Energy Research & Social Science 4 (2014) 124–134

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

The politics and economics of cross-border electricity infrastructure: A framework for analysis

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ARTICLE INFO

Article history:
Received 6 May 2014
Received in revised form 2 October 2014
Accepted 2 October 2014
Available online 5 November 2014

Keywords:
Infrastructure
Electricity interconnectors
The European Union
Loop-flows
Internal energy market

ABSTRACT

A common European electricity market requires both market integration and transmission grid expansion, including cross-border interconnectors. Although the benefits of increased interconnectivity are widely acknowledged, expansion of interconnectors is often very slow. What are the reasons behind this "grid-lock"? To date, the issue remains discussed largely from the perspective of practitioners. Academic research on interconnectors comes mostly from the discipline of energy economics, offering models that do not necessarily help us explain the dynamic situation in the EU. This paper sketches the problem and its scale, reviews existing approaches and proposes a framework for analysis of interconnector projects, including a set of hypotheses that could account for the stall in interconnector development. The hypotheses relate to inadequate financing, diverging interests, governance and administration problems, as well as political discourses and perceptions. As empirical illustration we use the case of the German–Polish border. Drawing on document analysis and stakeholder interviews, we evaluate the hypotheses. Evidence suggests that at this stage, political and governance-related issues rather than economics and finances might explain the "grid-lock" we are facing. The concluding section sums up the findings, highlights methodological difficulties and gaps, and proposes directions for further social scientific research in this issue area.

1. Introduction

One of the cornerstones of the European Union's (EU) energy policy is the creation of an Internal Energy Market (IEM). Market integration is to enhance EU economic performance, increase security of supply, and facilitate the transfer to a low carbon economy. Although the idea dates back to the end of the 1980s, only in March 2011 the European Council finally envisaged a common energy market for power and gas by 2014. This means both the alignment of rules and development of physical grid interconnections between the EU member states. The former is being developed with framework guidelines and grid codes, and most of the attention so far is on the alignment of trading rules and system operations [1]. 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.

Grid development has been recognized to bring various benefits such as increased system stability and enhanced security of supply [2]. Furthermore, transmission grid expansion is the cheapest way to integrate high shares of renewables and makes the power system more resilient [3]. In the light of the growing generation from scattered and intermittent renewable energy sources (RES), grid management faces new challenges such as unplanned energy flows [4], and interconnectors are one of the necessary components of achieving efficiency [5]. Finally, case studies of existing interconnectors reveal significant cost-effectiveness of interconnection and increased efficiency of the regional decarbonisation strategies compared to individual efforts [6].

Most recently in June 2014, in the light of the Ukrainian-Russian crisis, based on the Polish proposal [7], the EU recognized development of interconnectors as an inevitable element of the closer EU energy integration, towards an "Energy Union" [8]. In

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http://dx.doi.org/10.1016/j.erss.2014.10.003
2214-6296/

addition, the EU offers both financial and regulatory support for grid development.[1]

At the same time, the level of exchange capacity of most of the member states is below 10% of national generation capacity – a benchmark acknowledged by the EU already in 2002 [58]. While that 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 many EU states, for example between Belgium and the United Kingdom (UK) or Germany and Poland, projects are effectively stalled, while other important projects are delayed.

What are the reasons behind this "grid-lock"? Do states lack financial resources or are the interconnector projects simply economically inefficient? Or is this part of a general problem with large scale infrastructure development that we see in different issue areas where the society and technology meet? This paper is an attempt to map this important problem and propose pathways for further research coming from the social sciences. To date, electricity interconnectors have remained largely a topic for engineers and practitioners. On rare occasions and only in some countries a wider public debate around the issue was sparked. As a result, the lay understanding of the issue area is limited – not only because of its inherent technical complexity – and despite the importance of interconnectors for social welfare, public policy and the potential energy transformation, it remains visibly under-researched. Broader analyses and academic research on interconnectors is either limited to single cases, or comes from the discipline of energy economics, offering models that do not necessarily help us explain and understand the current situation in the EU with its complex dynamics. We thus aim to propose a framework for comparative social scientific research on electricity interconnectors, underlining the question of *politics* that makes energy *policies* achievable, in line with the suggestion made by Benjamin Sovacool in the journal's flagship article ([63]: 21).

This piece thus begins by sketching the problem and its scale, building an argument for the benefits of interconnectors contrasted with their visibly inadequate expansion. We then review the existing approaches that seek to explain different elements of the interconnector development problem, and based on these, propose a framework for analysis of interconnector projects, including a set of hypotheses that could account for the stall in interconnector development. The hypotheses relate to financing; stakeholder interests; governance and administration problems; and finally political discourses and perceptions.

As empirical illustration we use the case of the German–Polish border. Increased interconnectivity between the two countries has been recognized as an element of the cost-effective way to transform into low-emission economy in Europe by 2050 [9], nevertheless the progress is slow. Drawing on a document analysis and stakeholder interviews, we try to evaluate the four hypotheses introduced earlier. The case of the grid-lock in the project of the German–Polish interconnector thus becomes a case study of the opportunities and limitations to the European energy integration, as well as the challenges of social science research on the topic.

Evidence drawn from the case-study seems to suggest that political and governance-related issues rather than economics and finances might explain the "grid-lock" we are facing, although changes in the regulatory framework and EU support can also unlock much investment. The concluding section sums up the findings, points to existing gaps, discusses methodological issues, again relating to the broader themes of energy research within the social sciences [64], and proposes some further directions for social scientific research in this issue area, emphasizing the need for comparative studies of different cases.

2. Explaining the grid-lock: an analytical framework

Cross-border electricity interconnectors play many roles and are acknowledged to bring various benefits for different stakeholders. Initially, interconnectors were constructed mostly as an emergency backup option for national energy systems. Their positive impact on the *security of supply* has later been reinforced by *economic* and *social welfare* arguments. Literature on energy economics is in agreement that "interconnectors bring major benefits to electricity systems [. . .], improve reliability and allow for more economical system operation. They reduce the need for reserve and peaking generation capacity and allow more efficient dispatch" ([68]: 89). Welfare provision is a more complex issue, as interconnectors (or in fact any means of international trade) benefits some while others are forced to carry the burden, i.e. of energy price convergence ([66]: 122). From a wider perspective, however, it is visible that interconnectivity provides net welfare gains, and that is the argument that the European Commission uses to promote interconnectors as part of the Internal Energy Market ([58]: 4). In early 2014, Britain's Secretary of State for Energy and Climate Change claimed that a rapid and large-scale expansion of interconnectors was the only way to make European energy prices competitive with that of the U.S., and that such a network could "knock more than 10 per cent off electricity bills" Europe-wide [10]. Last but not least, interconnectors are seen as a vital part of the European *energy transformation* towards a system with large scale intermittent renewable generation [69]. It is widely recognized that to benefit from different geographical and weather conditions as well as connecting the efficient generation sites with urban and industrial demand, an expanded electricity network will be required. Under the emerging new characteristics of energy systems with high renewable penetration, interconnectors again help increase energy security, since the resilience of interconnected systems is dependent on the difference in the plant mix across regions ([54]: 580). Interconnector expansion in macro-scale can either take the form of a pan-European super-grid, like in the case of the Desertec project idea, combining large solar generation in North Africa with other renewables, such as North Sea and Baltic offshore wind; or slightly less ambitious, but still large-scale ideas like connecting different types of renewables with different qualities to achieve synergistic effects (cf. [57]). This type of a "complementary system" is expected to "play an increasing role in the years to come" ([58]: 11; [51]), while interconnectors have an important role to play also by reducing the need for flexible conventional capacity ([66]: 120).

It is thus clear that the expansion of cross-border exchange capacity combines all three elements of the "energy trilemma" – delivering increased security, enhanced economic performance and allowing for a transformation towards environmental stability. Brancucci Martínez-Anido and colleagues [51] show that under a minimum cost dispatch model, planned additional cross border capacity will reduce dispatch costs, and with a growing demand and increasing renewable generation will also help maintain security of supply and reduce RES curtailment needs. Taking only efficiency and sustainability into account, the Pathways project modelled two alternative scenarios, suggesting that the existing

[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.

European interconnector capacity of 42GW should be increased to 55–60GW by 2020 [69]. We are, however, very far from achieving comparable levels of investment and interconnectivity in the foreseeable future.

It is not possible to state that such infrastructure projects are completely blocked Europe-wide. However, progress is much slower than one could anticipate given the consensus on the need to expand interconnectivity. What is more, almost all transnational projects are subject to delays. And finally, such delays and even indefinite postponements at different stages are at times a diplomatic euphemism for dropping projects off the agenda. The most visible case is the expanded cross-border exchange capacity between Spain and France, which has been on the table since the early 1980s. The connection between the Iberian Peninsula and the rest of Europe, thus a crucial element of the integrated European grid and one of the possible entry points for electricity imports from North Africa, is still not open. Set to be finally completed in 2014, the project was again delayed until 2015 [70]. Another link that is important from the perspective of the pan-European grid is the expanded interconnection between Norway, host to abundant flexible hydro-power capacity, and Germany as well as Great Britain. While it is suggested that up to fifteen interconnectors could be constructed, the progress on new projects is very slow – and has recently been effectively halted, as Norwegian decision makers cited the lack of economic predictability.[2] Yet, pan-European considerations are not the only ones that should provide a political push for trans-border projects. Some states are facing energy shortages and need interconnectivity to support the foundations of their energy security. The Baltic States, which are not connected to the rest of continental Europe, are a prime example, with the Lithuanian–Polish interconnector being seemingly a priority for both neighbouring countries and yet – it took 22 years from the initial decision (1992) and 14 years from a EU and EBRD supported feasibility study (2000) to the beginning of actual construction, which is still far from completion.[3] Northern Ireland is also currently facing the risk of energy shortages as the expansion of exchange capacity with Great Britain and the Republic of Ireland has been further delayed.[4] Even supposedly simple (underwater) and pressing (first interconnector) projects like the Malta-Sicily link have seen delays before eventual completion.[5]

Why is the progress so slow, despite the seemingly obvious benefits of interconnectors? This question has been tackled already by energy economists, who treat the "grid-lock" as an "interconnector investment (market and regulatory) failure" [60]. The authors identify a number of investment barriers that preclude member states and private investors from unlocking the potential for cross-border exchange. What is important for our analysis, however, is that not only the level of investment is not sufficient, but that the already planned and launched projects suffer from delays and indefinite stalls. In the remainder of this section we thus try to categorize the different explanations for the existing "grid-lock" taking into account both the dominant economic focus on regulatory measures, as well as other factors including governance mechanisms and institutional complexity, administrative and legal issues or political discourses.

2.1. Financing

The most straightforward hypothesis about the insufficient investment in new infrastructure or the problems in completing projects that have already been launched is the lack of sufficient capital. This has to be dissected from other economic considerations, such as cost-benefit analyses and welfare provision, which concern distribution and thus touch the political economy of interconnectors, discussed under 'stakeholder interests'. According to Accenture [11], as much as €25 billion might be needed for grid expansion in Germany alone, hence financial constraints appear the simplest explanation for stalled investment. This relates to both models of interconnector development–the regulated model, in which transmission system operators (TSOs) are project developers, and the merchant model, in which a private investor sets to build the cross border line. A large part of the economic literature takes on the question of both project feasibility and optimality under the two models. While merchant lines seem to provide a necessary additional investment scheme that could prove useful, scholars point out that they are often improbable and sub-optimal [61].

Project financing rests on two additional issues: the way investment is recovered (i.e. rates of return and grid tariffs) and the payment for interconnector use (congestion payments, linked to price differences, or "postage stamp" payments, linked to the volumes of transferred energy). The first issue is coupled with possible overstretch of investors that goes beyond financial means–transmission grid projects are time consuming and require political and human resources (which links this hypothesis with 2.4), and the question of tariffs boils down to the fundamentals of political economy: who pays for new lines?

An inefficient 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 [12] 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 ([50], p. 2).

A case study of interconnector projects should thus consider, and make evident for the sake of a cross-case comparison, elements such as:

- Regulatory or merchant model;
- Unbundling and regulatory control;
- Number of simultaneously realized projects;
- Rate of return and grid tariffs.

2.2. Interests of stakeholders

In the broadest sense, slowness or stall in interconnector expansion 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 (that is – often hypothetical and uncertain) 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 ([2], p. 8). De Nooij [13] 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

[2] http://uk.reuters.com/article/2013/10/30/uk-norway-uk-cable-idUKBRE99T0NZ20131030.

[3] http://ec.europa.eu/energy/infrastructure/doc/assessment/20130724_litpol_link.pdf.

[4] http://www.bbc.com/news/uk-northern-ireland-28024610.

[5] http://www.ice.org.uk/News-Public-Affairs/ICE-News/The-Electricity-Interconnection-between-Malta-and-.

benefits to one country but fewer benefits to the neighbouring country, is unlikely to be constructed and congestion at the border will increase" ([50], p. 3).

What becomes crucial for studying interconnector projects is then stakeholder mapping and assessment of their interests. At the very basic level, project developers and direct supporters need to be dissected from other stakeholders who are only indirectly linked to projects. For a further analysis, different approaches can be taken. Sovacool proposes an interest-centred *critical stakeholder analysis* ([65]; cf. [59]). A different approach can be the focus on issues around which stakeholders position themselves. Analysing the feasibility of Norway becoming a 'green battery' for Europe, through expanded interconnectivity as well as pumped-storage hydropower capacity, Gullberg ([56]: 620) points to seven case-specific factors that help to map stakeholder (interest group in this case) positions on interconnectors: profitability, cost-efficiency, energy security, nature conservation, greenhouse gas emissions reductions, domestic electricity prices, and finally economic growth and jobs.

No matter how we emphasize it, every analysis of stakeholder interests will have to analyze or at least hypothesize about the cost-benefit analyses that the key players make. In the piece under the telling title "Interconnector economics", Turvey points out that while "the uncertainties of cost estimation [for a new interconnector] are the same as with many other kinds of large engineering project, but, except perhaps for uncertainties about obtaining the necessary planning permissions for possible routes, they are second order as compared with the uncertainties afflicting estimation of benefits" (2006: 1458). The latter are "extremely complicated" (Ibidem, 1459), and different investors reply on different models and methodologies. This generally leads to the suboptimal utilization of interconnectors – and to fundamental methodological problems for scholars studying stakeholder networks.

What needs to be considered in a case study:

- Stakeholders involved (directly/indirectly);
- Relations of power between stakeholders;
- Interests related to the interconnector and associated issues;
- Assessment of costs and benefits as calculated/understood by stakeholders.

2.3. 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. As Goldthau ([55]: 136) points out, energy infrastructure may be simultaneously part of several scales, that is: cut across both legal, administrative, mental and governance levels. This is perhaps especially true for transmission infrastructure, which functions in continental and regional macro-scale, has national and sub-national welfare implications, but is realized through localized investments, coexists with local communities and impacts local landscapes.

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 [14,46], worsened still by a general lack of public acceptance of infrastructure projects, including new grids [15]. 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 [16].

Elements to be considered:

- Decision making about localization;
- Permitting procedures and societal consultations;
- Land-tenure, compensation mechanisms etc.;
- Degree of correspondence between governance levels: local, national, regional, EU.

2.4. Political discourses and perceptions

Different levels of system reliability may result in attempts to implement different generation security standards, as well as restrictions of trade across interconnectors [2]. 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. Issues of trust and credibility, Sovacool notes, "have been shown to play a significant role in shaping decisions about energy technologies" ([63]: 17).

Political feasibility of different projects can escape existing economic analysis, and this gap can be filled by qualitative social scientific studies. For example, Gullberg and colleagues [57], analysing the bilateral relations of Germany and Norway, point to the importance of political factors and interests defined more broadly than just in economic (cost-benefit) terms. These issues can be difficult to trace, can be fluid and case-dependent. Gullberg [56] notes, that such analysis might be conducted on a case by case basis, with separate political processes around each single interconnector, rather than a wider grid-expansion programme. While this is a challenge for comparative research, it should not undermine the attempts at compiling knowledge from different contexts.

A visible role to play for political scientists, but also scholars in sociology or social anthropology, is in assessing the following key factors:

- Perspectives on energy security;
- Role of the interconnector project in national energy policies;
- Mutual perceptions of involved national actors;
- Foreign policy and trade context of the project.

Each study should also provide a wider context, focusing on the technical aspects of both the national energy systems and the interconnector to be constructed, as well as the history of bilateral cooperation in the domain of energy policy.

3. Empirical illustration: German–Polish interconnector project

The case of Germany and Poland allows us to observe the interplay of the different factors discussed in Sections 2.1–2.4: 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. Regarding data collection, the following study draws on a research project conducted throughout 2013, involving a wide desktop analysis of governmental, sectorial and academic reports, data from European as well as national energy agencies, media analysis as well as stakeholder and expert interviews held in Berlin, Warsaw as well as via telephone and email with key parties and analysts.

3.1. Energy systems: an overview

Although neighbours, Poland and Germany operate in very different settings. German generation and consumption of electricity is roughly four times bigger than the Polish one [18]. 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 also slow (the project has been discussed since the early 1990s). Poland is a part of the Central Eastern and Northern-Western European regions (the latter limited to the connection with Sweden).

Germany has been an electricity exporter and transfer country for the last decade. In the last years, the country effectively increased its electricity exports, and decreased imports, and consumption. Decrease in electricity consumption is caused by increase in energy efficiency and, more importantly, decrease in industry consumption as electricity process push companies towards individual production of energy (est. 16% of German utilities by mid-2013; [19]). At the same time, in 2013, net export of electricity in Germany equalled 6% of electricity production, 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. Poland, with half of the population of Germany, consumed in 2013 only 27% of the amount of electricity of Germany. This is because of the less developed manufacturing sector, and lower individual electricity consumption in Poland, due to the less developed economy. At the same time, as the society gets more wealthy, the electricity consumption in Poland slowly rises. In 2014 the country is likely to become net electricity importer, mainly from Germany. In 2013, in absolute values, Germany exchanged more than five times the electricity volumes exchanged by Poland. 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 24-fold difference in aggregated flows [18]. 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 (Table 1).

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 ([20], 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 [21]. 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 ([20], 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) [22–24].

3.2. Historical background

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. In October 1995 the Polish system was switched and became part of the Union for the Coordination of Transmission of Electricity (UCTE) [25], as part of a general turn to the West. 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 (Table 2). 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.

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 – Vattenfal 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.

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 Baltic Energy Market Interconnection Plan Action Plan [26]. It was assumed that it could further increase the transmission by 1500 MW in import to Poland, and export by 500 MW ([27,28], p. 283). At the same time, grid infrastructure projects of both countries came onto the EU list of the Projects of Common Interest (PCI), including the third interconnector.

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 relatively weak. For several years in a row, physical unplanned and non-commercial electricity flows (*loop flows*) have been noted to use the Polish system, flowing from large scale renewable and conventional generation sites in North-East Germany, further through Czech Republic and Slovakia to Bavaria and Austria. Loop flows are the result of insufficient grid development and inadequate market design ([24], p. 13). Contrarily, more interconnectors, installation of phase shifters, early information and effective grid management would minimize the risk of black-outs, and expand trans-border exchange capacity, diminishing the detrimental effect of loop flows on the affected systems and markets (for a more in depth discussion see [62]).

3.3. Evaluating hypotheses

3.3.1. Financing

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 the development of the third interconnector between Germany and Poland. 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, these are higher on new investments than

Table 1
Comparison of German and Polish electricity markets 2011–2014.

Germany (DE)	Poland (PL)	1.5.2014		2013		2012		2011	
DE production	PL production	232	60.8	571.8	150.8	570.8	148.4	557.9	151.6
DE consumption	PL consumption	211.7	61.3	530.6	145.5	539.9	144.9	544.3	145.7
DE export	PL export	32.7	4.9	72.3	12.3	67.3	12.6	56	12
to PL	to DE	3.8	0.03	5.4	0.5	6.1	0.2	5.1	0.4
DE import	PL import	15.8	5.6	38.5	7.8	44.2	9.8	49.7	6.8
from PL	from DE	0.03	3.8	0.5	5.4	0.2	6.1	0.4	5.1
DE import/export	PL import/export	15.8/32.7	5.6/4.9	38.5/72.3	7.8/12.3	44.2/67.3	9.8/12.6	49.7/56	6.8/12

Source: ENTSO-E[a], own elaboration.
[a] Data after ENTSO-E; https://www.entsoe.eu/db-query/country-packages/production-consumption-exchange-package.

Table 2
Existing interconnectors, technical details.

	Type of the interconnector and voltage	Number of circuits, and rating
Mikułowa in Poland–Hagenverder in Germany	AC 400 kV	2 × 1386 MVA
Krajnik in Poland–Vierraden in Germany	AC 400 kV (temporarily operating on 220 kV)	2 × 457 MVA

Source: Majchrzak, PSE, 2013; 50Hertz, own elaboration.

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. This is an issue in itself, and we will address it in the discussion of stakeholder interests and governance mechanisms. It is important to underline, however, that in many national contexts where grid development remains a technical, depoliticized issue, a TSO can put the financial burden on consumers in the longer term, and thus finances cease to be a major impediment for new projects.

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. ([50], p. 3). Additional interconnection could reduce these differences. However, EU regulation requires that such congestion revenue is used to fund 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. Again – revenues of both TSOs would rise if the trade was unblocked by the construction of a third interconnector (and limiting non-commercial loop flows).

However, constructing several major lines at the same time can exhaust management and investment capacity. Both TSOs in the German–Polish case 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). 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 in the future.

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. [29]). 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 [30]. Battaglini and Lilliestam ([50], 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. Furthermore, in the unlikely event of a long-term, visibly lower price in Poland, generation deficit would make exports difficult.

3.3.2. *Stakeholder interests*

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 (although other ministries, including Foreign Affairs, have also been making statements about the project at different points). 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. European Commission and other European institutions are further actors involved in the policy process, while the engagement of NGOs and societal groups has to date been very limited. Table 3 provides an overview of the actors involved and attempts a stakeholder analysis, taking into account actor categories and roles, the degree of engagement, power and influence, as well as their perspective on the project itself, nested in the wider set of their underlying interests. This technique draws on what Sovacool (2011, [63]) terms *critical stakeholder analysis*, but downplays the critical ambition, emphasizing stakeholder mapping instead.[6]

The third interconnector is included in both grid development plans of the TSOs [31]. However, national deadlines for its completion 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 completing the interconnectors [16,32,33]. In the national plan, the Polish TSO, PSE Operator, assumes that the interconnector would be completed in 2022–2025. On the German side, the Bundestag declared that the

[6] In the original exposition of critical stakeholder analysis as found in Jones and Fleming, the critical component had visible post-structuralist underpinnings, as the authors accused conventional stakeholder theory of failing to consider the underlying structural linkages that may exist between various stakeholders along with complex and deeply embedded (institutionalized) processes that constitute stakeholders' materiality, identity, and even forms of rationality" (2003: 433). Our focus is closer to Sovacool's reading, which focuses on the in-depth analysis of interest convergence around a particular project rather than a critical theoretic analysis of structural and power relations.

Table 3
Stakeholder analysis (drawing on Sovacool, 2011, [59,63]; own elaboration).

	Actor	Category	Engagement	Influence	View of project	Interest
Poland	PSE Operator	TSO (public ownership)	Direct (developer)	Strong	Initiator of the project, publicly supporting the idea of a third interconnector and maintaining the cooperation	Providing system stability, stopping or taming loop flows, achieving new grid investment, high rates of return
	URE	Regulator (public)	Direct	Strong	Supporting the project as part of internal and regional grid expansion	Balancing TSO interest with social welfare (tariffs), stopping or taming loop flows, new grid investment
	Ministry of Economy	Government	Indirect	Strong	General support, Supervising the project, delegating to URE	Control over the process, impact on wider energy policy
	TGE	Energy exchange	Indirect	Moderate	Seen as positive (possibilities for trade) but secondary to market coupling	Maintaining a strong regional position, increasing volumes of trade
	Enea, PGE, Tauron	Utilities	Indirect	Weak	Cautious	Maintaining high market shares in electricity sales, cautious of competition but open to export opportunities
	EnercoNet	Private investor	Direct	Weak	Proponent of the merchant line project (PSE refused to grant permit)	Attempt to begin a merchant project on the same line, seen as promising investment for a private consortium
Germany	50 Hertz Transmission	TSO (private ownership)	Direct (developer)	Strong	Initiator of the project, publicly supporting the idea of a third interconnector and maintaining the cooperation	Providing system stability also in the short term, finalizing new grid investment, high rates of return
	BNetzA	Regulator (public)	Direct	Strong	Supporting the project as part of national and regional grid expansion	Securing and realizing investment in the national system, balancing TSO capital requirements with customer interests
	Federal Ministry for Economic Affairs and Energy	Government	Direct	Strong	General support, seen as part of *Energiewende*	Impact on energy and economic policy of the country
	EPEX Spot	Energy exchange	Indirect	Moderate	Positive, opportunity to expand the Internal Energy market	Becoming a major hub for Western European energy trade and setting the tone for market integration in the EU
	Vattenfall	Utilities	Indirect	Weak	Cautious	Maintaining high sales domestically, wary of competition
EU	European Commission	EU executive	Direct	Moderate	Seen as very important (Project of Common Interest)	Achieving physical and economic market integration
	ENTSO-E	TSO forum	Indirect	Moderate		Achieving governance coordination, dealing with loop flows
	ACER	Regulator forum	Indirect	Moderate		Achieving governance coordination

project of the third interconnector was urgently needed already 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. 50Hertz 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 [34].

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 (PS) on the existing links (cf. [1]), or the internal German grid is developed ([35], p. 18). Only then can the concerns of PSE for the functioning of the Polish system be addressed. 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 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 the "virtual phase shifter" and payments under Inter TSO Compensation mechanism). On the other hand, 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". However, the Polish expert community and specialized 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. This points to the difficulty of analysing the interest of all stakeholder, an issue to which we come back in the concluding section.

The interests of other parties involved are even 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 similarly and remain close, while at the end of 2013 the prices were on exactly the same level. However, the Polish side might 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).

Long-term information on the impact of the third interconnector on prices is not available, and the modelling at this stage is highly unreliable [13]. The pace of market coupling is also uncertain, although it may have some impact on energy prices. 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 ([36], p. 8).

3.3.3. Governance and administrative processes

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. Lengthy procedures, regarding permitting, case by case negotiations, public consultations, and land tenure issues, are definitely a problem, and most interviewees point it out 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. [14]). 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.e. the strategic line in Thuringia. Recent legislative change and dialogue involving TSOs, societal groups and NGOs raises hopes that this can be resolved. Germany's "Law Concerning Measures to Accelerate the Expansion of the Electricity Grids" (NABEG) is an attempt to reconcile centralized grid development with responsiveness to local dissent through mechanisms of democratic supervision, thus legitimizing the grid investments.

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 (e.g. 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 such cases, 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. A number of 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.

One can argue that the German model evolved towards a more participatory and legitimate formula [14,37]. 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. [38,39]) It is also argued that increased transparency and public participation can maintain the legitimacy of the process without compromising its effectiveness [40]. 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".[7]

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 ([21], 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).

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. [41]). 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.

3.3.4. Political discourses and perceptions

Our research shows that 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 is expressed in the language of

[7] E-mail communication with former German NGO representative.

national security (cf. [42,43]). 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. Scholars go as far as to argue that the German–Polish border divides two different traditions "energy cultures" [17].

"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 [44], expressing a view widely shared by Poland's policy-makers and experts. This was also confirmed by the Prime Minister Donald Tusk, who called energy independence the fundamental task for any government. The value of high energy independence is underlined in national strategies. 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".

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. Between 2005 and 2009 the interstate consultations over the Nord Stream gas pipeline took place. The pipeline, transferring Russian natural gas directly to Germany under the Baltic Sea – bypassing Poland – was perceived as a major blow to Poland's energy and economic security, and a severe breach of energy solidarity on the part of Germany [45]. It visibly deteriorated the bilateral relations, especially in the energy sector. This experience overlapped with the emergence and securitization of the loop-flows issue in electricity, with the deterioration of trust diffusing from one sector to the other.

4. Conclusions

This paper tried to summarize the existing discussion about the barriers for trans-border electricity grid expansion, and to provide a framework for analysis that goes beyond technical and economic factors and at the same time, if applied to a wider set of cases, could make the insights gathered comparable. We believe that this combined emphasis on a wider social-scientific outlook, and the promise of comparative research, balancing depth and breadth ([63]: 13) can move the current debate forward, with the ultimate goal being a functioning and indeed–existing Internal Energy Market. Our empirical illustration, the case of Germany and Poland, however, already points to some difficulties of that research–related to methodology as well as ethics and even deeper questions of epistemology.

Our empirical research clearly points to the importance of governance mechanisms, as well as political issues and discourses, while finances and a wider economic analysis behind interconnectors seem to matter less in the process. While this is of course overgeneralization from our single-case, it is in line with earlier research on the topic [46]. Why are interconnector economics less of a factor (at least in explaining processes that have already been declared as needed)? A key reason is the problem with appropriate cost-benefit analysis (cf. [13,67]). Expert and stakeholder interviews, as well as our literature review, suggest that actors are making decisions without sufficient information about realistic costs and benefits – overestimating one or the other side, or downplaying the role of such modelling. Economists have noted some time ago that "the question of how to best judge the desirability of significant new transmission investment in interconnected grids under different TSOs remains empirically and institutionally unresolved" ([52]: 91). This is of course also a great methodological challenge for the researcher trying to understand stakeholder rationale and interest in a given process.

The latter – that is interests – are of great importance, but pose research problems even beyond methodology. In our study, drawing on Sovacool's earlier work, we tried to map stakeholders and assess their interests. While it could seem that those interests should in some way be "given", depending on the role and function of the stakeholder, a historical analysis makes it clear that interests evolve and are quite fluent–spreading from support for an interconnector, to a more or less vocal opposition. In-depth studies of stakeholder interests in this sector, although desirable, would be very time consuming, and one cannot be sure if they would in the end be fruitful. This is both due to the possibly limited access to relevant interlocutors and data, as well as a deeper, epistemological issue related to the way interests/preferences relate to other – material and social – factors (Compare: [53]). A different issue still is the delimitation of stakeholder networks – rightly asking where does the list of stakeholders end?

With economic calculations uncertain, and interests in flux, the political decision making process becomes fundamental, but it is also difficult to escape methodological individualism–especially if we rely on qualitative methods and interviews as our main data collection tools. What it boils down to is that "individuals and their choices matter" ([63]: 11) – a statement at the same time fairly obvious and incredibly challenging for any attempt at generalizing knowledge beyond single instances. A possible way out is the focus on *energy systems* as a whole – understanding the way technological path dependencies and directions of energy transformation impact on individual choices (such as increased interconnectivity with a given neighbour) combined with a *historical process tracing* of different projects, combined with the awareness of *discourses* organizing the energy sector, the economy and interstate relations. Such a multi-disciplinary awareness of these three dimensions could help make sense of individual decisions of actors beyond single cases.

Governance as well as legal and administrative issues constitute a different object of analysis. They too have impact on interest formation, trust building and the changing political momentum. Governance coordination across levels and legal/administrative issues, especially those related to localization and societal level acceptance of infrastructure development, are a separate avenue of research – necessary to understand the current "grid lock", and one that has to be merged with the three factors discussed above.

Finally, in research that is driven by an underlying normative preference for a common energy market–however sensible it may be – researchers cannot forget that the process involves political economic dilemmas, and requires attention for *ethics*. Interconnectivity creates winners and losers – some countries taking all the welfare benefit [66], and burden sharing is uneven, unless organized otherwise. Costs and benefits are also spread differently within societies undergoing energy transformations, it is therefore important to keep *fairness* and *allocation* in mind.

Acknowledgements

The authors would like to acknowledge the constructive comments received from Karsten Neuhoff, Aleksandra Gawlikowska-Fyk, Andrew Judge, Benjamin Sovacool, Kirsten Westphal, Ingmar Juergens, two anonymous reviewers, and the participants of several workshops: in Berlin (Hertie School and DIW), Brussels (CEPS), London (LSE) and Warsaw (PISM), as well as the panellists at ECPR 2014 general Conference, where the earlier versions of the paper were presented. The empirical illustration draws on a research project conducted as part of the Dahrendorf Symposium 2013, supported by Stiftung Mercator.

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