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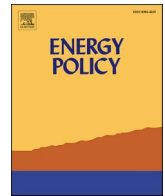
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The political economy of coal in Poland: Drivers and barriers for a shift away from fossil fuels

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ABSTRACT

Poland is the largest hard coal and second largest lignite producer in the EU, generating around 80 percent of its electricity from coal. Resistance to a reduction in coal production and consumption comes from various actors, namely, coal corporations, unions, parts of civil society and the government – as well as their coalitions. Their opposition centres around the prospect of losing their business, past negative experiences with structural change, fears of rising energy prices and energy security concerns, as well as potential unemployment in regions almost entirely dependent on coal.

This paper identifies key political and economic drivers and barriers of a reduction in coal production and consumption in Poland using the Triple Embeddedness Framework. Uneconomic coal mining, unavoidable energy infrastructure investments, rising air pollution levels and pressure from the European Union might provide new political momentum for a shift away from coal in line with international climate targets. However, results show that to achieve political feasibility, policies targeting a reduction in coal production and use need to be implemented jointly with social and structural policy measures, addressing a just transition for the affected regions in line with the vision of a ‘European Green Deal’.

1. Introduction

Greenhouse gas emissions related to coal combustion are the biggest single contributor to global climate change. In order to avoid exceeding dangerous levels of global warming by 1.5 °C or 2 °C, burning coal needs to be cut drastically in the coming decades (UNEP, 2017, chap. 5; Rockström et al., 2017; McGlade and Ekins, 2015). Internationally, efforts to curb coal production and consumption are increasing, as demonstrated by e.g. the Powering Past Coal Alliance (see e.g. (Green, 2018; Jewell et al., 2019)) and the commitment of many European Union (EU) countries to a coal phase-out. This shift away from coal can be seen as one important pillar of the sustainable energy transition.¹

So far, the main focus on how to reduce coal (and more generally fossil fuel) consumption and production was on demand side policies (e.g. carbon pricing or emissions performance standards for coal-fired

power plants). This is increasingly complemented by more research on supply side policies (e.g. a moratorium on new mines or enforced mine closures; see Special Issue on ‘Fossil Fuel Supply and Climate Policy’ (van Asselt and Lazarus, 2018), Mendelevitch et al. (2019) or potential effects on coal exporting countries (Oei and Mendelevitch, 2019; Richter et al., 2018)). Supply-side policies can e.g. contribute to reducing overall mitigation costs, slowing down investments in fossil fuels, limiting carbon lock-in effects, increasing moral pressure as well as public support for climate protection measures and restricting a short-term production increase (Lazarus and van Asselt, 2018).

This is complemented by research focusing specifically on coal transitions, combining the analysis of supply and demand side policies as well as climate policy and transition (e.g. social and regional) policies (Spencer et al., 2018). The combination has been found to be so important as, from a political economy perspective, policies tackling the

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¹ ‘Energy (system) transformation’ and ‘energy (system) transition’ are frequently used interchangeably in the scientific discourse, although differentiations – such as a stronger focus on societal contributions to change in the energy transition literature, or bottom-up ‘transformations’ rather than top-down structured ‘transitions’, as well as the transformation term comprising comprehensive social upheavals - have been identified (Child and Breyer, 2017). In the following, we use the term ‘transitions’ to refer to substantial changes in societal, economic and, more specifically, energy systems. The term transformation will be used if scholars explicitly refer to it.

transition just from only one of these aspects has proven very challenging. Especially anticipatory and long-term policies to support affected regions need to be included in a successful climate-policy induced coal transition policy mix (Spencer et al., 2018; Sartor, 2018; Oei et al., 2020).

Poland, until now, shows little ambition to limit its coal extraction and use – as can be seen within its newest National Energy and Climate Plan (NECP).² It is an interesting country to study for two main reasons. Firstly, it is the largest hard coal producer and second largest lignite producer in the EU (IEA, 2017). Unlike other main coal producers in the EU (e.g. the UK, Germany, Spain, etc.), Poland has not committed itself to end coal mining. Secondly, Poland does not only lag behind in its missing commitment to end coal and to reduce its energy dependence on coal as main energy carrier, but is also one of the main countries vetoing EU policies that aim to increase climate protection ambitions (Janowska, 2017). This shows that it is not just a time lag between the transition compared to other EU countries, but an active choice to protect its coal industry. At the international climate conference COP 24 in Katowice, coal was proudly showcased, while President Andrzej Duda confirmed that “*there is no plan today to fully give up on coal*” and that Polish supplies would last for another 200 years.³ Poland has hence become an outlier within the EU, which makes it an interesting case to analyse which factors hinder the necessary transition and which policy options might overcome this.

Explaining current policy outcomes regarding coal in Poland, but also in other countries, requires recognising the political influence of powerful stakeholders (Goulder and Parry, 2008). In recent years, attention in academic literature looking at energy transitions has shifted from a more technical and innovation perspective – with a focus on renewables and niche-innovations support (Bergek et al., 2008; Geels, 2002; Smith et al., 2010) – to the general call for a stronger integration of social sciences in energy and transition research (Sovacool et al., 2015) – including the analysis of how the incumbent fossil fuel regimes can be destabilised and eventually replaced (Kivimaa and Kern, 2016; Kungl and Geels, 2016; Turnheim and Geels, 2013).

Resistance to a shift away from coal originates from various actors – namely, coal firms, unions, parts of civil society, and the government – albeit for different reasons. Policy outcomes regarding coal production and consumption are deeply influenced by these actors and their coalitions, as analyses for other countries have shown (Leipprand and Flachland, 2018; Kungl, 2015; Turnheim and Geels, 2013, 2012; Brauers et al., 2018; Vögele et al., 2018).

Politics and power (structural forms, institutional politics and discursive expressions of power) are important for the creation of a certain pathway. A transformation is not planned and then put into place by politicians. It is rather a “*product of competition and interaction between a number of pathways, supported by diverse social actors with highly uneven political power*” (Scoones et al., 2015). Hence, looking at the various actors in and around the coal regime in Poland, their interests, relation, and their influence is important to explain why the coal regime has been able to uphold its position.

In addition to politics and power, economic development and technological innovation are important elements influencing energy transitions (Cherp et al., 2018). A framework suitable to include all these factors is the Triple Embeddedness Framework (TEF) (Geels, 2014), which conceptualises interactions of an industry regime with its economic and socio-political environments. Although the TEF focuses on the technological and market level, it enables the incorporation of state and citizen power, as well as politics in general. Regime destabilisations,

as transformations in general, have never been linear, structured, and planned with specific targets, but are always messy and contested (Scoones et al., 2015). The TEF enables the descriptive analysis of main trends influencing the coal regime to make sense of such past developments.

We combine this socio-technical transitions approach with political economy thinking, which has been identified as a research gap in energy transitions research (Goldthau and Sovacool, 2012; Meadowcroft, 2011) and is increasingly becoming a focus of analysis (see e.g. Newell and Mulvaney (2013); Baker et al. (2014); Power et al. (2016); Kern and Markard (2016); Arent et al. (2017); Paterson and P-Laberge (2018)). Importantly, it complements the more innovation and techno-economic focus of the socio-technical transitions literature with aspects of power, interests, institutions, discourses and politics. The political economy literature puts emphasis on the influence of power imbalances, political business cycles, (informal) actor networks, institutions and inequality.

This paper aims to contribute to the literature by analysing why the coal regime in Poland aims at maintaining the role of coal as major energy source for the electricity industry (in contrast to most other EU states), and which role socio-political and economic dimensions play in this. To answer this question, we analyse which actors (and their networks) are supporting coal and which actors and interests might have already started to destabilise the coal regime. The paper identifies drivers and barriers for a reduction of Polish coal dependence, acknowledging the underlying politics as well as the technical, economic and social context.

The analysis of the coal regime in Poland for three decades from 1990 until 2019 is followed by an analysis of how policies addressing the reduction of coal production and consumption can be complemented by structural policies to increase political feasibility. The paper proceeds as follows. Section 2 introduces the theoretical background and methodology. Section 3 presents the status-quo of coal in Poland and conducts the analysis of the political economy of coal. Section 4 looks at supply and demand side policy options to accelerate a decline of coal, as well as structural policies suitable for the current status of the political economy. Section 5 concludes. The supplementary material gives a more extensive description of the situation of coal in Poland and the TEF analysis.

2. Methodology

2.1. Theoretical background: The Triple Embeddedness Framework

The TEF is a conceptual framework developed by Geels (2014) that is part of the socio-technical transitions literature (for further information see Supplementary Material Section 7.3). The framework refers to the situation of firms within an industry regime, which is itself embedded in two external environments – the economic and the socio-political environment. An industry regime is influenced by its *socio-political* environment, where e.g. legitimacy and social fitness determine its success, and the *economic environment* that demands economic competitiveness, efficiency and financial performance. The TEF acknowledges the ability of firms to respond to their environments and influence them through strategic actions. The responses of firms-in-industries are both externally-oriented (towards the economic and the socio-political environment) and internally-oriented (Geels, 2014). The TEF enables us to investigate how incumbency can be weakened when single pressures from the two environments align.

Industries that can be analysed with this framework are reluctant to change, hold a high political influence and are scale-intensive with many sunk investments, which is all true for the coal sector. The TEF recognises institutional change and includes strategic behaviour as well as power of actors. By enabling the analysis of the co-evolution and the bi-directional relationships between an industry regime and its environments, the TEF addresses shortcomings of previous methodologies (e.g. industrial economists focusing only on economic pressures or neo-

² gov.PL. 2019. ‘Executive Summary of Poland’s National Energy and Climate Plan for the Years 2021–2030 (NECP PL)’. https://ec.europa.eu/energy/sites/ener/files/documents/pl_final_necp_summary_en.pdf.

³ Reuters. 2018. ‘Katowice COP24 Notebook: Spotlight Descends on Mining’. <https://af.reuters.com/article/worldNews/idAFKBN1O41NE>.

institutionalism simply on socio-political pressures) (see [Kungl and Geels \(2018\)](#) for discussion).

The framework is part of the field of sustainability transition studies, where the most prominent theoretical frameworks encompass transition management, strategic niche management, the multi-level perspective and technological innovation systems ([Markard et al., 2012](#); [Fünfschilling and Truffer, 2014](#)). For several reasons, they are not suitable for our research questions: One of the criticism of all four approaches is that they have a “rather unpolitical understanding of transitions” ([Haas, 2019](#)), however, the Polish case can only be understood when including politics. Also, the multi-level perspective ([Geels, 2002](#)) and strategic niche management ([Kemp et al., 1998](#)) focus on emerging niches and changes to a system. Hence, those approaches are not useful for this analysis, as it focuses on the incumbent regime itself (see also [Johnstone et al. \(2017\)](#) and [Kivimaa and Kern \(2016\)](#) for a discussion on regime destabilisation) and aims to identify stabilising factors, besides the ones enabling change. The technological innovation systems approach ([Carlsson et al., 2002](#)) puts a specific emphasis on the interaction of actors including firms, but the approach is also most suitable for the analysis of niches and innovation processes, while we focus on the opposite – prevention of innovation and inclusion of new technologies. Transition management focuses on active government intervention, being partly prescriptive and focusing on strategic, tactical, operational and reflexive management approaches ([Loorbach, 2010](#)). This framework would not enable us to understand the economic or technical context sufficiently.

Hence, we chose the TEF, as it makes it possible to focus on the incumbent regime, while it also enables us to include politics and structural power as well as historical developments (see also [Johnstone and Newell \(2018\)](#)), allows us to apply a political economy perspective to understand the particularities of the Polish situation (see also [Newell and Paterson \(1998\)](#), [Levy and Newell \(2002\)](#) and [Newell \(2018\)](#)), and nevertheless include technology developments and the country specific societal context as relevant influencing factors of sustainable energy transitions. By highlighting the embeddedness of the regime in the socio-political and techno-economic environment, we can highlight how the incumbents protect their interests and create lock-ins into coal dependence, but also identify current threats to coal’s dominance and potential avenues for change.

2.2. Data collection and framework application

The TEF has been applied in several case studies, e.g. to analyse the destabilisation of the British coal industry ([Turnheim and Geels, 2013, 2012](#)), in the context of electric mobility ([Sovacool et al., 2017](#)) and incumbent electricity utilities in Germany and Switzerland ([Kungl and Geels, 2018](#); [Mühlemeier, 2019](#)). To our knowledge, we are the first to apply it to the case of Polish coal use.

Data-collection is guided by the conceptual framework focusing on the relevant actors and contexts rather than on dependent and independent variables ([Kungl and Geels, 2016, 2018](#)). Our explorative study relies on a literature review to determine the general political, technical and economic situation of coal, its social relevance and aforementioned actors’ positions. Collection of data on this includes primary literature, such as statements provided by ministries, unions and NGOs, company press reports and annual reports, as well as a range of daily newspaper articles and blogs. The secondary literature used comprises of scientific peer-reviewed journals, as well as other articles, reports and books. Additionally, we consulted databases, e.g. by the Central Statistical Office of Poland, to obtain information on the development of coal mines, power plants and employment figures. In total we collected and analysed more than 600 documents, mostly written in English or German.

To gain a deeper understanding of the Polish situation regarding coal, we had several informal background discussions with Polish stakeholders on research visits to Warsaw, Łódź and Katowice in 2017

and 2018, involving industry, civil society, and academia representatives. A potential shortcoming is that only English and German documents⁴ and no unofficial/secret government or corporate documents have been analysed. However, we believe this has at least partly been corrected for by discussions of preliminary results and draft versions of the paper with Polish energy sector experts.

The extracted information from these different sources is then analysed with the TEF framework (compare e.g. with the approach taken by [Vögele et al. \(2018\)](#)). The inductive approach intends to generate new insights about the Polish coal sector based on empirical data. In our iterative approach we refined intermediate results after presentations and discussions with (Polish) stakeholders at five international academic conferences.

The main aim of the paper is to provide an overall picture of the Polish political economy of coal in a novel way. Many of the single elements included in the TEF have been studied by other authors. Our main contribution is to bring these empirical results into the descriptive framework to better understand the complexities of the many mechanisms influencing the political economy of coal in Poland. We derive policy implications through the identification and comparison of main drivers and barriers of a coal phase-out.

Actor groups which are included in the analysis due to their importance for the coal industry more specifically, and sustainability transitions more generally, are the firms of the incumbent coal regime, non-governmental organisations (NGOs), governments, labour unions, civil society and competitors for coal (based on [Hess \(2014\)](#) and [Turnheim and Geels \(2013\)](#)). The analysis is conducted over the time period from 1990 to 2018, as the destabilisation of a regime is a long-term process and historic events can reveal broader societal and economic trends creating path dependencies and lock-in effects (see also [Kungl and Geels \(2016\)](#)). Also, most data are only available post-1989, after the end of the communist regime in Poland.⁵ A special emphasis is put on the more recent past after the Paris Agreement and the election of a new Polish government as well as leading up to COP 24 in Poland from 2015 to 2019. Due to the close connection of upstream coal mining and coal use for downstream electricity generation, both are included in the coal regime analysis.

3. Results

The following section includes the analysis of the three main elements of the TEF: The socio-political environment, the economic environment, and internal as well as external response strategies by the regime to those influences.

3.1. Socio-political environment analysis of polish coal industry

Poland is, as a legacy from the communist regime, very centralised ([Baran et al., 2018](#)). The national Polish government, now a coordinated market economy ([Rentier et al., 2019](#)), has continuously supported the coal industry, even though it also managed the historical decline e.g. by enforcing the closure of the most inefficient mines ([Szpor, 2017](#); [Zientara, 2009](#)). The coal sector’s inefficiency due to overcapacity and over-employment inherited from Soviet-era influence was targeted for the first time at the beginning of the 1990s. In 1990, almost 388,000 people worked in Polish coal mines ([Szpor, 2017](#)). During the 1990s, four different government programs led to several mine pits closures, while other mines were grouped together (profitable with unprofitable ones) and later merged into larger coal corporations ([Baran et al., 2018](#); [Suwala, 2010](#); [Zientara, 2009](#)). Decisive restructuring failed in important factors including the total expenditure levels, delays in decisions of

⁴ As none of the authors speak Polish, no Polish texts were analysed.

⁵ A detailed description of the development of the Polish coal sector, including periods before 1990, can be found in the Supplementary Material.

employment cuts and a missing legal framework (Zientara, 2007; Suwala, 2010). By 2015, 99,500 miners were left with around 13,000 people employed in coal fired-power plants (Alves Dias et al., 2018, 21).

A very dominant influence on the socio-political environment and hindering coal industry restructuring has been, and still is, the miners' unions. Their political power led to high employment and high salaries, even in times when the coal sector was in a very poor state (Gurgul and Lach, 2011). The extent of Polish coal miners' power becomes apparent when comparing their status to miners in other countries: Polish miners work fewer hours a day and fewer days a year, have additional public holidays, additional monthly salary, benefits for long-term employment and earlier retirement options. Trade unions fought hard to obtain these working conditions. They exert political power by lobbying through direct talks with politicians but also strikes (Trappmann, 2012). The government's first attempt in 1991 to restructure the unprofitable mining sector failed due to internationally low prices for coal and the strong political power of the trade unions. The unions successfully resisted all proposals to reduce wages or to cut employment until around 1996 (Suwala, 2010).

A government programme from 1998 was successful in winning support from unions as well as corporations for the restructuring program and related mine closures. Efficiency of mines increased for the first time, especially by reducing employment numbers. Workers losing their jobs got retirement benefits but no retraining (Suwala, 2010). Less than three percent of all expenditures on restructuring programs during these years went to job creation in other sectors. As local authorities, which were meant to create new job opportunities, had little experience with this task and received no support, success in that respect was very limited (Suwala, 2010).

Reductions in coal mining and employment continued during the 2000s, however, much more slowly (see Fig. 1 for an overview of coal mining, and coal related employment and electricity generation). Unions continued to protest against the shutdown of mines, e.g. in January 2015, after the announcement of the closure of four loss-generating mines owned by KW,⁶ employees went on strike. Only after

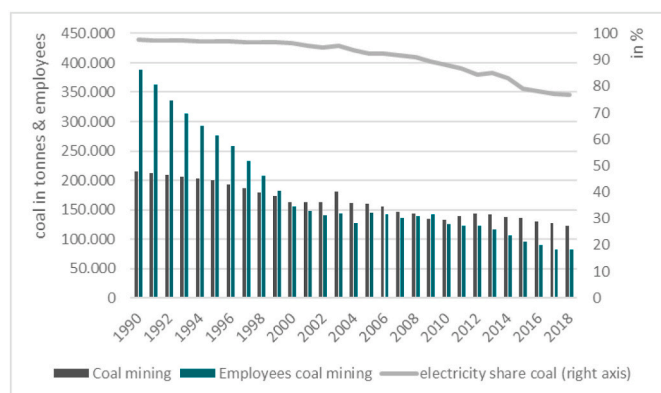


Fig. 1. Coal mining, electricity generation and number of employees in Poland from 1990 to 2018.

Own depiction based on Central Statistical Office of Poland (various years; 2019), World Bank (2017), and own calculations.

⁶ Kompania Węglowa (Polish coal mining company). For information on the mentioned corporations see Supplementary Material.

the parliament agreed on a special bill to restructure the coal mines to prevent closures did the protests cease. Strikes restarted only days later when JSW⁷ announced that the number of miners' working days would be increased and their benefits cut.⁸

The PiS party ('Law and Justice' party) has a strong pro-coal stance (Osička et al., 2020), and won the parliamentary election in 2015⁹ partly on promises to protect the coal industry. Under the new PiS government, (partly) state-owned utilities were forced to form the new mining group PGG, rescuing various other mining companies from bankruptcy (EIA, 2016; Ancygier and Szulecki, 2016). As a consequence, PGG bought KW, formerly Europe's largest coal mining company, and later merged with KHW¹⁰. The debt of the entire coal sector amounted to around €3.4 billion at the end of October 2015. Additional financial support for PGG emerged from state-owned investors PGNiG, PGE, Enea, Energa and TF Silesia, creating an even stronger link between mining and electricity generation (Polityka Insight, 2017; Kuchler and Bridge, 2018).

Polish public opinion on coal mining is split: In several referendums of villages affected by mine openings, the majority of citizens voted against new coal mines (e.g. 2009 in Gubin and Brody) (Widera et al., 2016). In other communities where mine openings were under discussion, public acceptance for coal mine development was high (Badera and Kocoń, 2014). Factors influencing public opinion are especially fears with respect to employment losses, rising energy prices and energy security. Fuel poverty in Poland is high, and fears persist that reducing coal consumption might increase electricity prices further (Bouzarovski and Tirado Herrero, 2017). High energy security concerns are mostly linked to dependence on Russia (Szabo and Fabok, 2020; Szulecki, 2020; Szulecki and Kuszniir, 2018). Those concerns are often related to natural gas consumption, but also an important argument mentioned in favour of continuing Polish coal production (Szulecki and Kuszniir, 2018; Kuchler and Bridge, 2018). The Green Party and Greenpeace also refer to energy security concerns regarding Russia, stating that only renewables would reduce this dependence long-term (Szulecki and Kuszniir, 2018).

Surveys show that Polish citizens are less interested in the economic situation of the coal industry than in energy affordability and energy security.¹¹ Coal-based energy is not the preferred energy source of the future; instead, the majority of people favour renewable energies and to a lesser extent nuclear energy. Similarly, subsidies towards the coal sector are increasingly unpopular. Only around one-quarter support the social privileges to miners and 64% want coal mines to receive the same treatment as other companies (Bukowski et al., 2015). At the same time, there are parts of society that would support trade unions in a conflict over mine closures with national policymakers (Szpor and Witajewski-Baltvilks, 2016).

The interplay between the political agenda, media and public opinion is complex (Osička et al., 2020). However, generally stated, public opinion is influenced by the media. Independent media can enable civil society and science to disseminate their findings and thereby inform the general public and assert pressure on incumbents.

State controlled media, on the other hand, has the potential to strengthen socio-political protection of an (uneconomic) industry regime opposing phase-out processes. State-owned media companies in Poland tend to reproduce state-level policymakers' views (Schwartzkopff and Schulz, 2017). Partisanship of the media has traditionally

⁷ Jastrzębska Spółka Węglowa (Polish coal mining company).

⁸ Czarzasty, Jan. 2017. 'Poland: Tensions in Coal-Mining Escalate into Major Conflict'. Eurofound. May 19. <https://www.eurofound.europa.eu/observatories/eurwork/articles/industrial-relations/polandtensions-in-coal-mining-escalate-into-major-conflict>.

⁹ As well as the parliamentary elections in 2019.

¹⁰ Katowicki Holding Węglowy (Polish coal mining company).

¹¹ See e.g. CEM Institute. 2015. Polish people's attitudes towards the coal industry (Polacy wobec przemysłu górnictwo). Cited in: Bukowski et al. (2015).

been high in Poland. Polish state-owned media companies receive a large share of their revenue from other state-owned companies through state advertisement funds. Since the election of PiS in 2015, senior management of major state media radio and TV channels can be appointed by the government (Kundzewicz et al. 2019), increasing partisanship (Dzięciołowski, 2017). Progressive voices and regime critics speak only occasionally in mass media and more often in specialised media (Schwartzkopff and Schulz, 2017).¹² Polish media focuses on the importance of coal for the Polish economy and society, highlights energy security concerns and mobilises support for the industry. Often the future of coal is discussed as in how the government needs to keep the coal industry alive, despite its uncompetitiveness (Osička et al., 2020). Climate change and related policy has been covered less than in other EU countries; Politicians speak out less about climate change and do not refer to or downplay the link between coal and climate change (Kundzewicz et al., 2019).

The only actor group actively working against coal mining and power plants are, increasingly, NGOs like Greenpeace, “Development Yes – Open Pit Mines No!”, Action Democracy or Client Earth. As the government is backing coal, more lawsuits are being filed to stop the expansion of new mines and construction of new power plants.

Climate change concerns are not as strong as in most other EU countries (Ceglarz et al., 2018; Kundzewicz et al., 2019). Opposition to coal therefore arises mainly due to relocation of citizens and air pollution. The poor air quality led to a ban of coal furnaces for household heating in Krakow taking effect in 2019. However, the media discourse focuses on smog related to local heating, and mostly not on coal mining and large-scale coal-fired power plants (Osička et al., 2020). Nevertheless, due to the high air pollution levels in Poland (World Health Organization, 2016), awareness about the topic is generally high. A survey found that Polish citizens believe that a “lack of policy coherence for sustainable development in terms of air protection” is one of the greatest barriers for the use of renewable energies (Wojciechowska-Solis, 2018).

Chandler et al. (2018) categorised actors in environmental and energy policies in Poland according to their position on coal and political power. According to the analysis, NGOs remain weak political actors, ranking far behind incumbent energy companies and political parties in terms of political power. Polish NGOs are relatively small and lack experience in applying for (EU) grants. Difficulties are enhanced by high costs of employment and the absence of national funds supporting NGOs (Wagner et al., 2016; Szpor and Ziółkowska, 2018). Hence, as those actors in support of a decline of coal use have less political power, they can influence decision making less than pro coal forces.

3.2. Economic environment analysis of polish coal industry

The Polish coal sector is in a dire financial situation. Without direct subsidies and government enforced bailouts, there would hardly be any hard coal mining left within Poland: Problems persist with profitability and liquidity in the hard coal mining sector leading to bankruptcies (Vaněk et al., 2017; Jonek Kowalska, 2015; Kuchler and Bridge, 2018). The lignite sector is still generating (at least small) revenues; but lignite reserves in currently operating mines are shrinking. Also, the economics of coal-fired power plants is eroding, partly because of rising CO₂ prices (CTI, 2018).

Poor grid infrastructure and missing installed capacities to cover the entire electricity demand are further aggravating the difficult situation of the Polish energy system. Power cuts happened during the summer of 2015, with further outages expected for the next years (Wierzbowski et al., 2017). More than 50% of the total installed capacity is expected to come offline between 2020 and 2035, including many coal power plants

¹² In the Freedom House ranking, Poland’s “Press Freedom Status” was degraded in 2018 from “free” to “partly free”, <https://freedomhouse.org/report/freedom-world/2018/poland>.

(RAP, 2018), making new investments necessary.

Hard coal exports have decreased from more than 30 million tonnes in 1995 to less than 7 million tonnes in 2017 (Szpor and Ziółkowska, 2018; Alves Dias et al., 2018). Hard coal imports increased to more than 10 million tonnes in 2017 (Statistics Poland, 2018), which makes Poland a (small) net coal importer, mainly from Russia.¹³ Domestic coal extraction costs are higher than the costs of importing coal, mostly due to difficult geological and mining conditions as well as the comparatively low calorific value. Analysis shows that average productivity of hard coal production in Poland decreased by 50% from 2005 to 2013 (Rybak and Rybak, 2016).

Despite the financial problems threatening several companies with bankruptcy and expected cost increases for both hard coal and lignite (Baran et al., 2018), the Polish hard coal and lignite mining industry sets hopes in the small net profits made in 2017 by several of the coal mining companies (e.g. PGG, JSW, PGE). However, other mining companies are still generating losses and consider closing further mines (e.g. Tauron). In March 2020, Polish climate minister therefore mentioned for the first time the option of rearranging assets of state-run energy groups (PGE, Tauron, Enea and Energa), similar to the German example of RWE and E.ON.¹⁴

Investment plans for a new coal-fired power plant (Ostrołęka C, 1 GW) existed as part of the government’s energy security plan in 2019. Latest news from February 2020, however, have led to a suspension due to financial problems. It remains unclear if the plant will ever be built or whether it might be transformed into a gas power plant.¹⁵ Without capacity payments, which will be ruled out under EU law for plants emitting more than 550 gCO₂/kWh Regulation (EU) 2019/943 Article 22(4)¹⁶, estimates suggest that investors including Enea and Energa could lose up to €1.7 billion (net present value) (CTI, 2018). The new EU standard will apply for all new power stations as soon as it enters into force and as of July 2025 for all existing power plants. However, Poland managed to introduce a “grandfathering clause”, which allows the payment of power plants for capacity provision for all contracts approved before 31 December 2019, regardless of the 550 gCO₂/kWh rule. In effect, this enables Poland to continue to subsidise coal-fired power plants.¹⁷

Polish coal has still no major competition in the electricity sector, with only slowly improving market shares of wind energy and natural gas (renewables <15% share in electricity production, solar <1% and natural gas ~7% in 2018¹⁸). Reasons include hindering renewable regulations and a strong political focus on energy security and

¹³ The Atlantic coal market is mostly dominated by hard coal from Russia, USA, Colombia and South-Africa (Oei and Mendelevitch, 2019). Entering the Baltic Sea, however, increases the costs for potential coal deliveries to Poland. The majority of imported coal in Poland therefore originates from the cheapest exporter Russia. In 2015, the price per ton of Polish hard coal was ~260 PLN, while the price of coal from Russia was only ~180 PLN (Kamola-Cieślak, 2017).

¹⁴ Reuters. 2020. Polish utilities may consider German-style reorganization: minister, 12 March 2020. <https://www.reuters.com/article/us-climate-change-poland/polish-utilities-may-consider-german-style-reorganization-minister-idUSKBN20Z2HD>.

¹⁵ Forbes. 2020. Polish Firms Suspend Financing for New Coal Plant, in Latest Sign That King Coal is Slipping. 15 February 2020. <https://www.forbes.com/sites/scottcarpenter/2020/02/15/polish-firms-suspend-financing-for-new-coal-plant-latest-sign-that-king-coal-is-slipping/#93bd0f019373>.

¹⁶ Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN>.

¹⁷ Euractiv. 2018. ‘EU Forges Deal on Coal Phase-out, with Special Polish Clause’, 19 December 2018. <https://www.euractiv.com/section/electricity/news/eu-hammers-deal-on-coal-phase-out-with-special-polish-clause/>.

¹⁸ <https://www.statista.com/statistics/1003292/poland-power-production-by-fuel/>.

independence of Russia (Kuchler and Bridge, 2018) (see also Supplementary Material, Section 7.2). To lower dependence on the Russian gas, Poland build a state-owned Liquefied Natural Gas (LNG) terminal, to important gas e.g. from Norway or the MENA region. High utilisation rates despite a price premium compared to Russian pipeline gas prices are another example for the strong ambition by the Polish state for independence of Russia (Szabo and Fabok, 2020). Adding biomass to coal-fired power plants was a (temporary) cheap way of lowering specific emissions per kWh and helped Poland to achieve its (relatively low) renewable energy targets (Piwowar and Dzikuć, 2016). However, the renewable energy target of a 15% share of overall gross final energy consumption for 2020 will most likely not be met (Janeiro and Resch, 2017).

3.3. External and internal response strategies of the coal regime

The discourse on the importance of coal mining and combustion is not only enforced by the sector's companies but also by policymakers, the media and trade unions (Świątkiewicz-Mośny and Wagner, 2012). In general, the government's influence on coal is strong – especially in the (partly) state-owned companies: When energy companies and mines were merged (see section 3.1), the organisational changes entailed the replacement of management staff with party officials. Zientara (2007) describes how these former politicians lacked economic as well as business knowledge and skills and instead were colluding with labour union leaders. Additionally, costs were manipulated and the financial losses were covered up. The interconnection between the government and energy company management was able to enforce the decision to write off most of the industry's debt (Zientara, 2007). Within the first months after the 2015 elections, the PiS-led government replaced the managers of almost all state-run energy companies, in which the Treasury holds stakes of at least 50%. This has further politicised the energy sector (Vasev, 2017). The Polish Treasury and since 2016 the Prime Minister has ownership rights over the partly state-owned companies PGE, Tauron, Enea and Energa.

The influence between politicians and firms involved in coal, however, works in both directions. The large energy utilities are often consulted when changing laws, while representatives of renewable energy or environmental groups are excluded (Szulecki, 2017). Additionally, personal links between the energy corporations and the government (revolving-door principle) increase the influence of the coal regime on policy outcomes (Szulecki, 2017, 2018). With a continuing coal dependency from the power and heating sector, mining companies can demand further political and financial support by the government, especially as the main alternative would be importing more Russian coal. The substantial number of employees in energy utilities and mining companies and their supporters can exert indirect pressures on policymakers in the form of election votes (Chandler et al., 2018), especially in local ones.

The energy utilities have formed alliances in the past to achieve favourable regulation. The four biggest electricity companies, e.g., formed a bloc opposing any changes to the Energy Act in 2013 law that would improve conditions for distributed renewable energy and, hence, potentially threaten their secure market position (Skjærseth, 2014). One argument that coal-based utilities have frequently used is that the lack of high-voltage power lines and an insufficiently developed electricity grid would not allow for an expansion of distributed renewable energy resources (Szulecki et al., 2015). Among the coal mining companies seemingly making progress in restructuring efforts is JSW. The corporation has replaced its management board and after transferring one of its seven mines to the restructuring company in 2017 and selling some of its assets, it has been making net profit in 2017, following years of net loss (Jastrzębska Spółka Węglowa, 2018). As a measure to save money, the company stopped providing social benefits like bonuses and free coal for employees between 2016 and 2018. In June 2019, the CEO of JSW was fired after a dispute with the Polish energy ministry, including the

refusal to buy a hard coal mine from struggling state-owned energy utility and mining company Tauron.¹⁹

As societal acceptance for the expansion of lignite opencasts was eroding, operators of lignite mines developed new strategies to gain public support. For example, information points and meetings as well as other participatory structures were set up to involve local citizens more in decision-making processes (Badera and Kocoń, 2014). However, this served mainly as an information tool for companies that would not only learn more about the motives and aims of citizen groups, but also use this knowledge to prepare targeted response strategies (Wagner et al., 2016).

Both hard coal and lignite companies have developed Corporate Social Responsibility (CSR) strategies, at least after they became mandatory in January 2017. As they see their business model threatened by “an uncertain political situation, many media attacks and unfavourable public opinion”, they use CSR as a strategy to improve their public image (Pactwa and Woźniak, 2017). Additionally, coal is often rebranded as “clean coal” to create an image of coal being a long-term solution compatible with climate protection (Kuchler and Bridge, 2018). Some energy firms start to implement more structural changes: The largest electricity utility PGE (majority state-owned), e.g., starts to invest in several onshore and offshore wind farms.²⁰

Polish policy makers are, besides setting favourable domestic regulation for the coal industry, also responding to the external environment. This can especially be seen by their attempts to influence and soften EU regulation (e.g. air pollution standards and CO₂ pricing mechanisms) to protect the Polish coal industry: The dependence on coal played an important role in creating opposition to EU climate policies (Braun, 2014; Zapletalová and Komínková, 2020). Polish influence on EU climate policies has been increasingly assertive, partly in coalition with other Central and Eastern European countries (Bocquillon and Maltby, 2017; Zapletalová and Komínková, 2020). Poland aimed to lower ambition especially in the case of the EU GHG targets for 2020 and 2030, the EU ETS reforms, argued against country specific renewable energy targets, and blocked conclusions on the Low Carbon Roadmap for 2050 (Bocquillon and Maltby, 2017; Marcinkiewicz and Tosun, 2015; Skjærseth, 2016). Vetoes on EU common energy and climate policy were justified by stating that the resulting economic costs would be too high (Creutzig et al., 2014; Skjærseth, 2016).

4. Discussion

4.1. Continuing polish coal industry incumbency

Changing the status quo will be challenging: Coal has structural power over the Polish state, as it relies on coal for electricity and heat provision, tax revenues, employment, and support for coal at least partly influences election results. Increasingly, coal corporations use also more internally-oriented responses (changing aspects within the corporation in contrary to influencing the economic or socio-political environments). They have, for example, abolished miners' privileges, replaced management boards, liquidated several mines, limited production from remaining ones and started the diversification of some electricity utilities towards more natural gas and renewable energies. However, both externally-oriented and internally-oriented strategies energy generation and coal mining firms still aim mostly at securing coal's future in Poland's and the corporations' energy mix. Despite dwindling available resources, international decarbonisation efforts and renewable energy expansion commitments, the main corporate response strategies are:

¹⁹ <https://www.mining.com/web/poland-sacks-ceo-of-state-run-coal-miner-jsw-shares-tumble/>.

²⁰ PGE. 2020. 'PGE in Transition'. https://www.gkpg.pl/investor-relations/content/download/5473/file/PGE%20in%20transition_January_II%202020.pdf.

lobbying for favourable legislation for coal, lobbying against support for renewables, creating a discourse about coal being necessary for energy security and the economic development of Poland as well as possibilities for so-called ‘clean coal’ technologies. This includes revolving-doors between government ministries and energy corporations, CSR policies and media campaigns. Common requirements of the *economic environment* like economic competitiveness, efficiency and financial performance, have – so far – only played a subordinate role, made possible through state-ownership. The *socio-political* environment still legitimises coal; however, parts of civil society’s acceptance of coal is declining.

Negative experiences with restructuring programmes, especially during the late 1990s, created opposition by unions and citizens to exit coal. The analysis above as well as previous analyses have shown that the entanglement of the government with mining and electricity corporations as well as unions led to the protection of a sector that has been unprofitable for decades (Zientara, 2007, 2009). Until now, there appears to be no clear governmental strategy on how to reduce the dependence on coal. The newest NECP, however, acknowledges parts of this shortcoming and outlines future work within this area (gov.PL, 2019).

A challenge for the Polish energy sector will be to refurbish the aging power plant fleet. This will need major investments – no matter whether they will be in coal, natural gas, nuclear or renewables. The government, however, struggles with their preferred option of new coal power plants – due to stricter European regulations and little interest from investors that are too afraid of potential stranded assets (Löffler et al., 2019; Gerbaulet et al., 2019). Also, the vision of nuclear appears very unlikely observing rising costs of ongoing constructions in the UK, France or Finland (Schneider et al., 2019). This leaves only two options: Natural gas – which would potentially mean an increasing dependence on Russia and relying on a fossil fuel that needs to be phased out under EU climate neutrality targets by 2050 – or renewables.

A barrier for renewable instalments (in comparison to conventional power sources) are its division of costs, consisting of high investment costs and very low residual operating costs (Hirth and Steckel, 2016). Furthermore, as most coal-based electricity was distributed centrally from Silesia to the rest of Poland, much of the Polish electricity system would need to be redesigned (Szabo and Fabok, 2020). This results in a need for high upfront funding, exceeding the planned investments by the Polish government, which would pay-off in the medium and long run. Additional external financial volumes from the EU – e.g. through the expected ‘European Green Deal’ (EC, 2019) – or private investors are therefore needed to start of a successful energy transition in Poland.

Table 1 summarises drivers and barriers identified through the TEF analysis for a reduction of coal’s dominance. Coal miners and company board members have high political influence; citizens’ support persists because of fears about rising energy prices if coal would be pushed out of the market also due to limited access to information about renewables and NGOs have limited influence. Coal has still no major competition on the electricity market. The coal regime remains protected as jobs, energy security, political and corporate power all depend on it. The only actor group actively working against coal is NGOs. Their main argument hereby concentrates on the reduction of air pollution, or in some cases other environmental issues. Climate protection, on the other side, is of much lower concern to the majority of population. The main political driver for a coal phase-out is hereby the EU, with a mix of regulations weakening the already bad economic condition of the coal industry as well as policies supporting alternative industries.

4.2. Possible future policies to reduce coal’s importance

The analysis suggests that for a Polish pathway towards less reliance on coal, external pressures (e.g. legislation by the EU or falling renewable energy prices, see Table 1) – in addition to domestic pressure, so far mostly by NGOs – will be necessary, as the majority of powerful Polish actors are still in favour of continuing coal consumption.

Table 1
Drivers and barriers for a reduction in Polish coal production and consumption.

Drivers	Barriers
Economic Factors	
Limited economic feasibility of domestic hard coal mining. (+++)	Regional economic dependence and high employment share in the coal sector. (—)
Limited economic feasibility of new coal-fired power plants. (+++)	Limited financial support mechanisms for renewables (need for upfront investment). (—)
Aging infrastructure of power plants and the electricity grid and limited domestic coal resources in still operating mines. (+++)	Potentially rising (household) electricity prices in the short-term. (—)
Reduction of load factors due to cheaper electricity imports. (++)	No need for corporations to make profits as the state does not expect them to be competitive. (—)
Increasing competition of renewables (including potential offshore wind farms) and natural gas (availability of LNG imports). (++)	Restricted government budget for new investments in renewables, structural policy programs, etc. (—)
EU ETS: fewer free certificates and rising CO ₂ prices. (+)	
Political & Legislative Factors	
Power plants breaching EU emission limits (Industrial Emissions Directive, IED). (+++)	Energy security concerns (about energy imports and perceived unreliability of RES). (—)
(Conditional) Financial incentives from the EU for the instalment of renewables and cohesion policies to help carbon intensive regions. (+++)	Government in favour of continuing high coal dependency (bail-out of bankrupt companies, subsidies, capacity market, etc.). (—)
Increasing pressure by the EU: Ban on coal mining subsidies, restriction of capacity markets, climate policies, etc. (++)	Vested interests and high political influence of coal companies. (—)
Rising international pressure on coal. (+)	High political influence of coal labour unions. (—)
	Investments in and discourse of “clean coal” technologies. (-)
Social & Environmental Factors	
(Local) protests due to air and water pollution and against new mine openings. (+)	Fear of change and loss especially in coal regions (energy poverty levels, past negative restructuring experiences, etc.). (—)
(International) climate change concerns. (+)	Ideology and culture: Belief that growth is only possible with coal, that coal is central to development, defining national and regional identities. (—)

Note: For drivers and for barriers the (+), (++), (+++) and (-), (--), (—) indication illustrates the relative strength of the impact, respectively. That an equal number of drivers and barriers is included in the table does not mean that they have an identical weight. To date, the barriers still dominate the drivers of a coal phase-out. While economic drivers and EU legislation are the main points weakening the coal regime, political and ideological reasons are the main identified barriers for an end to coal production and consumption.

The European Union serves as spokesperson for the international climate targets signed within the Paris Agreement, especially after the announcement of the US to step aside. The European Commission has announced to reduce emissions in Europe by 50–55% by 2030 (compared to 1990) and to reach full carbon neutrality by 2050 (EC, 2019). A necessary condition for these targets is the phase-out of Polish coal sector. The European Union hereby uses a strategy of ‘sticks and carrots’ to incentivize an energy transition in Poland: i) stricter climate and environmental regulation to reduce coal consumption as well as ii) (conditional) financial incentives for the instalment of renewables and most important cohesion policies to help carbon intensive regions. An example of this is the ‘European Green Deal’ which could provide

support of up to 2 billion € to Poland, conditional on the promise of carbon neutrality.²¹

A policy discussion needs to take into account political feasibility as one of the most important aspects. Going back to textbook first best examples like carbon taxes or moratoria seem unrealistic in the context of the political economy of coal. It is therefore important to account for policy errors, to include upscaling mechanisms, to think about policy-learning and sequencing while at the same time creating planning security and credibility (Purkus, Gawel, and Thrän, 2017; Kern and Rogge, 2018). Additionally, for a successful transition, policies need to include anticipatory, long-term planning and to combine supply and demand policy options as well as one focused on social aspects next to climate impacts (Spencer et al., 2018).

As discussed in section 2, a destabilisation of a regime occurs when more and more pressures align. Both the identified drivers and barriers (see Table 1) should be addressed simultaneously when designing concrete policy packages. When looking at policy outcomes regarding coal since the 1990s, policy objectives focus on energy security before anything else, while sustainability and climate change concerns rank quite low. Therefore, any policy targeting GHG emission reductions, at least in the beginning, needs to be coupled with other policies with different objectives, like lowering energy import dependence or energy poverty levels, increasing jobs in other sectors or at least address their influence on any of these aspects.

As part of a more sustainable energy strategy,²² the Polish government might therefore include coal phase-out and renewables phase-in policies, structural policies aiming to increase social security and innovations support to create regions fit for the future in a new policy mix. Table 2 includes therefore measures out of the climate policy toolkit (Green and Denniss, 2018, Table 1), complemented by structural policy measures, addressing the identified drivers and barriers:

5. Conclusions and policy implications

The aim of the paper was to analyse the political economy of coal in Poland for three decades from 1990 until 2019, identifying reasons for the persistence of the coal regime, but also identifying potential avenues for change. Besides examining which actors are supporting coal and who benefits from coal production and electricity generation, the paper identified key barriers (factors stabilising the current status quo) and drivers (initial factors that are destabilising the coal regime) using the Triple Embeddedness Framework. By separating socio-political aspects from economic aspects, it allows to distinguish between the main influencing factors of the different contexts. These partly work in opposite directions in Poland: The socio-political considerations mostly argue in favour of the continued use of coal, while most economic considerations are an argument for a decline or phase-out of coal. Additionally, the framework shows how the coal regime responds to the pressures from the two environments, highlighting their so far successful strategies to prevent major changes to coal use and mining in Poland. Based on these findings, policy options to support the existing drivers and reduce barriers of reducing coal's dominance were discussed.

Resistance to a shift away from coal exists mainly due to the deep incumbency of the coal industry and a supportive government. Vested interests of the coal regime are protected due to strong links between coal corporations and the government. Most coal corporations are majority state owned and unions are highly involved in political decisions. This makes it more difficult for coal opposing voices to weaken the political support for coal. The main arguments put forward against a

coal phase-out are similar to other countries and include aspects of energy security, energy independency concerns, fears of rising energy prices, concerns about the reliability of renewables and the prospect of unemployment in regions mainly dependent on the coal industry. Other specifics for Poland - locking the country even deeper into its dependence on coal - are past negative restructuring experiences, strong concerns about relying on Russia's energy resources, little influence by environmental NGOs, and limited financial strengths to experiment with new investments.

We conclude that the socio-political environment of Poland still favours coal and therefore limits the potentially negative impact of the economic environment by protecting the coal regime. However, as restructuring efforts by coal corporations are increasing, their strategies shift from targeting temporary problems to structural ones. Nevertheless, a deep-restructuring of core beliefs, identities and values within the country is still pending. So far, the production and use of coal is linked in political discussions as well as in most media coverage to the functioning and prosperity of the entire Polish economy (see Newell and Paterson (1998) and Newell (2018) for structural power of fossil fuel corporations through connections of energy with economic growth). A limited but increasing amount of studies and news headlines, however, starts to point out the existing potential for a growth of renewable energies, resulting also in additional job opportunities.

There are several internal drivers that might decrease coal's dominance in the future: Among them limited economic feasibility of domestic hard coal mining and of new coal-fired power plants, dwindling resources in currently open lignite mines, aging energy infrastructure as well as increasing competition by natural gas, renewables, and cheaper electricity imports, but also increasing public protests. Additionally, external pressures by the European Union are growing: This becomes apparent e.g. within the discussions surrounding the 'European Green Deal' and the push towards climate neutrality by 2050 (EC, 2019). The EU hereby pairs stronger environmental and climate regulation with additional (conditional) incentives in the form of cohesion policies to enable a 'just transition' of carbon intensive regions leaving no one behind.

The need for energy security is deeply engrained in Polish politics, so that no change will be possible without changing the belief that a secure and affordable energy supply is possible without (a large amount of) coal - especially as domestic renewables also increase energy security. To be part of the EU's ongoing energy transition, Polish policies aiming at reducing coal production should be included in policy packages bundled with renewable phase-in policies and structural policies addressing the related negative social impacts. Important positive and negative lessons can hereby be learned from other international examples, e.g. structural policy programs guiding the phase-out of coal mining in Germany since the 1960s (Oei et al., 2019; Stognief et al., 2019), long-lasting unemployment effects in former coal mining areas in the United Kingdom (Fothergill, 2017), and just transition approaches addressing interests from labour and affected regions in negotiated settlements in Spain (Rentier et al., 2019).

Poland is, like e.g. Spain, a coordinated market economy (CME), where a major share of coal assets are owned and managed by the state (Rentier et al., 2019). The research by Rentier et al. (2019) shows that in this case, decisions about the phase-out of coal are "essentially public decisions", as opposed to one left to the electricity market. Decision making is, therefore, more strongly influenced by employment protection concerns and not mainly by competitiveness (in contrast to liberal market economies). However, the example of Spain also shows that social and structural policies can help overcome resistance to phasing-out coal and need to accompany climate policies to achieve a just transition.

The majority of discussed policy measures are aimed at using the identified drivers as well as to reduce the barriers. However, none of these measures directly targets lowering the political influence of the coal industry and unions. Analysing this further would be an interesting

²¹ Euractiv 2020. „Gerechte Energiewende“: Wer kriegt die EU-Gelder? 27 February 2020. <https://www.euractiv.de/section/energie-und-umwelt/news/gerechte-energiewende-wer-kriegt-eu-gelder/>.

²² A draft for the Polish Energy Plan until 2040 was presented in November 2018 with continued support for coal and very limited support for renewables.

Table 2
Overview of policies addressing specific drivers and barriers of Poland's political economy of coal.

	Restrictive Policies	Mix	Supportive Policies
Supply Side Policies	<p>Restructuring of the remaining coal mining sector and subsidies Reducing and eventually stopping financial support could end domestic production of coal before 2040* (Bukowski et al., 2015). A continuous phase-out plan like e.g. in the UK or Germany (with production quotas or specified years for mine closures) could increase planning security for all affected actors. Our analysis shows that a stronger policy like an immediate moratorium on coal mining is currently politically infeasible.</p> <ul style="list-style-type: none"> Addressing <i>drivers</i> of financial problems of the coal industry, limited coal resources in already operating mines, pressure from the EU banning coal subsidies, international pressure to phase-out coal as well as concerns due to climate change, air and water pollution. Reducing barrier of limited financial resources by freeing state money that could be redirected to renewables or structural/social programmes. 	<p>Diversifying corporations As most corporations are state-owned, obligations for a minimum diversification of energy sources can be implemented: could encourage a process from coal mining towards more sustainable industries.</p> <ul style="list-style-type: none"> Using the <i>drivers</i> of increasing competition from renewables and natural gas, as well as the electricity capacity gap, rising CO₂ prices and societal concerns about climate change, air and water pollution Might contribute to reducing <i>barriers</i> of rising electricity prices, energy security and lower concerns by civil society about negative consequences related to reducing coal production. 	<p>Renewables phase-in Pointing out how dwindling domestic coal resources would make Poland import dependent in the medium term future, and that ~50% of the total installed electricity capacity comes offline between 2020-2035 could serve as a justification for more renewable energy support (e.g. feed-in-tariffs, revoking of law from 2016 restricting wind power expansion**, investment of state owned-companies in renewables). Domestic production of renewable energy related technologies or development of auxiliary services could create prosperity and knowledge apart from coal.</p> <ul style="list-style-type: none"> Addressing <i>drivers</i> of increasing competition by renewables, electricity capacity gap after 2020, coal power plants breaching EU emission levels, concerns about climate change, general pressures to phase-out coal open up space for renewables. Need to overcome <i>barrier</i> of limited support mechanisms for renewables; renewables incorporating a larger market share could increase pressure for coal companies to be competitive and reduce fears about unreliability of RES.
Demand Side & Structural Policies	<p>Restructuring of coal-based electricity generation Limiting financial support and subsidies for coal power plants. No support for 'clean coal' projects or further modernisation. Being part of the EU means that tighter emission standards e.g. enforcement of already decided emission limits (IED), limited capacity payments (e.g. a ban on capacity payments for generation with more than 550 g CO₂/kWh), increasing CO₂ prices, etc. need to be implemented.</p> <ul style="list-style-type: none"> Addressing <i>drivers</i> of financial problems of existing coal-fired power plants, increasing competition of renewables and natural gas, as well as EU emission limits, rising CO₂ prices and societal concerns with respect to climate change, air and water pollution. Might contribute to reducing <i>barrier</i> of unnecessary investment in so called "clean coal" technologies. 		<p>Social and structural policy measures A socially acceptable coal phase-out needs to prevent electricity price increases for low-income households. Negotiations with trade unions can result in a social security programme including the creation of new, well-paid jobs, a reliable social security net, retraining programmes and job search support. Support for former coal regions needs to increase their capacity to diversify the local economy and create more resilient, attractive and competitive regions. Local authorities need sufficient funds and capacity training for implementation.*** Household coal demand can be reduced e.g. by subsidies for building refurbishments or shift from coal heating to alternatives like heat pumps.</p> <ul style="list-style-type: none"> Addressing <i>driver</i> of air pollution concerns. Contribution to reducing the <i>barrier</i> of fears of workers and citizens about negative impacts for the region and themselves.

Notes: * This is not to say that 2040 should be the target year. Analysis has shown that compliance with the Paris Agreement would require an EU-wide coal phase-out by 2030 (Climate Analytics, 2017).** Polish Act on Investments in Wind Power Plants (Sejm paper no. 961/2016). *** See Brauers et al. (2018) for dimensions for a just transition in coal regions.

research question. Additionally, more specific policies, not just policy fields, tackling the coal industry, should be analysed in-depth. As Poland is an outlier within Europe in how the media covers climate change, and only few publications deal with public opinion about coal, an analysis of the Polish coal discourse and how it influences political decision making would be important. Additionally, identifying and mapping the role of media – in times of increasing social media use and fake-news – can be an important aspect for future advancements and applications of the Triple Embeddedness Frameworks and similar approaches. Finally, a stronger focus should be put on the influence of the EU as external driver pressuring the Polish coal industry and vice versa.

An alignment of rising internal and external pressures has started to destabilise the coalition between a pro-coal government, coal dependent and market dominating upstream and downstream corporations as well as unions. This opens up the floor for more direct policies aiming at reducing coal also in Poland. First signs can be seen within pledges of the main opposition party (Civic Coalition) in their election campaign in July 2019 to phase-out coal use in the energy sector by 2040.

The proposed measures identified by this research could be the start for an increasingly ambitious plan for a just and timely transition of the

Polish energy system which:

- Limits its impact on the climate, the environment and human health, and at the same time also
- Provides energy security, increases competitiveness of the Polish economy and job opportunities, and therefore
- Becomes a cornerstone within the 'European Green Deal' – leaving no one behind.

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CRedit authorship contribution statement

Hanna Brauers: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Visualization. **Pao-Yu Oei:** Investigation, Writing - original draft, Visualization, Funding acquisition.

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Appendix A. Supplementary data

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References

- Alves Dias, P., Kanellopoulos, K., Medarac, H., Kapetaki, Z., Miranda-Barbosa, E., Shortall, R., Czako, V., et al., 2018. EU Coal Regions: Opportunities and Challenges Ahead'. EUR 29292 EN. Publications Office of the European Union, Luxembourg. <https://doi.org/10.2760/064809>. https://www.researchgate.net/profile/Kacper_r_Szulecki/publication/292893972_Die_polsche_Energie-_und_Klimapolitik_in_der_Verantwortung_von_PiS/links/56b1c42808ae56d7b06b0927/Die-polsche-Energie-und-Klimapolitik-in-der-Verantwortung-von-PiS.pdf.
- Ancygier, Andrzej, Szulecki, Kacper, 2016. Die polnische Energie- und Klimapolitik in der Verantwortung von PiS. Deutsches Polen-Institut Darmstadt, Forschungsstelle Osteuropa an der Universität Bremen, Institut für Öffentliche Angelegenheiten (Instytut Spraw Publicznych – ISP) Polen-Analysen Nr. <https://library.oapen.org/bitstream/id/33d25f0e-62b8-4074-b973-6f0f6e853170/629602.pdf>.
- Arent, Douglas, Arndt, Channing, Miller, Mackay, Finn, Tarp, Owen, Zinaman (Eds.), 2017. *The Political Economy of Clean Energy Transitions*. World Institute for Development Economics Research. Oxford University Press, New York, NY.
- Zientara, Piotr, 2009. Restructuring the coal mining industry: unionism, conflict, and cooperation: evidence from Poland. *E. Eur. Econ.* 47 (1), 41–59. <https://doi.org/10.2753/EEE0012-8775470103>.
- Badera, Jarosław, Kocoń, Paweł, 2014. Local community opinions regarding the socio-environmental aspects of lignite surface mining: experiences from Central Poland. *Energy Pol.* 66, 507–516. <https://doi.org/10.1016/j.enpol.2013.11.048>.
- Baker, Lucy, Newell, Peter, Phillips, Jon, 2014. The political economy of energy transitions: the case of South Africa. *New Polit. Econ.* 19 (6), 791–818. <https://doi.org/10.1080/13563467.2013.849674>.
- Baran, Jan, Lewandowski, Piotr, Aleksander Szpor, Witajewski-Baltvilks, Jan, 2018. 'Coal transition in Poland: options for a fair and feasible transition for the polish coal sector'. IDDRI and climate strategies. https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Rapport/20180609_ReportCOAL_Poland-def.pdf.
- Bergeck, Anna, Jacobsson, Staffan, Carlsson, Bo, Lindmark, Sven, Rickne, Annika, 2008. Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Res. Pol.* 37 (3), 407–429. <https://doi.org/10.1016/j.respol.2007.12.003>.
- Bocquillon, Pierre, Maltby, Tomas, 2017. The more the merrier? Assessing the impact of enlargement on EU performance in energy and climate change policies. *E. Eur. Polit.* 33 (1), 88–105. <https://doi.org/10.1080/21599165.2017.1279605>.
- Bouzarovski, Stefan, Herrero, Sergio Tirado, 2017. Geographies of injustice: the socio-spatial determinants of energy poverty in Poland, the Czech republic and Hungary. *Post Commun. Econ.* 29 (1), 27–50. <https://doi.org/10.1080/14631377.2016.1242257>.
- Brauers, Hanna, Herpich, Philipp, Oei, Pao-Yu, 2018. The transformation of the German coal sector from 1950 to 2017: an historical overview. In: *Energiewende 'Made in Germany' Electricity Sector Reform in the European Context*, edited by Clemens Gerbaulet, Claudia Kemfert, Casimir Lorenz, and Pao-Yu Oei. Springer International Publishing AG, Berlin, Germany. <https://link.springer.com/book/10.1007/978-3-319-95126-3>.
- Braun, Mats, 2014. EU climate norms in east-Central Europe: EU climate norms in East-Central Europe. *J. Commun. Media Stud.: J. Common. Mark. Stud.* 52 (3), 445–460. <https://doi.org/10.1111/jcms.12101>.
- Bukowski, Maciej, Maśnicki, Jędrzej, Śniegocki, Aleksander, Trzeciakowski, Rafał, 2015. Whither Are You Headed, Polish Coal? Development Prospects of the Polish Hard Coal Mining Sector. *Wise Europa* (Warsaw Institute for Economic Studies), Warsaw, Poland. <http://wise-europa.eu/wp-content/uploads/2016/03/Whither-are-you-headed-Polish-coal.pdf>.
- Carlsson, Bo, Jacobsson, Staffan, Holmén, Magnus, Rickne, Annika, 2002. Innovation systems: analytical and methodological issues. *Res. Pol.* 31 (2), 233–245. [https://doi.org/10.1016/S0048-7333\(01\)00138-X](https://doi.org/10.1016/S0048-7333(01)00138-X).
- Ceglaz, Andrzej, Benestad, Rasmus E., Kundzewicz, Zbigniew W., 2018. Inconvenience versus rationality: reflections on different faces of climate contrarianism in Poland and Norway. *Weather Clim. Soc.* 10 (4), 821–836. <https://doi.org/10.1175/WCAS-D-17-0120.1>.
- Central Statistical Office of Poland, 2019. Energy Statistics in 2017 and 2018. Central Statistical Office of Poland. <https://stat.gov.pl/en/topics/environment-energy/energy/energy-statistics-in-2017-and-2018,4,14.html>.
- Central Statistical Office of Poland, various years. Concise Statistical Yearbook. Central Statistical Office of Poland. <https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/concise-statistical-yearbook-of-poland-2017,1,18.html>.
- Chandler, William, Kassenberg, Andrzej, Hille, Ewaryst, 2018. 'Moving Poland beyond Coal: Assessment of Potential and Strategy'. Annapolis. Energy Transition Research Institute, Maryland USA. <http://www.etransition.org/Entri.2018.Poland%20Beyond%20Coal.pdf>.
- Cherpp, Aleh, Vinichenko, Vadim, Jewell, Jessica, Brutschin, Elina, Sovacool, Benjamin, 2018. Integrating techno-economic, socio-technical and political perspectives on national energy transitions: a meta-theoretical framework. *Energy Res. Soc. Sci.* 37, 175–190. <https://doi.org/10.1016/j.erss.2017.09.015>.
- Child, Michael, Breyer, Christian, 2017. Transition and transformation: a review of the concept of change in the progress towards future sustainable energy systems. *Energy Pol.* 107, 11–26. <https://doi.org/10.1016/j.enpol.2017.04.022>.
- Climate Analytics, 2017. A Stress Test for Coal in Europe under the Paris Agreement. KR Foundation. https://climateanalytics.org/media/eu_coal_stress_test_report_2017.pdf.
- Creutzig, Felix, Marcus, Hedahl, James, Rydge, Szulecki, Kacper, 2014. Challenging the European climate debate: can universal climate justice and economics be reconciled with particularistic politics? *Glob. Pol.* 5 (October), 6–14. <https://doi.org/10.1111/1758-5899.12156>.
- CTI, 2018. Burning more money than coal - the asset economics and financial implications of enega's and enea's proposed new Ostrołęka coal power plant C. Carbon Tracker Initiative. <https://www.carbontracker.org/reports/burning-more-money-than-coal/>.
- Dzięciolowski, Krzysztof, 2017. Is There a Chance for Non-partisan Media in Poland? 'Reuters Institute Fellowship Paper, University of Oxford. <https://reutersinstitute.politics.ox.ac.uk/sites/default/files/2017-12/Is%20there%20a%20chance%20for%20non-partisan%20media%20in%20poland%20-%20Krzysztof%20Dzieciolowski%20Paper.pdf>.
- EC, 2019. Communication from the Commission to the European Parliament. The European Council, the Council. https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.
- EIA, November 2016. 'Poland - Analysis'. EIA (Energy Information Administration) Beta. <https://www.eia.gov/beta/international/analysis.cfm?iso=POL>, 2016.
- Fothergill, Steve, 2017. 'Coal Transition in the United Kingdom'. IDDRI and Climate Strategies. https://coaltransitions.files.wordpress.com/2016/09/coal_uk_v04.pdf.
- Fünfschilling, Lea, Truffer, Bernhard, 2014. 'The structuration of socio-technical regimes—conceptual foundations from institutional theory'. *Res. Pol.* 43 (4), 772–791. <https://doi.org/10.1016/j.respol.2013.10.010>.
- Geels, Frank W., 2002. 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study'. *Res. Pol.* 20 (8–9), 1257–1274. [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8).
- Geels, Frank W., 2014. Reconceptualising the Co-evolution of firms-in-industries and their environments: developing an inter-disciplinary Triple embeddedness framework. *Res. Pol.* 43 (2), 261–277. <https://doi.org/10.1016/j.respol.2013.10.006>.
- Gerbaulet, Clemens, von Hirschhausen, Christian, Kemfert, Claudia, Lorenz, Casimir, Oei, Pao-Yu, 2019. European electricity sector decarbonization under different levels of foresight. *Renewable Energy*. <https://doi.org/10.1016/j.renene.2019.02.099>.
- Goldthau, Andreas, Sovacool, Benjamin K., 2012. The uniqueness of the energy security, Justice, and governance problem. *Energy Pol.* 41 (February), 232–240. <https://doi.org/10.1016/j.enpol.2011.10.042>.
- Goulder, L.H., Parry, I.W.H., 2008. Instrument choice in environmental policy. *Rev. Environ. Econ. Pol.* 2 (2), 152–174. <https://doi.org/10.1093/reep/ren005>.
- govPL, 2019. 'Executive summary of Poland's national energy and climate plan for the years 2021-2030 (NECP PL)'. https://ec.europa.eu/energy/sites/ener/files/documents/pl_final_necp_summary_en.pdf.
- Green, Fergus, 2018. Anti-fossil fuel norms. *Climatic Change*. <https://doi.org/10.1007/s10584-017-2134-6>.
- Green, Fergus, Denniss, Richard, 2018. Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies. *Climatic Change* 150 (1), 73–87. <https://doi.org/10.1007/s10584-018-2162-x>.
- Gurgul, Henryk, Lach, lukasz, 2011. The role of coal consumption in the economic growth of the polish economy in transition. *Energy Pol.* 39 (4), 2088–2099. <https://doi.org/10.1016/j.enpol.2011.01.052>.
- Haas, Tobias, 2019. Comparing energy transitions in Germany and Spain using a political economy perspective. *Environ. Innov. Soc. Transit.* 31 (June), 200–210. <https://doi.org/10.1016/j.eist.2018.11.004>.
- Hess, David J., 2014. Sustainability transitions: a political coalition perspective. *Res. Pol.* 43 (2), 278–283. <https://doi.org/10.1016/j.respol.2013.10.008>.
- Hirth, Lion, Christoph Steckel, Jan, 2016. The role of capital costs in decarbonizing the electricity sector. *Environ. Res. Lett.* 11 (11), 114010. <https://doi.org/10.1088/1748-9326/11/11/114010>.
- IEA, 2017. *Coal Information 2017*. OECD/IEA, Paris.
- Insight, Polityka, 2017. Energy report. http://webcache.googleusercontent.com/search?q=cache:T_IH2eHtNc8J:www.politykainsight.pl/en/politics/politicsofmemory_re

- source/multimedia/20113859+&cd=4&hl=en&ct=clnk&gl=de&lr=lang_en&client=firefox-b.
- Janeiro, Luis, Resch, Gustav, 2017. '2020 Renewable Energy Target Realisation Forecast for Poland: Final Report'. Ecofys by Order of Polish Wind Energy Association. Ecofys and TU Wien, Berlin. <http://psew.pl/en/wp-content/uploads/sites/2/2017/04/2020-Renewable-Energy-Target-Realisation-Forecast-for-Poland.pdf>.
- Jankowska, Karolina, 2017. 'Poland's clash over energy and climate policy: green economy or grey status quo?' in *the European Union in international climate change politics: still Taking a lead?*. In: Rüdiger Wurzel, James Connelly, and Duncan Liefierink. Routledge, London. <http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1427563>.
- Jastrzębska Spółka Węglowa, S.A., 2018. 'Jastrzębska Spółka Węglowa SA - for Contractors - Coal Properties'. <https://www.jsw.pl/en/for-contractors/coal-properties/>.
- Jewell, Jessica, Vinichenko, Vadim, Nacke, Lola, Cherp, Aleh, 2019. Prospects for powering past coal. *Nat. Clim. Change* 9 (8), 592–597. <https://doi.org/10.1038/s41558-019-0509-6>.
- Johnstone, Phil, Newell, Peter, 2018. 'Sustainability Transitions and the State', 27. *Environmental Innovation and Societal Transitions*, pp. 72–82. <https://doi.org/10.1016/j.eist.2017.10.006>. June.
- Johnstone, Phil, Stirling, Andy, Sovacool, Benjamin, 2017. 'Policy mixes for incumbency: exploring the destructive recreation of renewable energy, shale gas "fracking," and nuclear power in the United Kingdom'. *Energy Res. Soc. Sci. Pol. Mixes Energy Transit.* 33 (November), 147–162. <https://doi.org/10.1016/j.erss.2017.09.005>.
- Jonek Kowalska, Izabela, 2015. Challenges for long-term industry restructuring in the upper silesian coal basin: what has polish coal mining achieved and failed from a twenty-year perspective? *Resour. Pol.* 44, 135–149. <https://doi.org/10.1016/j.resourpol.2015.02.009>.
- Kamola-Cieslik, Małgorzata, 2017. 'The government's policy in the field of hard coal mining restructuring as an element of Poland's energy security'. *Pol. Polit. Sci. Yearbk.* 46 (2), 247–261. <https://doi.org/10.15804/pspy2017215>.
- Kemp, René, Schot, Johan, Hoogma, Remco, 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technol. Anal. Strat. Manag.* 10 (2), 175–198. <https://doi.org/10.1080/09537329808524310>.
- Kern, Florian, Markard, Jochen, 2016. Analysing energy transitions: combining insights from transition studies and international political economy. In: Thijs Van de Graaf, Sovacool, Benjamin K., Ghosh, Arunabha, Kern, Florian (Eds.), *The Palgrave Handbook of the International Political Economy of Energy*, Michael T. Klare, 291–318. Palgrave Macmillan UK, London. https://doi.org/10.1057/978-1-137-55631-8_12.
- Kern, Florian, Rogge, Karoline S., 2018. Harnessing theories of the policy process for analysing the politics of sustainability transitions: a critical survey. *Environ. Innov. Soc. Transit.* 27 (June), 102–117. <https://doi.org/10.1016/j.eist.2017.11.001>.
- Kivimaa, Paula, Kern, Florian, 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Res. Pol.* 45 (1), 205–217. <https://doi.org/10.1016/j.respol.2015.09.008>.
- Kuchler, Magdalena, Bridge, Gavin, 2018. Down the black hole: sustaining national socio-technical imaginaries of coal in Poland. *Energy Res. Soc. Sci.* 41 (July), 136–147. <https://doi.org/10.1016/j.erss.2018.04.014>.
- Kundzewicz, Zbigniew W., Painter, James, Kundzewicz, Witold J., 2019. 'Climate change in the media: Poland's exceptionalism'. *Environ. Commun.* 13 (3), 366–380. <https://doi.org/10.1080/17524032.2017.1394890>.
- Kungl, Gregor, 2015. Stewards or sticklers for change? Incumbent energy providers and the politics of the German energy transition. *Energy Res. Soc. Sci.* 8 (July), 13–23. <https://doi.org/10.1016/j.erss.2015.04.009>.
- Kungl, Gregor, Geels, Frank W., 2016. The Destabilisation of the German Electricity Industry (1998–2015). Application and Extension of a Multi-Dimensional Framework. University of Stuttgart Institute for Social Sciences. https://www.sowi.uni-stuttgart.de/dokumente/forschung/soi/soi_2016_2_Kungl_Geels_Destabilisation_of_the_German_Electricity_Industry.pdf.
- Kungl, Gregor, Geels, Frank W., 2018. 'Sequence and alignment of external pressures in industry destabilisation: understanding the downfall of incumbent utilities in the German energy transition (1998–2015)'. *Environ. Innov. Soc. Transit.* 26, 78–100. <https://doi.org/10.1016/j.eist.2017.05.003>.
- Lazarus, Michael, van Asselt, Harro, 2018. Fossil fuel supply and climate policy: exploring the road less taken. *Climatic Change* 150 (1), 1–13. <https://doi.org/10.1007/s10584-018-2266-3>.
- Leipprand, Anna, Flachsland, Christian, 2018. Regime destabilization in energy transitions: the German debate on the future of coal. *Energy Res. Soc. Sci.* 40 (June), 190–204. <https://doi.org/10.1016/j.erss.2018.02.004>.
- Levy, David L., Newell, Peter J., 2002. Business strategy and international environmental governance: toward a neo-gramscian synthesis. *Global Environ. Polit.* 2 (4), 84–101. <https://doi.org/10.1162/152638002320980632>.
- Löffler, Konstantin, Burandt, Thorsten, Hainsch, Karlo, Oei, Pao-Yu, 2019. Modeling the low-carbon transition of the European energy system - a quantitative assessment of the stranded assets problem. *Energy Strat. Rev.* 26 (November) <https://doi.org/10.1016/j.esr.2019.100422>.
- Loorbach, Derk, 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance* 23 (1), 161–183. <https://doi.org/10.1111/j.1468-0491.2009.01471.x>.
- Marcinkiewicz, Kamil, Tosun, Jale, 2015. Contesting climate change: mapping the political debate in Poland. *E. Eur. Polit.* 31 (2), 187–207. <https://doi.org/10.1080/21599165.2015.1022648>.
- Markard, Jochen, Raven, Rob, Truffer, Bernhard, 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Pol.* 41 <https://doi.org/10.1016/j.respol.2012.02.013>, 995–967.
- McGlade, Christophe, Paul, Ekins, 2015. The geographical distribution of fossil fuels unused when limiting global warming to 2 °C. *Nature* 517 (7533), 187–190. <https://doi.org/10.1038/nature14016>.
- Meadowcroft, James, 2011. Engaging with the politics of sustainability transitions. *Environ. Innov. Soc. Transit.* 1 (1), 70–75. <https://doi.org/10.1016/j.eist.2011.02.003>.
- Mendelevitch, Roman, Hauenstein, Christian, Holz, Franziska, 2019. The death spiral of coal in the U.S.: will changes in U.S. Policy turn the tide? *Clim. Pol.* 19 (10), 1310–1324. <https://doi.org/10.1080/14693062.2019.1641462>.
- Mühlemeier, Susan, 2019. Dinosaurs in transition? A conceptual exploration of local incumbents in the Swiss and German energy transition. *Environ. Innov. Soc. Transit.* 31 (June), 126–143. <https://doi.org/10.1016/j.eist.2018.12.003>.
- Newell, Peter, 2018. *Transformismo* or transformation? The global political economy of energy transitions. *Rev. Int. Polit. Econ.* 26 (1), 25–48. <https://doi.org/10.1080/09692290.2018.1511448>.
- Newell, Peter, Mulvaney, Dustin, 2013. 'The political economy of the "just transition": the political economy of the "just transition"'. *Geogr. J.* 179 (2), 132–140. <https://doi.org/10.1111/geoj.12008>.
- Newell, Peter, Paterson, Matthew, 1998. A climate for business: global warming, the state and capital. *Rev. Int. Polit. Econ.* 5 (4), 679–703. <https://doi.org/10.1080/096922998347426>.
- Oei, Pao-Yu, Mendelevitch, Roman, 2019. Prospects for steam coal exporters in the era of climate policies: a case study of Colombia. *Clim. Pol.* 19 (1), 73–91. <https://doi.org/10.1080/14693062.2018.1449094>.
- Oei, Pao-Yu, Hanna, Brauers, Herpich, Philipp, 2019. 'Lessons from Germany's hard coal mining phase-out: policies and transition from 1950 to 2018'. *Clim. Pol.* 1–17. <https://doi.org/10.1080/14693062.2019.1688636>.
- Oei, Pao-Yu, Herrmann, Hauke, Herpich, Philipp, Oliver, Holtemöller, Lünenbürger, Benjamin, Schult, Christoph, 2020. 'Coal Phase-Out in Germany – Implications and Policies for Affected Regions', 196. *Energy*. <https://doi.org/10.1016/j.energy.2020.117004>.
- Osička, Jan, Kemmerzell, Jörg, Zoll, Maksymilian, Lehotský, Lukáš, Černoch, Filip, Knodt, Michèle, 2020. 'What's next for the European coal heartland? Exploring the future of coal as presented in German, Polish and Czech press'. *Energy Res. Soc. Sci.* 61 (March), 101316. <https://doi.org/10.1016/j.erss.2019.101316>.
- Pactwa, Katarzyna, Woźniak, Justyna, 2017. Environmental reporting policy of the mining industry leaders in Poland. *Resour. Pol.* 53 (September), 201–207. <https://doi.org/10.1016/j.resourpol.2017.06.008>.
- Paterson, Matthew, P-Laberge, Xavier, 2018. Political economies of climate change. *Wiley Interdiscipl. Rev.: Clim. Change* 9 (2), e506. <https://doi.org/10.1002/wcc.506>.
- Piwowar, Arkadiusz, Dzikuć, Maciej, 2016. Outline of the economic and technical problems associated with the Co-combustion of biomass in Poland. *Renew. Sustain. Energy Rev.* 54 (February), 415–420. <https://doi.org/10.1016/j.rser.2015.10.044>.
- Statistics Poland, 2018. Energy statistics in 2016 and 2017. Warsaw, Poland. https://stat.gov.pl/en/topics/environment-energy/energy/energy-statistics-in-2016-and-2017_4,13.html.
- Power, Marcus, Newell, Peter, Baker, Lucy, Bulkeley, Harriet, Kirshner, Joshua, Smith, Adrian, 2016. The political economy of energy transitions in Mozambique and South Africa: the role of the rising powers. *Energy Res. Soc. Sci.* 17 (July), 10–19. <https://doi.org/10.1016/j.erss.2016.03.007>.
- Purkus, Alexandra, Gawel, Erik, Thrän, Daniela, 2017. 'Addressing uncertainty in decarbonisation policy mixes – lessons learned from German and European bioenergy policy'. *Energy Res. Soc. Sci.* 33 (November), 82–94. <https://doi.org/10.1016/j.erss.2017.09.020>.
- RAP, 2018. 'Report on the Polish power system'. Country profile, version 2.0. Berlin: the regulatory assistance project. Agora Energiewende. https://www.agora-energiewende.de/fileadmin2/Projekte/2018/CP-Polen/Agora-Energiewende_report_on_the_Polish_power_system_WEB.pdf.
- Rentier, Gerrit, Lelieveldt, Herman, Kramer, Gert Jan, 2019. Varieties of coal-fired power phase-out across Europe. *Energy Pol.* 132 (September), 620–632. <https://doi.org/10.1016/j.enpol.2019.05.042>.
- Richter, Philipp M., Mendelevitch, Roman, Frank, Jotzo., 2018. 'Coal taxes as supply-side climate policy: a rationale for major exporters?' *climatic change*. <https://doi.org/10.1007/s10584-018-2163-9>.
- Rockström, Johan, Gaffney, Owen, Rogelj, Joeri, Meinshausen, Malte, Nakicenovic, Nebojsa, 2017. A Roadmap for rapid decarbonization. *Science* 355 (6331), 1269–1271. <https://doi.org/10.1126/science.aah3443>.
- Rybak, Aurelia, Rybak, Aleksandra, 2016. Possible strategies for hard coal mining in Poland as a result of production function analysis. *Resour. Pol.* 50 (December), 27–33. <https://doi.org/10.1016/j.resourpol.2016.08.002>.
- Sartor, Oliver, 2018. 'Implementing coal transitions: insights from case studies of major coal-consuming economies'. IDDRi and climate strategies. <https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Idddri/Rapport/201809-Synthesis%20Report%20Idddri-COALTRANSITIONS-def.pdf>.
- Schneider, Mycle, Antony, Froggatt, Hazemann, Julie, Katsuta, Tadahiro, Lovins, Amory B., Ramana, M.V., von Hirschhausen, Christian, Ben, Wealer, 2019. World Nuclear Industry Status Report 2019. Mycle Schneider Consulting, Paris, London. <https://www.worldnuclearreport.org/IMG/pdf/wnrsr2019-v2-hr.pdf>.
- Schwartzkopf, Julian, Schulz, Sabrina, 2017. Climate & energy snapshot: Poland - the political economy of the low-carbon transition. https://www.e3g.org/docs/Climate_energy_snapshot_PL.pdf.

- Scoones, Ian, Leach, Melissa, Newell, Peter (Eds.), 2015. *The Politics of Green Transformations. Pathways to Sustainability*. Routledge, London; New York. <https://www.routledge.com/The-Politics-of-Green-Transformations-1st-Edition/Scoones-Leach-Newell/p/book/9781138792906>.
- Skjærseth, Jon Birger, 2014. 'Implementing EU Climate and Energy Policies in Poland: from Europeanization to Polonization?' 8/2014. FNI Report. Fridtjof Nansen Institute. <https://www.fni.no/getfile.php/131921-1469869880/Filer/Publikasjoner/FNI-R0814.pdf>.
- Skjærseth, Jon Birger, 2016. Linking EU climate and energy policies: policy-making, implementation and reform. *Int. Environ. Agreements Polit. Law Econ.* 16 (4), 509–523. <https://doi.org/10.1007/s10784-014-9262-5>.
- Smith, Adrian, Voß, Jan-Peter, Grin, John, 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Res. Pol.* 39 (4), 435–448. <https://doi.org/10.1016/j.respol.2010.01.023>.
- Sovacool, Benjamin K., Sarah, Ryan, Stern, Paul C., 2015. Kathryi Janda, Gene Rochlin, Daniel Sng, Martin J. Pasqualetti, Harold Wilhite, and Loren Lutzenhiser. *Energy Res. Soc. Sci.* 6 (March), 95–99. <https://doi.org/10.1016/j.erss.2014.12.005> integrating social science in energy research.
- Sovacool, Benjamin K., Noel, Lance, Orsato, Renato J., 2017. 'Stretching, embeddedness, and scripts in a sociotechnical transition: explaining the failure of electric mobility at better place (2007–2013)'. *Technol. Forecast. Soc. Change* 123 (October), 24–34. <https://doi.org/10.1016/j.techfore.2017.05.037>.
- Spencer, Thomas, Colombier, Michel, Oliver, Sartor, Garg, Amit, Tiwari, Vineet, Burton, Jesse, Caetano, Tara, Green, Fergus, Teng, Fei, Wiseman, John, 2018. The 1.5°C target and coal sector transition: at the limits of societal feasibility. *Clim. Pol.* 18 (3), 335–351. <https://doi.org/10.1080/14693062.2017.1386540>.
- Stognief, Nora, Paula, Walk, Oliver, Schöttker, Oei, Pao-Yu, 2019. Economic resilience of German lignite regions in transition. *Sustainability* 11 (21), 5991. <https://doi.org/10.3390/su11215991>.
- Suwala, Wojciech, 2010. Lessons Learned from the Restructuring of Poland's Coal-Mining Industry. Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD). Winnipeg, Manitoba. International Institute for Sustainable Development, Geneva, Switzerland. <http://www.deslibris.ca/ID/223308>.
- Świątkiewicz-Mośny, Maria, Wagner, Aleksandra, 2012. How much energy in energy policy? The media on energy problems in developing countries (with the example of Poland). *Energy Pol.* 50 (November), 383–390. <https://doi.org/10.1016/j.enpol.2012.07.034>.
- Szabo, John, Fabok, Marton, 2020. Infrastructures and state-building: comparing the energy politics of the European Commission with the governments of Hungary and Poland. *Energy Pol.* 138 (March), 111253. <https://doi.org/10.1016/j.enpol.2020.111253>.
- Szpor, Aleksander, 2017. 'Coal transition in Poland'. An historical case study for the project "coal transitions: research and dialogue on the future of coal. IDDRI Clim. Strat. www.iddri.org/Publications/Rapports-and-briefing-papers/COAL_PL_v04.pdf.
- Szpor, Aleksander, Witajewski-Baltvilks, Jan, 2016. The polish views on climate policy. *Pol. Int. (Blog)*, 2016. <https://www.pol-int.org/en/salon/polish-views-climate-policy-en>.
- Szpor, Aleksander, Ziółkowska, Konstancja, 2018. The Transformation of the Polish Coal Sector. International Institute for Sustainable Development. <https://www.iisd.org/sites/default/files/publications/transformation-polish-coal-sector.pdf>.
- Szulecki, Kacper, 2017. 'Poland's renewable energy policy mix: European influence and domestic soap opera'. *SSRN Electron. J.* <https://doi.org/10.2139/ssrn.2964866>.
- Szulecki, Kacper, Kuznir, Julia, 2018. Energy security and energy transition: securitisation in the electricity sector. In: *Energy Security in Europe*, vols. 117–48. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-64964-1_5.
- Szulecki, Kacper, 2018. The revolving door between politics and dirty energy in Poland: a governmental-industrial complex. In: *Revolving Doors and the Fossil Fuel Industry: Time to Tackle Conflicts of Interest in Climate Policy-Making*. The Greens/EFA Group in the European Parliament. The Greens/EFA Group in the European Parliament. https://energiaklub.hu/files/news/Report%20of%20REVOLVING%20DOORS_DIGITAL_.pdf.
- Szulecki, Kacper, 2020. 'Securitization and state encroachment on the energy sector: politics of exception in Poland's energy governance'. *Energy Pol.* 136 (January), 111066. <https://doi.org/10.1016/j.enpol.2019.111066>.
- Szulecki, Kacper, Ancygier, Andrzej, Szwed, Dariusz, 2015. Energy Democratization? Societal Aspects of De-carbonization in the German and Polish Energy Sectors. *SSRN*. <https://doi.org/10.2139/ssrn.2575695>.
- Trappmann, Vera., 2012. Trade Unions in Poland Current Situation, Organisation and Challenges. Friedrich-Ebert-Stiftung Central and Eastern Europe, Berlin. <https://library.fes.de/pdf-files/id-moe/08949.pdf>.
- Turnheim, Bruno, Geels, Frank W., 2012. 'Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913–1997)'. *Energy Pol.* 50, 35–49. <https://doi.org/10.1016/j.enpol.2012.04.060>.
- Turnheim, Bruno, Geels, Frank W., 2013. The destabilisation of existing regimes: confronting a multi-dimensional framework with a case study of the British Coal Industry (1913–1967). *Res. Pol.* 42, 1749–1767. <https://doi.org/10.1016/j.respol.2013.04.009>.
- UNEP, 2017. The Emissions Gap Report 2017 - A UN Environment Synthesis Report. United Nations Environment Programme, Nairobi. <http://www.unepfi.org/wordpress/wp-content/uploads/2017/10/Emissions-Gap-Report-2017.pdf>.
- van Asselt, Harro, Lazarus, Michael, 2018. Fossil fuel supply and climate policy. *Climatic Change* 150 (1–2). <https://link.springer.com/journal/10584/150/1/page/1>.
- Vaněk, Michal, Bora, Petr, Maruszewska, Ewa Wanda, Kašpárková, Alena, 2017. Benchmarking of mining companies extracting hard coal in the upper silesian coal basin. *Resour. Pol.* 53 (September), 378–383. <https://doi.org/10.1016/j.resourpol.2017.07.010>.
- Vasev, Nikolay, 2017. 'Governing energy while neglecting health – the case of Poland'. *Health Pol.* 121 (11), 1147–1153. <https://doi.org/10.1016/j.healthpol.2017.09.008>.
- Vögele, Stefan, Kunz, Paul, Rübhelke, Dirk, Stahlke, Theresa, 2018. Transformation pathways of phasing out coal-fired power plants in Germany. *Energy Sustain. Soc.* 8 (1) <https://doi.org/10.1186/s13705-018-0166-z>.
- Wagner, Aleksandra, Grobelski, Tiffany, Haremski, Marcin, 2016. Is energy policy a public issue? Nuclear power in Poland and implications for energy transitions in central and East Europe. *Energy Res. Soc. Sci.* 13 (March), 158–169. <https://doi.org/10.1016/j.erss.2015.12.010>.
- Widera, Marek, Kasztelewicz, Zbigniew, Miranda, Ptak, 2016. Lignite mining and electricity generation in Poland: the current state and future prospects. *Energy Pol.* 92, 151–157. <https://doi.org/10.1016/j.enpol.2016.02.002>.
- Wierzbowski, Michał, Filipiak, Izabela, Lyzwa, Wojciech, 2017. 'Polish energy policy 2050 – an instrument to develop a diversified and sustainable electricity generation mix in coal-based energy system'. *Renew. Sustain. Energy Rev.* 74, 51–70. <https://doi.org/10.1016/j.rser.2017.02.046>.
- Wojciechowska-Solis, J., 2018. Polish society in the light of the use of renewable energy sources. *Appl. Ecol. Environ. Res.* 16 (1), 893–901. https://doi.org/10.15666/aer/1601_893901.
- World Bank, 2017. Electricity Production from Coal Sources (% of Total). The World Bank. <http://data.worldbank.org/indicator/EG.ELC.COAL.ZS?locations=DE>.
- World Health Organization, 2016. WHO global urban ambient air pollution database update 2016. *Publ. Health Environ. Soc. Determ. Health.* http://www.who.int/health_topics/outdoorair/databases/cities/en/.
- Zapletalová, Veronika, Komínková, Magda, 2020. 'Who is fighting against the EU's energy and climate policy in the European parliament? The contribution of the visegrad group'. *Energy Pol.* 139 (April), 111326. <https://doi.org/10.1016/j.enpol.2020.111326>.
- Zientara, Piotr, 2007. 'Polish government policy for coal (1989–2006)'. *Int. J. Energy Sect. Manag.* 1 (3), 273–294. <https://doi.org/10.1108/17506220710821143>.