the issue of loop flows should be interpreted from the perspective of international relations. The scale of the problem seems to be unprecedented, but so is its nature. The asymmetrical situation is comparable to that of upstream and downstream states in watercourse governance, where actions of the former have impact on the latter, but not vice versa. In what sense, however, is Germany as a nation state obliged to deal with the problem on levels other than technical cooperation between TSOs and regulators? One could also ask why a private company like 50Hertz should be interested in anything but its own system – and confront issues like the weakness of Polish electricity infrastructure. The answer here is, as in other areas of European energy policy, energy solidarity, and good cross-border governance has to remain part of the frame, and only then can issues of low trust be improved. Limited trust is, however, a factor visible more on the higher political levels, where there is also less expertise. In technical cooperation, where frequency of contact is much higher and areas – narrowly defined, the picture is different and much more cooperative. A general mood of pragmatic cooperation dominates.

5. Conclusions and Policy Implications

In the context of the integrating European electricity markets, we have analysed the case of the third German-Polish electricity interconnector, asking why the investment, although seemingly beneficial for both countries and all the major stakeholders, came to a stall. We considered four hypotheses that could explain this grid-lock: financing constraints, contradicting stakeholder interests, administrative and governance related obstacles, and psychological and discursive differences related to energy security. The research shows that financing is has not been a major impediment, although strategic EU funding could create some additional incentives to build. Stakeholder interests are fluctuating and complex, and on the whole all major stakeholders are inclined to support the project. However, the German side lacked a clear incentive to participate in the construction, when the project was much more pressing for Poland. Lengthy administrative processes and governance shortcomings are a major general obstacle, while the differences between Germany and Poland in approaching energy security, combined with low levels of trusts between higher level policymakers (especially in Poland) are an additional case-specific impediment. Learning from the above, some policy options and actions can be discussed:

Windows of opportunity open again. The plans to phase out electricity production facilities, be it nuclear or coal, create the need for electricity imports or, more costly, additional investment in generation facilities. These "gaps" should be used to develop trade, thus shifting the perception of cross border interdependencies, from "risk" to the "means to stabilize the system". Germany's decision to phase out nuclear energy by 2022, and rapid development of intermittent renewable generation, at current stage of underdeveloped national infrastructure, makes the country's system growingly interdependent on cyclical imports and exports. Poland, facing generation shortages after 2016, could consider electricity imports as an

inexpensive way to fill in the gap, especially that the Western border seems a reliable direction. This, however, would require a reorientation of the national policy paradigm, which assumes "generation adequacy independence". Learning from the experience of the loop flows, the coordination of generation adequacy between the countries should be considered, as it would not only help deal with power deficits, but also regional surpluses and unplanned flows.

The EU as a trigger. The work of EU-level forums and institutions, namely the European Network of Transmission System Operators for Electricity (ENTSO-E), the Agency for the Cooperation of Energy Regulators (ACER), as well as the prospects of financing of the PCIs through the Connecting Europe Facility, legitimise and push forward the European energy market integration. In this process the Polish-German joint effort to receive financing should be prioritised. EU co-financing would keep the difficult to coordinate bilateral projects high on the agenda. This is beneficial for all the parties involved, as their construction stabilizes the national systems and creates the necessary infrastructure for the development of a functional Internal Energy Market. The EU can also provide additional guarantees that help overcome case-specific deficits of mutual trust.

Trust-building measures. Knowing the tensions in bilateral relations in the last years, increased contacts between partners at all levels, combined with measures that bring a minimum of mutual security (e.g.. phase shifters) should be promoted. The German-Polish case shows that expert communities are needed to efficiently handle even complex and controversial issues of bilateral concern, while their politicization can reduce the effectiveness of cooperation.

Effective market design. The energy market is an entity on the border of market mechanisms and security, and because of this, it needs careful design and receptive oversight. Markets alone might not be able to deliver the infrastructural improvements needed, especially in the absence of clear signals leading there. Poland, which is linked to the North-West European (NWE) market coupling zone through the link with Sweden and therefore a possible stakeholder in NWE should get more involved in the market designing at this stage, not to be caught by surprise once the regulations from this largest and most powerful market zone. Should the pilot project of NWE prove successful, it will become a benchmark for other zones, also for the CEE. In more general terms, there is a visible discrepancy between the political drive to create the Internal Energy Market for electricity, an idea that is accepted at face value, and the technical and economic specifications. There is a need for EU wide cooperation and consultations in this regard, as the market takes shape. Also, the loop flows question shows that European market zones should resemble the actual flow of electricity, with the optimal transactions based on flow-based allocation.

Speedy completion of the phase shifters. In the absence of effective market design to ensure timely information on generation and load patterns and response capacity with TSOs, and in the face of inadequate grids, unplanned loop flows remain a concern and can be limited through phase shifters. Their completion in 2015-16 will minimise the current burden on neighbouring systems but should not undermine efforts to capture synergies from an integrated system operation in the long run. In a longer perspective, implementation of Flow Based Capacity Calculation and grid expansion can relieve the situation, as could a new paradigm of generation coordination.

Legislative best practice sharing. While working out the legislative solutions to ease the administrative burden as well as to give the legitimacy to the projects, an increased Polish-

German cooperation and best practice sharing is advisable. The Polish 'Corridor Act', which is still in the making, can draw important lessons from the German experience. This best practice sharing and policy learning should be enhanced by EU institutions, as most member states are now facing very similar administrative and governance challenges which, as our research has shown, are a major obstacle for transmission grid expansion.

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References

50Hertz, ČEPS, ELES, MAVIR, PSE, SEPS, TenneT, APG; BSP, EPEX Spot, EXAA, HUPX, OTE, OKTE, TGE; and National Regulatory Authorities of the Central Eastern European Region, and ACER, 2014, Memorandum of understanding of on the implementation of the day-ahead congestion management target model in the CEE region in conjunction with other European Regions. Available at: http://www.acer.europa.eu/Electricity/Regional_initiatives/Cross_Regional_Roadmaps/Documents/memorandum-of-understanding-CEE.pdf (last accessed: 24 April 2014).

50Hertz, 2013. Press release. Available at: www.50hertz.com Date 08/01/2013 (last accessed: 30 January 2014).

50Hertz, 2012. [Map of a grid development plan]. Available at: http://www.50hertz.com/de/file/50Hz_Netzkarte_1304_de.pdf (last accessed: 30 January 2014).

Accenture, 2013. The evolution of the electrical grid industry in Germany by 2020. Available at: http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Evolution-Electrical-Grid-Industry-Germany-2020.pdf (last accessed: 23 Jan. 2014).

ACER, 2011. Cross-regional roadmap
for Day-Ahead Market Coupling, XXI Florence Forum, Florence, 5 December 2011. Available at: http://www.acer.europa.eu/Electricity/Regional_initiatives/Cross_Regional_Roadmaps/Documents/Final%20version%20Cross-regional%20road%20map%20Market%20Coupling.ppt (last accessed: 30 January 2014).

Ancygier, A. Szulecki, K., 2013. German-Polish cooperation in renewables: towards policy convergence?. Dahrendorf Symposium Paper Series. Available at: http://ssrn.com/abstract=2377981 (last accessed 17 Jan. 2014)

Battaglini, A. Lilliestam, J., 2011. On transmission grid governance. ERENE Issue Paper. Heinrich Boell Foundation, Berlin.

Battaglini, A., Komendantova, N. Brtnik, P., Patt, A., 2012. Perception of barriers for expansion of electricity grids in the European Union. Energy Policy. 47, 254–259.

Blazejczak, J., Diekmann, J., Edler, D., Kemfert, C., Neuhoff, K. and Schill, W. P., 2013. Energy Transition Calls for High Investment, DIW Economic Bulletin. 9, pp. 3-14.

Buras, P., 2012. Implikacje Energiewende dla zmiany modelu niemieckiego społeczeństwa, in: Kwiatkowska-Dróżdż, A. (ed.), Niemiecka transformacja energetyczna: Trudne początki. OSW, Warsaw, pp. 17-25.

Council of the European Union, 2013. Recommendation on Germany's 2013 national reform programme and delivering a Council opinion on Germany's stability programme for 2012-2017, from 19 June 2013, 10636/1/13 REV 1, Brussels.

ČEPS, MAVIR, PSE, SEPS, 2013. Joint study by ČEPS, MAVIR, PSE and SEPS Regarding the Issue of Unplanned flows in the CEE region. In relation to the common market area Germany-Austria. Available at: http://www.ceps.cz/CZE/Media/Tiskove-zpravy/Documents/German-AustriaMA_Study.pdf (last accessed: 3 Jan. 2014).

CESI, 2009. Phase I: present status of the electricity sector in the EU Member States surrounding the Baltic Sea, including Norway, Belarus, Kaliningrad region and Ukraine; main gaps and bottlenecks, qualitative assessment of new interconnection projects. Report of the Working Group Electricity Interconnections, BEMIP.

Ćwiek-Karpowicz, J., Gawlikowska-Fyk, A., and Westphal, K., 2013. German and Polish Energy Policies: Is Cooperation Possible?. PISM Policy Paper. 49, January 2013. Warszawa: Polski Instytut Spraw Międzynarodowych.

De Nooij, M., 2011. Social cost-benefit analysis of electricity interconnector investment: A critical appraisal. Energy Policy. 39, 3096–3105.

DG Energy. 2013. Quarterly Report on European Electricity Markets. Market Observatory for Energy, 6 (2), Second Quarter 2013.

Industrial Emissions Directive, 2010. Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), 17.1.2010. Official Journal of the European Union, L 334/17.

Ecofys, 2013. Impacts of restricted transmission grid expansion in a 2030 perspective in Germany. Berlin, August 2013.

ENTSO-E, 2010.Ten-Year Network Development Plan 2010. European Network of Transmission System Operators for Electricity, Brussels.

ENTSO-E, 2012.Ten-Year Network Development Plan 2012. European Network of Transmission System Operators for Electricity, Brussels.

ENTSO-E, 2013. Monitoring Update – Table of TYNDP 2012 Projects. European Network of Transmission System Operators for Electricity, Brussels.

European Commission, 2012., Making the internal energy market work COM(2012) 663, Communication from 15 November 2012. Available at: http://ec.europa.eu/energy/gas_electricity/doc/20121115_iem_0663_en.pdf (last accessed 30 Jan. 2014).

European Commission, 2014. Overview of Projects of Common Interests by Country. Available at: http://ec.europa.eu/energy/infrastructure/pci/pci_en.htm (last accessed: 30 Jan. 2014).

European Commission, 2013. Quarterly Reports on European Electricity Markets, Q2 2013. Available at: http://ec.europa.eu/energy/observatory/electricity/doc/20130814_q2_quarterly_report_on_european_electricity_markets.pdf (last accessed: 30 Jan. 2014).

Eurostat, 2013. Electricity production and supply statistics. Available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_production_and_supply_statistics (last accessed: 22 Jan. 2014).

Gawlikowska-Fyk, A., 2012. Towards common energy market regulation in the EU. PISM Bulletin. 101 (434), 19 October 2012.

General Electric, E3G, 2013. Creating new electricity markets in Europe to meet energy policy challenges. Explaining the Electricity Market Reform Landscape. Report. E3G and GE, Berlin, London, Brussels and Washington D.C.

Groebel, A., 2013. Energy infrastructure development and financing in Germany. Presentation at the DG Competition Workshop on Review of the Environmental State Aid Guidelines, Brussels, 12 April 2013. Available at: http://ec.europa.eu/competition/state_aid/modernisation/groebel_en.pdf (last accessed: 3 March 2014).

Goldthau, A., 2012. Introduction – Policy Agendas for the Future of Global Energy. Global Policy, 3 (2), pp. 182–183. DOI: 10.1111/j.1758-5899.2011.00161.x

Henriot, A., 2013. Financing investment in the European electricity transmission network: Consequences on long-term sustainability of the TSOs financial structure. Energy Policy. 62, 821–829.

Hertie School of Governance, 2013. The Governance Report 2013. Oxford University Press, Oxford.

IEA. 2011. Energy Policies of IEA Countries – Poland 2011 Review. IEA/OECD, Paris. Available at: http://www.iea.org/publications/freepublications/publication/Poland2011_web.pdf (last accessed 30 January 2014).

IEA. 2013a. Energy Balances of OECD Countries 2013, IEA, Paris.

IEA. 2013b. Energy Policies of IEA Countries – Germany 2013 Review. IEA/OECD, Paris.

Jagiellonian Institute, 2013. M. Roszkowski o wstrzymaniu inwestycji w Opolu, 24. 04. 2013, Available at: http://jagiellonski.pl/?p=2656 (last accessed 12 Dec. 2013).

Kanagawa, M., Nakata, T., 2006. Analysis of the impact of electricity grid interconnection between Korea and Japan. Feasibility study for energy network in Northeast Asia. Energy Policy. 34, 1015–1025.

Kasprzyk, S., 2006. Jesteśmy częścią zgrupowania systemów europejskich. *Rzeczpospolita. Energia - Środowisko – Infrastruktura*, 21 March. Available at: http://www.pse-operator.pl/index.php?dzid=14&did=246 (last accessed: 22 Jan. 2014).

Kogdenko, N., 2013. Public acceptance: why does it frequently become a 'show stopper'?. EDI Quarterly, 4 (4), 16-17.

Majchrzak, H., 2013. Rozbudowa sieci elektroenergetycznych w ramach jednolitego rynku energii. Presentation prepared for the seminar „Infrastruktura dla europejskiego rynku energetycznego", 7 March 2013. Available at: http://www.prezydent.pl/download/gfx/prezydent/pl/defaultaktualnosci/2177/31/1/majchrzak_pse_rozbudowa_sieci_07032013.pdf (last accessed: 3 Jan. 2014).

Majchrzak, H., 2012, Planowanie rozwoju polskiej sieci przesyłowej w perspektywie 2025 r., *Energetyka*, nr 6, Oficyna Wydawnicza Energia, Katowice.

Majchrzak, H., 2012a, Pełny zapis posiedzenia Komisji Skarbu Państwa (nr 17) z 26 kwietnia 2012 r. Available at: http://orka.sejm.gov.pl/Zapisy7.nsf/0/091345171F134335C12579FA004BEAB2/$file/0048907.pdf (last accessed: 3 Jan. 2014).

Majchrzak, H., Purchała, K., Sikorski, T, Tomasik, G., 2012. Krajowy rynek energii elektrycznej jako element zintegrowanego rynku europejskiego od Lizbony po Helsinki. Elektroenergetyka - Współczesność i Rozwój. 1-2 (11-12), 8-19, available at: http://www.elektroenergetyka.org/11/8.pdf (last accessed: 3 Jan. 2014).

Mielczarski, W., 2010. Annual Activity Report September 2009 – September 2010 of the European Coordinator. Project of European Interest. Poland-Lithuania Link and Germany – Poland Power Lines, Brussels, 30 September 2010. Available at:

http://ec.europa.eu/energy/infrastructure/tent_e/doc/power_link/2011_power_link_annual_report_2009_2010_en.pdf (last accessed: 3 Jan. 2014).

Ministry of Economy, 2013. Sprawozdanie z wyników monitorowania bezpieczeństwa dostaw energii elektrycznej za okres od dnia 1 stycznia 2011 do dnia 31 grudnia 2012 r. Available at: http://bip.mg.gov.pl/files/upload/14223/PL_MG_DE_sprawozdanie_2011_2012_20130731_SKAN_w_ost.pdf (last accessed: 3 Jan. 2014).

NEP. 2013. Neue Netze für neue Energien. NeP und O-NeP 2013: Erläuterungen und Überblick der Ergebnisse. Available at: http://www.netzentwicklungsplan.de/_NEP_file_transfer/Neue_Netze_fuer_neue_Energien_2_Entwurf.pdf (last accessed: 3. March 2014).

Neuhoff, K., Hobbs, B. F., Newbery, D., 2011. Congestion management in European power networks. Criteria to assess the available options. DIW Discussion Papers, 1161. DIW, Berlin.

Piontkowski, D., 2013. Interpelacja nr 17311, do ministra gospodarki, w sprawie tranzytu niemieckiej energii elektrycznej przez terytorium Polski. Available at: http://www.sejm.gov.pl/sejm7.nsf/InterpelacjaTresc.xsp?key=5774E5E2 (last accessed: 3 Jan. 2014).

Pronińska, K., 2013. Development of "Green Energy" in coal-based energy culture – Implications for Poland's energy security. E-Politikon. 7, 54-75.

RCB, 2013. Narodowy Program Ochrony Infrastrutury Krytycznej. Załącznik 1. Rządowe Cenrum Bezpieczeństwa Available at: http://rcb.gov.pl/wp-content/uploads/NPOIK-za%C5%82%C4%85cznik-1.pdf (last accessed: 3 Jan. 2014).

Rosenau, J. N., 2000. Change, complexity and governance in globalizing space, in: Pierre, J. (ed.), Debating governance: Authority, steering and democracy. Oxford University Press, Oxford, pp. 167-200.

Ratz, J., 2012. Unintended cross-border electricity flows in Central Eastern Europe and their regulatory implications. Presentation prepared for the 14th Baltic Electricity Market Mini-Forum, Riga, Latvia, 21 Sept. 2012. Available at: http://www.acer.europa.eu/Electricity/Regional_initiatives/Meetings/14th_Baltic_SG/Document%20Library/1/Unintended%20cross-border%20electricity%20flows%20in%20Central%20Eastern%20Europe.pptx (last accessed: 3 Jan. 2014).

Rottmann, K., 2013. Recommendations on Transparency and Public Participation in the Context of Electricity Transmission Lines. Germanwatch Position Paper. Germanwatch, Berlin and Bonn.

Skånlund, A. B., von Schemde, A., Tennbakk, B., Gravdehaug, G., Grøndahl, R., 2013. Loop flows – Final advice. THEMA Report 2013-36. THEMA, Brussels and Oslo.

Spiecker, S. and Weber, C., 2014. The future of the European electricity system and the impact of fluctuating renewable energy – A scenario analysis. Energy Policy. 65, 185-197.

Steinbach, A., 2013. Barriers and solutions for expansion of electricity grids—the German experience. Energy Policy. 63, 224–229.

Świątkiewicz-Mośny, M. and Wagner, A., 2012. How much energy in energy policy? The media on energy problems in developing countries (with the example of Poland). Energy Policy. 50, 383–390. DOI: 10.1016/j.enpol.2012.07.034.

Tomczykiewicz, T., 2013. Odpowiedź sekretarza stanu w Ministerstwie Gospodarki - z upoważnienia ministra na interpelację nr 17311 w sprawie tranzytu niemieckiej energii elektrycznej przez terytorium Polski, 7 June 2013. Available at: http://www.sejm.gov.pl/sejm7.nsf/InterpelacjaTresc.xsp?key=64A1E09B (last accessed: 3 Jan. 2014).

Van Koten, S., 2012. Merchant interconnector projects by generators in the EU: Profitability and allocation of capacity. Energy Policy. 41, 748-758.

WNP, 2014. MG: Prace nad projektem ustawy korytarzowej w zasadzie uończone, 03.01.2014. Available at: http://energetyka.wnp.pl/mg-prace-nad-projektem-ustawy-korytarzowej-w-zasadzie-ukonczone,215107_1_0_0.html (last access 30 January 2014).

WNP, 2012. Czy powstanie prywatna linia przesyłowa Polska-Niemcy? 15.10.2012. energetyka.wnp.pl Available at: http://energetyka.wnp.pl/czy-powstanie-prywatna-linia-przesylowa-polska-niemcy,181150_1_0_0.html (last access 30 January 2014).