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# Implementing Energy Transitions – Understanding Constraints, Pursuing Opportunities

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## Summary

In order to mitigate the accelerating climate change, the transformation of the current energy systems from being primarily fossil fuels-based to renewable energy sources-based, is of utmost importance. This process, commonly referred to as the energy transition, is a complex and multifaceted endeavour that faces various challenges in its realisation. This dissertation compiles four articles which deal with factors constraining the implementation of the energy transition. It does this by investigating how the politics behind different constraints influence the implementation of different elements of the energy transition. The first Chapter introduces the topic of the energy transition by situating it in the context of the climate change and the European Union's climate policy. The next section of this Chapter provides a conceptualisation and understanding of the energy transition by explaining the components of its definition. The following sections present different dimensions of the energy transition (technological, environmental, and socio-political) and situate how energy transition processes operate at different governance levels (global, supranational, national, regional, and local). Furthermore, this Chapter proposes an analytical framework that introduces: (i) *categories of implementation constraints*, including: public engagement; climate denialism; imaginaries, storylines, and frames; governing processes and outcomes, and (ii) *implementation elements*, classified as: technologies; policies/ system coherence; partnerships; methodologies. The interdependencies between these components are further elaborated in four scientific papers, in which various theoretical and methodological approaches, as well as case studies, are applied.

The first paper entitled "Understanding the role of trust in power line development projects: Evidence from two case studies in Norway" and published in the journal *Energy Policy*, evaluates the process of public participation in power line development projects in Norway. It deals with the socio-political dimensions of the energy transition that takes place at the regional and local level. This publication shows that public engagement and deliberation approaches can positively influence the implementation of specific technologies (electricity power lines) indispensable for the energy transition, but the scale of this impact can be context-dependent and determined by informal and nuanced factors, such as trust.

The second paper entitled "Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway" and published in the journal *Weather, Climate and Society*, looks at a more nuanced form of climate denialism – climate contrarianism in Poland and

Norway. It describes the presence and strength of this phenomena in both countries from a national level. This publication investigates the socio-political dimensions of the energy transition and demonstrates that embeddedness of the actors with contrarian viewpoints and interests in these two countries' political-economic systems have negatively influenced the implementation of policies driving energy transition. Nevertheless, the findings are relatively ambiguous and call for more comparative research in different national contexts to better understand universal determinants of the contrarian movement.

The third scientific contribution entitled "Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective" and published in the edited volume *Poland and Germany in the European Union. The Multidimensional Dynamics of Bilateral Relations*, investigates climate and energy cooperation between Poland and Germany. This research deals with the socio-political dimensions of the energy transition and shows that perceived asymmetries present in visions and imaginaries of key stakeholders in Poland can have a mixed impact on the energy transition partnership between these two countries, considering the national and supranational levels. Whether this influence is positive or negative depends on the context in which specific actors operate – the more embedded in the European decision-making processes (in comparison to national ones) and the more involved in day-to-day work they are (instead of representing high-political levels involved in sporadic relationship with the partners), the better and more trustworthy relationships can be established.

The fourth paper entitled "Model-based policymaking or policy-based modelling? How energy models and energy policy interact" and published in the journal *Energy Research & Social Science*, from socio-political and technological dimensions' standpoints examines the interactions between the processes of energy modelling and energy policymaking in five different European case studies: at the supranational level (the European Union) and at the national levels of Greece, Germany, Poland, and Sweden. The results are mixed and show that the application of different methodologies and tools aiming at supporting the energy transition's governance and its outcomes can differ depending on the context in which they are used. Depending on the framework conditions in different cases, energy models can support ambitious policies and a policy target setting, but energy modelling and its results can also be instrumentalised by certain actors to justify already decided directions of the energy policy.

The evidence presented in the papers contributing to this thesis indicates that in order to progress with the implementation of the energy transition, it is important to take into account the complexity and multidimensionality of the energy transition process. This is important, because the energy transition is much more than only a technological shift and requires a consideration of its environmental and socio-political facets. In this thesis the focus has been given to the latter one, presenting that the implementation process involving different energy transition implementation elements (technologies; policies/ system coherence; partnerships; methodologies) can be constrained by different socio-political processes behind them. While the dynamics and mechanisms of these processes can be very context-specific, their thoughtful analysis can help to develop countermeasures, solutions, and approaches that could ease the energy transition's implementation process. This is especially relevant, considering the urgency to accelerate with the fossil fuels phase-out and development and deployment of renewable energy sources, given the intensifying negative effects of climate change as well as the need to reduce the European dependency on Russian energy supplies in the aftermath of Russia's invasion of Ukraine in February 2022.

## Zusammenfassung

Um den sich beschleunigenden Klimawandel abzumildern, ist die Umstellung unserer derzeitigen Energiesysteme von fossilen Brennstoffen auf erneuerbare Energiequellen von größter Bedeutung. Dieser Prozess, der als Energiewende bezeichnet wird, ist ein komplexes und vielschichtiges Unterfangen, der bei seiner Umsetzung mit verschiedenen Herausforderungen konfrontiert wird. Diese kumulative Dissertation stellt vier Artikel zusammen, die sich mit Faktoren befassen, die die Umsetzung der Energiewende behindern. Dabei wird untersucht, wie die politischen Prozesse, die hinter den verschiedenen Zwängen stehen, die Umsetzung der verschiedenen Elemente der Energiewende beeinflussen. Das erste Kapitel führt in die Thematik der Energiewende ein, indem es sie in den Kontext des Klimawandels und der Klimapolitik der Europäischen Union einordnet. Der nächste Abschnitt dieses Kapitels bietet eine Konzeptualisierung und ein Verständnis der Energiewende, indem die Komponenten ihrer Definition erläutert werden. In den folgenden Abschnitten werden die verschiedenen Dimensionen der Energiewende (technologisch, ökologisch und soziopolitisch) dargestellt und es wird aufgezeigt, wie Energiewendeprozesse auf verschiedenen Governance-Ebenen (global, supranational, national, regional und lokal) ablaufen. Darüber hinaus wird in diesem Kapitel ein analytischer Rahmen vorgeschlagen, der folgende *Kategorien von Umsetzungsbeschränkungen* einführt: (i) öffentliches Engagement, Klimaleugnung, Vorstellungen, Geschichte und Rahmen, Governanceprozesse und Ergebnisse und (ii) verschiedene Umsetzungselemente, die wie folgt klassifiziert werden: Technologien, Politik/Systemkohärenz, Partnerschaften und Methoden. Die Interdependenzen zwischen diesen Komponenten werden in vier wissenschaftlichen Artikeln, in denen verschiedene theoretische und methodische Ansätze sowie Fallstudien angewandt wurden, näher erläutert.

Der erste Beitrag mit dem Titel "Understanding the role of trust in power line development projects: Evidence from two case studies in Norway", der in der Zeitschrift *Energy Policy* veröffentlicht wurde, bewertet den Prozess der Öffentlichkeitsbeteiligung bei Projekten zum Ausbau von Stromleitungen in Norwegen. Diese Publikation befasst sich mit den sozio-politischen Dimensionen der Energiewende, die auf regionaler und lokaler Ebene stattfindet. Die Publikation zeigt, dass Ansätze der Öffentlichkeitsbeteiligung und der Deliberation die Umsetzung spezifischer Technologien (Stromleitungen), die für die Energiewende unverzichtbar sind, positiv beeinflussen können. Das Ausmaß dieser Auswirkungen kann jedoch kontextabhängig sein und von informellen und nuancierten Faktoren, wie z. B. Vertrauen, bestimmt werden.

Die zweite Veröffentlichung mit dem Titel "Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway", der in der Zeitschrift *Weather, Climate and Society* veröffentlicht wurde, befasst sich mit einer nuancierteren Form der Klimawandelleugnung – dem Klimakontrarianismus in Polen und Norwegen. Sie beschreibt auf nationaler Ebene die Präsenz und Stärke dieses Phänomens in beiden Ländern. Die Publikation untersucht die soziopolitischen Dimensionen der Energiewende und zeigt, dass die Einbettung von Akteuren mit konträren Standpunkten und Interessen in die politisch-ökonomischen Systeme dieser beiden Länder die Umsetzung von Maßnahmen zur Förderung der Energiewende negativ beeinflusst hat. Dennoch sind die Ergebnisse relativ uneindeutig und erfordern mehr vergleichende Forschung in verschiedenen nationalen Kontexten, um die universellen Determinanten der Gegenbewegung besser zu verstehen.

Der dritte wissenschaftliche Beitrag mit dem Titel "Untapped Horizons and Prevailing Domestic Beliefs. Bilaterale Klima- und Energiebeziehungen aus polnischer Sicht", veröffentlicht in dem Sammelband *Poland and Germany in the European Union. The Multidimensional Dynamics of Bilateral Relations*, untersucht die Klima- und Energiekooperation zwischen Polen und Deutschland. Diese Untersuchung befasst sich mit den soziopolitischen Dimensionen der Energiewende und zeigt, dass wahrgenommene Asymmetrien in den Visionen und Vorstellungen der wichtigsten Interessengruppen in Polen einen gemischten Einfluss auf die Energiewendepartnerschaft zwischen diesen beiden Ländern haben können, wenn man die nationale und supranationale Ebene betrachtet. Ob dieser Einfluss positiv oder negativ ist, hängt vom Kontext ab, in dem bestimmte Akteure agieren – je stärker sie in die europäischen Entscheidungsprozesse eingebettet sind (im Vergleich zu den nationalen) und je stärker sie in die tägliche Arbeit eingebunden sind (anstatt hohe politische Ebenen zu vertreten, die nur sporadisch Beziehungen zu den Partnern unterhalten), desto bessere und vertrauensvollere Beziehungen können aufgebaut werden.

Das vierte Papier mit dem Titel "Model-based policymaking or policy-based modelling? How energy models and energy policy interact", das in der Zeitschrift *Energy Research & Social Science* veröffentlicht wurde, untersucht die Wechselwirkungen zwischen den Prozessen der Energiemodellierung und den energiepolitischen Entscheidungsprozessen in fünf verschiedenen europäischen Fallstudien: auf supranationaler Ebene (Europäische Union) und auf nationaler Ebene in Griechenland, Deutschland, Polen und Schweden. Die Ergebnisse sind gemischt und zeigen, dass die Anwendung verschiedener Methoden und Instrumente zur Unterstützung des

Governances der Energiewende und ihrer Ergebnisse je nach dem Kontext, in dem sie eingesetzt werden, unterschiedlich sein kann. Abhängig von den Rahmenbedingungen können Energiemodelle in verschiedenen Fällen ehrgeizige Politiken und eine politische Zielsetzung unterstützen, jedoch können Energiemodelle und ihre Ergebnisse auch von bestimmten Akteuren instrumentalisiert werden, um bereits beschlossene Richtungen der Energiepolitik zu rechtfertigen.

Die in den Beiträgen zu dieser Dissertation dargelegten Erkenntnisse zeigen, dass es für Fortschritte bei der Umsetzung der Energiewende wichtig ist, die Komplexität und Multidimensionalität des Energiewendeprozesses zu berücksichtigen. Dies ist wichtig, denn die Energiewende ist weit mehr als nur ein technologischer Wandel und erfordert die Berücksichtigung ihrer ökologischen und gesellschaftspolitischen Facetten. In dieser Arbeit wurde der Schwerpunkt auf den letztgenannten Aspekt gelegt, indem aufgezeigt wird, dass der Umsetzungsprozess, der verschiedene Elemente der Energiewende umfasst (Technologien, Politik/Systemkohärenz, Partnerschaften, Methoden), durch unterschiedliche soziopolitische Prozesse eingeschränkt werden kann. Während die Dynamik und die Mechanismen dieser Prozesse sehr kontextspezifisch sein können, kann ihre sorgfältige Analyse dazu beitragen, Gegenmaßnahmen, Lösungen und Ansätze zu entwickeln, die im Ergebnis den Umsetzungsprozess der Energiewende erleichtern könnten. Dies ist besonders wichtig, wenn man bedenkt, dass der Ausstieg aus fossilen Brennstoffen und die Entwicklung und der Einsatz erneuerbarer Energiequellen angesichts der zunehmenden negativen Auswirkungen des Klimawandels sowie der Notwendigkeit, die Abhängigkeit Europas von russischen Energielieferungen nach dem Einmarsch Russlands in die Ukraine im Februar 2022 zu verringern, dringend beschleunigt werden muss.

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Finally, thank you also, Seweryn.

## List of Tables

## List of Abbreviations and Acronyms

ADEME *Agence de la transition écologique*

AR5 Fifth Assessment Report (of the Intergovernmental Panel on Climate Change)

BMU *Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit*

BMWi *Bundesministerium für Wirtschaft und Energie*

CAKE Centre for Climate and Energy Analyses

CEE Central and Eastern Europe

CHASE-PL Climate Change Impact Assessment for Selected Sectors in Poland

$CO_2$ Carbon dioxide

CO2e Carbon dioxide equivalent

COP Conference of the Parties (of the United Nations Framework Convention on Climate Change)

CRES Centre of Renewable Energy Sources

DENA *Deutsche Energie-Agentur*

DFBEW *Deutsch-französisches Büro für die Energiewende*

DLR Deutsches Zentrum für Luft- und Raumfahrt

$E^3$MLab Energy-Economy-Environment Modelling Laboratory

EEA European Environmental Agency

EEG *Erneuerbare-Energien-Gesetz*

EIA Environmental Impact Assessment

EPA Environmental Protection Agency

ETS Emission Trading System

EWI *Energiewirtschaftliche Institut an der Universität zu Köln*

EU European Union

G7 Group of Seven

G20 Group of Twenty

GDP Gross Domestic Product

GHG Greenhouse Gases

IEA International Energy Agency

INSPIRE-Grid Improved and Enhanced Stakeholders' Participation in Reinforcement of Electricity Grid

IPCC Intergovernmental Panel on Climate Change

IPTO Independent Power Transmission Operator

IRENA International Renewable Energy Agency

ITRE Industry, Research and Energy Committee

KV Kilovolt

LTS Long-Term Strategy

LTU Luleå University of Technology

LULUCF Land Use, Land-Use Change and Forestry

NGO Non-Governmental Organisation

NECP National Energy and Climate Plan

NIER National Institute of Economic Research

NIPCC Nongovernmental International Panel on Climate Change

NRK Norwegian Broadcasting Corporation

NTUA National Technical University of Athens

NVE Norwegian Water Resources and Energy Directorate

OECD Organisation for Economic Co-operation and Development

OED Ministry of Oil and Energy

OFATE *L'Office franco-allemand pour la transition énergétique*

PGE S.A. *Polska Grupa Energetyczna S.A.*

PiS *Prawo i Sprawiedliwość*

PKEE *Polski Komitet Energii Elektrycznej*

PSE S.A. *Polskie Sieci Elektroenergetyczne S.A.*

PV Photovoltaic

RED II Renewable Energy Directive 2018/2001/EU

RES Renewable Energy Sources

SDG Sustainable Development Goals

SE4ALL Sustainable Energy for All

STES Socio-Technical-Ecological System

TSO Transmission System Operator

TWh Terawatt-hour

UNFCCC United Nations Framework Convention on Climate Change

## List of publication contributing to this thesis

| Publication number | Type of publication and reference |
|---|---|
| **P – 1** | **Journal article**<br>*Energy Policy*<br>SJR Score: 2.093; Impact Factor: 6.142<br>Status: Published<br>**Ceglarz, A.**, Beneking, A., Ellenbeck, S., & Battaglini, A. (2017). Understanding the role of trust in power line development projects: Evidence from two case studies in Norway. *Energy Policy*, 110, 570–580. https://doi.org/10.1016/j.enpol.2017.08.051. |
| **P – 2** | **Journal article**<br>*Weather, Climate, and Society*<br>SJR Score: 1.014; Impact Factor: 2.746<br>Status: Published<br>**Ceglarz, A.**, Benestad, R. E., & Kundzewicz, Z. W. (2018). Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway. *Weather, Climate, and Society*, 10(4), 821–836. https://doi.org/10.1175/WCAS-D-17-0120.1. |
| **P – 3** | **Book chapter**<br>Status: Published<br>**Ceglarz, A.** (2021). Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective. In E. Opiłowska, & M. Sus (Eds.), *Poland and Germany in the European Union. The Multidimensional Dynamics of Bilateral Relations* (pp. 43-56). London: Routledge. https://doi.org/10.4324/9781003046622. |
| **P – 4** | **Journal article**<br>*Energy Research & Social Science*<br>SJR Score: 2.313; Impact Factor: 6.86<br>Status: Published<br>Süsser, D., **Ceglarz, A.**, Gaschnig, H., Stavrakas, V., Flamos, A., Giannakidis, G., & Lilliestam, J. (2021). Model-based policymaking or policy-based modelling? How energy models and energy policy interact. *Energy Research & Social Science*, 75, 101984. https://doi.org/10.1016/j.erss.2021.101984. |

# 1. Introduction

## 1.1 Climate change and the energy transition in Europe

Climate change is one of the most pressing and important challenges confronting humanity. In March 2023, the Intergovernmental Panel on Climate Change (IPCC) published the Synthesis Report of the IPCC Sixth Assessment Report that summarises the available knowledge about climate change, its impacts, risks as well as mitigation and adaptation options (IPCC, 2023). This report shows that the effects of global warming are observable across every region in the world (ibid.). An increasing number of climate and weather extremes are contributing to a rise in the frequency and severity of wildfires, droughts, heat waves and typhoons, which negatively impact human health and lives, economies, nature, as well as food and water security (see also: Cook et al., 2018; Miller et al., 2021; Mirza, 2011; Nakamura et al., 2016; Pausas and Keeley; 2021). In Europe, the summer of 2022 was by far the warmest on record (Copernicus Climate Change Service, 2022). If the global average temperature continues to grow, by the end of this century the effects of global warming and climate change will make many parts of the Earth uninhabitable (Wallace-Wells, 2017; 2020).

Global warming has been unequivocally caused by human activities principally related to greenhouse gases (GHG) emissions, particularly carbon dioxide ($CO_2$). The IPCC reports that between the years 2011-2020 the global surface temperature increased by 1.1°C above the levels measured between the years 1850-1900 (so-called "pre-industrial levels") (IPCC, 2023). While some future changes in atmosphere, biosphere or human systems caused by the global warming are unavoidable and irreversible, a deep and rapid GHG emissions reduction can limit these changes and effects (ibid.). Under the Paris Agreement – that is a legally binding international treaty on climate change adopted in December 2015 at the 21st Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) – the countries agreed to reduce the GHG emissions aiming at "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (United Nations, 2015: 3).

In 2018, the IPCC warned that if global warming is to be kept at no more than 1.5°C relative to pre-industrial levels by the end of century, there is a short window of time left to radically cut greenhouse gases emissions, which should decline by 2030 by about 45% from 2010 levels (IPCC, 2018b). Despite these warnings and the global commitments made under the Paris Agreement, between 2010-2019 global greenhouse gases emissions have continued to increase. Currently, the policies and measures countries are implementing with the aim of cutting GHG emissions still put the planet on a trajectory leading toward a 3.2°C temperature increase above the pre-industrial levels by the end of century (IPCC, 2023).

The biggest contributor to greenhouse gases emissions globally is the energy sector that is responsible for more than 73% of the overall global GHG emissions (Ritchie and Roser, 2020b). This is because historically the energy systems of most countries in the world have relied on fossil fuels (mainly coal, gas, and oil), the combustion of which produces greenhouse gas emissions (Climate Action Tracker, 2021; IPCC, 2023). The transformation of the energy sector away from fossil fuels is therefore crucial to slowing down climate change and renewable energy technologies (especially wind and solar) are acknowledged as the most feasible and core elements of that transition (Gielen et al., 2019; IPCC, 2023). This transformation, that has come to be known as the energy transition, has begun. Existing technologies considered to be a part of the decarbonisation process (next to wind and solar) are being improved and new ones are being developed (De Vita et al., 2018). In 2021, energy transition investments surpassed $750 billion globally, with renewables and electrified transport being on the top of the list of "clean technologies" (BloombergNEF, 2022).

The transformation leading to a broad and rapid adoption of "clean" technologies in the energy sector is progressing, however, too slowly. After assessing the status of 55 critical energy system components, which need to be implemented or transformed to enable reaching net zero emissions by 2050 and completing the clean energy transition, International Energy Agency (IEA) concluded that only two of them (electric vehicles and lighting) are on track (IEA, 2022b). Despite the available knowledge about the devastating consequences of climate change, scientific information about how much and by when GHG emissions should be reduced, and the availability of technological solutions, energy systems are not transforming fast enough for countries to be in compliance with the Paris Agreement. This raises the questions: what are the constraints hindering the energy transition, and in particular, its implementation? Does the successful implementation of the energy transition depend solely on the technological development and progress? What should be taken into consideration when analysing constraints inhibiting rapid progress on the energy transition?

This thesis demonstrates that progressing with the energy transition that effectively supports climate change mitigation efforts, requires acknowledging the nuances and context-dependent components of energy transitions in different national and local contexts. This is what makes the energy transition so complex and is why it is important to reflect upon the socio-political, technological, and environmental dimensions of energy transition efforts. The energy transition is occurring in multiple places and multiple governance levels (global-supranational-national-subnational-local). Political processes behind the energy transition's implementation are complex and involve different actors, markets, institutions, regulations, technologies, and infrastructures. The topics related to the energy transition's politics have been investigated by other researchers (see for example: Bayulgen and Ladewig, 2016; Bourcet, 2020; Bues, 2020; Darmiani et al., 2014; Seetharaman, 2019; Stefes and Hager, 2020), however, these studies dealt mostly with the implementation of the renewable energy. This thesis takes a different stance and proposes a conceptual framework that combines various categories of the implementation constraints with different elements which need to be put in place in order to progress with the energy transition (technologies, policies/system coherence, partnerships, and methodologies). That allows to structure the constraints hindering the energy transition in a more holistic way and helps to explain why putting the energy transition on the ground is not keeping up with climate knowledge and technological development. Furthermore, consideration of different energy transition implementation constraints and elements can allow to identify the linkages between them and come up with measures to address and potentially overcome them in a synergistic and complementary way. This is relevant to avoid destructive effects of climate change and foster a faster shift toward a decarbonised future.

This cumulative thesis is based on three scientific papers and one book chapter published between 2017-2021. The empirical contributions of these publications are situated in the European context, as historically Europe is responsible for the largest share of carbon dioxide emitted globally (33% of global cumulative emissions), whereas the 27 countries of the European Union are the second largest historical $CO_2$ emitter (after the United States), responsible for more than 20% of global cumulative $CO_2$ emissions (Ritchie and Roser, 2020a). At the same time, for more than three decades the European Union has been considered as a global leader in fighting climate change (Delreux and Ohler, 2019; Oberthür, 2011; Oberthür and Dupont, 2021; Van Schaik and Schunz, 2012; Wurzel et al., 2017). Yet, this leadership has also been questioned, because of, among others, internal EU discrepancies reflected in significant differences in levels and scope related to the ambitions of GHG emissions reductions and the pace of the energy transition's implementation among the European Union member states (de la Esperanza Mata Pérez et al., 2019; Delreux and Ohler, 2019; Dupont and Torney, 2021; Gaventa, 2019; Oberthür and Dupont, 2021; von Homeyer at al., 2022). For that reason, the empirical contributions of this dissertation focus on three particular European countries: Norway[1], Poland and Germany, which represent different approaches and ambitions related to decarbonisation and the energy transition. Especially the two latter cases – Poland and Germany – have often been presented as two extreme examples of countries in terms of their approach to European climate and energy policies. While Germany has been considered as a long-standing climate leader, renewable energy pioneer and an important actor in linking climate and energy policies at the EU's level, Poland was the main country opposing more ambitious climate policies in the EU, because of its domestic energy system relying strongly on coal (Bocquillon, 2018; Delreux and Ohler, 2019; Dupont and Torney, 2021; Ringel and Knodt, 2018; Schreurs, 2020; Skjærseth, 2014; 2021).

The introduction of this thesis first shortly presents the embeddedness of climate change politics in the European Union, its development, impacts on energy policies, and the main regulations on climate and energy until 2021[2]. The following section explains and comprehensively defines the concept of the energy transition. Next, the complexity of the energy transition process resulting from its multidimensionality (socio-political, technological, and environmental) and multi-levelness (global-supranational-national-subnational-local) is discussed. Built on the literature presented, the following groups of auxiliary research questions are raised: (1) How does the public's engagement and deliberation impact upon energy transition implementation?; (2) What explains climate denialism and how has it impacted decisions on energy policy? How the factors determining climate denialism vary from place to place?; (3) How and to what extent can different visions and perceptions influence energy transition governance formats (approaches)?; (4) How to coordinate and govern the implementation of energy transition? What are the relevant tools and methods, which would enable to plan better the energy transition implementation process and foresee its potential effects? How and to what extend are these tools used? Next, these auxiliary questions bridge the discussions presented in previous sections and a conceptual framework applied in this dissertation is presented. An overview of the articles included in this thesis follows

[1] Although Norway is not a Member of the European Union, the Norwegian climate and energy policies are strongly linked with the EU's climate and energy policies (Szulecki et al., 2016).
[2] To be aligned with the timeframe when the publications contributing to this dissertation were published.

and is linked to a discussion summarising research objectives and the theoretical, methodological, and empirical contributions of this dissertation.

## 1.2 Climate policy in the European Union and its impact on the energy policy

Since the establishment of the European Union, energy policy has been one of the top priorities on the EU's political agenda (Kanellakis et al., 2013; Ringel and Knodt, 2018). However, over the last three decades climate action started to be a prevailing issue in the European Union's politics – with climate change dominating the EU's environmental agenda in the 1990s (Delreux and Ohler, 2019; Kanellakis et al., 2013) and incrementally shifting towards other policy areas and the center of the European politics (Oberthür and von Homeyer, 2023). Such development happened because climate change is a cross-cutting issue and many climate-relevant activities and decisions are taken in non-environmental policy areas (Kettner and Kletzan-Slamanig, 2020). In that context, the EU's energy policy represents the most notable policy field which the climate policy has been integrated to (Bocquillon, 2018; Dupont; 2016; Kettner and Kletzan-Slamanig, 2020; Lindberg, 2019; Oberthür and von Homeyer, 2023; Skjærseth, 2014; Wettestad et al., 2012). In result, the European Union's climate and energy policy and regulatory frameworks are considered to be the world's most advanced and comprehensive climate measures (Bocquillon, 2018; Delreux and Ohler, 2019; Oberthür and von Homeyer, 2023).

Climate change appeared as the subdomain of the EU's research policy already at the end of the 1970s, but it became institutionalised within the European Union politics in the 1990s, after its inclusion among seven priority areas of the EU's Fifth Environmental Action Program for the period 1993-2000 (Delreux and Ohler, 2019; Kanellakis et al., 2013). At the global level, the European Union had a leading role in the negotiations over the 1997 Kyoto Protocol, but still this international ambition was not reflected in the internal climate policies, as the regulatory instruments adopted at the EU level in the 1990s (e.g., the energy efficiency labelling or the cars' $CO_2$ labeling) had only informational character (Delreux and Ohler, 2019; Oberthür and Dupont, 2021; Oberthür and von Homeyer, 2023; Van Schaik and Schunz, 2012).

As a direct result of the EU's commitment under the Kyoto Protocol that assumed 8% of GHG emissions reduction by 2012 in comparison to 1990 levels, in the first half of the 2000s, the internal European Union's climate policies progressed (Oberthür and von Homeyer, 2023; Skjærseth, 2014). The so-called Burden Sharing Agreement, defining the levels of the needed GHG emission reductions by each of member states to achieve the EU's joint emission reduction target of the

Kyoto Protocol, became legally binding in 2002. The same year, the European Union adopted the climate-related, energy performance of buildings directive. The following year the directive on substituting biofuel for diesel and petrol in transport was adopted. Also in 2003, the EU's most important climate policy instrument – the EU Emission Trading System (ETS) – was established (Delreux and Ohler, 2019; Lindberg, 2019; Oberthür and von Homeyer, 2023; Skjærseth, 2014).

The EU's climate policies continued to progress in the second half of the 2000s with the view on the so-called post-2012 period, when the first Kyoto Protocol commitment period was to come to an end (Delreux and Ohler, 2019; Wettestadt et al. 2012). In January 2007 the European Commission proposed the EU's short-term climate and energy targets to be achieved by 2020 (Skjærseth, 2014). The so-called "20-20-20 targets" referred to 20% reduction of GHG emissions (compared to 1990 levels), 20% of renewables in total energy consumption and a 20% improvement in energy efficiency (Delreux and Ohler, 2019; Fitch-Roy et al., 2019; Wettestadt et al. 2012). The agreement over the legislative package enabling the implementation of the 20-20-20 targets, known as the 2020 Climate and Energy Package, was achieved by the European Council in December 2008, and enacted in legislation in 2009. The package introduced two legislative acts reforming the EU ETS – aimed at incentivizing the reduction of emissions from large industrial emitters and deciding about effort sharing among the member states to reduce emissions from sectors not covered by the ETS (transport, agriculture, buildings) (Delreux and Ohler, 2019; Skjærseth, 2014). It also included the Renewable Energy Directive (2009/28/EC), Directive on carbon capture and storage (2009/31/E), whereas the Energy Efficiency Directive (2012/27/EU) completed the package in 2012 (Kanellakis et al., 2013; Dupont, 2016; Lindberg, 2019; Oberthür and von Homeyer, 2023). With the adoption of 2020 Climate and Energy Package, climate action has been placed at the centre of a new EU energy policy (Bocquillon, 2018; Delreux and Ohler, 2019; Kettner and Kletzan-Slamanig, 2020). All later climate and energy packages and frameworks proposed and/or adopted by the European Union revised existing legislation and added new elements (Oberthür and von Homeyer, 2023), but the GHG emission reduction, renewable energy and energy efficiency targets proposed in the 2020 Climate and Energy Package became a reference point in tracking the comprehension of the EU's climate commitment (EEA, 2021; 2022; Fitch-Roy et al., 2019).

Although in 2011 the European Council confirmed the European Union's long-term climate objective aiming at reducing the GHG emissions by 80-95% by 2050 (compared to 1990 levels) (Capros et al., 2012), the first years of the 2010s, are characterized by a slowdown in the EU's climate policy dynamics resulting from the disappointing outcome of the 2009 United Nations Climate Change Conference in Copenhagen, increasing evidence about the ETS' shortcomings and the dominance of the financial-economic crisis on the EU's political agenda (Delreux and Ohler, 2019; Fitch-Roy et al., 2019; Oberthür and Dupont, 2021; Skjærseth, 2014; Van Schaik and Schunz, 2012). In October 2014, the European Council agreed on the EU's medium climate and energy targets, under the 2030 Climate and Energy Framework. The updated 2030 targets encompassed the GHG emission reduction by at least 40% by 2030 (in comparison to 1990 levels), an increase of the EU's energy consumption from renewables to at least 27% and energy efficiency increase by at least 27%. These targets have been considered as rather unambitious in comparison to 2020 targets, especially in relation to the renewable energy share by 2030 (Bürgin, 2015; Fitch-Roy et al., 2019; Kulovesi and Oberthür, 2020).

The success of the Paris Agreement in 2015 and the leading role that the European Union played in the negotiations at the COP 21 in Paris has generated a boost for internal climate and energy policy dynamics and created conditions for strengthening and accelerating with the EU's climate and energy legislation (Delreux and Ohler, 2019; Oberthür and Dupont, 2021; Schreurs, 2017). In 2016, the European Commission published proposals for eight new laws, known as "Clean energy for all Europeans package", which finalised in 2019, completed the 2030 Climate and Energy Policy Framework (Oberthür and von Homeyer, 2023). This package introduced a recast of the Renewable Energy Directive (2018/2001/EU) and a recast of the Energy Efficiency Directive ((EU) 2018/2002), which entered into force in December 2018 and increased the 2030 EU's renewable energy and energy efficiency targets to 32% and 32,5% respectively (Kettner and Kletzan-Slamanig, 2020; Kulovesi and Oberthür, 2020; Lindberg, 2019). In parallel, in November 2018, the European Commission published a Communication "A Clean Planet for All" that sets a target of achieving climate neutrality of the European Union by 2050 (Duwe, 2022; Skjærseth, 2021). In that context, as a core element of the "Clean energy for all Europeans package", the EU adopted at the end of 2018 the Governance regulation ((EU) 2018/1999) that requires each EU member state to establish 10-year national energy and climate plans (NECPs) for 2021-30 as well as a long-term strategy (LTS) by 2050, ensuring that collective efforts of each EU country contribute sufficiently to the realization of the EU's climate and energy targets by 2030 and the climate neutrality objective by 2050 (Kulovesi and Oberthür, 2020; Oberthür and von Homeyer, 2023).

At the end of 2019, the European Commission launched the European Green Deal – a comprehensive roadmap presenting how to make Europe the first climate neutral continent by 2050 (Dupont and Torney, 2021; Eyl-Mazzega and Mathieu, 2020; Skjærseth, 2021). This strategy encompassed not only all sectors responsible for GHG emissions (energy, industry, buildings, mobility, and food), but extended its scope towards a broader understood sustainability and addressed various policy areas on the pathway to climate neutrality, related to issues such as financing, research and innovation, ecosystems and biodiversity protection, social aspects to "leave no one behind" or the external action (Bloomfield and Steward, 2020; Gaventa, 2019; European Commission, 2019). Throughout 2020 and 2021 the European Commission proposed a number of sectoral and horizontal strategies and plans that should contribute to delivering the European Green Deal, such as the EU Offshore Renewable Strategy, the EU Biodiversity Strategy for 2030, the EU Adaptation Strategy or the Sustainable Finance Strategy (Duwe, 2022; European Commission, 2023). However, the most important among these proposal in terms of climate policy, was the European Climate Law presented in March 2020 and adopted in June 2021. The European Climate Law legally enshrined the EU's climate neutrality target by 2050 and it increased the GHG emission reduction target to at least 55% by 2030 from 1990 levels (von Homeyer et al., 2022; Oberthür and von Homeyer, 2023). Just a month later, in July 2021, the European Commission launched the "Fit for 55 Package" consisting of 15 legislative proposals, which should enable the implementation of the new, increased 55% GHG emission reduction target by 2030 (in comparison to 1990 levels). Among these policies and measures, increased targets of energy efficiency and renewable energy were also included. In that regard, the share of renewable energy in final energy consumption by 2030 should amount 40% and the energy efficiency target assumed reduction of 36% for final energy consumption and 39% for primary energy consumption by 2030 (Duwe, 2022; von Homeyer et al., 2022).

Since the adoption of the Paris Agreement the European Union's climate and energy targets have been revised upwards significantly, and the corresponding policies and measures followed accordingly. While this makes the EU's climate regulation most advanced in the world, the overall European Union's performance in regard to climate policies has been assessed as "internationally leading but insufficient" (von Homeyer at al., 2022). This is because although in the global comparison the EU's strivings to reduce its greenhouse gas emissions have been ambitious, the EU's climate action remain insufficient to be in line with the EU's fair share in achieving the Paris Agreement's goal and keeping the global temperature rise at the level of 1.5°C above the pre-industrial levels (Duwe, 2022; Kulovesi and Oberthür, 2020; von Homeyer at al., 2022; Oberthür and Dupont, 2021). This insufficiency has laid also in the level and extent of integration of climate objectives into energy policy, expressed in inconsistencies and conflicting solutions and regulations related to different energy policy areas (Bocquillon, 2018; Dupont; 2016; Kettner and Kletzan-Slamanig, 2020). Finally, the implementation of the EU's climate and energy targets cannot be attributed solely to the effectiveness of EU policies (Bocquillon, 2018; Delreux and Ohler, 2019). While the EU's "20-20-20 targets" related to GHG emissions reduction, renewable energy deployment and energy efficiency gains by 2020 were obtained, to a large extent this achievement was possible due to unusual circumstances and external factors, such as the economic crisis at the end of 2010s and the COVID-19 pandemic outbreak in 2020. These events disrupted the traditional energy consumption patterns and contributed to the realization of the EU's 2020 climate and energy targets (Delreux and Ohler, 2019; EEA, 2021; 2022). The latest projections and trends tracked by the European Environmental Agency (EEA) show that under the current policies, the European Union is not on track to achieve its 2030 and 2050 climate and energy targets (EEA, 2022).

Implementation and achievement of the climate and energy targets is the important component of the energy transition, but it is not synonymous to the energy transition implementation. The following sections introduce the conceptualisation of the energy transition and explain its multidimensionality, which are essential to analyse the energy transition implementation constraints.

### 1.3 Conceptualisation and understanding the concept of the energy transition

Over the last years the "energy transition" has become an internationally recognised term. Pastukhova and Westphal (2020) argue that while the energy transition started to be omnipresent in political debates and is a subject of numerous scientific inquiries, this term has been lacking a conceptual clarity and integrity. The lack of a unified and comprehensive definition of the energy transition resulted from its different understandings among various actors, which tend to focus on single components of the energy transition (ibid.). Conceptualising the energy transition is an important step, because the lack of its understanding and the possible use of different definitions of the energy transition, can imply different development trajectories of this process, different orientations of the needed policy interventions, or a different mix of technologies to be implemented (Meadowcroft, 2009).

The starting point to understand the energy transition is the definition provided by the International Renewable Energy Agency (IRENA) that conceptualises it as: "(…) a pathway toward transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century. At its heart is the need to reduce energy-related $CO_2$ emissions to limit climate change. (…) Renewable energy and energy efficiency measures can potentially achieve 90% of the required carbon reductions" (IRENA, 2021a). This definition shows that energy transition is a process of achieving a specified objective (zero carbon global energy sector) by development and implementation of concrete technologies and measures while phasing out others.

Sometimes the term "energy transition" is being used interchangeably with "low-carbon transition" (cf. Semieniuk et al., 2020; van den Bergh and Botzen, 2020). There is, however, a difference between both terms regarding the subject and the means to achieve the elimination of the GHG (predominantly $CO_2$) emissions. The "low-carbon transition" can be understood as being broader than the "energy transition" because it refers to the entire economy and not only to the energy sector. Thus, it encompasses the GHG emissions from other sectors, such as agriculture, forestry, land use or industry (Ritchie and Roser, 2020b). In terms of the technology applied, the "low-carbon transition" includes the use and deployment of nuclear energy (IEA, 2019b), whereas the IRENA-based definition of the "energy transition" assumes a broad utilisation of renewable energy and energy efficiency measures (IRENA, 2021a). Similarly, some studies make a clear link between the energy transition as a mean of achieving carbon neutrality (Dong et al., 2022; Millot and Maïzi, 2021). Carbon neutrality, also understood as net zero $CO_2$ emissions, is a broader term, as it can be achieved when anthropogenic $CO_2$ emissions are balanced by anthropogenic $CO_2$ removals (IPCC, 2018a).

The definition provided by IRENA determines the energy transition's objective as a zero-carbon energy system (IRENA, 2021a). It means that from all energy system's stages: generation, transmission, distribution and demand, the $CO_2$ emissions resulting from burning of fossil fuels, are eliminated. To the largest extent this elimination concerns the first component of the energy system's chain – the supply side – where energy is generated (IEA, 2019a; Piggot et al., 2020). On the supply side, there are three main fossil fuels responsible the $CO_2$ emissions: coal, oil, and gas (Ritchie and Roser, 2020b). Thus, the energy transition stands for coal- (Oei et al., 2020; Rentier et al., 2019), oil- (Rinscheid et al., 2019), and gas-phase outs (McGlade et al., 2018).

The processual component of the energy transition as a pathway means that it is stretched over time and entails a temporal dimension (Fouquet, 2016; Kern and Rogge, 2016; Sovacool, 2016). Internationally there are no pledges defining a clear end-date of the energy transitions' completion, but there are different time horizons in achieving net zero $CO_2$ emissions. For example, as mentioned in the previous section, in the European Union the European Climate Law adopted in 2021, enshrined legally the medium- and long-term EU's climate targets related to the reduction of green-house-gases emissions by 2030 and 2050 (von Homeyer et al., 2022). Some of the EU member states adopted laws and regulations, which oblige them either to achieve net zero emissions earlier than middle of the current century (e.g., Germany, Sweden, and Portugal by 2045) (Energy and Climate Intelligence Unit, 2022). However, the years of the climate neutrality achievement do not mean that the energy transition is going to be completed by these points in time. In comparison, the IRENA's energy transition's definition includes the middle of the current century, but it concentrates only on the elimination of fossil fuels from the energy sector (not referring to the entire economies) (IRENA, 2021a).

Introducing concrete dates into the temporal dimension of the energy transition has rather a symbolic character. It can mark points in time, in which a formal political decision took place or specific policies were approved, but it is challenging to draw clear cut lines, when the energy transition has started or when it will end (Markard, 2018). According to Lindberg and Kammermann (2021) the temporal dimension of energy transitions can be summarised in four consecutive phases. The first phase is an experimentation, start-up, or a predevelopment phase, where the new renewable energy and energy efficiency technologies remain at the testing level and do not spread beyond laboratories of demonstration projects. In phase two, these technologies take off, whereas in phase three, they accelerate and diffuse. The final stage is characterised by stabilisation, institutionalisation and anchoring the technologies in the entire system (ibid.; see also: Geels 2002; 2019). The process of the energy transition at all its stages can be disrupted as it is vulnerable to unexpected externalities, as, for example, the recent COVID-19 pandemic (Cazcarro et al., 2022; Quitzow et al., 2021).

The definition of the energy transition proposed by IRENA, as a main objective puts in the centre the zero carbon global energy sector by 2050 (IRENA, 2021a). However, the objectives, which energy transitions should realise and deliver, can make this process context-dependent (Markard, 2018). For example, Joas et al. (2016) in their analysis of the energy transition's goals in Germany (also known as *Energiewende*) show that implementing the energy transition should go beyond greenhouse gases reduction and contribute to other objectives, such as: protection and conservation of the national environment, or maintenance of high levels of the security of supply. In the German context, the implementation of the energy transition can also have an industrial policy's function – it can allow to build up capacities of domestic companies to become international market leaders (Joas et al., 2016; Marquardt et al., 2017; Steinbacher and Pahle, 2016).

Multiple objectives of energy transitions require not only the shift from fossil fuel-based systems of energy production and consumption to renewable energy sources. They encompass a transformation of entire sociotechnical systems, including intertwined mix of various technologies, infrastructures, organisations, markets, regulations, and actors' practices (Geels 2002; 2019; Geels et al., 2017; Miller et al., 2013). Thus, the energy transition is much more than merely a technological shift – it is also a social process (Hewitt et al., 2017) and involves a socio-cultural change having a deep effect on incumbent institutions, routines, behaviors, and beliefs (Markard, 2018; Markard et al., 2012; Meadowcroft, 2011; Midttun, 2012; Miller et al., 2013; Steg et al. 2015). A broad understanding of the energy transition makes this process multidimensional – it is embedded in complex structures and consists of multiple aspects and issues (Markard, 2018).

### 1.4 The multidimensionality of energy transitions

There is no single theory that could explain the entire energy transition (Pastukhova and Westphal, 2020) and its understanding requires combining insights from different disciplines. Sovacool and Hess (2017) identified ninety-six theories and conceptual approaches from twenty-two disciplines that can be helpful in explaining sociotechnical changes, including the energy transition. Cherp et al. (2018) proposed the most advanced meta-theoretical framework that integrates techno-economic, socio-technical, and political perspectives on national energy transitions. This thesis considers the complexity of the energy transition based on the socio-technical-ecological system (STES) approach[3] (Ahlborg et al., 2019, Markolf et al., 2018). All the dimensions of this system (socio-political, technological, and environmental) are interdependent and intertwined – many of their components influence each other (cf. Sovacool et al., 2020). The latest IPCC Sixth Assessment Report on the climate change impacts, adaptation and vulnerability situates energy transitions as a part of human systems transitions, which are interdependent with climate change and ecosystems transitions (IPCC, 2022a), reflected in this thesis as the environmental dimension.

[3] I will broaden the "social" component of this approach with political aspects and, thus, turn it into a "socio-political" dimension.

The next sections explain all three energy transition's dimensions, presenting what stands behind each of them. Since, historically, energy transitions were driven by the scaling up of technological solutions (Grubler, 2012; see also: Geels 2002; 2019; Midttun, 2012), a short description of the energy transition's technological dimension will be used as a starting point to reflect upon some of its interferences with environmental and socio-political dimensions. The demonstrated aspects of the energy transition will illustrate its complexity by indicating relations and overlaps between the technological, environmental, and socio-political dimensions.

### 1.4.1 Technological dimensions of energy transitions

The IRENA's definition of energy transition puts in the centre renewable energy and energy efficiency measures as the main technological means to reduce the $CO_2$ emissions (IRENA, 2021a). The technologies enabling the energy transition process have been developed and applied alongside entire energy system chain: generation, transmission, distribution, and demand (De Vita et al., 2018; Zepf, 2020). On the supply side, the fossil fuels-based technologies should be eliminated and replaced by the renewable energy technologies. This umbrella term refers to energy production using renewable energy sources, such as water (hydro and tidal), solar, wind, geothermal heat, and biomass (biofuels and waste) (Zepf, 2020). Globally, among the renewable energy technologies hydropower accounts for the largest share of the renewable generation capacity (43%), but in recent years solar and wind power dominated renewable capacity expansion, being jointly responsible for 91% of renewable additions in 2020 (IRENA, 2021b).

From a historical perspective, the requirements of different end-use sectors on the demand side of the energy system chain, have been the main drivers of energy transitions. As Grubler (2012:10) notices: "energy demand and supply systems coevolve, with innovations mutually enhancing each other, but without energy service demand changes, there would not have been the type of drastic changes in energy supply". All end-use sectors, such as transport (Dominković et al., 2018), buildings (both: residential and commercial buildings in terms of heating and cooling purposes) (Cabeza and Ürge-Vorsatz, 2020) and industry (Material Economics, 2019) are currently undergoing deep and dynamic changes aiming at eliminating $CO_2$ emissions in their energy consuming processes, mostly in the fossil fuels' combustion (IEA, 2019a). One of the means to help achieving that is sector coupling which means the integration of different end-use sectors and involves a broad use of electricity generated through renewable energy technologies (Heinisch et al. 2019; Ramsebner et al., 2021). For a successful coupling of different end-use sectors and connecting the demand with renewables-based supply, the energy system needs transmission and distribution grids, which transport the energy carriers (Fridgen et al., 2020). Thus, the grid networks are the enablers of the energy system's transition and can help to optimise the energy system and increase its efficiency (Fridgen et al., 2020; Ramsebner et al., 2021).

From the technological point of view, all components of the energy system chain need corresponding infrastructure that enables the energy transition process (Bridge et al., 2018). The infrastructural build-up for energy transition involves physical and non-physical assets and is driven by the decarbonisation paradigm, but also by other accompanying processes, such as digitalisation of the energy sector and decentralisation of energy production that results from deployment of renewable energy technologies (Di Silvestre et al., 2018; see also: Buck et al., 2019). The development of the infrastructure needed for the energy transition provides the most vivid example illustrating how the technological dimension of the energy transition interrelates with the environmental and socio-political ones.

### 1.4.2 Environmental dimensions of energy transitions

The development and deployment of the physical infrastructure needed for the energy transition, cause environmental impacts. A massive build-up of the assets generating renewable energy requires land and space and they visibly influence the local landscapes (Cowell, 2010). The energy transition infrastructure can affect ecosystems and biodiversity in several ways, depending on the technology applied (Pörtner et al., 2021). For example, wind farms can lead to the risk of bat and bird deaths on the order of thousands every year (Marques et al., 2014). In general, the development of renewable energy technologies can impact the local microclimate, increase ambient pollution (including non-chemical pollution such as sound, heat and light pollution), contribute to settlement of invasive-alien species and result in habitats' loss and changes (Gasparatos et al., 2017). Thus, scholars have called for the environmentally-friendly and trully sustainable energy transition (Ammermann et al., 2019; Süsser et al., 2022). Considering the entire life-cycle of the energy transition infrastructure, such as production, manufacturing, installation, or operation and maintenance, its development can also have an effect on freshwater ecotoxicity, marine eutrophication, material depletion, ozone depletion or terrestrial acidification and others (Jorge and Hertwich, 2014; Pörtner et al., 2021; Zepf, 2020).

The build-up of renewable energy technologies and infrastructure aims at reducing GHG emissions and contributing to climate change mitigation efforts. At the same time, this infrastructure does not remain indifferent to climate change impacts. Rising temperatures, changing precipitation patterns, sea-level rise and extreme weather events, such as tornadoes, heat-waves or flash floods, influence the entire energy system chain. For example, on the supply side climate change affects generation efficiency, creates a need for increased generation potential and puts infrastructure into physical risk. The latter one, next to efficiency changes, embodies the biggest threat for transmission and distribution. On the demand side, climate change impacts determine the heating and cooling needs as well as the water supply (IEA, 2021a). In consequence, the effects of climate change can question the entire system security or lead to higher electricity prices (Stanton et al., 2016; Van Vliet et al., 2012), which, for example, can negatively influence the most vulnerable members of society (cf. Frondel et al., 2015).

### 1.4.3 Socio-political dimensions of energy tranistions

The socio-political dimension of the energy tranistion involves different economic aspects (cf. Miller et al., 2013). This is illustatrated, for example, in the case of energy poverty that is a socio-economic phenomenon defined in terms of energy expenditures and incomes[4] (Sokołowski et al., 2020). The technologies and infrastructures advancing the energy transition can influence energy poverty rates (Karpinska and Śmiech, 2021). In this sense, the implementation of energy transition policies and programs may have equity and justice implications, as it can produce and perpetuate pre-existing sets of societal winners and losers (Bazilian et al., 2019; Carley and Konisky, 2020; Goldthau et al. 2019; Markard, 2018; Meadowcroft, 2011). For example, Sovacool et al. (2019) point out the complex system of injustices accompanying various low-carbon transitions, alongside differentiated technologies (e.g., electric vehicles and photovoltaics) and with a multi-scalar range. Equity and justice repercussions related to the energy transition's implementation can target individuals, communities (also with an international outreach; see for example: Lustgarten, 2018), various professional and social groups (Bendlin, 2014), entire national economies as well as those of third countries (Eicke and Golthau, 2021; Eicke et al., 2021).

Equity and justice can be important enablers of the energy transition by increasing the level of ambition and acceptance of its accelerated implementation (IPCC, 2022b). In order to make a speedier implementation possible, the energy transition should be implemented as a just transition, making sure that no individuals, communities, social groups, countries or regions are left behind

[4] However, this is a narrow view of this term and depending on the geographical location, energy poverty can be understood differently. For an overview see: González-Eguino, 2015; Sokołowski et al., 2020.

in this process (Carley and Konisky, 2020; IPCC, 2022b; McCauley and Heffron, 2018). Historically, the concept of the just transition comes from a labour movement and is centred around jobs, workers and communities affected negatively by a transition to a low-carbon economy (Heyen et al., 2020). This term can be, however, understood in a broader way and move beyond the jobs' argument by bringing together the energy transition with climate and environmental justice and addressing procedural, distributive, recognition, and restorative justice aspects (Carley and Konisky, 2020; McCauley and Heffron, 2018). In this way, the social dimension of the energy transition can interfere with the environmental dimension. Recognising the issue of justice in the energy transition is important, because if it is not addressed by decision-makers, it can be used to hinder public and political support for climate action and, in consequence, delay the energy transition (Lamb et al., 2020; Schreurs, 2020).

The expansion of the energy transition infrastructure showcases how the socio-political and technological dimensions are intertwined. The increasing presence of the decentralised renewable energy assets and the accompanying infrastructure changes people's perceptions, behaviours, and impacts their everyday lives (Buck et al., 2019; Miller et al., 2013). As a result, across countries citizens represent different levels of local and regional support and/or opposition for the build-up of relevant energy infrastructure, including various energy transition technologies, such as: solar power (Pascaris et al., 2022; Späth, 2018), wind power (Bues, 2020; Dugstad et al., 2020), tidal energy (Devine-Wright, 2011), bioenergy plants (Upham, 2009), or electricity power lines (Aas et al., 2014). At the same time local groups and initiatives oppose development and maintenance of fossil fuel technologies (Frantál, 2016) and at the global level broad social movements, such as Fridays For Future or Extinction Rebellion, advocate for faster and effective fossil fuel phase out (Buzogány and Scherhaufer, 2022). Independent from the formats and scale, the organised public opposition can influence the choice of technological solutions and their siting, impacting the speed of the energy transition.

The decentralised character of renewable energy technologies and infrastructure can allow citizens to get actively involved in the energy transition process and benefit from this participation[5] (Buck et al., 2019; Szulecki, 2017). This empowerment is illustrated, for example, by installing solar panels on rooftops, becoming prosumers that consume the energy which they themselves produce, or participating in ownership of the grid infrastructure (Pohlmann and Colell, 2020). Many

[5] To get acquainted with some critics regarding the active engagement of citizens as well as the inclusivity and profitability aspects see for example: Frankowski and Herrero, 2021; Radtke and Ohlhorst, 2021.

individuals organised themselves in energy communities, establishing and developing societally innovative different business models and/or participatory approaches (Hewitt et al., 2019; Wittmayer et al., 2020). The energy transition process enabled a higher number of people to interact with energy infrastructure, allowed many new actors to enter the energy market and made them actively involved in shaping energy futures by participating in energy policy-related decision-making processes (Balthasar et al., 2020; Bayulgen and Ladewig, 2016; Fitch-Roy et al., 2019; Lindberg and Kammermann, 2021; Lindberg et al., 2019; United Nations, 2021).

All the phenomena and aspects described above make the energy transition a complex process, challenging to predict, plan, and manage. In consequence, the implementation of energy transitions can be contested at multiple instances by different actors with conflicting interests and needs (Markard, 2018; Sovacool et al. 2022; Stefes and Hager, 2020; Weber and Cabras, 2017). The complexity, multidimensionality, and high number of actors involved in the energy transition can make the implementation of this process "messy, conflictual and highly disjointed" (Meadowcroft, 2009). Various participatory and democratic practices can ease the energy transition's implementation process and reduce its conflicting potential (Chilvers and Longhurst, 2016; Sovacool et al., 2020; Wahlund and Palm, 2022). It raises an additional question about how the public's engagement in energy infrastructure and the form that deliberation takes, impact upon energy transition implementation? At the same time, in different parts of the world, the process of the energy transition's implementation, called as a "battle of modernities" (Midttun, 2012), has been disturbed by a particular group of actors representing climate denial and contrarian viewpoints and interests (Dunlap, 2013; Lamb et al., 2020; Schmidt, 2010; Schreurs, 2020). It raises additional questions about what explains climate denialism and how has it impacted decisions related to on energy transition policies?  How do the factors determining climate denialism vary from place to place?

These auxiliary questions will be addressed, subsequently, by the first paper contributing to this thesis entitled "Understanding the role of trust in power line development projects: Evidence from two case studies in Norway" (published in the journal *Energy Policy*) and the second paper entitled "Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway" (published in the journal *Weather, Climate and Society*). The next subsection will discuss the issue of place (as signalised in the last of the above auxiliary questions), to present and consider the understanding where actually energy transitions can take place. This subsection will present the spatial component of energy transitions and different governance settings that influence the energy transition's implementation process.

## 1.5 The multi-levelness of energy transitions and the resulting governance arrangements

The energy transition process is not situated in one concrete place. Energy transition occurs simultaneously at various levels and scales and its implementation takes place in, and affects different geographies, landscapes, spaces, and territories (Bridge et al., 2013). Markard (2018) notices that: "there is not a single energy transition, but a multitude of more or less interrelated processes of change that occur in different regions". Geels (2002; 2019) maps the transition process as occurring at three different levels: niche, system, and landscape, which interplay between each other. The layers at which the energy transition process takes place, can also be structured based on the different governance levels.

As much as climate change is a global challenge that does not know borders, the implementation of mitigating measures, such as the build-up of infrastructure needed for the energy transition, takes place in concrete physical locations. This interrelation and the linkage between the global-level challenge of climate change with local responses and actions was investigated by Devine-Wright and Batel (2017), who analysed multiple individuals' place attachments in relation to energy transition infrastructure contextualised within neighbourhood, country, and Earth scales. Actions and measures undertaken at *micro* (local), *meso* (national) and *macro* (global) levels simultaneously to implement energy transitions can be reinforcing and cumulatively make a difference to progress with the energy transition (Ostrom, 2010b; Sovacool et al. (2019).

Hoppe and Miedema (2020) distinguish an additional level at which the energy transition can take place – regional (or subnational) – it is situated between the local and the national levels. It means that even within one country (that can be understood as representing the national level) there can be regional differences in the energy transition implementation process (Beermann and Tews, 2017; Ohlhorst, 2015; Ohlhorst et al., 2013; Wurster and Hagemann, 2018). Furthermore, energy transitions progress differently in rural areas (Buck et al., 2019; Naumann and Rudolph, 2020) than in urban areas (Bulkeley and Betsill, 2005). In case of the latter, municipalities implementing energy transitions have developed various governance structures supporting inter-municipal cooperation, an example being the transnational municipal networks, which allow municipalities to share best practices, learn from each other and create synergies between their actions (Andonova et al., 2009; Busch et al., 2018).

The European Union represents a different governance level, where the energy transition is being implemented – the supranational level (Tews, 2015), that is situated between the national and the global levels. The implementation of the energy transition within the European Union can go beyond the EU member states and resonate on other European countries, as for example on Norway, closely tied economically with the European Union through the European Economic Area (Szulecki et al., 2016), through bilateral arrangements, as for example in case of Switzerland or via various international organisations and organizational forms (as in case of Southeast and East European countries belonging to Energy Community) (Hofmann et al., 2019). The EU's multi-level governance structure enables and facilitates the interplay of all levels: local, regional, national, and supranational, by making them complementary and, thus, reinforcing the energy transition implementation's efforts on the ground (Jänicke and Quitzow, 2017; Schreurs and Tiberghien, 2007). The implementation of the European energy transition within the multi-level governance structure reaches out also to the international level (Eyl-Mazzega and Mathieu, 2020; Gaventa, 2019) in the form of bilateral relations with concrete countries, as for example China or the United States (Kuzemko and Hadfield, 2016) or the activities within the international climate change governance regime (Delreux and Ohler, 2019; Oberthür, 2011; Oberthür and Dupont, 2023).

At the global level, the international institutional energy transition architecture has developed significantly over the past decade (Quitzow et al., 2019). It includes multilateral fora, such as the United Nations Initiative Sustainable Energy for All (SE4ALL) and plurilateral governance fora (with a restricted membership), such as the G7 or G20 (Pastukhova and Westphal, 2020; Van de Graaf and Westphal, 2011). Countries cooperate also in different bilateral settings (e.g., partnerships) for a more coordinated energy transition implementation (Gullberg et al., 2014; Marquardt et al., 2017; Pescia et al., 2018). Thus, while the physical implementation of the technologies and infrastructures that enable the energy transition takes place at the local level, all other remaining governance levels (regional, national, supranational, and international) are also involved in the energy transition's implementation process, for example, by designing and deciding about the appropriate policy mixes enabling the energy transition (Rogge and Reichardt, 2016).

Multiple scales at which the energy transition is being implemented increase the complexity of this process, because the multi-levelness of the energy transition allows for participation of a high number of different actors pursuing various interests and building numerous coalitions (Balthasar et al., 2020; Lindberg and Kammermann, 2021; Lindberg et al., 2019; Markard et al., 2016). These actors can have different visions of how the energy transition shall be implemented (Lilliestam and Hanger, 2016; Schmid et al., 2017). It raises an additional question: how and to what extent can different visions and perceptions influence energy transition governance formats (approaches)? Furthermore, what kind of coordination and governance structures and processes are needed for the implementation of energy transitions? What are the relevant tools and methods, which would enable improvements in energy transition implementation processes and predict their potential effects? How and to what extend are these tools used?

These auxiliary questions will be addressed, subsequently, by the third paper contributing to this thesis entitled "Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective" (published in the edited volume *Poland and Germany in the European Union. The Multidimensional Dynamics of Bilateral Relations*,) and the fourth paper entitled "Model-based policymaking or policy-based modelling? How energy models and energy policy interact" (published in the journal *Energy Research & Social Science*). The next subsection will concentrate on and explain the term "the energy transition implementation constraint" and discuss different implementation elements as well as different categories of constraints. Based on this, a structure presenting how each of the auxiliary questions is being addressed by these elements and categories, will be introduced. This structure will conceptually embed the papers contributing to this thesis and indicate which of the energy transition's dimensions, levels, and governance arrangements each of the papers address.

## 1.6 The energy transition's implementation constraints

The main rationale guiding this dissertation deals with the factors constraining the energy transition's implementation. "Implementation" is a process of putting a decision or a plan into effect. It is an activity leading to execution, a process of making something active or effective (Merriam Webster, 2022b). In that sense, "implementation" is not an end state or final accomplishment, but a process (Lane, 1987) and it can refer to physical and non-physical elements to be implemented. "Constraint" is a limitation or restriction. It can also be understood as a "state of being checked, restricted, or compelled to avoid or perform some action" (Merriam Webster, 2022a). The energy transition's implementation constraints can be defined as any situation, action, process and mean, that hinder, prevent, slow down or create barriers and obstacles for the energy transition to be implemented. The energy transition's implementation constraints can be intentional and unintentional man-made factors or attributes of factors that operate in between actual and potential energy transition progress (Verbruggen et al., 2010). The factors constraining the energy transition's implementation can occur at each of the levels as well as the phases of the energy transition process.

In the energy transition literature, a lot of attention has been given to barriers and constraints hindering development and deployment of renewable energy technologies as the main factors determining progress on achieving energy transition goals (Bayulgen and Ladewig, 2016; Bourcet, 2020; Ćetković and Buzogány, 2016; Foster et al., 2017; Geng et al., 2016; Smith Stegen, 2015; Verbruggen et al., 2010). There are, however, more physical and non-physical implementation elements that need to be put in place in order to progress with the energy transition's implementation. For example, the recent United Nations report (2021), next to the need of scaling-up the deployment of renewables by 2030, recommends investing in physical infrastructure, mainstreaming energy policies into different sectors encompassing entire political-economic systems, establishing integrated energy planning strategies, or intensifying international cooperation. In the context of achieving and implementing the Sustainable Development Goals[6] (SDG), Caiado et al. (2018) distinguished four different implementation elements: (1) technologies, (2) policies/system coherence, (3) partnerships, and (4) methodologies. These broad categories will serve to frame the different implementation elements analysed in the publications contributing to this dissertation. "Technologies" refer to technological enablers of the energy transition's implementation including the renewable energy and beyond; "policies/system coherence" refer to the energy transition policies; "partnerships" refer to different forms of cooperation between actors responsible for energy transition implementation; and "methodologies" refer to tools and methods enabling the energy transition's implementation.

Among the constraints hindering the energy transition implementation, a lot of research has focused on the physical implementation barriers to build-up renewable energy technologies and centred around material feasibility or resource availability, such as the space needed for renewable energy development (Antonini and Caldeira, 2021), material supplies (Smith Stegen, 2015; Overland, 2019; Sprecher and Kleijn, 2021; Zepf, 2020) or the role of supplies of other energy carriers, including fossil fuels (Le Billon and Kristoffersen, 2020) as well as hydrogen (Van de

[6] Worthy noticing, among the seventeen UN Sustainable Development Goals, at least three of them contribute directly to energy transition (no. 7: Affordable and Clean Energy, no. 9: Industry, Innovation and Infrastructure, and no. 13: Climate Action).

Graaf et al. 2020). These material- and resource-based constraints can have implications on the non-physical aspects related to energy transition implementation barriers, as for example, an international conflict potential (Scholten at al., 2020; Vakulchuk et al., 2020).

There have been attempts to structure physical and non-physical factors constraining the development and deployment of renewable energy technologies across different broader concepts. For example, among different categorisations of the barriers impeding the renewable energy development, Verbruggen et al. (2010) mentioned the implementation constraints organised around the theoretical, geographical, technical, economic, and market potentials[7]. In the Chinese context, Geng et al. (2016) systematised renewable energy development barriers around five different categories: system, efficiency, supply, regional, and technology constraints. Among the factors determining renewable energy development, the most investigated by scholars are economic (98%) and environmental (67%) (Bourcet, 2020). Regulatory determinants, such as renewable energy support policies, and political factors, as for example, institutional quality, have received less attention, accounting for only 48% and 23% of the factors determining renewable energy development, respectively (ibid.).

Policies, especially those responsible for renewable energy technologies development, can be key to enabling progress on achieving energy transition aims (Lindberg et al., 2019; Rogge and Reichardt, 2016; Van den Bergh, 2013). Meadowcroft (2011:73) argues that "behind policy there is always politics, and getting the politics right appears to be a prerequisite to getting the policies right". The politics behind a country's or region's energy transition can play an essential role in energy transition implementation, because it influences political economies, regulatory frameworks, and access to resources, which determine the pace, scope, and direction of energy transitions (Goldthau et al., 2019). Hence, the processes and mechanisms of politics behind each of the energy tranistion's elements can act as implementation constraints.

The politics behind energy transition implementation can have multiple facets and relate to different aspects, issues, and elements across the cases. For example, Shum (2015) shows that the beliefs and perceptions of policymakers about resource availability and material feasibility influence the political will to manage the national energy transition in the United States. From a regional perspective, social movements can impact the renewable energy policies implementation

[7] "Potential" understood as "the amount (…) that could be but is not yet realised over time" (Verbruggen et al., 2010: 854).

as presented by Bues (2020) on the example of anti-wind power social movements in Canada and Germany. Political institutions and the way how different actors operate within their structures can determine (or at least influence) the extent to which these actors can advocate for or block progress on shifting towards renewable energy technologies and energy efficiency measures, related technological innovation or societal values related to sustainability (Balthasar et al., 2020; Bayulgen and Ladewig, 2016; Biresselioglu et al., 2020; Lindberg et al., 2019). The structures of the entire national political-economic systems in Europe – understood as varieties of capitalism – can influence renewable energy technology development (Ćetković and Buzogány, 2016).

Politics can create energy transition implementation constraints and the auxiliary questions outlined in previous sections can help to frame the categories of these constraints. The names of these categories have been extracted from the topics relevant for future climate and energy research as described by Sovacool et al. (2020). The additional question "How does the public's engagement and deliberation impact upon energy transition implementation?" encompasses the constraint's category related to (1) Downstream and upstream engagement and (2) Changing the dynamics of engagement. The additional questions addressing the explanations of climate denialism, its impact on decisions on the energy transition policies and the factors determining climate denialism in different places refer to the category (3) Climate denialism and competing problem constructions. The question "how and to what extent can different visions and perceptions influence energy transition governance formats (approaches)?" refers to the categories of (4) Imaginaries and (5) Storylines and frames. The last group of questions addressing the challenge of coordination and governance of the energy transition implementation and the relevant tools and methods enabling it, refers to the constraint's categories of (6) Governing processes[8] and (7) Governing outcomes (ibid.). A conceptual framework linking the auxiliary questions, the constraints categories, and the different energy transition implementation elements is presented in Table 1. This structure guides to specific publications contributing to this thesis. The two last columns of Table 1 indicate which energy transition dimensions, level(s) and, if relevant, governance arrangements, are being addressed by the papers. The next section presents the overview of the scientific publications and elaborates on the theoretical, methodological, and empirical contributions to the literature.

[8] For a further discussion on the governance of big transformations see: Schreurs and Wurster, 2019.

**Table 1: Synthesis of the conceptual framework applied in the dissertation.**

| **Factors constraining the energy transition's implementation** | | | | | |
|---|---|---|---|---|---|
| ***Politics* behind the *constraint*** | | **Implementa-tion element** | **Number of the publica-tion** | **Energy transition dimension** | **Energy transition level and corresponding governance arrangement (if relevant)** |
| **Guiding questions:** | **Constraints' categories based on Sovacool et al. (2020)** | | | | |
| How does the public's engagement and deliberation impact upon energy transition implementation? | Downstream and upstream engagement;<br>Changing the dynamics of engagement | Technologies | P – 1 | Socio-political; technological | Local and regional |
| What explains climate denialism and how has it impacted decisions on the energy transition policies?<br>How the factors determining climate denialism vary from place to place? | Climate denialism and competing problem constructions | Policies/ system coherence | P – 2 | Socio-political | National |
| How and to what extent can different visions and perceptions influence energy transition governance formats (approaches)? | Imaginaries;<br>Storylines and frames | Partnerships | P – 3 | Socio-political, technological | National and supranational;<br>Bilateral cooperation |
| How to coordinate and govern the implementation of the energy transition? What are the relevant tools and methods, which would enable to improve the energy transition implementation process and foresee its potential effects?<br>How and to what extend are these tools used? | Governing processes;<br>Governing outcomes | Methodologies | P – 4 | Socio-political, technological | National and supranational;<br>Multi-level governance |

1.7 Outline of the dissertation, including theoretical, methodological, and empirical considerations related to the scientific publications contributing to this thesis

This thesis consists of eleven sections, including six chapters and five appendixes. The introduction (Chapter 1) provides a background of this research by explaining the term "energy transition" and situating it in the context of the climate change politics. The conceptualisation and understanding of the energy transition are provided by describing and clarifying the components of the energy transition's definition. The following parts of this section present different dimensions of the energy transition (technological, environmental, and socio-political) and situate how energy transition processes operate at different governance levels (global, supranational, national, regional, and local). Finally, the last subsection of Chapter 1 proposes an analytical framework by introducing: (i) the *categories of implementation constraints*, including: public engagement; climate denialism; imaginaries, storylines, and frames; governing processes and outcomes and (ii) the *implementation elements*, classified as: technologies; policies/ system coherence; partnerships; methodologies.

Chapter 2-5 are the four scientific publications that constitute the main body of this dissertation. The research presented in each of these publications serves three main purposes: to explore, describe, and explain (Babbie, 2010) how and why different constraints affect the energy transition's implementation. From ontological and epistemological standpoints, the papers contributing to this dissertation are embedded in the interpretive paradigm of social science, linked to qualitative research. It means that while carrying out the qualitative research the scientist is located in the world, which through the researcher's interpretative practices (such as: field notes, interviews, focus groups etc.), is becoming represented and "visible". The "interpretive/qualitative research aims at understanding events by discovering the meanings human beings attribute to their behaviour and the external world" (Della Porta and Keating, 2008: 26). As result, the subjective meanings of specific events or phenomena as given by the observing or participating actors are put in the centre of knowledge (Della Porta and Keating, 2008; Sovacool et al., 2018). Chapters 2-5 represent findings generated and interpreted through an analytical process carried out by the author.

Chapter 2 is guided by the question: "How does the public's engagement and deliberation impact upon energy transition implementation?". This Chapter explores different facets of trust (interpersonal, generalised, and trust in public institutions) in order to explain how this phenomenon can influence the decision-making processes related to the development of electricity transmission lines. It describes the grid planning process in Norway and the insights from the accompanying public participation process, that includes the perceptions of different actors, which were involved in these processes as well as relations between these actors.

Chapter 3 deals with climate denialism and competing problem constructions (conceptualised as contrarianism) in Poland and Norway. This Chapter is guided by the questions "What explains climate denialism and how has it impacted decisions on energy transition policies? How do the factors determining climate denialism vary from place to place?". It explores the drivers of climate contrarianism in Poland and Norway and describes how it is embedded in socio-political structures of both countries. It tries to explain universal determinants of contrarian attitudes and calls for more contextualised research.

Chapter 4 is based on a book chapter; it focuses on the bilateral partnership between Poland and Germany in the field of climate and energy policy and addresses the question: "How and to what extent can different visions and perceptions influence energy transition governance formats (approaches)?". This Chapter explores the visions and perceptions of the roles of both countries in the EU's climate and energy policymaking as perceived by the key actors in Poland. By describing the asymmetries in the perceived roles of Poland and Germany in a multilateral setting of the EU's climate and energy decision-making processes, it explains how the perception of these roles influences climate and energy relations between both countries.

Chapter 5 addresses the auxiliary questions: "How to coordinate and govern the implementation of the energy transition? What are the relevant tools and methods, which would enable to improve the energy transition implementation process and foresee its potential effects? How and to what extend are these tools used?". From the angle of governing processes and outcomes of energy transitions, this Chapter explores how and when energy models and modelling results influence the policymaking process and vice versa. It describes how different energy models and methodologies were applied in five different cases (the European Union, Germany, Greece, Poland, and Sweden) and who were the key actors active in these processes. This Chapter explains how energy models can be used differently depending on different stages of these policymaking processes and national contexts.

Chapter 6 summarises the publications contributing to this dissertation, including the main argument and the empirical findings. This Chapter opens the discussion on the findings and how they contribute to a better understanding of the energy transition implementation constraints and what are the related implications of this research in the energy transition field.

The scientific publications included in this dissertation differ in terms of their thematic scope, as well as in terms of the applied theoretical and methodological approaches. Each of these papers and this thesis in general, contribute theoretically, methodologically, and empirically (Sovacool et al., 2018) to the social science literature dedicated to energy transitions, but in a differentiated way and to a different extent. While the theoretical and methodological approaches are described and presented in a detailed way in each of the publications, the next section will sketch how these papers add to different categories of novelty (theoretical, methodological, empirical). Some of the related challenges and shortcomings will also be discussed.

### 1.7.1 Theoretical contributions

According to Sovacool et al. (2018: 19): "theoretically novel studies can create, apply, advance, test, compare or critique concepts or theories". In this dissertation Chapters 2 and 4 apply under this definition. Chapter 2 (the paper entitled "Understanding the role of trust in power line development projects: Evidence from two case studies in Norway") applies the abductive reasoning, considered as an approach helping to advance theoretical innovation in social science (Van de Ven, 2007). The abductive reasoning is a creative inferential process aiming at delivering the best explanation based on research evidence (Timmermans and Tavory, 2012). It involves first developing hypotheses from existing theories and then confronting them with findings obtained during the empirical work, which can contribute to producing or advancing new theories or hypotheses (Héritier, 2008). In Chapter 2, the theoretical framework first developed for this research was changed during data collection and analysis as the analytical focus shifted towards the concept of trust, its comprehensive operationalisation and how it can influence the public participation process.

Chapter 4 of this thesis, entitled "Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective", was published in an edited volume dealing with the multidimensional dynamics of bilateral Polish-German relations in the European Union (Opiłowska and Sus, 2021). In the introduction of this book, the authors (Kirch et al., 2021) proposed a theoretical framework, based on the "Embedded Bilateralism" – a category introduced to analyse the German-French cooperation in the EU by Krotz and Schild (2012). This theoretical framework conceptualises three different dependent variables (regularised intergovernmentalism; symbolic acts and practices; and parapublic underpinnings of international relations) and three explanatory categories (historical legacy; interdependence;

and asymmetry), which should serve as a starting point to guide the authors of the following chapters to develop and innovate their own theoretical frameworks. The idea behind this structure was to provide flexibility and maximize the utilisation of different theoretical approaches as well as to answer two research questions: (1) “What are the external and internal factors at the supranational, national and subnational levels that support or hinder bilateral relations between Poland and Germany in specific policy areas?” and (2) “To what extent can the relations between Poland and Germany qualify as embedded bilateralism in the European Union in line with the conditions defined by Krotz and Schild?” (ibid.). Chapter 4 of this dissertation advances the proposed theoretical framework by acknowledging the role of different perceptions, imaginaries, and frames in explaining asymmetry of the regularised intergovernmentalism in case of Polish-German relations in the climate and energy field.

### 1.7.2 Methodological contributions and related challenges

The methodology of social science research refers to the instruments and techniques used to acquire knowledge (Della Porta and Keating, 2008). Sovacool et al. (2018) list seven dominant research methods within energy social science: (1) experiments and quasi-experiments; (2) literature reviews; (3) surveys and quantitative data collection; (4) data analysis; (5) quantitative energy modelling; (6) qualitative research, and (7) case studies. Most of these methods have been applied in the scientific publications contributing to this dissertation – the choice of a concrete method was determined by the problem under study and circumstances accompanying the research process (Flyvbjerg, 2006).

From a methodological standpoint, research carried out and described in Chapter 2 was developed in a transdisciplinary way – in close collaboration with different social actors and practitioners, who contributed to a joint co-creation process throughout the entire research process. The application of the transdisciplinary approach helps to incorporate the perspectives of different knowledge types, outside of academia, which has recently been acknowledged as a useful approach to address the complexities of energy transitions (see for example: Lutz and Bergmann, 2018; Heaslip and Fahy, 2018). Chapter 2 also combines elements distinctive of qualitative research and in-depth case studies (Sovacool et al., 2018).

Chapter 3 is predominantly based on a narrative literature review and supplemented with primary data collected in semi-structured interviews. The narrative review is the least structured type of literature review (in comparison to meta-analysis and systemic review) and has many shortcomings: it is prone to researcher bias, can result in missing relevant research included in the review, and might lack transparency and replicability (ibid.). These shortcomings were addressed through carrying out this research in collaboration with two experienced scientists, which is considered as an appropriate strategy to overcome such shortcomings (Sovacool et al., 2018). Nevertheless, the methodological approach applied in research described in Chapter 3 turned out to be relevant, since it concerned an exploratory investigation of the topic related to climate denialism in Poland and Norway, which thematically dealt with knowledge that had not been analysed anywhere else before.

Chapters 4 and 5 draw from various techniques and approaches typical for qualitative research and case studies. The data analysis progressed through carefully designed analytical frameworks that identified and coded specific categories, themes, and patterns. The data collection process was guided by structured research questions and carried out via semi-structured interviews or via secondary sources, such as official documents, reports, or websites (Sovacool et al., 2018). The first of the listed methods – semi-structured interviews – were conducted during fieldwork carried out in Norway, Poland, and Germany, which allowed to gain a deep understanding of the conditions and knowledge, contextualised in each of these countries (cf. Ostrom, 2010a). Semi-structured interviews allowed for flexibility in discussing the topics to be covered: the qualitative interviewing design was iterative and enabled and enabled the interviewer to interview in a way that facilitated obtaining the sought after information while at the same time making it possible for the interviewee to speak freely (Leech, 2002). Conducting semi-structured interviews enabled the researcher to gather the most relevant information needed to explore the phenomenon and aspects under study and without having to follow a set of questions that must be asked "with particular words and in a particular order" (Babbie, 2010). Implementing this method and interviewing a broad range of actors representing the policymaking, industry, research, and civil society spheres, provided access to very specific information, thereby allowing to capture informal interactions between these actors as well as their motivations, meanings, beliefs, and experiences (Beyers et al. 2014; Sovacool et al., 2018). The data collected via semi-structured interviews delivered information that was not revealed in publicly available sources, such as official statements or formal documents.

Despite multiple benefits of data collection via semi-structured interviews, this method is not without particular challenges. Conducting semi-structured interviews can be a time-consuming activity as it requires substantial resources dedicated to first, preparation for interviews and second, to transcription of the recordings and analysis. In the preparation phase, the interviews' guidelines, including the design of the questions, their order and adjustment in regard to the actor's type to be interviewed, were prepared in a way to minimise the risk of measurement error. All of the interview guidelines, which were used, can be found in Appendix 1. The preparation of the interview guidelines was accompanied with preparatory work, based on the literature review. This was done to obtain a better understanding of the contextual setting where respondents were operating and to ensure a common sense of specific words, phrases and formulations used in the interview guidelines. This preparatory work served also to get a clear idea of what data is needed to address the research questions and what information is feasible to get from the selected interviewees.

The selection and involvement of a sufficient number of well-selected interviewees is challenging (Beyers et al. 2014; Sovacool et al., 2018). To address this challenge, the interviewees engaged in the research described in Chapters 2, 4 and 5 were selected based on the criteria of participation and expertise. Participation means that the interviewees were involved in the social and political processes under scrutiny. Expertise means that the interviewees had relevant knowledge to share, considering the topic under investigation. To ensure different perspectives and complementary information on the scope of the research presented in the scientific papers, the interviewees were chosen from different groups of actors, representing policymaking, business/industry, academia, and civil society. The initial sample of interviewees was identified during the preparatory stage via relevant secondary sources, such as official/government documents, media coverage, scientific articles, and grey literature. After conducting first interviews in the field, the samples for each analysis were broadened through a snowball technique (Beyers et al., 2014) that allowed to identify further interviewees based on the recommendations of the actors that already had been interviewed.

The time and energy invested in gaining contextualised knowledge paid off as it helped to persuade respondents to devote time to being interviewed. Different personalised strategies were applied while reaching out to specific interviewees and communicating about the research, for example, activating existing networks or additional commitment to deliver something in return after the interview (e.g., sharing the paper after its publication) (cf. Beyers et al., 2014). The preparatory work before conducting the interviews helped to minimise the relational asymmetry with the interviewees (which in many cases were specialised experts with substantial knowledge and experience related to the topics or processes under investigation) and helped to address the situation in which the interviewees could deliver answers perceived as socially desirable, over- or underestimate some information, or remembering more clearly details from the past (Beyers et al., 2014).

### 1.7.3 Empirical contributions

In the study of energy, the social sciences can offer the empirical novelty either through either new applications, new data, or new types of evidence (Sovacool et al., 2018). The first category introduced by Sovacool et al. (2018) – new applications – refers to research that employs existing theories or methods to new case studies, contexts, or regions. This category is used most frequently in the social science research related to energy. The "new data" category refers to data that is challenging to access or collect, because of, for example, high costs or lack of a sampling frame. Difficulties in accessing new types of data relate, for example, to carrying out elite or expert interviews or approaching small or vulnerable populations. The "new types of evidence" category refers to extremely large datasets (such as big data) that are more prominent in digitalised energy research (ibid.). The empirical contributions of the research presented in this thesis concern the "new applications" and "new data" categories.

Chapter 2 adds to the body of literature on energy transition challenges in Norway (see for example: Bauknecht et al., 2020; Ćetković and Skjærseth, 2019; Dugstad et al., 2020; Gullberg et al., 2014; Normann, 2017; Skjølsvold et al., 2017; Sovacool et al., 2019). It takes a closer look at the development of high-voltage electricity transmission lines, which are a key enabler of renewable energy sources integration into the energy system. The new data collected and analysed during the fieldwork in Norway contributes to the literature discussing the electricity transmission grids in this country (Knudsen et al., 2015; Øystein et al., 2014; Späth and Scolobig, 2017) at the same time addressing this topic from the angle of one of the main bottlenecks hindering the energy transition's implementation – insufficient electricity grid infrastructure and capacity (Borshchevska, 2016; Strunz, 2014).

Chapter 3 investigates climate contrarianism in the new, under-researched case studies of Poland and Norway and allows to understand the nuanced differences between these two countries when it comes to the presence of their respective climate denialism movements. The knowledge and information collected in this paper have never been published before, thus, Chapter 3 contributes empirically to literature dealing with climate denialism adding two interesting case studies. Furthermore, by applying and investigating the phenomenon of climate denialism in these locations, this paper adds important context-related information, which can also be used by future researchers. This contextual knowledge can help to address and better understand the developments within the contrarian movement in the last years (for example in Poland; cf. Ceglarz, 2021) as climate denialists adopted new activities and strategies, which do not deny directly the anthropogenic causes of climate change, but aim at slowing down climate action in general (Lamb et al., 2020; Mann, 2021; Schreurs, 2020).

Chapter 4 and Chapter 5 deal, respectively, with the topics related to partnerships and methodologies. Both chapters manifest empirical novelty by utilising data collected during elite and expert interviews (Beyers et al., 2014; Leech, 2002; Sovacool et al. 2018) with actors, which directly participated in the policymaking processes under investigation. These encompass, for example, stakeholders representing the energy industry as well as national and European legislative and executive political bodies. The exact lists of the institutions and organisations, which were represented by interviewed actors can be found in the respective chapters. At the same time, the thematic scope of Chapter 4 is relevant to the current political challenges of the energy transition on the European level. Chapter 4 discusses the Polish-German cooperation in climate and energy policy fields. Since Russia's attack on Ukraine in February 2022, bilateral and multilateral partnerships in Europe have been an important element in allowing the implementation of energy policies, progressing with the energy transition as well as guaranteeing energy security. This aspect was particularly evident in view of the reduction of fossil fuel imports (most notably natural gas) from Russia to Europe, which, in the context of Polish-German energy cooperation, contributed to the opening of discussions on European energy solidarity (see for example: Hecking et al., 2022). Therefore, the insights presented in this paper may allow for a better understanding of how to address the challenges of bilateral climate and energy cooperation, so that, under the current geopolitical conditions, such partnerships could have a positive impact on the implementation of the energy transition throughout the entire European Union.

The thematic scope of Chapter 5 is also relevant for current policymaking processes. It deals with the use of energy models in climate and energy policymaking, which are increasingly be used in the European Union (Chang et al., 2021). For example, the European Union, through the use of energy models, is evaluating "the impact of macro-economic, fuel price and technology trends and policies on the evolution of the EU energy system, on transport, and on their greenhouse gas emissions" (European Commission, 2021). The energy models and scenarios are also vital for deciding about the EU's intermediate climate target, i.e., to understand what percentage reduction in greenhouse gas emissions must occur in 2040 compared to 1990 to ensure that the European Union achieves climate neutrality by 2050

(ESABCC, 2023). Hence, the insights presented in this Chapter can help to understand the complexity of the interactions between energy modelling and policymaking and at the same time to understand what specific policy decisions about long-term climate and energy targets are based on.

2. Understanding the role of trust in power line development projects: Evidence from two case studies in Norway.

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| Abstract | In recent years the processes of stakeholder involvement in power line development projects raised a critique of inflexible decision-making processes and calls for new participatory approaches. Given that attempts of Transmission System Operators (TSOs) to implement new forms of engagement are insufficient to explain the potential success behind stakeholders' participation, we investigated two cases in Norway characterized by high rates of acceptability, small opposition and satisfied stakeholders. In order to explain this phenomenon we conducted an experimental research based on an abductive procedure that has focused our attention on trust. Although trust has been mentioned by many scholars as important component of engagement processes, its multidimensionality has been presented in selective configurations. Drawing on interdisciplinary insights and empirical data, we develop the conceptual meaning of three dimensions of trust in grid extension projects: interpersonal, social and institutional; and we examine how they influence the stakeholder engagement process. Acknowledging diversified meanings of trust we suggest putting more attention to the informal aspects of stakeholder engagement. In this context, in order to build up trustworthy relationships with affected stakeholders, we propose recommendations to TSOs and respective decision-makers, addressing different trust dimensions. |

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# Understanding the role of trust in power line development projects: Evidence from two case studies in Norway

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ABSTRACT

In recent years the processes of stakeholder involvement in power line development projects raised a critique of inflexible decision-making processes and calls for new participatory approaches. Given that attempts of Transmission System Operators (TSOs) to implement new forms of engagement are insufficient to explain the potential success behind stakeholders' participation, we investigated two cases in Norway characterized by high rates of acceptability, small opposition and satisfied stakeholders. In order to explain this phenomenon we conducted an experimental research based on an abductive procedure that has focused our attention on trust. Although trust has been mentioned by many scholars as important component of engagement processes, its multidimensionality has been presented in selective configurations. Drawing on interdisciplinary insights and empirical data, we develop the conceptual meaning of three dimensions of trust in grid extension projects: interpersonal, social and institutional; and we examine how they influence the stakeholder engagement process. Acknowledging diversified meanings of trust we suggest putting more attention to the informal aspects of stakeholder engagement. In this context, in order to build up trustworthy relationships with affected stakeholders, we propose recommendations to TSOs and respective decision-makers, addressing different trust dimensions.

## 1. Introduction

Growing electricity consumption, integration of more renewable energy sources (RES), ageing grids and challenges of balancing the system put a pressure on Transmission System Operators (TSOs) to modernize their electricity infrastructure (Battaglini et al., 2009; Bruckner et al., 2014; Späth and Scolobig, 2017). One of the biggest obstacles for building new electricity transmission lines is the lack of public acceptability and opposition at the local level (Battaglini et al., 2012; Cain and Nelson, 2013; Devine-Wright, 2013), despite of support for such infrastructural developments in general (Aas et al., 2014; Batel and Devine-Wright, 2015; Bell et al., 2005, 2013). Under existing procedural frameworks, combined with local opposition, the realization of projects in some cases can take up to twenty years or even be dismissed (Battaglini et al., 2012; Cain and Nelson, 2013).

Many scholars have tackled acceptability and/or opposition towards the energy infrastructure (see for example: Wüstenhagen et al., 2007; Zoellner et al., 2008). They investigated phenomena like justice (Gross, 2007; Keir et al., 2014; Walker et al., 2010), landscape issues (Cotton and Devine-Wright, 2012b; Cowell, 2010; Soini et al., 2011; Wolsink, 2007), socio-psychological aspects, like place attachment (Bell et al., 2013; Devine-Wright, 2013; Devine-Wright and Howes, 2010) or images, visualizations, understandings and associations of the energy infrastructure (Devine-Wright and Devine-Wright, 2009; Devine-Wright et al., 2010). Negative attitudes towards grid extension projects result from health concerns related to electro-magnetic fields (EMF), loss of property values, visual and noise impacts, land use attributes, psychological stigma and environmental risks (Cain and Nelson, 2013; Cotton and Devine-Wright, 2012b; Elliott and Wadley, 2012; Porsius et al., 2016). All these issues are related to stakeholder participation and decision-making processes criticized for top-down approaches, overregulation and ingrained procedures (Aas et al., 2014; Batel et al., 2013; Battaglini et al., 2012; Cotton and Devine-Wright, 2012a; Keir et al., 2014; Komendantova et al., 2015). Affected stakeholders, understood here as "groups of organisations and individuals with vested interests or functions in power grid development projects" (Hildebrand et al., 2015), often feel powerless and dissatisfied with the engagement process, blaming TSOs for a "decide-announce-defend" approach.[1] Disappointment combined with stakeholders' concerns and expectations prior to the process, do not foster the acceptability of projects (Keir

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[1] Or a "command and control" approach (see Van Ark and Edelenbos, 2005).

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et al., 2014; Knudsen et al., 2015; Porsius et al., 2016). Therefore, experts have called to design decision-making processes that to a larger extent would empower stakeholders (Devine-Wright, 2013; Devine-Wright and Batel, 2013; Komendantova et al., 2015; Späth and Scolobig, 2017; Whitton et al., 2015). There are examples of innovative approaches[2] strengthening stakeholder participation, but there is still a space for further improvements (Späth et al., 2014; Späth and Scolobig, 2017) and it remains challenging how to apply new forms of engagement with the formal, legally binding procedures (Richter, 2016). Decision-making and participation processes seem to focus on formal competencies (Wolsink, 2012), whereas there is a gap in understanding how the engagement is enabled and how different mechanisms between involved parties shape its outcomes (Bell et al., 2012). Even if TSOs test different engagement forms and tools, social processes accompanying the participation can play a more decisive role for its success (Voinov and Bousquet, 2010).

A focus on examples of local opposition or insufficiently carried out engagement processes, is not enough to understand the social context of the energy infrastructure and planning processes (cf. Aitken, 2010; Battaglini et al., 2012; Cain and Nelson, 2013; Devine-Wright and Devine-Wright, 2009; Ellis et al., 2007; Knudsen et al., 2015; Späth and Scolobig, 2017). Therefore we take a different approach. In this paper we investigate two cases of grid extension projects in Norway characterized by high rates of acceptability,[3] relative small local opposition and satisfied stakeholders. The starting point is the question why in both cases the engagement processes have been carried out in a way that did not cause serious opposition towards the projects. It could be explained by higher levels of stakeholder's empowerment (Späth and Scolobig, 2017), implementation of novel approaches (Komendantova et al., 2015), perceived procedural and distributive justice (Devine-Wright, 2013; Knudsen et al., 2015) or by relative low levels of perceived risk in comparison to different technologies like radioactive waste (Flynn et al., 1992). However, acknowledging a need for a research considering social factors in energy systems (see for example: Demski et al., 2015), we concentrate on informal elements outside of regulated frameworks determining stakeholders' acceptability of the process (but not the decision itself), namely on trust. Basing on the literature review, combined with empirical data gathered during the project "Improved and Enhanced Stakeholders' Participation in Reinforcement of Electricity Grid" (INSPIRE-Grid), we discuss different dimensions of trust and its impact on the engagement process. We argue that high levels of trust dedicated to different types of actors and individuals, increase the acceptability of the decision-making process, what in result can, but does not have to, lead to the acceptability of new power lines. We propose measures that could be implemented by TSOs and regulatory authorities in order to build stocks of trust and to reduce tensions between (and among) stakeholders and a perceived process-owner. We see that trust building activities happen not only during the formal process, but also in-between or even outside of it. Therefore we suggest more attention to be given to the informal aspects or "soft factors" of stakeholder engagement.

In Section 2 we conceptualize three different dimensions of trust present in grid extension projects. The research approach is introduced in Section 3 and in Section 4 investigated case studies are described. Subsequently Section 5 presents our empirical findings and Section 6 concludes.

## 2. Theoretical approach – Trust and its conceptualizations

### 2.1. Theoretical underpinnings

This research was based on the theoretical framework developed intentionally for INSPIRE-Grid, focusing on the social elements of stakeholder engagement in grid extension projects, like values or beliefs (Lilley et al., 2014). After fieldworks in Norway we shifted the focus of the research to trust and we improved the existing theoretical framework (Ceglarz et al., 2017). It means that the explorative filed research enabled gaining an inspiration for alternative hypotheses that were not included in the first framework. The detailed research approach is described in Section 3.

### 2.2. The relevance of trust

Trust is understood as a complex, multidimensional and context-dependent concept (Berardo, 2009; Goudge and Gilson, 2005; Höppner, 2009; Laurian, 2009; Petts, 1998; Straten et al., 2002). Rousseau et al. (1998: 395) explain trust as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another". The open and vulnerable position results from the similar values of trustor and trustee[4] (Siegrist et al., 2003) and trustworthy relations reduce the complexity of given issues as well as uncertainty (Van Ark and Edelenbos, 2005). Trust allows for flexibility in dynamic processes, characterized by changing circumstances, new information and problem definitions. It is considered as an indispensable component of a satisfying cooperation of diversified actors striving to solve environmental and social problems (Berardo, 2009; Cuppen, 2012; Höppner, 2009; Klijn et al., 2010; Lowndes and Wilson, 2001; Ostrom, 2010a, 2010b; Sharp et al., 2013). Trust has been investigated in the context of risky technologies, like $CO_2$ storage (Midden and Huijts, 2009), electromagnetic field (Siegrist et al., 2003), waste management (Petts, 1998) or genetically modified food (Poortinga and Pidgeon, 2005). Its importance has been emphasized by Huijts et al. (2012) that conceptualize it as one of the preconditions for the new technology acceptance. The issue of trust is also well embedded in social energy research. Sumpf (2017), for example, argues that we are witnessing a paradigm shift, from acceptance to trust. Although a combination of energy issues with trust is not a completely new area of research (see for example: Flynn et al., 1992), there are voices claiming that it is still underappreciated or that too much attention has been given to nuclear energy and nuclear waste sites (for the overview see: Greenberg, 2014). Nevertheless, scholars basing on a plethora of case studies, report trust as a pivotal element for fostering the acceptability of energy infrastructure, but they do it only in selective configurations: as trust in the relevant company, project developer, other members of the community and/or in public institutions (Aas et al., 2014; Aitken, 2010; Bell et al., 2005; Cain and Nelson, 2013; Cotton and Devine-Wright, 2012b; Demski et al., 2017; Devine-Wright and Devine-Wright, 2009; Devine-Wright, 2013; Devine-Wright and Howes, 2010; Flynn et al., 1992; Friedl and Reichl, 2016; Kalkbrenner and Roosen, 2016; Keir et al., 2014; Knudsen et al., 2015; Komendantova et al., 2015; Raven et al., 2009; Rayner, 2010; Walker et al., 2010; Wolsink, 2012).

[2] Forms (or tools) of informal stakeholder engagement are today applied by many European TSOs during all stages of the planning process. These are mostly voluntary, not formalized and not legally binding. Examples are: Town hall meetings, Roundtables, Mediation or Field visits, only to name a few. They differ not only in the structure of the audience but also in their aims and empowerment level (for a more detailed overview see: Späth et al., 2014).

[3] For the purpose of this paper we use the term "acceptability" in order to use it for both case studies, since the process phase of both power lines projects was at different stages during our investigation: Bamble-Rød was a finished project and Aurland-Sogndal was at the early stage of stakeholder engagement. We are aware about conceptual differences between "acceptability" and "acceptance": the latter can be understood as a state regarded as proper, normal or inevitable (Batel et al., 2013: 2). It implies a general assumption that even if something is not ideal, it is probably the best compromise available. "Acceptability" refers to making all the best acceptable to the greatest number of people (Twichten, 2014). Moreover, "acceptability" refers to a given issue *before* its implementation (evaluation *ex-ante*), whereas "acceptance" refers to an attitude on this issue *after* it has been accomplished (evaluation *ex-post*) (Cowell et al., 2011; Schuitema et al., 2010). For a critical discussion on a term "acceptance" and a clear distinction from "support" see Aas et al. (2014) and Batel et al. (2013).

[4] A trustor is an actor doing trusting and a trustee is an actor being trusted.

In our view trust's multidimensionality should be reflected in a more structured way. Therefore we systematized these contributions from the literature (Hardin, 1998; Höppner, 2009; Klijn et al., 2010; Larzelere and Huston, 1980; Laurian, 2009; Leach and Sabatier, 2005; Marquart-Pyatt and Petrzelka, 2009; Rousseau et al., 1998; Straten et al., 2002; Switzer et al., 2013) and extracted three dimensions of trust present in grid extension projects: interpersonal trust, generalized trust and institutional trust.

### 2.3. Interpersonal trust

Laurian (2009: 371) defines **interpersonal trust** as “a mode of interpersonal relations embedded in a complex network of social relations and norms”. It develops between individuals, mostly through first-hand contact in which a person gets to know the other. This form of trust holds emotional features as loyalty, empathy or concern. Interpersonal trust features the rule of reciprocity, characterized by a positive feedback loop: when the trustor trusts the trustee, the latter is encouraged to be trustworthy[5] (Laurian, 2009; Lyon, 2000; Ostrom, 2010b; Sharp et al., 2013; Switzer et al., 2013; Teles, 2012). It can be asymmetrical – generating, building and maintaining trust is a complex, long-term undertaking, but it can be destroyed fast and negative events have much stronger impact than positive (Greenberg, 2014; Laurian, 2009; Lyon, 2000; Siegrist et al., 2003; Switzer et al., 2013). Interpersonal trust is characterized by a confirmatory tendency implying that actors will believe more in information that is in line with their prior beliefs than a contradictory one (Laurian, 2009; Switzer et al., 2013). Last but not least, trust is closely related to issues of power relations and uncertainty (Aitken, 2010; Berardo, 2009; Laurian, 2009; Sharp et al., 2013; Stein and Harper, 2003).

Certain individuals are perceived as critical for interpersonal trust building and its maintenance with stakeholders (Switzer et al., 2013; Tait, 2011; Van Ark and Edelenbos, 2005). They are identified as *public entrepreneurs* (Ostrom, 2000) or *facilitators* (Reed, 2008), who work as “catalyst” and “engine” of trust creation (Switzer et al., 2013; Van Ark and Edelenbos, 2005). Such individuals are expected to realize different tasks: mediation in case of disputes (Laurian, 2009; Lyon, 2000); creation of a shared vision among stakeholders including their different perspectives, values and beliefs (Demski et al., 2015; Leach and Sabatier, 2005; Raven et al., 2009; Reed, 2008; Switzer et al., 2013); optimization of network's functioning (Devine-Wright et al., 2001; Van Ark and Edelenbos, 2005); supporting the overall communication (Switzer et al., 2013); being accessible for stakeholders (Reed, 2008); periodically checking whether engaged stakeholders feel respected and as having an appropriate level of control over the final outcome (Leach and Sabatier, 2005); and supervising that the decision-making process' owner will act in stakeholders' best interest (Wolsink, 2012). Such facilitators, mostly characterized by strong involvement and good managerial skills, can be found among civil servants, planning officers, public authorities or mediators and in case of grid extension the respective project managers are predestined to play this role (Devine-Wright et al., 2001; Keir et al., 2014; Raven et al., 2009; Van Ark and Edelenbos, 2005).

### 2.4. Generalized (social) trust

**Generalized trust** is rooted in interpersonal trust and concerns a character of people in aggregate. It emerges from shared values and it is based on personal experiences, on communication of other's experiences and on mass communication, determining at the same time, how individuals react in interpersonal trust situations (Larzelere and Huston, 1980; Straten et al., 2002; Switzer et al., 2013). Generalized trust is an essential element of building qualified social relationships between people,[6] which connect citizens, create the feeling of collectiveness (Walker, 2011), and group identity (Laurian, 2009). Collective relations of trust lubricate cooperation and reduce transaction costs, because individuals trusting society members to act as expected, do not need to control them (Klijn et al., 2010; Ostrom, 2000; Van Ark and Edelenbos, 2005). Instead of that they rely on information on reputations, moral norms and potential social sanctions (Lyon, 2000). It is the generalized trust in other community members that motivates people to get engaged at the local level (Greenberg, 2014; Lewicka, 2005; Lowndes et al., 2006) including energy-related projects (Kalkbrenner and Roosen, 2016).

### 2.5. Trust in public institutions and governments

Similarly as in case of social trust, shared values are the ground to **institutional trust** (Laurian, 2009: 372). Miller (1974: 989) defines trust in governments as “the belief that the government is operating according to one's normative expectations of how government should function”. It is embedded in a wider, historically-dependent context, like the political culture of a country or the identification with the democratic system (Inglehart, 1999). Trust in public institutions is important, because in formal interactions they introduce “the rules of the game” (Höppner, 2009; Switzer et al., 2013). High stocks of trust in public officials have a positive influence on the involvement of stakeholders in local politics (Marquart-Pyatt and Petrzelka, 2009), on the functioning of administrative units (Teles, 2012) and on the perceived legitimacy of public institutions (Hough et al., 2010). In the context of energy issues and stakeholder engagement, governments and public institutions are strongly involved in delivering policies, transitions and appropriate measures (Demski et al., 2017; Flynn et al., 1992; Greenberg, 2014; Kollmann and Reichl, 2015; Späth and Scolobig, 2017).

It is challenging to find clear borders between individual-to-individual, individual-to-group and individual-to-institution trust relationships (Hardin, 1998) and between levels at which they operate, since they can be interrelated, interdependent and interchangeable (Inglehart, 1999). For example, a customer-oriented understanding of trust towards a person (*interpersonal trust*) responsible for the engagement process can – in case the expectations are not met – lead to questioning the whole formalized processes (*trust in institutions*) by undermining the legitimacy of the responsible person and questioning what is, who can and should represent the “common good/public interest” (*generalized trust*) (Tait, 2011). Similarly, studies on the conflicts over energy infrastructure in Germany, show that debates at the national level have an impact on forming opposition at the local level. It results from the distrust about the actual purpose of a project and conflicting energy-political visions (Fahrenkrug et al., 2016; Neukirch, 2015; Richter, 2016). As one of the studies considering acceptability aspects states: “The conflicts over wind power possibly represent a contemporary basic phenomenon of the political-legal-societal consensus: it is not understood nor accepted that higher-level political or legal entities can make decisions that are not wanted on the ground” (Fahrenkrug et al., 2016). Thus, trust is more than an interpersonal, societal or institutional phenomenon, it is “something that emerges from an individual's or institution's position within a wider matrix of social, economic, political, and cultural ideas” (Tait, 2011: 161).

[5] Therefore, trustworthiness is here understood as a quality of the trustee, while trusting is something that the trustor does (see also Sharp et al., 2013).

[6] A different theoretical approach substantially related to generalized trust and underlying the importance of social bonds and ties in making people's lives more productive, stimulating social relations and being “glue” for the society is the social capital. However, there is not enough space in this paper to develop and explain in detail this concept. For a detailed overview see: (Fukuyama, 2002; Pretty, 2003; Putnam, 2001, 2000; Rydin and Holman, 2004).

**Table 1**
A comparison of the Norwegian case studies according to six different criteria (Source: Molinengo et al., 2015, own compilation).

| | Bamble-Rød | Aurland-Sogndal |
|---|---|---|
| Line characteristics | New 34 km 420 kV overhead transmission line, old 5-km 132 kV power line has been taken down parallel with the new line | New 420 kV overhead transmission line between an existing hydropower station and a newly built substation some 60 km away |
| Status | Operation phase, public participation process was finished at the time of the interviews | Permitting phase, initial notification was sent to the regulator in March 2014, public hearings were still pending at the time of the interviews |
| Location/area | Province of Telemark, rural western part with small mountains, lakes, large forests, some agriculture and a more densely populated eastern part with larger industrial activity | Province Sogn og Fjordane, high mountains with high plateaus, divided by deep fjords, the new line will mostly follow the old route which is almost not inhabited. Only where it is supposed to cross Sognefjord close to a small city, residents could be affected. |
| Purpose | Improve the security of supply in Southern Norway, facilitate increased power exchanges, favour the development of renewable energy | Replace a 300 kV power line crossing the Sognefjord that is considered the main bottleneck in the regional grid and will be removed at the end of the project, improve the capacity to develop renewable energy production in the region |
| Stakeholders | Local and national authorities and services, around 30 NGOs identified, about 150 landowners affected by the project (interaction with stakeholders took place in June 2015 in form of semi-structured interviews) | Local and national authorities and services, around 5 NGOs identified, about 100 landowners affected by the project (interaction with stakeholders took place in May 2016 in form of semi-structured interviews combined with two focus groups) |
| Line alternatives/ possible conflicts | On the northern part, there was only one main alternative route, including a few minor possible adjustments. On the southern part, there were originally five alternatives after the first hearing. The one called "Herum komb. C" had the largest potential to cause conflicts | Three line alternatives were in discussion. Two of them would span over a little village of ten houses some kilometres away from a city. The third one was proposed by the inhabitants of this village and should run closer to the city on top of a mountain that is used as a major recreational area for the city |

### *2.6. Operationalization of trust dimensions*

Unlike measuring different levels of trust in a quantitative way (cf. Flynn et al., 1992; Goudge and Gilson, 2005; Larzelere and Huston, 1980; Straten et al., 2002), we focus on its qualitative dimensions. In the scheme of the theoretical overview, we recognize trust dimensions and their elements within different formal and informal aspects of the engagement process. The former include all official rules and roles present in the participation process, no matter whether they are legally binding or not. The informal aspects comprise all aspects that are outside of official settings and not formalized, meaning everything "between the lines". Thus, we do not look at the difference between formal and informal decision-making designs, but into the difference between what is said and/or performed and what is meant and/or perceived. For example, interaction between actors discussing a certain power line issue as a part of formalized engagement process (i.e. during public hearings) will be considered differently in the context of trust, as having the same talk, with the same individuals around the coffee machine during the break (cf. Strauss, 1998; Townsend et al., 2013).

Since there is no universal definition of trust and agreement how it should be measured (Midden and Huijts, 2009; Sharp et al., 2013; Siegrist, 2010), scholars evoke competence and values as the two most common indicators evoke competence and values (Demski et al., 2017; Greenberg, 2014; Siegrist, 2010). Yet, without consensus on its meaning, the multidimensionality of trust is assigned by referring to its different understandings, derived from empirical data, descriptions and experiences (Flynn et al., 1992; Höppner, 2009; Petts, 1998; Rayner, 2010; Sharp et al., 2013). We agree that in general competence and values can be relevant determinants of trust, however in the context of stakeholder engagement in transmission line projects it is not enough to rely on these two general indicators. Therefore, in this paper we combine the abovementioned contributions with our theoretical considerations and the research approach (see Section 3), what expands the overall conceptualization of trust, name its concrete constituents and order them accordingly to each of the three forms. We attribute trust's dimensions with following meanings: (1) interpersonal trust is embodied by building good personal relationships based on reciprocity, fairness, honestly, respect, openness, reliability, caring, objectivity and competence. (2) General trust is reflected in shared attitudes, the general political culture, the perceived purpose of the new line as serving for the public good (Laurian, 2009) and the ability to resign from one's own interests. (3) Institutional trust is understood by direct expressions of trust to the institutions under consideration (including a TSO) and their competence; by questioning of the communicated need for the new power line; and by the informal decision-making process' elements: perception of the process quality and fairness, acceptability and legitimacy of the planning process, confidence in the outcomes and intention to participate and cooperate. We do not assign the characteristics of institutional trust as a reliance of the other in a one-way manner, but as the reliance in a reciprocal manner, what means that (representatives of) institutions also trust individuals (Sharp et al., 2013).

## 3. Research approach

The research approach used in this paper has an experimental character (cf. Greenberg, 2014; Siegrist, 2010). Firstly, because the investigation of trust issues was a part of research project, INSPIRE-Grid (http://www.inspire-grid.eu/), carried out under a transdisciplinary consortium integrating scientists, different European TSOs and practitioners. Therefore, while analysing the issue of trust, we acknowledged contributions delivered by our project partners enhancing diversified disciplines and areas of expertise. Secondly, the applied abductive approach gave the flexibility in modification of theoretical approach, hypotheses and operationalisations, improved with empirical data (Héritier, 2008).

Results are based on the case-driven research (Della Porta, 2008), including two in depth case studies in Norway (Bamble-Rød and Aurland-Sogndal), selected in a deliberative process by consortium partners, ensuring a high degree of variation according to diversified geographical, temporal, technical and "need-justification" criteria (for a detailed argumentation see: Molinengo et al., 2015). Norwegian cases are relevant, because of well-documented examples of strong opposition and dissatisfaction from the engagement process in this country in the past (Hillberg et al., 2012; Jacobsen et al., 2013; Knudsen et al., 2015; Ruud et al., 2011). Distinct aspects of investigated case studies are presented in Table 1.

Our findings are based on the analysis of primary and secondary literature, data collected during seventeen semi-structured interviews (eleven in Bamble-Rød and six in Aurland-Sogndal) and two focus groups carried out during an interdisciplinary workshop[7] in the latter case, participatory observation during five expert workshops (between

[7] To see an exemplary design of such workshop see: Maran and Garofalo (2017).

October 2014 and January 2017) (Yin, 2003) and supplemented by insights gathered through constant exchanges with consortium partners.

We attempted to gain interviewees representing diversified stakeholder groups (Cuppen, 2012; Friedl and Reichl, 2016) in order to avoid collecting data only from certain actors, often overrepresented in real life engagement processes, what can create an impression of their dominating positions (Schneider, 2015). We based the selection of stakeholders on the mapping tool (Hildebrand et al., 2015), however we reduced broad types of them into three groups: "private stakeholders" (including: broad public, residents, civil initiatives, land owners, forest owners and farmers), from which we interviewed seven stakeholders; "officials" (including: local planning, permitting and implementing authorities and energy providers and producers), from which we interviewed six stakeholders; and "NGOs" (including: environmental as well as civic NGOs and nature conservationists), from which we interviewed four stakeholders. Interviewees have been identified and recruited in cooperation with the Norwegian TSO, Statnett, and the Norwegian Water Resources and Energy Directorate (NVE).

Such technique of stakeholders' selection might lead to a sampling bias, nevertheless the cooperation with both institutions enabled us to include participants with different views and experiences. Although our sample was small and it might be not sufficient to draw conclusions for the general public, these kind of results can be very valuable (see also: Petts, 1998). First, all interviewees have been directly involved in the engagement process, therefore the provided information is first hand. Second, relying only on large-n data sources (cf. Aas et al., 2014; Devine-Wright and Batel, 2013; Soini et al., 2011) might not be enough in explaining processes related to stakeholder engagement, since they present only snapshot of the reality related to a certain point in time (Aitken, 2010) and they might include people that have not been affected by grid projects or have not participated in any engagement process. Third, since many theories failed to explain the behaviour and motivational structures of interacting individuals, it is important to understand a specific context in which affected actors operate, what kind of processes take place at micro (personal) level and to extract unique aspects of certain settings determining these processes (Ostrom, 2010b; Petts, 1998).

Since data collection took place in English, we overcame language challenges (see: Behr, 2009) with assistance of a professional interpreter, and cooperation with NVE and Statnett. All interviews were audiotaped and transcribed. We did not ask directly about trust issues, but about general opinions and experiences related to the project, actions, engagement and decision-making processes.[8] We employed a coding system along the operationalization of the three trust dimensions among all stakeholders groups (cf. Petts, 1998), what was the ground to organize and compare data from both cases. Coded transcripts were analyzed and interpreted in two rounds. Quotations have been selected in order to underline significant examples of trust. If not stated differently, all quotations come from transcribed interviews with stakeholders.

Additionally, close collaboration with NVE and Statnett throughout the project duration, as well as participatory observation pursued in the course of professional workshops, allowed us to take an insider perspective. In other words, we could learn how the second side of the same "engagement process coin" looks like. This is an innovative approach that enriches the findings, since it happens rarely that TSOs allow researchers to accompany them for a longer period of time in their actions (cf: Komendantova et al., 2015).

[8] To have a detailed overview of the interview guide, see Appendix A and B.

## 4. The specific case of Norway and its grid planning process

Each country's grid system is embedded in particular social, cultural, political and technical regimes that influence decision-making procedures and public responses to grid extension projects (Sataøen et al., 2015). In this context Norway is an interesting case for at least three reasons. First, trust plays an important role in the overalls country's functioning. In international comparison Norway occupies highest positions in trust rankings (for detailed data see Section 175). High levels of all trust dimensions result from the combination of social, cultural, economic and political factors (Delhey and Newton, 2005; Inglehart, 1999), like: Protestant tradition, ethnic homogeneity, egalitarianism, income equality, wealth (despite of relatively modest standards of living up until recently), strong public sector, developed welfare system and a stable democracy system that people feel attached to and satisfied with (Arnold et al., 2016; Christensen and Lægreid, 2005; Gulbrandsen, 2007; Ortiz-Ospina and Roser, 2016). Second, regarding big infrastructural projects, landscape and nature protection issues take an important place in public discussion, since Norwegians consider themselves as environmentally friendly, outdoor-oriented and pristine nature surroundings are strong components of their social identity (Arnold et al., 2016; Daugstad, 2008; Vorkinn and Riese, 2001). Third, the Norwegian electricity system is characterized by a unique set of features: almost 99% of electricity is produced from hydropower; electricity distribution and production are highly decentralized; the transmission grid is owned and controlled by the state, but decoupled from the political sphere; grid development directions are assessed in an expert-driven, non-politicized process; the system has a clear market-orientation; with a huge potential to export electricity abroad (Ballo, 2015; Gullberg, 2013; Gullberg et al., 2014; Sataøen et al., 2015).

The Norwegian planning process for power lines can be divided into three phases: need definition, spatial planning, and permitting. The process is led by NVE, whose role is to ensure a fair use of resources, especially in the interest of communities. The need is defined on a national basis considering exchanges with the European level. At this stage Statnett discusses the need and various concepts with established stakeholders like NGOs and public authorities, but not with the public. In the spatial planning phase NVE invites the public for a first official consultation, where information about the different routes and a proposal for the Environmental Impact Assessment (EIA) are provided. This phase is the most important time to consult stakeholders that share various interests, ideas and remarks. The dialogue continues during the permitting phase, and then bilaterally between Statnett and the stakeholders. In this phase, once NVE receives the application from Statnett and the EIA, it organizes a second round of hearings whereupon it decides on the most accurate route. After that, only minor changes are possible. After the regulator and the Ministry of Oil and Energy (OED) give their approval to the selected route, they send an information letter including the background of the decision to stakeholders. The negotiation with the landowners about compensations that cover only the economic losses, starts after the application hearing. Common interests with landowners and municipalities may appear, resulting in the provision of local benefits (e.g. new roads/streets) (Sataøen et al., 2015; Späth and Scolobig, 2017). The structure of the planning process in Norway is presented in Fig. 1.

## 5. Findings and interpretation

### 5.1. Trust in institutions

Norway is reported as a country with very high trust in government and public institutions, including the parliament, the cabinet, the civil service, local councils, political parties, and politicians (Christensen and Lægreid, 2005; Kollmann and Reichl, 2015; OECD, 2013, 2015). This dimension of trust is of a general and reinforcing character: trust in one public institution gives a fertile ground to extend it to other institutions

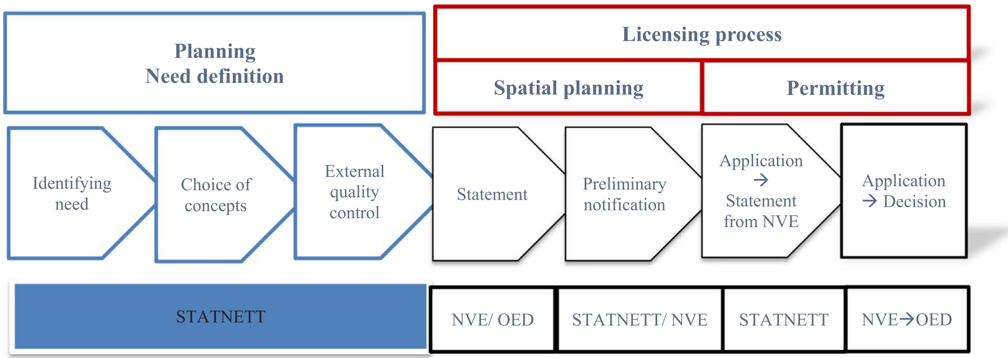


**Fig. 1.** The structural visualization of the power lines planning process in Norway (Source: Späth et al., 2014; Späth and Scolobig, 2017).

(Christensen and Lægreid, 2005; Gulbrandsen, 2007). 66% of the people are expressing their confidence with its national government, in comparison to the OECD average of only 40% (OECD, 2013). Similarly, trust in the legal and political system is one of the highest among OECD countries (Ortiz-Ospina and Roser, 2016). It is a consequence of a well-established democratic system, in which political and administrative institutions have developed their trust over a long period of time and very active state's participation in shaping the economic system (Christensen and Lægreid, 2005; Delhey and Newton, 2005; Gulbrandsen, 2007). Analysis of trust levels in TSOs shows that in Norway it is valued the highest in comparison to UK and Sweden (Aas et al., 2014).

Trust in public institutions was very often mentioned, however, with some exceptions. The general picture of Statnett was not always positive. The TSO was described as *"a big company which has a tradition of not listening to people"* (Stakeholder 2: private) and being a *"big brother"* (Stakeholder 7: private).

These statements did not come from personal negative experience, but they show scepticism stemming from a public perception of the company. One stakeholder explicitly mentioned a highly controversial grid extension project in western Norway, in which Statnett has built a new overhead line crossing the Hardanger Fjord, a very important natural and touristic area.

> *"If you see the case of Hardanger […], that's not a good story. It also shows how this politics of grid happens in Norway*." (Stakeholder 14: NGO)

The media debate around this case in 2010 contributed to an image of Statnett as a company that withholds information and does not comply with the official approval procedure (Ruud et al., 2011). The Hardanger case has led to a societal debate about the role of the government, responsible companies and citizen participation. It has also motivated Statnett to improve its general internal and external approach to stakeholder engagement. The TSO developed and implemented a comprehensive document *"Communication guide for the early stages of the projects - analysis and concept selection"*, aiming at "facilitating a better dialogue with all stakeholders, because they can help us to become better", "increasing understanding of the work Statnett does" and "contributing to better decisions" (Statnett, 2014).

Following this policy could have a positive impact on the perception of Statnett, because it was conceived widely as a trustworthy institution and it was believed by some interviewees to be the actor taking the actual decision about the power line project and being the engagement process' owner. Confidence in public information and a general trust in Statnett were shown by the fact that not a single interviewee questioned the need for the power line, determined by the TSO.

> *"So when Statnett says we need it bigger and stronger, I accepted that. […] I think we trust these decisions."* (Stakeholder 7: private)

More explicitly, one stakeholder elaborated on the trade-offs between the need of the line and personal or environmental interests.

> *"I think it's not a good thing. All the things we build [are] a bad thing. But we need power. […] It's too expensive to put all the power [lines] down in the ground or the sea. If we want a modern lifestyle we have to make some sacrifices."* (Stakeholder 16: private)

As regards to the level where decisions in grid planning should be made, stakeholders mostly rated the national level. It is seen to consider the bigger picture and might be less prone to particular interests than the local level.

It was in line with the perception of the NVE, as a state actor, that is widely perceived as trustworthy:

> *"And I have trust in NVE, I have no other choice."* (Stakeholder 11: private)

Regarding their perceived influence interviewees were varyingly confident: on the one hand they felt that they have an actual impact, on the other hand they were aware that this impact is limited and they are not able to shape the whole process and its outcome according to their interests. Nevertheless, the fact that stakeholders witnessed that they have an influence, created a feeling of mutual trust and gave legitimacy to the decision-making process.

> *"I think Statnett will listen and consider seriously our arguments."* (Stakeholder 12: official)

To maximise their impact stakeholders also actively established informal channels and strategies. For example, in the Aurland-Sogndal case, a group of potentially affected neighbours, next to discussions directly with Statnett, reached out to the media, to local and national politicians and to the NVE. While the process in this case was still running during the data collection, this group could record a first success, as NVE led Statnett to include a third line alternative into the EIA. It was stipulated by this group, but initially not planned by the TSO.

In the Bamble-Rød case a group of private stakeholders pursued a different strategy:

> *"We engaged a lawyer to face this because we are kind of small land owners […]. So we put up a good resistance, I would say, or problem solving solutions, we handed in to them because we know the geography up there, so it was easier for us to put lines where they […] easily can be build and which was not affecting us that much."* (Stakeholder 2: private)

Although this could be interpreted as a lack of trust in Statnett, it could at the same time be considered as a rational strategy of using all possible channels of influence. Stakeholders saw their resistance as *"problem solving solutions"*, providing the TSO with local knowledge reducing the impacts of the power line that otherwise would be more difficult to obtain.

Some of the stakeholders expressed even higher levels of trust to the TSO than to the local politicians. It resulted from two reasons: first, one of the line alternatives in the Aurland-Sogndal case would go directly above interviewees' houses what caused concerns regarding EMF. Although communicating these uncertainties to local authorities, they were not considered as included in exchanges with Statnett. Thus, local authorities were perceived as advocating a certain line alternative and not representing the local power balance and public interests. Second, this dissatisfaction was reinforced, because stakeholders found out that the commune played an active role before they were engaged in the process (although it was in line with the official procedure; see Section 4). It produced mistrust, since stakeholders had the impression the commune was not working in a transparent manner and did not consider the opinion of citizens.

*"Yes, and they said it is no danger, because it's safe. But I think that things that are safe now, in 10 years they find out that it was actually not so safe as we have thought. And they said when you are sleeping in the night it is more dangerous with a mobile telephone on your table. But that you can choose, to put it there, but if someone else is choosing for you… that's a difference. […] I think that Statnett has done its part, but the commune should have taken the situation more serious."* (Stakeholder 11: private)

It shows that on the one hand perceived intransparency of one official body weakened the institutional trust, however it was replaced by a TSO taking into account citizens' concerns and including them in the EIA. On the other hand, although clearly stated uncertainties related to EMF, stakeholders did not question the power line itself, but they undermined the role of certain actors in the decision-making process, whereas the TSO was perceived as a reliable and competent partner in finding solutions to deal with such risk (but not eliminating it). This is in line with findings of Flynn et al. (1992) indicating a strong relation between risk perceptions and trust in a responsible body.

### 5.2. Interpersonal trust

While looking at the relation between stakeholders and the responsible project managers one could observe high level of interpersonal trust. Their role was positively acknowledged by almost all stakeholders, which was not always the case for the perception and trust in the TSO (see Hardanger case). Our data shows that a negative institutional level perception of the TSO can be altered with evolving personal contacts and relationships between stakeholders and the TSO's representative.

*"The initial [attitude] one was negative. But further in the process we got more information about it. And I also think [the project manager] did a good job. I think she came from outside [the TSO]. So she was not part of this old, big […], [TSO]. And she was very open-minded. I think she wanted to spread information, instead of sitting tight on it."* (Stakeholder 2: private)

Even opponents of certain line alternatives described the contact and communication with a TSO representative as fair:

*"And Statnett has been really ok, when we first [got to] know about it. And we have contact. When I call, they answer. It is ok to be in contact with them."* (Stakeholder 11: private)

*"They have been available through the process, I don't think we can say anything negative about that."* (Stakeholder 14: NGO)

Several stakeholders (mostly private ones and NGOs) complained that they were disappointed with the initial contact with Statnett and that they only received a short formal letter with vague information – if they got it at all. That caused insecurity and rumours about who and which area would be affected and to what extent.

The interviews showed that as the project proceeded the contact often intensified and stakeholders did not feel excluded or not having influence. Most interviewees underlined the direct personal contact with the responsible project manager. Alongside public hearings, information events or site visits, they mentioned face-to-face meetings, a constant contact via emails and phone calls. Especially when conflicts appeared or stakeholders had special requests, project managers were reported to listen and being open for compromise.

This attitude allowed for flexible and even individual solutions which were part of the trust building process. Compromise took the form of placing single pylons somewhere else, considering line alternatives or line alternations and removing existing old lines. Compensation measures were acknowledged to a lesser extent – their added value was appreciated as a benefit for the society and some individuals (i.e. allowing for less loss of the economic value of houses), but it was not the main driver of acceptability (cf. Cowell et al., 2011; Wolsink, 2012). Statnett used these social interactions to better understand stakeholders' needs and to gain local knowledge. Such approach helped also to reduce the feeling of disproportional power-relations between the TSO and affected stakeholders which often results from the asymmetrical endowment of resources (see also: Hovik et al., 2010; Stein and Harper, 2003). This feeling was expressed in a stakeholder's demand for a proactive role of the TSO that should be responsible for leading the process as well as communication policies:

"*It's very important to understand and to get together. Statnett is a very big company and we are amateurs. And you can't expect that the amateurs lead on in the communication. So it's very important that the big one contacts [us] and we will try it better, but that's very difficult."* (Stakeholder 3: NGO)

However, interpersonal trust was not only stimulated by the proper provision of information and communication. Stakeholders considered it to be manifested in the overall quality of the mutual relationship with project managers, which took place both, in formal and informal settings. The interviewees indicated elements like openness, reliability, reciprocity or respect, but they often referred also to the professional competence of this person.

*"Yes, I think the behaviour of the project members, especially [the name of project manager]. It was […] – the leader, the planner. We three had a lot of contact regarding how we can solve that to get the lines over our head."* (Stakeholder 2: private)

*(Interviewer): "How would you describe this contact?" (Interviewee): "Loose talk and connected directly with the line when we had that excursion. So both, informal and several topics concerning the different knowledge of the area."* (Stakeholder 12: official)

It shows that the ability to listen and to treat input from stakeholders seriously, combined with representing technical or regulatory competence in a non-arrogant way were necessary conditions for creating a trustful relationship.

### 5.3. Generalized (social) trust

Among involved stakeholders prevailed a perception that people generally trust each other. Often it was expressed, that Norway *"is a small country"* (Stakeholder 15: NGO), meaning small in population, where people know each other. These statements are backed by Eurostat surveys that measured trust on a scale from 0 ("you do not trust any other person") to 10 ("most people can be trusted"), where Norwegians score 7.3, one of the highest levels among European countries (with an average score of 5.8) (Eurostat, 2016). This is in line with various studies demonstrating that Norway ranks highest in the world as to social trust (Delhey and Newton, 2005; Inglehart, 1999; Ortiz-Ospina and Roser, 2016).

Generalized trust manifested itself in various ways. Most stakeholders reasoned the new powerline as providing a "common good", which should serve the community. Usually it was secure electricity supply, but also integration of RES was mentioned as positive for environment and health. Stakeholders were reasoning that the local community or the whole society could benefit from the new power line and it was needed for a development in the future.

> *"Well, of course we would prefer not to have it. But as an association we see the necessity to have it and we can't say we don't want to have it and the neighbour can take it, so we saw the need for it."* (Stakeholder 3: NGO)

> *"But we could see it from the start that it is an important project on the national level. So we had a constructive attitude to the project from the start to find good terms and good solutions."* (Stakeholder 6: official)

> *"It is impossible not to support it. Because, as long as we need electricity, we need lines."* (Stakeholder 15: NGO)

This shared value of collectivity by interviewees can be understood as a pre-existent form of trust, in relation to the one developed during the process. However, conflicts can arise, when different meanings of values exist (Tait, 2011). In the Aurland-Sogndal case study the line alternative proposed by private stakeholders collided with the interests of NGOs. Both sides claimed to act in the common interest. The potentially affected private stakeholders argued that nature should not be put above the interest of people to live in their homes free of power line's impacts. NGO highlighted the need of an undisturbed nature for recreation purposes. As of the time of data collection, this conflict was not resolved, however this example shows that although presenting different meanings of a "common good", this value is highly appreciated in Norway. Most interviews demonstrated that the attitude of stakeholders in general was less self-oriented whatever stakeholder type. It was cooperative and constructive, what by most of them was considered as something natural, in the sense "how things are getting done".

> *"In Norway we are used to support the society when it has big needs and normally you always find someone who could be around when there are difficulties. We tried to be around in this big case [power line] (…) So this societies meaning is important."* (Stakeholder 7: private)

Additionally, affected citizens were able to sacrifice their own particular interests, or at least to accept what was not the best alternative for them, as long as it was considered positive for other members of the community. It shows the social cohesion across stakeholders and the perception of the common well-being of higher priority than individual well-being.

In both cases interviewees operated sufficiently among neighbourhood ties and existing networks to mobilize their resources and involve others in interaction with the TSO. In that way, they could exchange information and build up knowledge internally; externally the organization of interests gave them more weight for discussing with Statnett's project managers. A process of creation of such neighbourhood's groups was characterized by an informal and ad-hoc nature, but was based on the social interactions from the past. For example, in the Bamble-Rød case stakeholders initiating such mobilization were neighbours or members of the local associations, which built upon earlier experience with other infrastructural projects in their region.

Last not but least, interviewees referred to common values of the political culture in Norway. One stakeholder, while summarizing the engagement process, underlined directly the importance of trust, indirectly reflecting all its three dimensions: in institutions organizing the formalized setting (*"a process"*), in (abstract) individuals (as *"people"*) and in the society expressed as an aggregate (*"all of them"*).

> *"I think in a process like this people trust each other, all of them."* (Stakeholder 4: official)

## 6. Conclusions and policy implications

Practitioners in participation processes often stress the role of trust in their day-to-day work. Scientifically, however, the role and the specific elements of trust have not been fully understood. In this article we shed light on the role of trust in two case studies of stakeholder engagement processes in grid extension projects in Norway and we differentiated into three dimensions of trust: institutional, social and interpersonal. All of them are important in order to conduct the engagement process effectively. **Institutional trust** can lower conflicts about the need definition; provides stakeholders with confidence of having impact on the project; increases legitimacy of the decision-making; ensures them about intentions of public bodies acting in their interests; finally, it reduces concerns related to risk perceptions of EMF. **General trust** is important for the willingness of affected people to support the idea of the "common good". Especially if the grid infrastructure should be built to serve the "public good" understood as wealth, income or climate protection, this form of trust increases the motivation to desist from special own interests. Social trust also motivates people to get involved into the process at all, what enables collecting more diversified opinions and detailed local knowledge. However, we find that the most relevant form in the given context is **interpersonal trust**, occurring mainly between stakeholders and the project manager. Having a "face", a responsible person available throughout the process raises the chance to open up the image of the TSO as a big anonymous entity. Discussing certain power line's issues and possible solutions on an interpersonal basis, seriousness in taking the stakeholder input, a reciprocal way of communication, understanding of stakeholders' personal values and being treated as equal partners by a big state-owned institution can be seen as positive experiences of self-efficacy. Additionally, our findings show the central role of a proactive information policy supported by a personal contact. Not only the kind of information matters but also when and how it is provided.

We endorse the view of Friedl and Reichl (2016) that regulated aspects of the decision-making process (like stakeholders' empowerment or elements related to procedural and distributive justice) can lead to project's acceptability only when trust in relevant institutions is high enough. However, it is not always clear for stakeholders what kind of role different institutions in the process play and because of being the project's contractor, a TSO is often perceived as the engagement process' owner. Thus, it offers a space to a respective project manager to be a process facilitator and perform this role with high attention dedicated to informal aspects. Given that, we conclude that if stakeholders do not have huge trust in institutions or the society, a trustful relationship with the project manager can, under certain circumstances, make up for that and turn a beforehand negative impression of the TSO into something positive.

Although we did not experience this, also the opposite is thinkable: if the project manager behaves in a way that stakeholders do not trust him or her, institutional trust might suffer and – maybe as a consequence also trust in society might change. Therefore, these "informal" aspects of stakeholder participation and the role of the project manager play an essential role for the acceptability of the process. If stakeholders do not feel taken seriously, if the project manager does not work in a transparent and reliable way or communication cultures differ widely between the actors, distrust might arise and hamper a good, acceptable participation process.

Summarizing, trust can be understood as a *conditio sine qua non* for the acceptability of an engagement process that can lead to the acceptability of new power lines. In this sense we support the argument of Petts (2008) that carrying out the engagement process will not by itself and automatically build trust. Trust relationships present during the engagement process are not built from scratch and they exist partly *a priori* in a social sphere as pre-conditions of the formalized process. However, social interactions influencing trust would not have the chance to happen, if a formalized process was not established and a space for stakeholder interaction was not created. Therefore, how the process is conducted determines whether these stocks of trust will be diminished or developed. We do not argue that stakeholders participating in the process should "blindly" trust everything they face during the process. Some levels of mistrust or scepticism, especially in regard to technologies considered as risky, are necessary to ask inconvenient questions and present critical views that in consequence can improve the process and can lead to novel solutions. In this context we suggest some recommendations for TSOs and regulatory authorities that would like to establish trustworthy engagement processes in grid planning:

1. The project manager is a key person to lead the communication with stakeholders. Of course, only face-to-face communication alone will not build trust, therefore the capabilities of project managers should include not only technical or economical skills, but also (intercultural) communication, local context comprehension, patience, reflexivity and updated knowledge about national energy policies. Stakeholders should be provided with personalized and tailored information. Project manager should not concentrate only on strongly polarized stakeholders, but also put attention to those not courageous enough to speak up and possibly feeling excluded from the process. Relying only on professional public relations employees could work against the building of trust relationships as they might be perceived as "marketers of a TSO's desired image".
2. In order to increase the institutional trust, lower conflicts about the need definition and ensure stakeholders feeling to have actual influence on the process and its outcome, the regulatory authority should underline its independency from the TSO, clearly define rules for engagement, and transparently explain the purposes for the line as well as the weights of different factors influencing the final decision. Public interests should be separated from private ones and possible overlaps should be justified. It should be clearly indicated where and how stakeholder's input can be integrated into the decision-making process. If there are negative examples in dealing with stakeholders, institutional actors should be self-reflexive, reactive, admit a mistake, and ideally change the approach from the inside. Trust should be treated as a resource, and trust building and maintaining measures should be central in the companies' policy and constitution. Since, as emphasized above, this is mainly performed by a project manager, he or she should be provided with enough resources and internal support to face this multitasking responsibility.
3. General trust in society during grid planning processes should be backed in a way that enables stakeholders open debates about line alternatives, their siting and potential impacts, which are helpful for understanding why specific lines are needed. Such format should provide enough room and time for discussion about different stakeholders' interests, positions they hold, understandings of values they pursue, and possibly for working together on joint meanings, interpretations and solutions. Creating opportunities for constant and structured explanation of discussed issues allows for mutual understanding and reduces the conflict potential between different stakeholders groups.

Nevertheless, these "informal" aspects of participation have certain limitations. Informal activities are ambiguous insofar as they can also include non-legitimate behaviour of actors, such as executing non-transparent and bilateral agreements, holding back information to a specific group or even bribery. Although in investigated cases the informal aspects contributed to the development of trust, informal settings and arrangements can also contribute to distrust and frustration. That means "informal" aspects of a participation process can turn in both directions – they can create trust or distrust, depending on various issues beside the formalized process.

Moreover, since the trust into institutions deals with legal conditions such as compensation rules or safety thresholds of EMF, one should remember that these official rules cannot be altered in the short term and not only by the TSO. Furthermore, the acceptability of the engagement process does not necessarily lead to the acceptability of its outcome. Thus, the acceptability of the decision-making process does not depend on the process' final outcome. However, it is fairly plausible to assume that a trustworthy process can lower transaction costs and lead to an outcome that people at least accept. Even though stakeholders might not support the positioning of the new line, trust is a key element for a deliberate process.

It is challenging to track and measure trust as it is a multidimensional phenomenon. Even if we have systematized three levels of trust, including their different elements, different sub-levels could be listed. For example, in regard to interpersonal trust it is difficult to observe how deep such a relationship between the project manager and an involved stakeholder is and how exactly it was established: because of the personal characteristics and behaviour of both individuals, professional competence, sufficiently devoted time, openness, empathy, information-managerial or facilitating skills etc. Most probably it is a combination of all these elements. Moreover, it is impossible to simply state which type of trust is bigger or better, because this phenomenon cannot be easily counted.

We are aware, that each project is context specific and strongly embedded in national regulations, policies and cultures as well as in geographical structures. In the analyzed cases the TSO had the advantage that it could build on pre-existing high levels of social and institutional trust. Our findings showed that Norway could be imagined as an idyllic place where everyone trusts other people, society and public institutions, what is strongly determined by the culture and politics. Yet, it does not mean that conflicts do not arise and stakeholders do not question certain solutions proposed by a TSO. Also, in both investigated projects a decommissioning of old power lines was envisaged, they were situated in low populated regions and they were not very controversial projects in terms of risk (Molinengo, 2016), what also probably contributed to high levels of process' acceptability. Moreover, Statnett also drew conclusions from the Hardanger case and improved their approach to stakeholder engagement. Although both cases are characterized by strong context-dependency, we think that the results are transferable to other grid extension projects, in the sense that actors responsible for stakeholder engagement should acknowledge the importance of informal aspects of social interactions and processes during the project's realization and should not remain in ivory towers as "knowing better than lay people". In order to be sure about these conclusions, we suggest further investigating the impact of these three dimensions of trust on the acceptability of the engagement process either in more contested, or different infrastructural or planning projects. Lessons learned about trust mechanisms in society in regard to grid planning are most likely very relevant to many ongoing political processes dealing with large scale infrastructure.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.enpol.2017.08.051.

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3. Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway.

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| Abstract | There has been increasing scientific evidence related to climate change and its attribution, impacts, and possibilities of mitigation. Yet, climate contrarianism still persists. This paper concentrates on Poland and Norway—two fossil fuel giants that represent essential differences on climate contrarianism. In Norway there is a broad social and political consensus about the attribution and importance of climate change and a motivation to undertake climate change mitigation measures, whereas in Poland the inconvenient truth on anthropogenic climate change remains particularly inconvenient. By taking a qualitative approach, this paper discusses different drivers of climate contrarianism in both countries; provides examples of contrarian attitudes present in society, media, politics, and research; and compares their role in Polish and Norwegian contexts. The findings show the difficulties in defining universal factors determining contrarian attitudes, because their understanding and weight can be different among countries and a more nuanced analysis is needed to scrutinize different national contexts. The conclusion calls for more comparative research, which would combine quantitative and qualitative approaches investigating climate contrarianism. |

# Inconvenience versus Rationality: Reflections on Different Faces of Climate Contrarianism in Poland and Norway

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ABSTRACT

There has been increasing scientific evidence related to climate change and its attribution, impacts, and possibilities of mitigation. Yet, climate contrarianism still persists. This paper concentrates on Poland and Norway—two fossil fuel giants that represent essential differences on climate contrarianism. In Norway there is a broad social and political consensus about the attribution and importance of climate change and a motivation to undertake climate change mitigation measures, whereas in Poland the inconvenient truth on anthropogenic climate change remains particularly inconvenient. By taking a qualitative approach, this paper discusses different drivers of climate contrarianism in both countries; provides examples of contrarian attitudes present in society, media, politics, and research; and compares their role in Polish and Norwegian contexts. The findings show the difficulties in defining universal factors determining contrarian attitudes, because their understanding and weight can be different among countries and a more nuanced analysis is needed to scrutinize different national contexts. The conclusion calls for more comparative research, which would combine quantitative and qualitative approaches investigating climate contrarianism.

## 1. Introduction

Although climate change is one of the most severe challenges that humanity faces in the twenty-first century (Feulner 2017) and a majority of climate scientists agree upon the anthropocentric causes of global warming (Anderegg et al. 2010), climate contrarianism still persists. Scholars have investigated factors influencing environmental views and behaviors, including climate change attitudes (see Engels et al. 2013; Franzen and Vogl 2013; Freymeyer and Johnson 2010; Marquart-Pyatt 2012a; McCright et al. 2016a; Tranter and Booth 2015; Whitmarsh 2011), but most of these studies remain descriptive and atheoretical, and some findings have been contradictory (McCright et al. 2016b; Whitmarsh 2015). However, several authors conclude that politics is one, if not the most, important predictor of climate change views and attitudes (Brulle et al. 2012; Goebbert et al. 2012; Marquart-Pyatt et al. 2014; Whitmarsh 2011). This is not surprising since political views determine individual responses to climate change (Knight 2016; McCright et al. 2016b; Whitmarsh 2011); policy-makers influence the general public's perception and understanding of climate change (Diethelm and McKee 2009; Moser 2010), they have the power and legitimacy to undertake the mitigation measures (Lorenzoni et al. 2007), and, no matter what kind of measures would be introduced, politicians need public support to implement them (Moser 2010). In other words, climate change is an extraordinary example of how a scientific fact can become politicized by public actors. While combining

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the political sphere with attitudes about climate change, Engels et al. (2013) suggest that climate contrarianism might actually be a phenomenon of the Anglo-Saxon cultural sphere. Even if there are studies investigating climate change views from contrarian countries outside of this sphere, such as Poland (see, e.g., Knight 2016; Kvaløy et al. 2012; McCright et al. 2016a), they represent a quantitative approach, which often does not provide contextual information needed to reflect the nuances in which climate contrarianism has developed.

In this paper, we portray an overview of climate contrarianism in Poland and compare it to the Norwegian counterpart. While conducting the Climate Change Impact Assessment for Selected Sectors in Poland project (CHASE-PL; see http://www.chase-pl.pl/ for a description), we noticed that both countries present different positions on climate change. There is a broad social and political consensus about the significance of climate change in Norway, while in Poland the inconvenient truth about anthropogenic climate change remains particularly inconvenient. Thus, we would like to use the scientific capital and accumulated empirical knowledge that have been developed and collected during the project and later to address the following question: What are the potential explanations for the embedded contrarianism in Poland and Norway? We chose these two cases to verify propositions about drivers of climate contrarianism and to learn more about it from a context other than the Anglo-Saxon sphere. Moreover, since we did not come across relevant literature dealing with this issue in a comparative way, with this paper we would like to call for intensive research explaining public and state responses to climate change in Poland and Norway. Last, we think it is important to look more closely at cases representing different faces of climate contrarianism in both countries, namely, fossil fuel giants and large carbon dioxide ($CO_2$) emitters, and on the basis of such an investigation we could launch a discussion on how the scientific understanding in the wider community differs between the two countries.

We base our deliberations on an extensive literature review, including documents, scientific papers, gray literature, media reports, and data coming from different surveys. This represents a comprehensive collection of knowledge that has not been analyzed anywhere else. In addition, some information is strengthened with primary data coming from semistructured interviews with actors active in the climate and energy field in Poland, conducted by the first author. Section 2 starts with a short overview of climate change contrarianism, and it distinguishes actors participating in spreading the contrarian information. Later, this section summarizes factors explaining climate contrarianism at the individual and systemic levels and presents our research approach. A systemic profile of both countries is reviewed in section 3. Then section 4 concentrates on society and media, section 5 refers to contrarian examples present in a public (political) sphere, and section 6 offers conclusions.

## 2. Definitions, grounds, and factors determining climate contrarianism

### a. *Literature review*

Differences among terms such as ''climate skeptic,'' ''denier,'' and ''contrarian'' have been already discussed in the literature (see, e.g., O'Neill and Boykoff 2010), and studies investigating climate change skepticism have used differentiated conceptualizations to detect it, such as people's awareness, perceived risks, seriousness and impacts of climate change, its anthropogenic roots, scientific consensus about it, or support for climate policies (see, e.g., Engels et al. 2013; Knight 2016; McCright et al. 2016a). In this paper we use the term ''contrarian,'' broadly understood as an individual who disagrees with the scientific evidence on climate change trend, cause and impacts, processes of scientific knowledge generation, and climate decision-making and responses in the form of policy instruments, independent from the level of certainty of skeptic belief (Van Rensburg 2015) and independent from narratives that these individuals are following (Hobson and Niemeyer 2013).

The scientific examination of climate contrarianism is relatively new. Its development is related to the awakening of global environmental awareness at the end of the 1980s and the early 1990s, and contrarianism's development was driven by the fossil fuel industry (Jamieson 2011). This ''crusade'' began in the United States,[1] and it coincided with the collapse of the Soviet Union and resulted in the rhetoric proclaiming a replacement of the ''red threat'' with the ''green threat'' (Dunlap and McCright 2011). As a next step, corporate actors joined forces internationally to protect their interests (Miller and Dinan 2015) while at the same time other types of contrarian actors globally arose (such as think tanks), which resulted in the development of a strong international network of such entities (and also in Poland), which remained connected with actors operating in the United States as a center (Harkinson 2009).

The ''climate change denial machine'' discussed by Dunlap and McCright (2011) gives an overview of mechanisms determining the spillover of climate

[1] For a detailed description of a contrarian strategy pursued by an industry actor in the United States, see, e.g., Supran and Oreskes (2017).

contrarianism and functioning of contrarian actors. Next to fossil fuel corporations, they list politicians, scientists, conservative think tanks, amateur climate bloggers and self-designated experts, public relations firms, ''astroturf'' groups, and (conservative) media. The roles and activities of contrarian actors are interdependent and intertwined, and they reinforce themselves (Dunlap and McCright 2011). For example, at the beginning of this movement, fossil fuel corporations tried to mobilize scientists[2] to promote contrarian views on climate change (Jamieson 2011). Unsuccessful international efforts to undermine the climate change science turned into developing domestically politically viable tactics such as financing think tanks that could continue producing contrarian information on climate change (Miller and Dinan 2015). While being active in national and international networks of policy-makers, these actors try to create conditions under which any mitigation measures can be challenged as too costly, in economic or political terms (Layzer 2007; Miller and Dinan 2015), and, to blur their linkages to the fossil fuel industry, contrarian scientists try to present their opposing views as intellectual courage against "mainstream" political correctness (Diethelm and McKee 2009). Although over 97% of climate scientists support the tenets of anthropogenic climate change (Anderegg et al. 2010), the credence given in public space to contrarian researchers creates a false impression, as if both stances were of comparable weight. The remaining 2%–3% of papers rejecting anthropogenic climate change are characterized by methodological flaws and a pattern of common mistakes (Benestad et al. 2016).[3] All in all, the presence of contrarian points within the scientific community negatively influences its perception and credibility (Lewandowsky et al. 2015).

While media play an important role in spreading information on climate change (Boykoff et al. 2015; Vainio and Paloniemi 2013; Whitmarsh 2011), they can also act as agents in the contrarianism-production process by providing unreliable information; reproducing unchecked claims of politicians; or, in the name of presenting ''balanced'' information, referring to contrarian scientists/experts (Dunlap and McCright 2011; Miller and Dinan 2015; Norgaard 2011). In this manner, the activities of contrarian actors concentrate on spreading and advocating messages, which activity can be identified as an ''organized disinformation campaign'' (Dunlap and McCright 2011) or ''manufacturing uncertainty'' (Dunlap 2013). While different strategies of creation of such messages can be recognized (see, e.g., Diethelm and McKee 2009; Lewandowsky et al. 2015; Moser 2010), they focus mostly not on the *goal* of the climate change mitigation but on the *need* for it, and they aim to reinforce the status quo (Miller and Dinan 2015). Since the public derives knowledge about climate change mostly from the media and from the claims of politicians, people remain vulnerable to these strategies. Moser (2010) distinguishes three dimensions through which contrarian views are present: cognitive, affective, and behavioral. While taking a broader, anthropological approach aimed at explanation of future political outcomes, Norgaard (2011) defines these individual's contrarian responses as ''an active resistance'' to disturbing information that could evoke negative feelings. She explains it as a psychological process of creation of emotions, leading to collectively organized patterns of thinking and understanding. Eventually, these cultural norms come to be reflected in political–economic systems.

### b. *Research approach*

In this context, it is not surprising that scholars combine different factors determining climate change views and behaviors, including individual and systemic variables. The former group encompasses, for example, age, gender, income, education, environmental values and beliefs, postmaterialist values, political orientation, class identification, energy source preferences, urban residence, or different trust forms. The latter group of variables comprises, for example, gross domestic product (GDP), climate vulnerability, environmental quality, population density, urbanization level, postsocialist past, democracy level, and country's level of $CO_2$ emissions (see, e.g., Brulle et al. 2012; Chaisty and Whitefield 2015; Franzen 2003; Franzen and Meyer 2010; Kim and Wolinsky-Nahmias 2014; Marquart-Pyatt 2012b; McCright and Dunlap 2011; Nawrotzki 2012; Orru and Lilleoja 2015; Pisano and Lubell 2017; Poortinga et al. 2011; Sandvik 2008). After scrutinizing key predictors of climate change views, McCright et al. (2016b) recently proposed a theoretical framework explaining the strength of some of

[2] Many of them had at this time a similar experience working for industry on spreading doubts about scientifically based evidence of ozone depletion or for the tobacco industry on refuting the argument that second-hand smoke causes cancer.

[3] In their paper, Benestad et al. (2016) analyzed 38 commonly cited contrarian papers and found substantial errors in all of them that put their conclusions into question. One common shortcoming for all of these papers was that they ignored previous work and information that did not fit their conclusion. Another explanation for erroneous results included insufficient model evaluation, leading to results that were not universally valid but rather are an artifact of a particular experimental setup. The examined contrarian papers also suffered from flaws that included false dichotomies, using inappropriate statistical methods (or even containing misunderstanding of basic statistical concepts), or basing conclusions on misconceived or incomplete physics.

these factors in relation to their position embedded in the political–economic system. This model is based on a broad interpretation of the antireflexivity thesis (McCright 2016; McCright and Dunlap 2010) defining contrarian actors as a collective force defending the industrial capitalist system. This framework integrates two principles: 1) climate contrarianism can be predicted by variables aligning with ideological or material positions within the capitalist system and 2) the strength of these ideology-based positions depends on the strength of the contrarian countermovement (McCright et al. 2016b).

On the basis of presented insights and by taking a qualitative approach, we would like to depict how climate contrarianism functions in the Polish and Norwegian contexts. Thus, while discussing the system's spheres from the denial machine, where the contrarianism is reflected (society, media, politics, and, to some extent, science), we will apply the abovementioned framework into our cases. Recognizing the model's limitations resulting from its embeddedness in late-industrial capitalism, which can make it inadequate for different political–economic settings (McCright et al. 2016b) such as Eastern Europe with its communist legacy (Chaisty and Whitefield 2015; Jorgenson et al. 2014; Marquart-Pyatt 2012b), we will discuss purposively selected drivers that are essential for the framework's functionality and check their applicability in our cases. From component 1 of the framework as defined above, we focus on indicated variables related to the ideological position in the political–economic system, that is, environmental values, beliefs and identity, and political orientation (McCright et al. 2016b, p. 186); within component 2, we elaborate on the strength of the (contrarian) movement. Yet, although we think that the investigated cases are extraordinary in comparison with the U.S. setting for which the framework was designed, we do not want to dissociate ourselves from it but rather to adjust some propositions that can clarify the formation of climate contrarianism. In this manner, within component 1, we would like to expand the understanding of the identity factor, not limiting it to its environmental dimension but rather extending it to the broader identity issues that can distort the uptake of scientific information, as elaborated in the cultural cognition thesis by Kahan et al. (2011, 2012). Thus, with this complementary information, we will put emphasis on elements constituting identity that we find especially relevant in the Polish and Norwegian realities and, as such, important to explain and understand how contrarianism works there. Component 2 of the framework will be shown by taking an actor-oriented approach, as suggested in the research dedicated to social acceptance of energy infrastructure (Dermont et al. 2017; Devine-Wright et al. 2017) or climate adaptation measures (Moser and Ekstrom 2010). Since we are aware that most of the interactions in the nexus between the industrial actors and the political domain take place "behind closed doors," we will recall public statements made by decision-makers regarding climate change, climate policies, and the energy system. In this sense, we understand public authorities to be a voice of the strongest industrial actors in the political–economic system. Recognizing that there is an evident lack of data dedicated to Poland, it will be our natural focus, considering also that there is (almost) a nonexistence of such statements expressed by Norwegian politicians.

## 3. Comparison of Poland and Norway

Poland and Norway can be considered as two most different case studies (Della Porta 2008) with many substantially differing elements, which include climate and energy policies. Except for comparable geographical areas (Norway is the sixth largest country in Europe, whereas Poland is ninth), significant differences can be observed in the population size, economy, and energy indicators. Table 1 summarizes selected categories that give an overview of systemic conditions represented by both cases. In addition, both countries have undergone different paths of development. Starting in 1989, Poland has experienced a dynamic transition from communism to democracy, from single-party rule to party pluralism, and from a planned economy to an open-market economy. In contrast, Norway is one of the most established and developed democracies worldwide, with the strong role of state that assures high standards of living (Christensen and Lægreid 2005; Gulbrandsen 2007). According to the Organisation for Economic Cooperation and Development (OECD) "Better Life Index," which measures the well-being of societies, Norway is the leader among 35 investigated countries, whereas Poland occupies the 27th position (OECD 2017). The Norwegian wealth is related to the discovery of huge oil and gas deposits in the North Sea during the 1960s and contributed significantly to the economic development of the country. This discovery resulted in the founding of the integrated oil and gas company Den Norske Stats Oljeselskap A/S by the Norwegian government in 1972, to participate on the continental shelf and build up a Norwegian competency within the petroleum industry and to establish the foundations of a domestic petroleum industry. It grew to become a large company that represented a pillar in the wealth creation that supported the Norwegian welfare system through taxes, and it had a big share in Norwegian gas export (Norsk Petroleum 2018). A large part of the revenues from the offshore industry has been

TABLE 1. Comparison of Poland and Norway [compiled by the authors from EDGAR (2016), GUS (2016a), IEA (2017), Kaspersen (2016), and World Bank (2017)].

| Category | Poland | Norway |
|---|---|---|
| Area ($km^2$) | 312 679 | 385 252 |
| Population (m) | 38.430 | 5.213 |
| GDP per capita (USD) | $27,811 (39th globally) | $59,302 (8th globally) |
| Energy production (Mt of oil equivalent) | 67.33 | 196.31 |
| Total primary energy supply (Mt of oil equivalent) | 94.02 | 28.75 |
| Electricity production (GW h) | 159 059 | 142 327 |
| Employment in fossil fuels sector | 147 000 jobs in the mining and quarrying sector in 2015, with a decrease of 38 000 jobs in comparison with 2005 | 185 300 jobs in the petroleum industry in 2016, with a decrease of 40 000 jobs relative to 2014, primarily due to a reduction in the oil price |
| Annual emissions of $CO_2$ (excluding LULUCF) (kt) | 294 879.37 | 43 109.01 |

invested in the Government Pension Fund Global rather than being spent instantly on public goods (to avoid the so-called Dutch disease and to prepare for the future when the oil has run out). In public, supporters of the Norwegian offshore industry often argued that natural gas was a more environmentally friendly alternative to coal and sometimes even a means to reduce $CO_2$ emissions, as scenarios for future energy mix by the International Energy Agency (IEA) included fossil fuels (Lund 2012). The company changed its name to Statoil ASA when it became privatized and was listed on the Oslo Stock Exchange and the New York Stock Exchange in 2001. In 2018 the company profile was again rebranded, and it changed its name to Equinor ASA. Its ambitions were to become an energy company with a basis in a wider range of energy sources than just oil and gas (Aftenposten 2018). The resources themselves have not, however, determined the shape of the electricity regime—in both Norway and Poland this has been determined by a combination of historical developments and/or availability of certain resources. Poland's electricity system is centralized, and it has been dependent on coal. Large coal production was inherited from the communist system, and nowadays Poland is the largest hard coal producer in the European Union (EU) (BP 2015, pp. 30 and 32). The Norwegian electricity system has always been decentralized and has been based on locally based hydropower (Satøen et al. 2015). As a result, in Norway 96% of electricity comes from hydropower, whereas in Poland 82.7% of electricity originates from coal (IEA 2017). In contrast, electricity production from renewables in Poland in 2015 amounted to 22.5 TW h (around 14% of the total electricity production), with prevailing biomass and wind power (GUS 2016b). However, the increase of electricity from renewables has been hampered by legislation passed in 2016 that blocks investments in windmills in proximity to built-up areas. Such patterns of electricity generation affect the emissions profiles of both countries: power generation is responsible for more than 50% of total Polish greenhouse gas (GHG) emissions (KOBIZE 2015), whereas emissions from electricity production in Norway are very low and emissions resulting from oil and gas extraction are considerable (Steentjes et al. 2017).

With regard to climate change policies, both countries signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and the Kyoto Protocol in 1998, under which they agreed to control their GHG emissions. The emission targets foreseen in the Kyoto Protocol for the time horizon 2008–12 were −6% for Poland and +1% for Norway (which could increase emissions in reference to the base year). Countries with an economy in transition, such as Poland, had the right to select the base year. Poland chose the year 1988 with higher emissions, instead of 1990 as chosen by most countries, including Norway. After the collapse of the communism system in Poland, in 1989, there was a rapid decline of industrial production and outdated, ineffective, highly polluting and energy-consuming industries were gradually overhauled. The information compiled by UNFCCC (cf. Shishlov et al. 2016) gives the base-year GHG emissions for Poland and Norway as respectively 563.443 and 49.619 Mt CO2e ($CO_2$ equivalent). The average emissions of Poland and Norway for 2008–12, including land use, land use change, and forestry (LULUCF), were 396.038 and 51.898 Mt CO2e, respectively. This means that, in relative terms, the GHG emissions in Poland for 2008–12 decreased from the base year by 29.7% while in Norway they increased from the base year by 4.6%. Hence, in Poland the Kyoto Protocol target (−6%) was easily met with considerable surplus while in Norway the target (+1%) was not met. In addition, the drivers and means of the domestic climate policies are considerably different. Whereas the Norwegian government declared in January of 2008 an ambitious goal of becoming carbon neutral by 2030, mostly by buying carbon offsets from other countries (Norwegian Government 2014), the development of climate policies in Poland is mostly driven by the EU (Ceglarz and Ancygier 2015). Although, the transformation of the 1990s gave optimistic assumptions for ambitious developments of climate policies in Poland, they were hampered in the late 2000s (Karaczun and Szpor 2013), including selective and insufficient implementation of EU climate policies (ClientEarth 2013) and an open opposition to the EU climate and energy policy targets (Ancygier 2013). The Polish government has been promoting a success story of effective long-term decoupling of GDP growth and reduction of GHG emissions (KOBIZE 2013) and potential threats resulting from the change from coal-based, low-cost electricity production toward a low-carbon economy, as was projected in a report contracted for by the Polish Electrical Energy Committee, arguing that such change can lead to an almost 8% GDP decline in 2030 (EnergSys 2014). At the same time, the Polish government has been ignoring alternative opinions that show that low-carbon innovation can give an impulse to the Polish economy (Karaczun and Szpor 2013).

## 4. Society and media: Values, identity, and political orientation

To the knowledge of the authors, there is no study covering climate issues and attitudes in Poland and Norway in a comparative manner, but data and information regarding both countries, in an international comparison or focusing on single issues, are available. For example, the study by Tranter and Booth (2015) comparing 14 industrialized countries revealed that Norwegians are placed at the second position as climate contrarians (after Australians). Yet, these results are embedded under specific conditions of the whole analysis and still the number of contrarians amounts to 15% of the nation, that is, a relatively small part of the society. The most current and complementary study investigating climate attitudes of Norwegians[4] (including concerns, beliefs, emotions, identities, energy choices, and climate policy support) shows that contrarianism in this country is a marginal phenomenon (Steentjes et al. 2017).

This picture is different when we look at Poland: international opinion polls clearly show that Poles are less concerned about climate change and take fewer personal actions to fight climate change when compared with the rest of Europe (European Commission 2015, 2017). A survey of 40 countries by the Pew Center showed that the percentage of individuals in Poland who thought that climate change was a very serious problem was just 19%, far less than in other EU countries, which ranged from 41% to 56% (Stokes et al. 2015). According to the survey carried out by Ipsos MORI in 21 countries, 47% of Poles agree that ''climate change we are currently seeing is a natural phenomenon that happens from time to time'' (Ipsos MORI 2016b). They also belong to nations that have a relatively large minority who disagree that ''climate change is largely the result of human activity'' (19%; Ipsos MORI 2016a). Although these trends have changed in comparison with 2014 in a less contrarian direction, in both categories, Poland was in the most skeptical quartile of compared countries. A survey carried out in Poland in 2016 presents similar results: 44% of Poles agree that the ongoing climate change manifests a cyclical and natural phenomenon (warmer periods follow colder periods). This statement is contested by almost the same number (43%) of Poles. The same study states that, although almost one-half of Poles (49%) think that the scientific community agrees on anthropogenic climate change, a high percentage (40%) still think that scientists are divided about such scientific evidence (Feliksiak 2016).

Such a difference in attitudes between both societies can be partially explained by visible signs of global warming such as retreating glaciers, increasing temperature, the disappearance of snow, mild winters, more rain, or the appearance of new species, which Norwegians conscientiously notice because of their distinctive relationship to nature (Arnold et al. 2016; Daugstad 2008; Vorkinn and Riese 2001). Indeed, the outdoor orientation is one of the essential Norwegian values (O'Brien 2009), and being friendly toward the environment is an important part of being a Norwegian (Steentjes et al. 2017). It does not mean, however, that contrarianism does not exist in Norway at all—it adopts a special form resulting from the other side of the same ''identity coin.'' Namely, the Norwegian identity is closely connected to good governance, democracy, wealth, egalitarianism, and economic prosperity that all are assured by the state, and many think that it would have not developed without oil and gas production, which therefore can be listed among the identity's constituencies as well (Arnold et al. 2016; Gulbrandsen 2007). According to Norgaard (2006a,b) this double-sided consciousness leads to a dissonance, and, in consequence, a socially organized denial that is reflected in political–economic relations that, in the case of Norway, are historically very strong and

[4] The study also included France, Germany, and the United Kingdom.

guarantee a maintenance of the universal welfare system (Gulbrandsen 2007). It does not, however, have a reflection in political (left–right) orientation (Steentjes et al. 2017), because the political class agrees upon the significance of climate change and any politician who makes a public contrarian statement is usually subject to social ostracism (see, e.g., Ørstavik et al. 2015).

In contrast, in Poland there is unanimity between political parties in contesting climate change and subsequent reluctance for climate policies (Marcinkiewicz and Tosun 2015; Szpor and Witajewski-Baltvilks 2016) (more examples on this are provided in the next section); therefore, political orientation is also not necessarily the crucial factor determining contrarianism in Poland. Although Poles declare that they appreciate and care about the environment, most of them think that protecting jobs and economic growth should be the top priority, even if the environment suffers to some extent (Szpor and Witajewski-Baltvilks 2016). Thus, many believe that the cure (climate change mitigation) could be worse for Poland than climate change itself (Kundzewicz et al. 2015), particularly when faced with a high carbon tax and the threat of ''carbon leakage'' and, in consequence, loss of jobs in Poland to non-EU countries, which may not partake in global climate change mitigation (Kundzewicz 2013). There is a strong link between identity and the fossil fuel (coal) sector in Poland, but it has only a local/regional dimension related to geographical distribution of the coal resources (Mandrysz 2011; Wódz et al. 2012). The values that are important components of identity in Poland are family, friends, and religion, which gave a feeling of stability during the unstable period of political–economic transition that the state was not able to assure (Krasowska 2013; Swadźba 2014; Wódz et al. 2012). This is also reflected in a public statement expressed in 2016 by the former minister of foreign affairs Witold Waszczykowski that (although it was a rhetorical shortcut) presented all of the abovementioned ''traditional Polish values'' and underlined that the renewable energy sources do not belong to them (OKO.press 2018). In just the opposite way, most public actors underline coal's significance in a national context (see next section), although a considerable part of the society prefers the development of renewable energy sources instead of coal (Gwiazda and Ruszkowski 2016).

In this context, it is relevant to compare media coverage since it is a preferred source of information that plays a crucial role in forming the understanding of environmental problems (Biernacki et al. 2008). Norwegian media pay attention to scientific and international dimensions of climate change. For example, the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) was reported four times in the Norwegian Broadcasting Corporation (NRK) *Dagsrevyen* television news (Painter 2015), and there were 39 articles discussing it, in three differently oriented newspapers, published in the days adjacent to the AR5 plenaries of IPCC working groups. In Poland, there were only seven published articles in the three monitored newspapers, and the Polish evening news programs *Wiadomości* and *Fakty* had no reports on the launching of IPCC AR5 (Kundzewicz et al. 2017b). In a similar vein, an international study investigating newspaper coverage of the IPCC reports in 22 countries showed that Poland has the second-least amount of coverage (Kunelius et al. 2016). With regard to the coverage of articles in weekly or monthly magazines in Poland from September 2013 to February 2014, Kundzewicz et al. (2017b) found out that one-half of 22 examined articles were contrarian. These magazines contrasted the IPCC findings with Nongovernmental International Panel on Climate Change (NIPCC) conclusions that were conveyed as a proxy for truth. In contrast, in Norway, groups such as ''klimarealistene'' that promote the NIPCC—and, in what is not a surprise, collaborate with the Heartland Institute in the United States, which backs the NIPCC—have not been taken seriously.

## 5. Strength of the contrarian movement: Policymakers and scientists

The media often uncritically reproduces contrarian declarations and statements of political actors, which influences and reinforces the public attitude toward climate change. These arguments, often coming from the fossil fuel industry but expressed by politicians and officials, sound more credible and legitimized. In Poland, this interrelation is obvious, given that the privileged position of the coal industry results from the communist era, when coal was produced in very high quantities and largely exported to earn convertible currencies. Thus, the coal-mining lobby became very influential and continues to remain strong (Bokwa 2007; Stoczkiewicz and Jędrasik 2014; Szulecki 2018). Although in Norway clear links between political class and the fossil fuel industry exist as well (see the previous section), they do not lead to publicly verbalized contrarianism. For example, as a response to the U.S. withdrawal from the Paris Agreement in June of 2017 that was led by U.S. President Donald Trump, the Norwegian government was one of the most critical ones in the global comparison, and it was supported by the fossil fuel industry, showing a strong disapproval of this step (Berglund 2017), whereas the Polish government was the only one, globally, that was happy about Trump's decision (Popkiewicz 2017).

Polish politicians support the energy system that is based on coal, even if the production in many deep Polish coal mines is unprofitable and the preference leads to the import of cheaper coal (Kundzewicz et al. 2017a). Indeed, the Polish government has frequently intervened to help coal companies affected by unfavorable conditions on the international market. Jarosław Kaczyński, head of the ruling ''Law and Justice'' party, declared that a part of coal production could be treated as ''non-market commodity'' (http://next.gazeta.pl/next/7,151245,20042100,6-najciekawszych-pogladow-jaroslawa-kaczynskiego-na-tematy-gospodarcze.html). Smoothing variability of coal prices is regarded as consistent with the Polish *raison d'état*. In the presidential and parliamentary election campaigns in 2015, the winning party repeatedly promised support to the Polish coal industry. In one of the presidential campaign's speeches, Andrzej Duda (current president of Poland at the time of writing this paper) said, ''I do not agree on closing the Polish mines . . . Coal is our national treasure and guarantee of energy security'' (http://wpolityce.pl/spoleczenstwo/245431-duda-nie-ma-zgody-na-zamykanie-polskich-kopaln-wegiel-to-jest-nasz-narodowy-skarb-i-gwarancja-suwerennosci-energetycznej). In December of 2015, he stated that decarbonization and reduction of coal extraction are a heresy and an action against the state (http://www.pap.pl/aktualnosci/news,441099,prezydent-mowienie-o-dekarbonizacji-jest-herezja-i-jest-antypanstwowe.html), and in October of 2015, he vetoed an amendment extending the Kyoto Protocol until 2020, arguing that the country needed more time to analyze its impact on the national economy.

Similarly, but already in 2011, Janusz Lewandowski, then the EU Budget Commissioner, said that ''the thesis that coal energy is the main cause of global warming is highly questionable . . . Moreover, more and more, there is a question mark put over the whole 'global warming' as such'' (http://www.euractiv.com/section/public-affairs/news/poland-s-eu-commissioner-in-surprise-climate-denial-move/). This is not an isolated example of doubting the scientific findings on climate change: J. Kaczyński stated that there is no evidence that $CO_2$ emissions play any role in climate change and there are very many proofs that they do not play any role (http://www.newsweek.pl/polska/co2-nie-ma-znaczenia-dla-klimatu--kaczynski-na-slasku,89656,1,1.html). Zbigniew Ziobro, at present the minister of justice and attorney general, said (ironically?) that ''We drink carbon dioxide in carbonated drinks, so it cannot be harmful'' (http://naukaoklimacie.pl/aktualnosci/klimatyczna-bzdura-roku-2014-wybrana-72). Jan Szyszko, a former minister of environment, stated that ''carbon dioxide emitted in Poland is the gas of life for living natural systems so that they get better'' (http://www.klimatycznabzduraroku.pl/gaz-zycia). He advocates climate change mitigation measures related to the forestry sector, which he is closely related to, although they are overrated, insufficient, and unsuitable (Szulecka 2016). A former member of the European Parliament, Janusz Korwin-Mikke, delivered a peculiar speech in European Parliament on 25 June 2014, in which he proposed the prosecution of bad-faith climate scientists for their ''lunacy.'' (https://www.youtube.com/watch?v=AjMQYE6Qp-k). He stated that ''the global warming—if it is real—is not anthropogenic. . . But it is the instrument to achieve a specific goal: zero growth. And this goal. . . has been reached. For 2 trillion Euro spent—and wasted.'' Contrarian views can be also met among civil servants dealing with climate and energy policies, claiming that ''there are many different views on causes of climate change''[5] (see also Braun 2014).

In this context, the acceptance of the EU climate and energy package and related climate change mitigation policies have been perceived as an externally imposed policy problem (Ancygier 2013). A clear noncooperative approach represented by Polish officials at the EU level led to a situation in which, on 23 October 2014, the eve of the European Council's meeting supposedly to agree on the EU's climate and energy goals until 2030, three ambassadors (British, French, and German) in Warsaw published an article titled ''To leave the dangerous path'' in the influential Polish daily newspaper *Rzeczpospolita* (Buhler et al. 2014). The authors sketched a vision of an ambitious global agreement that would improve the chances that a dangerous level of warming will not be reached and presented positive national experiences in decarbonization of the energy sector. The article was a specific appeal to the Polish government, because of a threat that it would veto a European climate and energy agreement again (cf. Ancygier 2013). Nevertheless, to show that Poland is not a ''black sheep'' of the international community, the government organized two Conferences of Parties (COP) of the UNFCCC: COP 14 in 2008 in Poznan, Poland, and COP 19 in 2013 in Warsaw.[6] The latter attracted considerable attention, because in the opening speech, Prime Minister Donald Tusk emphasized the role of coal for economic growth of Poland, whereas development of renewables was not mentioned at all. Parallel to COP 19, the Polish Ministry of Economy organized a ''coal summit.'' For this ''achievement,'' Poland was given the ''Fossil of the Day''

[5] Interview in Ministry of Energy, Warsaw, Poland, 25 October 2017.

[6] The COP 24, in 2018, is going to be organized in Poland as well, this time in Katowice in Upper Silesia.

award (http://www.climatenetwork.org/fossil-of-the-day/poland%E2%80%99s-blind-addiction-coal-earns-them-fossil). In addition, Marcin Korolec, who opened COP 19 as the minister of environment and took the duty of conference president, was dismissed from the ministerial position during the conference by Mr. Tusk, which was interpreted by the leading nongovernmental organizations (NGOs) as a clear signal that the Polish government was not treating the COP seriously (PAP 2013).

The fossil fuel sector can attempt to strengthen its position in the system to some extent by using the support of scientists. Typically, contrarian scientists are not climatologists, but rather are, for example, geologists, astronomers, economists, or mining or energy engineers, whose arguments in the case of climate change often reach beyond their competence field. For example, in February of 2009, the Committee of Geological Sciences of the Polish Academy of Sciences presented a position paper on global warming in which an opportunity to explain the current warming by geological analogies was suggested (KNG 2009). This manifesto, delving into an area outside of the Committee's competence and contradictory to the statement of the General Assembly of the Polish Academy of Sciences, included many mistakes, did not refer to any scientific literature, and eventually was challenged by the Committee of Geophysics of the Polish Academy of Sciences (Popkiewicz 2013). It is interesting to note that an informal Polish–Norwegian collaboration of climate contrarians commenced in the late 1980s and early 1990s. For example, contrarian arguments created by such collaboration have been "smuggled" into a peer-reviewed journal (Jaworowski et al. 1992b) and other publications (Jaworowski et al. 1990, 1992a). The late Zbigniew Jaworowski, professor of medical sciences, was very successful in disseminating contrarian views in Poland (Doskonale Szare 2013) such as, for example, his contributions to the opinion-making Polish weekly magazine *Polityka*. His scientific advice backed selection of the advent of a new ice age (on the ground of orbital theory) as a fake-news cover story in July of 2003, during the record-hot summer weather in Europe. This is not to say that there have been no scientifically informed and bona fide voices on climate change in Poland—they can be found, for example, in two Polish websites: Doskonale szare (Perfectly Gray Body; http://doskonaleszare.blox.pl/html) and Nauka o klimacie (The Climate Science; http://naukaoklimacie.pl/). The latter website bestows an annual "award" for the climate hoax of the year, and it is worth noting that two of these awards have been given to abovementioned ministers in the Polish government, Mr. Szyszko (2015) and Mr. Ziobro (2014).

In this manner, it is difficult to find a countervailing force to the position of the fossil fuel sector in the political–economic system. Such a role should be naturally ascribed to the NGOs, which could influence the social perception of climate change, but this is not the case in Poland. Although there are examples of successful actions led by environmental NGOs and environmental movements in Poland, such as stopping the development of a motorway crossing the small Rospuda River in northeastern Poland (Szulecka and Szulecki 2013), their endeavors advocating action on climate change result in a small social resonance. Therefore, instead of concentrating directly on the importance of climate change, they try to redirect their actions and link climate change with the issue of smog[7] that became a highly discussed topic in Poland in recent years and that was able to mobilize environmental movements at the local level (Szulecka and Szulecki 2017).

## 6. Concluding remarks and discussion

In this paper we presented an overview and explanation of climate change contrarianism and compared national contexts of Norway and Poland. These countries represent two different approaches with regard to climate change contrarianism, and this is what encouraged us to investigate their respective drivers. We based our analysis on the model proposed by McCright et al. (2016b), emphasizing the ideological factors determining positions in political–economic systems and the general strength of the contrarian movement. In addition, we supplemented this approach with the cultural cognition thesis proposed by Kahan et al. (2011) underlining the role of identity in the creation of contrarianism. Our findings show that factors suggested by these authors are confirmed only partially and that it is still difficult to define universal drivers of contrarianism that are valid in different cases.

Although one can state that in both countries environmental values are important for the society, this does not have a direct reflection on the occurrence of contrarian attitudes. One reason for that could be that Norway seems to be more vulnerable to climate change, and its direct implications are much more visible "on the ground" for the public in Norway than in Poland. Another explanation could be that environmental values are inevitably coupled with the Norwegian identity, which is not the case in Poland. In this context it could be

[7] Interview with ClientEarth, Warsaw, 14 November 2017; interview with Greenpeace Poland, Warsaw, 16 November 2017; telephone interview with WWF Poland, 5 December 2017.

reasonable to scrutinize the relationship between other elements important in shaping the identity and its impact on the contrarianism, such as religious beliefs, which have been excluded from McCright et al.'s (2016b) model. Actually, such investigation would be relevant in the case of Poland—as suggested by Kvaløy et al. (2012), religion can have only a moderate impact on climate attitudes or, at least, it does not increase the level of contrarianism (Tranter and Booth 2015). Yet, this nexus is different in the Polish case, as illustrated by the reaction to Pope Francis's encyclical, ''*Laudato sí*'' (Pope Francis 2015), which devotes paragraph 26 to the need for climate change mitigation. In the largely Roman Catholic Polish society, the teachings of the church and of the Pope are usually heeded with much attention and respect, but since publication of the encyclical it has been regarded by nominally conservative authors as anti-Polish; it was also noted that the papal infallibility dogma is not necessarily valid for the issues of global warming (Lamża 2016).

Similarly, political orientation (left–right), considered to be one of the strongest factors of contrarianism, is not an important driver in both countries, where the political spheres are like a monolith in representing climate change attitudes. Perhaps in such cases it would be more relevant to focus on different elements regarding the political dimension such as trust in governments and political system, especially when scholars are not sure about its exact impact. For example, Tranter and Booth (2015) showed that less trust in the government is correlated with climate contrarianism, whereas Vainio and Paloniemi (2013) found that distrust in governments and the political system motivates people to take climate-friendly actions. In the case of both countries, it would be relevant to check such a relation, especially when Norwegians are characterized by one of the highest levels of trust in governments and public institutions globally (Christensen and Lægreid 2005) and Poles, on the contrary, hold comparatively low levels of trust in government (OECD 2013; Ortiz-Ospina and Roser 2016). Moreover, the public acceptance of the Government Pension Fund Global in Norway, built on offshore revenues, creates a space for a careful analysis, since it could contribute to the high level of general trust. This, in turn, could be explained by the fact that people in Norway have experienced the benefits of a welfare system that they consider to be unique, built on the ''Nordic model,'' with a trusted way of governance (Eklund et al. 2011). The Nordic social democracy and an inclusive and egalitarian society distinguish Norway from Poland and Anglo-Saxon countries, characterized by stronger competition, a fiercer market economy, and a purer brand of capitalism. These differences may also be possible explanations for how the fossil industries respond differently to climate change in the respective countries. In this context, cultural aspects of interpersonal trust among Norwegians may also affect climate change attitudes, because climate change is a collective responsibility and coping strategies require collaboration on par with the Norwegian term ''*dugnad*'' (meaning volunteer collective effort, dating back to the Viking era).

With regard to the last element of the framework, the strength of the contrarian movement, we find it appealing that the strong position of fossil fuel actors in the political–economic system can lead to two different outcomes with regard to contrarianism. Since the oil and gas sector is much more important for the Norwegian economy in general than the coal sector is for the Polish economy, it should mean that fossil fuel industrial actors have a stronger position in the Norwegian system than in the Polish one and that they would undertake many actions to spread contrarian information in Norway. However, it is just the opposite—they are involved in activities calling for climate change mitigation measures or they advocate, at least, for a broader energy mix. One can interpret this by stating that the strength and the behavior of the fossil fuel industrial actors in the political–economic system can differ from sector to sector and among different fossil fuel types. Moreover, the continuously diminishing role of the coal sector for the Polish economy over time could justify a hypothesis that, in the past, contrarianism could have been even stronger there. This would, however, be difficult to validate because of the lack of historical data and the fact that the decline of the coal sector in Poland is temporally related to the political–economic transformation as well as to contrarianism's development at the global scale. Therefore, it shows that the relative strength of contrarian movement positions can be a result not only of the currently available resources but also of the path dependency of developments of social, political, economic, and technical regimes. This would be an interesting domain to investigate in a comparative way in the future with cases from different countries, such as Germany, with its low level of contrarianism (Engels et al. 2013) but with a very strong (and protected) position of the automobile industry (Eddy and Ewing 2017). Moreover, we agree with McCright et al. (2016b) that the strength of the contrarian movement may have different repercussions in political–economic settings that are different than late-industrial capitalism. A fast and aggressive introduction of the free-market economy in Poland resulted in ''winners and losers'' of the transformation and in occurrence and growth of many social problems (Wódz et al. 2012). Therefore, we could identify other challenging areas of further research, such as geographical distribution of fossil fuels and its impact on identity in the regional comparison or the role of the fossil fuel industry in redistribution of national wealth.

We are aware of the shortcomings of our work resulting from the lack of a big primary dataset and the descriptive character of our analysis. However, we think that this work shows that, in analyzing climate contrarianism in differentiated contexts, in-depth qualitative case studies can add value and shed light on issues that require more detailed elaboration, interpretation, and insider knowledge. This work can also trigger a discussion as to how to investigate climate contrarianism at all—the dominant form of surveys cannot always give a nuanced understanding of the surroundings in which it develops and functions. It also concerns the understanding of potential drivers of contrarian attitudes, as exemplified by environmental values, which can have multiple meanings for different societies and which may bring different effects in various settings. Last, it raises a question about the researcher's role in counteracting contrarian information spread in specific contexts.

Although dissemination of scientific knowledge on climate change can overcome contrarian attitudes (Shi et al. 2016), it still has a one-direction character of communication, and, to be effective, communication strategies should take more sophisticated and tailored forms [for a discussion, see Moser and Dilling (2011)]. One suggestion for that could be establishing collaborations that integrate actors from industry, politics, and civil society (Kundzewicz et al. 2017a; Wall et al. 2017). Next, learning from our cases in preparing tailored communication strategies, we would turn to Smith et al. (2017) who underscore basic values, like security or well-being, in evoking climate change concerns.[8] One line of argumentation could be smog and ambient air pollution–related concerns, which could improve awareness of the coal–air health-quality link (Pillay and van den Bergh 2016), and this issue has the potential to make a clear tie with climate change. Since energy security and energy independence are presented in the Polish public debate as very important issues (Świątkiewicz-Mośny and Wagner 2012), linking climate change with energy security (Toke and Vezirgiannidou 2013) could be another starting point to reduce contrarian attitudes in Poland. Last, but not least, in the latter context, we think that an extended Norwegian–Polish cooperation could bring additional outcomes in showing how seriously climate change and its attribution, impacts, and possibilities of mitigation can be treated by decision-makers. We do not refer here to academia, because, as our research project's example (and many others) show, there is an understanding and willingness to cooperate. We think, however, that the latest developments in Polish–Norwegian gas cooperation, building a special energy infrastructure (the Baltic Pipe), and its importance in the Polish public debate about gaining independence from Russian gas supplies (Jakóbik 2018; KAB 2018), give opportunities to create a forum in which representatives from the fossil fuel industry, policy-makers, and researchers could together tackle the issue of climate change significance.

This is not to say that in both countries only examples of black–white division are present. We are aware that this is not true, and it would be unfair to state so, because there are many people in Poland who point to the importance of climate change, and the general attitude of the political establishment seems to be slowly but continuously changing. Nevertheless, with this paper we hope to stimulate a deeper discussion about climate contrarianism, its drivers, and different channels of spreading contrarian information, as well as to contribute to the campaign against contrarian claims.

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[8] However, we do not intend to call for creation of negative feelings related to fear (see, e.g., Janković and Schultz 2017) or to selective science communication strategies that could evoke ethical concerns (Persson et al. 2015).

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4. Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective.

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| Abstract | For many years diverging issues and interests have dominated bilateral relations between Poland and Germany in the field of climate and energy policies, contributing to a feeling of mistrust between both countries. Yet existing thematic controversies cannot fully explain the lack of cooperation, especially since there are sectoral areas in which a close collaboration is possible and desirable. In order to uncover the nuances of Polish–German relations in the fields of climate and energy, this chapter analyses in detail one dimension of embedded bilateralism: regularised intergovernmentalism. It argues that a weak formalised cooperation between Poland and Germany results from different perceptions of their roles in the EU policy-making process, which is reinforced by dominating narratives around the climate and energy policies of both countries, manifested by decision-makers. Nevertheless, the EU contextual policy-making sphere, as well as stable and experienced human resources at the working level, can overcome this drawback. |

# Poland and Germany in the European Union

This book explores the political and social dynamics of the bilateral relations between Germany and Poland at the national and subnational levels, taking into account the supranational dynamics, across such different policy areas as trade, foreign and security policy, energy, fiscal issues, health and social policy, migration and local governance.

By studying the impact of three explanatory categories – the historical legacy, interdependence and asymmetry – on the bilateral relationship, the book explores the patterns of cooperation and identifies the driving forces and hindering factors of the bilateral relationship. Covering the Polish–German relationship since 2004, it demonstrates, in a systematic way, that it does not qualify as embedded bilateralism. The relationship remains historically burdened and asymmetric, and thus it is not resilient to crises.

This book will be of key interest to scholars and students of European and EU politics, German politics, East/Central European politics, borderlands studies and, more broadly, for international relations, history and sociology.

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# Poland and Germany in the European Union

## The Multidimensional Dynamics of Bilateral Relations

**Edited by**
**Elżbieta Opiłowska and Monika Sus**

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*Andrzej Ceglarz*

### Introduction

Polish–German collaboration in the field of climate and energy policies is highly desirable, and both countries could meaningfully benefit from greater cooperation and coordination in this area. However, the existing literature points out that bilateral dialogue remains dominated by controversial topics, which reinforce divergences and mistrust between the two countries (Ancygier & Szulecki, 2014; Gawlikowska-Fyk *et al*., 2017; Heinrich *et al*., 2016; Ruszel, 2016). These studies identify and expand areas of Polish–German misunderstandings as well as propose areas of shared interests. However, they are mostly descriptive and policy-oriented and do not reflect the dimensions of embedded bilateralism proposed by Krotz and Schild (2012), as outlined in the Introduction to this volume. In consequence, they do not capture the nuances of the factors that determine bilateral relations in the climate and energy policy fields. In order to fill this gap, this chapter addresses the research questions guiding this book, with the goal of evaluating whether Polish–German climate and energy relations can be classified as an example of embedded bilateralism, and provides an empirical analysis of the state of bilateral relations in this policy field. To achieve this, it sheds light on selected elements presented in the Introduction, which thereby comprise a further developed theoretical framework. More precisely, it focuses on the first condition of embedded bilateralism – regularised intergovernmentalism (as dependent variable), the choice of which has been determined for two reasons. First, it reflects the character of policy-making in this field: although the Lisbon Treaty constituted energy as a common European Union competence, member states preserved the right to decide on their energy mix (Braun, 2011). Moreover, particularly since the beginning of the last decade, there has been a clear trend towards the EU's climate and energy policy-making

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process assuming an intergovernmental character, especially in deciding upon future developments and directions in that realm (Fischer, 2014). Second, taking into account a practical perspective, although subnational levels have played an increasing role in the creation and implementation of climate and energy policies (Jänicke & Quitzow, 2017), it is the governmental level that is able to design favourable conditions to support Polish–German cooperation (Gawlikowska-Fyk *et al.*, 2017). Hence, the focus of this chapter lies on the national level, strongly considering the EU level too.

As the explanatory category, this analysis features asymmetry as the main factor for bilateral Polish–German relations in the climate and energy policy fields. Acknowledging the multidimensionality of asymmetry, it explores its political facet in the immaterial context, concentrating on soft factors such as identities and roles. An in-depth explanation and operationalisation of this category in the next section reveals the auxiliary goals of this chapter: it not only contributes to theoretical deliberations on factors determining Polish–German relations but also delivers an additional analytical layer broadening the conceptual comprehension of bilateral relations in terms of climate and energy policies.

I refer consistently to climate and energy policies as a unified policy field, since, with its introduction in the Lisbon Treaty, energy started constituting a horizontal policy issue, deeply accommodating the climate change component, making both areas increasingly complex, interlinked and intertwined (Braun, 2011; Helm, 2014). Renewable energy sources (RES), embodying a cornerstone of the EU's decarbonisation efforts and placed very high on the political agenda of the Cabinets of consecutive Commissions, represent a prominent example illustrating this interrelation, as appointed in the Energy Union Strategy (European Commission, 2015). The political significance of this sectoral area is additionally emphasised by studies situating the development and deployment of RES together with greenhouse gases (GHG) reductions (which are decisive for the speed of energy transformation), among other conflictual and controversial issues in Polish–German climate and energy relations, such as Nord Stream, electricity loop flows, shale gas extraction and nuclear energy (Gawlikowska-Fyk *et al.*, 2017; Heinrich *et al.*, 2016; Ruszel, 2016). Although these issues gained their political momentum and public attention at different points in time over the last decade, the timeframe applied in this chapter mostly concerns the period after 2015, when for the first time the responsibility of government for climate and energy policies in Poland has been lying entirely with one party – Law and Justice (Prawo i Sprawiedliwość: PiS), with some references made to the years before 2015 in order to provide comparative elements and capture perceptions of the changes that occurred after the change in government.

This chapter claims that Polish–German relations in the climate and energy field are not likely to qualify as embedded bilateralism, especially in view of the established and formalised bilateral collaboration. Such a state of affairs is explained by dominating perceptions of Poland's and Germany's assymetric roles in climate and energy policy-making process at the EU level, combined with the climate and energy policies of the two countries, which are strongly related to their technological energy choices. These together create a perception of being competitive and antagonistic, which in combination contribute to a mistrust that hinders bilateral relations. However, despite the fact that dominating mutual views on the two countries' roles are of a rather rivalrous character, the EU policy-making sphere remains a contextual space that facilitates an intensification of Polish–German cooperation in the discussed field.

This chapter is structured as follows. First, based on a literature review, I sketch the theoretical framework of my analysis. Second, I propose the methodological approach that guides the chapter, and subsequent sections present the empirical findings. The final section concludes, provides an answer to the questions guiding this book and suggests possible avenues for further research.

## Theoretical underpinnings of asymmetry in the climate and energy field

A recent publication discussing asymmetries in Polish–German relations highlights the role of structural conditions and power (Szwed, 2019). This chapter takes a different stance, built on the constructivist tradition, and concentrates on contextualised settings embedded in broader, ideational and more abstract concepts, such as political discourses, perceptions, identities and visions, which have recently begun to play an important role in research in the climate and energy field. For example, Schmid *et al*. (2017) focus on visions of corporate actors and practitioners from the energy sector, uncovering different imagined characteristics of the future German electricity system. It is crucial to include such heterogeneity of visions when designing political and institutional reforms in the climate and energy realm. Different visions of the electricity system represented by corporate actors from the renewables sector, but on a higher, European scale, are in the centre of Lilliestam and Hager's (2016) study. They conclude that the final, preferred outcome of the system design, which determines actors' choices and behaviour, does not depend solely on rational, 'hard' premises, such as costs or technological feasibility, but is strongly embedded in normative foundations and governance choices.

More relevant from the perspective of this chapter is the question as to how perceptions of key policy-makers determine the state's preferences and political decisions. This issue has been investigated by scholars in the EU context, where, for example, the ideological preferences of agents sitting in the Council of the European Union can determine the member state's position on deepening European integration (Miklin, 2009). A similar stance has been taken by Pointvogl (2009), who investigates perceptions of energy supply security, presented by member states, and their impact on the integration of energy policies. In his research Mišík (2015) has developed the approach of investigating the correlation between perceptions of policy-makers from central and eastern European (CEE) countries on the preference formation in the context of common European energy policies. Based on the role theory, he introduces the categories of a *weak negotiator* and an *independent negotiator*, which reflect decision-makers' subjective perceptions of their states' vulnerabilities and strengths, which, in turn, determine either support for or resistance to further integration in different energy policy areas. This contribution shows that the state's role subjectively recognised by policy-makers is stable, but can differ depending on the issue's details, filtering the objective structural and institutional state's attributes. This process, although heavily influenced by dominating domestic narratives and perspectives, can resonate not only in the case of European integration. Screening the information through the existing lenses of established beliefs and ideas and, in turn, ascribing to the state specific meanings and roles by decision-makers can lead to conviction about the correctness of a country's own national energy policies resulting, for example, from historical relations with neighbouring countries (Osička & Černoch, 2017). This can contribute to the overall feasibility of bilateral energy projects, as illustrated by Puka and Szulecki (2014) with the example of the Polish–German cross-border electricity interconnector. They emphasise that political factors and interests defined beyond economic calculation can influence bilateral relations in the energy field. In this context, the perceptions of involved national actors from both countries have a meaningful impact on dominating domestic discourses on climate and energy issues. Thus, although material factors, such as costs and technologies, play an important role in determining bilateral relations, intangible factors, such as perceptions, identities, beliefs and visions, may prove to be crucial to overcome the difficulties and challenges of the material ones.

Based on these thoughts, in the context of bilateral cooperation not only the asymmetric perceptions of the issue at stake matter but also the asymmetric perceptions of countries' roles and their subjective importance and prevalence in multilateral, complex policy-making processes. Hence, the European Union delivers an adequate umbrella framework for the analysis, since not only are Poland and Germany under the significant influence of the EU's climate and energy policies but they also shape the policy-making process in this field. Whereas that aligns with the study of Mišík (2015), in order to explain Polish–German relations in the climate and energy realm, I concentrate on perceived roles defined differently. I apply the categories of the roles mentioned in the analysis by Jankowska (2011): a *shaper* and a *taker* of European policies. The situation in which a state asymmetrically perceives the roles of itself and a partner state in a multilateral setting (shaper versus taker) will have a negative impact on the bilateral relations between the two states and hinder the establishment of stable and formalised relations. Not only are such conceptions related to perceived influence on the policy-making process but they also result from past experiences as well as conceptualisations of national purposes and interests. The latter are linked to specific policies implemented domestically as well as to technological choices, which, when not convergent, can be understood as an institutional and structural asymmetry, reinforcing the asymmetric perceptions of the states' roles. Specific practices constituting (embedded) bilateral relations refer here to regularised intergovernmentalism, conceived as various forms of formalised and institutionalised structures, such as recurring intergovernmental meetings or intergovernmental and interministerial working groups.

Against the backdrop of the intergovernmental arrangements, I utilise the groupthink analytical model applied in the context of US foreign policy by Rosati and Scott (2011), which explains how the policy-making process operates within the executive branch. This enables a better understanding of the dynamics behind the process of ascribing states' roles. In this context, groupthink can be characterised as having a centralised policy-making structure and being based on dominating group norms and beliefs. Rosati and Scott (2011) describe this policy-making mode as closed to new information, resisting the consideration of alternative policy options: 'Instead of deliberating the relevant goals, searching for information, considering alternatives, and selecting the policy option that maximizes goals, groupthink often results in a nonrational process' (Rosati & Scott, 2011: 264). Indicators of groupthink encompass 'an overestimation of the competency and inherent morality of the group, a tendency to stereotype out-groups and rationalize decisions, and the tendency to pressure members toward uniformity (usually through self-censorship), providing the illusion of unanimity' (Rosati & Scott, 2011: 264–265). Yet, although this model puts much emphasis on the executive's aggregated mindset, this may lead to an oversimplification of this domain, especially in the European context. Therefore, I distinguish between different operative levels of decision-makers: those exposed at a higher political level, usually nominated by a political provision; and those at the working level, such as ministerial civil servants, who are involved in the European climate and energy policy-making process on a day-to-day basis, for example by long-standing exchanges with counterparts from other member states or the EU's representatives.

## Case selection and method

Renewable energy policy is a highly suitable sectoral area with which to understand Polish–German climate and energy relations and their European component (cf. Ancygier & Szulecki, 2014). With this analysis I aim to take a stance on more current affairs and focus on the Polish–German cooperation accompanying the work on the revised Renewable Energy Directive 2018/2001/EU (RED II) and the Governance Regulation 2018/1999/EU, which are parts of the EU's comprehensive energy policy framework 'Clean energy for all Europeans' package. Both legislative pieces are essential for the development of European renewable energy policies after 2020 (for more details, see Ringel & Knodt, 2018). They came into force in December 2018, but the work on them had started in November 2016, when the European Commission published the so-called Winter Package – a set of eight proposed legislative measures to implement the Energy Union Strategy. The time period taken into account was extended until December 2019 in order to include the work of both countries dedicated to the creation of the national energy and climate plans (NECPs) up to 2030, which serve as the main tools to improve the overall governance of the EU's energy and climate policies and measures (effected also by means of bilateral cooperation between member states).

This chapter is based on data collected in 33 expert semi-structured interviews[1] with Polish policy-makers, business and industry stakeholders, representatives of research, experts and NGOs, conducted in Warsaw and Brussels in 2017 and 2018 as part of a PhD project. The anonymised list of interviewees can be found in Table 9.1. When using a direct quotation, I refer to the interviewee's category and the overall number of the interview.[2] Additional material was obtained from primary documents (e.g. ministerial documents), personal written communications and secondary sources. If not stated differently, all empirical information presented in this chapter comes from these interviews.

It is important to note that, although the aim of this chapter is to provide an overview of bilateral relations in a comparative perspective (especially regarding differently perceived roles in the policy-making process), I concentrate here mostly on the data provided by the Polish actors, for three reasons. First, the analysis based only on data extracted from actors operating in one country has been proved to be sufficient in delivering comprehensive information about the climate and energy interrelations in a comparative view (see, e.g., Černoch *et al.*, 2017), especially if it encompasses a broad spectrum of actors, representing differentiated groups, which reinforces the general message. Second, an in-depth exploration of the Polish institutional and political context and its nuances, as reflected by domestic actors, can improve our understanding of Poland's 'exceptionalism' in this area, contributing to discussions led by other scholars, whether on the unanimity of political parties on the EU's climate and renewable energy policies[3] (Marcinkiewicz & Tosun, 2015), the presence of climate change issues in Polish media (Kundzewicz, Painter & Kundzewicz, 2019) or a general securitisation of energy policy (Szulecki, 2020). Third, as this chapter is based on empirical data collected for a PhD project, it has been decided not to use the whole dataset before publishing the dissertation. This decision has been additionally backed by the limited space dedicated to each chapter.

The next section provides an empirical description of elements representing regularised intergovernmentalism, as elaborated in the theoretical part, complemented with subjective evaluations of this cooperation by involved agents.

*Table 9.1* List of interviewees from the climate and energy field in Poland

| *Category* | *Institution* | *Date* | *Place* |
|---|---|---|---|
| Policy-making (9) | Ministry of Energy, Department of Energy Production (2 interviewees) | 25 Oct. 2017 | Warsaw |
| | Member of the Polish Parliament (Committee on Energy and Treasury) | 25 Oct. 2017 | Warsaw |
| | Ministry of Foreign Affairs, EU Economic Department (2) | 26 Oct. 2017 | Warsaw |
| | Ministry of Energy, Department of Renewable Energy (2) | 27 Oct. 2017 | Warsaw |
| | Ministry of Environment, Department of Ambient Air and Climate Protection | 7 Nov. 2017 | Warsaw |
| | Energy Regulatory Office, Department of Market Development and Consumer Affairs (2) | 28 May 2018 | Warsaw |
| | Ministry of Foreign Affairs, EU Economic Department (2) | 23 Jul. 2018 | Warsaw |
| | Permanent Representation of the Republic of Poland to the European Union (2) | 11 Sep. 2018 | Brussels |
| | Assistant of the Polish MEP (ENVI Committee) | 11 Sep. 2018 | Brussels |
| Business and industry (10) | An umbrella association in the renewables sector | 27 Oct. 2017 | Warsaw |
| | Polish Confederation Lewiatan | 6 Nov. 2017 | Warsaw |
| | National Chamber of Biofuels | 13 Nov. 2017 | Warsaw |
| | PSE S.A. (transmission system operator) | 16 Nov. 2017 | Warsaw |
| | PGE S.A. (Polish Energy Group) | 18 May 2018 | Warsaw |
| | The Polish Economic Chamber of Renewable and Distributed Energy | 21 May 2018 | Warsaw |
| | The Polish Wind Energy Association | 29 May 2018 | Warsaw |
| | Former board member of PGE S.A. | 24 Jul. 2018 | Warsaw |
| | Central Europe Energy Partners | 6 Sep. 2018 | Brussels |
| | PKEE (Polish Electricity Association) | 10 Sep. 2018 | Brussels |
| Research and experts (10) | University of Warsaw | 7 Nov. 2017 | Warsaw |
| | Institute for Structural Research | 14 Nov. 2017 | Warsaw |
| | Institute for Renewable Energy | 17 Nov. 2017 | Warsaw |
| | CEC Government Relations | 30 Nov. 2017 | Phone interview |

(*continued*)

*Table 9.1* Cont.

| *Category* | *Institution* | *Date* | *Place* |
|---|---|---|---|
| | University of Oslo | 26 Jan. 2018 | Phone interview |
| | Expert portal Wysokie Napięcie | 17 May 2018 | Warsaw |
| | Expert portal Nauka o klimacie | 17 May 2018 | Warsaw |
| | The Energy Forum | 24 May 2018 | Warsaw |
| | Polish Institute of International Affairs | 25 May 2018 | Warsaw |
| | WiseEuropa | 22 Jun. 2018 | Phone interview |
| NGOs (4) | ClientEarth | 14 Nov. 2017 | Warsaw |
| | Institute for Sustainable Development | 15 Nov. 2017 | Warsaw |
| | Greenpeace Poland | 16 Nov. 2017 | Warsaw |
| | WWF Poland | 5 Dec. 2017 | Phone interview |

## Formalised formats of Polish–German bilateral cooperation

Looking through the prism of the German–French regularised intergovernmentalism in the climate and energy field, it fully fulfils the criteria of embedded bilateralism, since it encompasses, among others, a high-level bilateral group between French and German ministries responsible for energy issues, an inter-ministerial high-level working group on climate change, the French–German office for energy transition (OFATE/DFBEW) and the partnership between the German and French energy agencies (DENA and Ademe) (Pellerin-Carlin *et al.*, 2018). In this context, German–Polish cooperation looks much more modest. In recent years the two countries have been working on a bilateral climate and energy dialogue: between January 2016 and June 2019 a total of 29 different intergovernmental consultations, bilateral ministerial meetings, meetings of experts from both countries, conferences on energy issues and study visits took place (Ministry of Energy, 2019; personal communication with the Ministry of Energy, 24 June; Bundesministerium für Wirtschaft und Energie [BMWi], 2019; personal communication with the BMWi, 10 July). These endeavours mostly involved high-level political contacts, but did not result from formalised and institutional structures. In fact, representatives of business, industry and NGOs point out that, after the 2015 elections, Poland's lines of cooperation with Germany drew back and the number and intensity of intergovernmental exchanges decreased (Interviews 6, 10, 15, 16, 24). Prominent examples of successful initiatives between the two countries before 2015 were efforts to establish expert platforms, bringing together government, business and industry representatives, launched with the first German–Polish Energy Summit in Berlin in June 2014. After this event there were several meetings and intergovernmental consultations, but after the

PiS government came to power they were suspended (Interviews 6, 24). One exception in this matter under the PiS government was an ad hoc intergovernmental working group established in May 2017, with an objective to prepare positions on proposals included in the Winter Package. This work resulted in joint Polish–German positions for four of them (out of eight), presented by both countries at the Transport, Telecommunications and Energy Council in December 2017. Afterwards, this working group was disbanded (Ministry of Energy, 2019; personal communication with the Ministry of Energy, 24 June). This cooperation left a very positive impression among civil servants at the working level in different ministries. As one of the interviewees described it, ‘I must admit that from the perspective of Warsaw, if I were to point out a country with which we cooperated closest, at such an expert level, Germany was, I suppose, even number one’ (Interview 38, ‘Policy-making’). A different respondent described this cooperation as characterised by ‘a very constructive approach by Germany for final positive outcomes seen from the Polish perspective’ (Ministry of Energy, 2019; personal communication with the Ministry of Energy, 24 June). This was a result of having convergent opinions on many issues proposed in the Winter Package, which, at first sight, might seem surprising. One of the interviewees noted: ‘Probably from an outsider perspective, as someone isn’t involved, it is slightly shocking, but, no …, we had a lot in common’ (Interview 38, ‘Policy-making’). This, in turn, is seen as a consequence of many similarities in the energy system in the two countries, which can make both systems compatible: ‘I don’t see this opposition between the Polish and German sectors either. They very often have the same problems … Not only that, one can imagine a future in which … we will be compatible, we will complement each other’ (Interview 3, ‘Policy-making’; expressed also by Interviewee 4, ‘Business and industry’).

Despite this positive experience the cooperation between respective ministries at the working level has not been continued. The lack of institutional coordination is reflected by the example of the integrated NECPs. Plans prepared by Poland and Germany say surprisingly little about the possible measures that the neighbours could jointly undertake. Both countries mention each other mostly in the context of the EU’s internal electricity market, when referring to existing or planned cross-border interconnectors. In contrast, the document prepared by BMWi often mentions fruitful cooperation with west European countries as an important component for the domestic success of the Energiewende (energy transition). Close cooperation with France in particular is described as crucial and exemplary in this manner (BMWi, 2019). Meanwhile, the first version of the Polish NECP emphasises cooperation with the Visegrád Four or with ‘pro-nuclear like-minded states’ (Ministry of Energy, 2019), and the final version of the NECP states that no feedback has been received from Germany despite the sending of an invitation to comment on the document (Ministerstwo Aktywów Państwowych [Ministry of State Assets], 2019).[4] The lack of cooperation with Germany at that time was also seen as disappointing in a broader context; since the

Ministry of Energy was working in parallel on another strategic document, the 'Polish Energy Policy until 2040', it was expected to refer in this document to some aspects presented in the NECP published by the German government (Interview 29, 'Policy-making'), which eventually did not happen. Although the close collaboration in strategic, long-term and holistic terms represented by the NECPs was missing, representatives of the two governments focused their cooperative endeavours purely on selected issues that, in their opinion, had the potential to bring the two countries closer, such as electromobility or the development of offshore wind in the Baltic Sea and undersea electricity grid connections, which were discussed in a multilateral format as part of the Baltic Energy Market Interconnection Plan – an initiative under EU auspices (Ministry of Energy, 2019; personal communication with the Ministry of Energy, 24 June; BMWi 2019; personal communication with the BMWi, 10 July). Against this backdrop, the European Union delivers an institutional setting in which Polish–German collaboration in the climate/energy field continues in a formalised format, embodied by working groups preparing meetings of the Committee of Permanent Representatives and the Council of the European Union. Constant and regular contacts at the working level foster a mutual understanding and cooperation and have been treated as something natural, as one of the employees of the Polish Permanent Representation stated: 'Because here [in Brussels], of course, one simply cooperates more with others, because that is the specificity of working here' (Interview 38, 'Policy-making').

As shown above, Polish civil servants from the working level involved in bilateral climate and energy policy-making processes are sympathetic to cooperation with their German counterparts. This situation is different when it comes to the higher political level, which can explain the lack of formalised structures of cooperation. As experts in the field assess, the overall approach of politicians and politically assigned high-level officials has been unresponsive to the changing sectoral and political environment, including its international component, be it in regard to direct cooperation with Germany or to EU policy-making in general (which is very often perceived as convergent – more on that in the next section) (Interviews 21, 24, 25, 28). As one of the interviewees put it, 'in recent years, in principle, this position seems to have changed, although neither yet at the level of high civil servants, nor at the political level' (Interview 28, 'Research and experts'). In this context, experts underlined a need for a generational change of the prominent policy-making positions, in which the dominating mindsets and mental maps of the decision-makers influence the policy-making process to such a degree that people risk losing their position if they disagree or present differing views (Interviews 20, 21, 24, 25, 28; Interview 27, 'Business and industry'). The hostile, group-think attitude of the ruling party with regard to Polish–German climate and energy relations in the European context can be illustrated by a statement by one of their representatives, a presidential adviser, Andrzej Zybertowicz. He criticised Germany for Nord Stream II,[5] attributing the realisation of the

German–Russian gas pipeline to a large fall in Warsaw's trust in Berlin and, at the same time, to Poland's continuing attachment to coal. Moreover, with this argument he undermined the idea of a common European climate and energy policy, and even questioned the general existence of the EU, suggesting that Germany is treating it as a 'transitory project' (Godlewski, 2019). Although the controversy around the Nord Stream pipeline has influenced overall Polish–German relations in the climate and energy policy field, as well as in sectors other than gas (see also Puka & Szulecki, 2014), this state has been reinforced by the perceptions of both countries' roles in the EU's climate and energy policy-making.

## Views on the roles of Poland and Germany in the EU's climate and energy policy-making

Poland and Germany pursued their own interests in creating European frameworks for climate and energy policies foreseen in the Winter Package. However, opinions on the roles that the two countries play in this process are quite different. Poland has been perceived as structurally reactive, unable to develop a position that would impose an agenda in the policy-making process (Interviews 13, 23, 'Business and industry'; Interview 28, 'Research and experts'). In other words, Poland has adopted the role of a *taker* of European policies. This is a substantial change in comparison to a few years ago, when the Polish government displayed entrepreneurial skills in delivering EU compromise during the negotiations over the first climate and energy package, in 2008 (Jankowska, 2011); played an essential role in the initiation and establishment of the Energy Union (Gawlikowska-Fyk, McQuay & Parkes, 2014); and when its activity at the European level even led to considerations about a 'Polonisation' of EU climate and energy policies (Ancygier, 2013; Skjærseth, 2014).

In contrast, not only was Germany perceived as the most influential member state in negotiations over the Winter Package but the whole EU climate and energy policy was seen as tailored to its domestic needs (Interviews 9, 13, 22, 23, 'Business and industry'; Interview 12, 'NGOs'), thus making Germany an important policy *shaper* of the policies included in the package. Such a role has been manifested in several aspects, such as the ability to proactively develop certain streams of clear, consequent, long-term-oriented and durable narrative with regard to national energy policy, or in adequate reactions at the EU level to domestic developments and changes in the energy sector (Interviews 13, 22, 'Business and industry'; Interview 19, 'Research and experts'; Interview 12, 'NGOs'). Despite the fact that, during the negotiations over the Winter Package, the German government changed and German representatives in the EU for a long time did not present clear positions on concrete policy proposals (Interview 9, 'Business and industry'; Interview 38, 'Policy-making'), the perception of strength was not neglected at any point in time. Even more, some actors expected Germany to play a stronger leadership role, especially with regard to the ambition levels of some policy proposals (Interview 9, 'Business and industry'; Interview 14, 'NGOs'). The perception of Germany's role in this process has been reinforced by other material and immaterial capabilities, asymmetrical when compared to Poland, such as better provisioning of human and material resources, longer EU membership, the ability to facilitate cooperation among German public and private actors in Brussels, experience in influencing European institutions and competence in coalition building (Interviews 13, 22, 34, 'Business and industry'; Interview 38, 'Policy-making'). In the case of the latter aspect, the partnership with France in particular was mentioned as exemplary (Interview 9, 'Business and industry'; Interview 12, 'NGOs').

The behaviour of the Polish government has been perceived quite differently, since it gave the impression of being unprepared for negotiations over the Winter Package, and even of not understanding how policy-making in the EU functions (Interview 19, 'Research and experts'). Some experts evaluated the Polish government's proceedings at the EU level as obstructive instead of constructive, stemming from a personal 'mixture of aggression combined with complexes' and not being aware of exerting an actual influence on the policy-making process (Interviews 16, 19, 24, 28). Such powerlessness was bluntly reflected during the negotiations in the Environment Council in 2017 over the reform of the EU Emissions Trading System (ETS),[6] which ended with Poland's conspicuous failure, and also in terms of undermining the informal leadership role of CEE countries (Interviews 19, 28; cf. Jankowska, 2011; Mišík, 2015). In this context, two points need further elaboration. First, such behaviour has been assigned to high-level officials, who were described as being 'mentally stuck somewhere else, in some kind of national reality' (Interviews 24, 28, 'Research and experts'), which stands in contrast to representatives at the working level, who were perceived as professional and capable of pursuing a continuous and coherent approach to policy-making. One of the interlocutors admitted: 'If you don't leave negotiations to politicians, who have a bad idea about it, but to public administration employees, it just looks different' (Interview 19, 'Research and experts'). Second, although it could be assumed that EU decision-makers and negotiators from other member states could become tired of such an attitude of Polish officials (Interview 16, 'Research and experts'), no matter how extreme the position of the Polish decision-makers with regard to the overall direction of EU climate and energy policies might be, it is always considered and treated seriously (Interview 35, 'Business and industry').

Experts pointed out one particular exception in Poland's behaviour in negotiations over the Winter Package, which concerned Directive (EU) 2019/944 on common rules for the internal market for electricity and Regulation (EU) 2019/943 on the internal market for electricity,[7] strongly related to state aid rules and capacity markets. In this case Polish officials took a proactive role in starting the discussions with the European Commission very early, presented some ideas and concepts, pre-notified the Commission and initiated the process of constant communication, exchange and constructive commenting on new versions of political proposals. One of the interviewees described this process as follows: 'It came as a complete shock to me, because this is the first situation, where suddenly Poland behaves as other countries behave, when it comes to energy policy … . This is a complete novelty in the way Poland deals with energy policy' (Interview 19, 'Research and experts'). Very strong involvement on the part of the Polish transmission system operator, Polskie Sieci Elektroenergetyczne (PSE S.A.), over the course of the negotiations made a powerful contribution to the change of behaviour and the professionalisation of activities.

## Views on climate and energy policies of Poland and Germany

The way the roles of the two countries in the policy-making process dedicated to the 'Clean energy for all Europeans' package are ascribed with different meanings is strengthened by discourses around the climate and energy policies of Poland and Germany, manifested by prominent decision-makers. In this context, the dominating narrative presented in Poland encompasses several elements. On the one hand, policy-makers followed a defensive line in the context of EU climate and energy policy-making and complained about external attacks on Poland in the European sphere, the imposition of law or the lack of effort by EU institutions to take into account the Polish specificity and domestic conditions (Interview 14, 'NGOs'; Interview 19, 'Research and experts'; Interview 27, 'Business and industry'). On the other hand, they created specific discourses around the climate and energy policies of both countries. With regard to Poland, one of the most important arguments has concerned energy security, broadly identified with domestic coal resources and reflecting a strategic and securitised approach to energy (for more information, see Szulecki, 2020). Since the predominance of coal in domestic energy production in Poland has not been in line with the ambitious climate policy promoted by the EU, policy-makers presented it as a burden on the economy and underlined Poland's huge emission reductions since 1990 in accordance with the UN Framework Convention on Climate Change, additionally juxtaposed with increasing GHG emissions in Germany[8] (Interview 14, 'NGOs'; Interview 28, 'Research and experts'). Policy-makers have also criticised Germany's overly radical development of RES (mostly wind and solar power). That was interpreted as leading to unfavourable outcomes: within the German domestic context, RES development has resulted in higher electricity prices for consumers, presented as a threat for households in Poland. Within the bilateral dimension, the RES development was associated with an imposition of certain expensive technological choices, which would be beneficial to German industry and expand its technological prevalence (Interview 14, 'NGOs'; Interviews 23, 27, 'Business and industry'; Interviews 24, 28, 'Research and experts'). Although it is recognised that Germany sees the energy system based on RES as an opportunity for technological innovations and for industrial and economic development, for many years such a vision has not been shared by many Polish policy-makers (Interviews 10, 12, 'NGOs'; Interview 23, 'Business and industry'). Moreover, the awareness of different structural and institutional conditions in the two countries – such as the long history of RES support policies in Germany (consolidating a market-based approach to energy); the significant involvement of German research institutes in energy matters; and a bill introduced by PiS strictly regulating the minimum distance for wind turbines from the nearest residential building, which has stopped the majority of onshore wind investments – only reinforced the prejudice about the incompatibility of Poland and Germany in the climate and energy realm (Interviews 4, 9, 22, 'Business and industry'; Interview 10, 'NGOs'; Interview 15, 'Research and experts'). This misalignment has also been reflected in thinking about the energy system in general: whereas Germany represents a pan-European approach to energy systems, connecting the whole continent, Polish policy-makers prefer to see Poland as 'a lonely island' (Interview 27, 'Business and industry').

The Polish narrative developed around RES technologies also has broader repercussions, since it has presented them as western European and foreign, in contrast to domestic coal resources, understood as 'ours' and identified with Poland's national interest. In consequence, policy-makers have often presented the discussion about RES technologies in terms of EU ideology, whereas they have not attributed the same 'ideological' features to the discussions about coal in Poland (Interview 27, 'Business and industry'; Interviews 24, 28, 'Research and experts'). Furthermore, although the anti-RES technology rhetoric was in line with the general anti-EU discourse, created by policy-makers for the internal needs of the ruling party (Interview 12, 'NGOs'; see also Cianciara, 2017), it reasserted a dissonance between the roles of the two countries in the EU (Interview 13, 'Business and industry'). Such a narrative also had an impact on the behaviour of the Polish business actors from the RES sector, who, despite having professional contacts with their German counterparts, preferred not to mention them during exchanges with policy-makers, in order not to be perceived negatively (Interviews 23, 27, 'Business and industry'). However, such a mechanism also works in the German domestic context, in which energy system incumbents were not eager to expose their contacts with Polish business actors from the conventional sector, in order not to be associated with anti-climate-change and anti-EU attitudes (especially since they started investing enormously in RES technologies a few years back) (Interviews 10, 12, 'NGOs'; Interviews 19, 20, 28, 'Research and experts').

## Conclusions

This chapter has presented an empirical analysis of Polish–German relations in the climate and energy field and assessed them through the prism of regularised intergovernmentalism as a building block of embedded bilateralism as defined by Krotz and Schild (2012). This analysis shows that collaboration between the two countries does not qualify as embedded bilateralism, especially with regard to formalised structures, which would holistically encompass various dimensions in the climate and energy realm. In contrast, the existing exchange and cooperation have a cherry-picking and ad hoc character and concern only few selected issues.

The main factor responsible for such a state of affairs is asymmetry in the perceived roles of Poland and Germany in the EU climate and energy policy-making process, in which Poland represents the position of a *taker* and Germany that of a *shaper* of certain European policies. The asymmetry between the two countries is additionally reinforced by dominating narratives around their climate and energy policies as well as the accompanying technological energy choices and structural and institutional conditions, whereby Poland (in a broad sense) tries to oppose external influences coming from Germany and the European Union. When the perceived roles of two countries in a complex, multilateral policy-making setting do not align, it is difficult to foster bilateral cooperation between them. This claim seems to be backed up by positive examples, such as the German–French tandem at the EU level in general, or Poland, the Czech Republic and Slovakia, as shown in the analysis by Mišík (2015).

Yet, paradoxically, it is the EU policy-making sphere that is able to guarantee a contextual space to foster Polish–German cooperation in the climate and energy realm. An additional factor able to boost bilateral collaboration is related to the administrative capacities identified with stable and experienced human resources at the working level, which, being politically and ideologically free, can work against misconceptions but also acknowledge existing differences. This imbalance of capabilities between the operative levels of decision-makers and its impact on Polish–German relations has been especially visible since the PiS government assumed power.

Asymmetry of roles represents just one dimension of the factors influencing Polish–German bilateral relations in general, developed here as an additional, conceptual layer. Analysing other facets of Polish–German asymmetry (whether material or immaterial) with a multi-layered approach could contribute to a better understanding of bilateral cooperation in the climate and energy field. This is true also in relation to other categories outlined in the Introduction, as some of the empirical findings presented in this analysis suggest, such as interdependence, understood as compatibility in terms of the Polish and German energy systems and the interconnectedness of the two countries' electricity systems, or (to a very specific extent) the historical legacy, which always shows up as a 'Nord Stream/Ribbentrop–Molotov Pact' nexus – especially since it started to be a reference point in discussions about Polish–German climate and energy relations in sectors other than gas. That also proves the growing complexity and interrelatedness of climate and energy topics, manifested in the mixing of different issues by the interviewees, such as EU ETS, the electricity market or RES development. Finally, to have a comprehensive overview of Polish–German cooperation in climate and energy policies, other dimensions of embedded bilateralism can be analysed too, such as, for example, parapublic underpinnings, which represent a promising research field in analytical (Jänicke & Quitzow, 2017) as well as practical terms (Serre & Schneider, 2018).

## Notes

1 With 39 interview partners: during some interviews more than one person representing a given institution participated.

2 The empirical information used in this chapter represents only data collected from the Polish interviewees, whereas the PhD project is broader, consisting of data collected in 65 interviews, including also German and EU actors. Therefore, in order to guarantee full anonymity, the number of the interview applied in a quotation does not reflect any interviewees' number listed in Table 9.1. Furthermore, regarding the policy-making sphere, I refer here to the respective ministries existing at the time of data collection (Ministry of Energy and Ministry of Environment), since, following the government restructuring of 2019, the responsibilities of these entities in the case of climate and energy policies have been divided between the newly established Ministry of Climate and the Ministry of State Assets.

3 However, it should be noted that the analysis presented in this research encompasses data up to 2014, and in the meantime some Polish political parties have started espousing different views on these topics. Furthermore, in October 2019, for the first time in history, some representatives of non-mainstream political parties that pay close attention to climate change issues in their political programmes (*Zieloni*: the Greens; and *Razem*: Together) have been elected to the Polish parliament.

4 It should be noted that member states were required to submit their draft plans for the period 2021 to 2030 to the European Commission by the end of 2018 and the final plans by the end of 2019, taking into account the Commission's assessment and recommendations on the draft plans. At the time of writing this chapter the final version of Germany's NECP has not been submitted yet. Therefore, the information provided here encompasses one document submitted by Germany and two documents submitted by Poland (including a change of responsible ministry, as indicated in note 3).

5 It should be remembered that, back in 2006, the then defence minister, Radek Sikorski, 'legendarily' compared the first line of the Nord Stream pipeline to the Ribbentrop–Molotov Pact.

6 However, it should be noted that the EU ETS reform was not a part of the policy proposals included in the Winter Package. Nevertheless, interviewees referred to this example as having meaningful consequences for the general perception of Polish negotiators in the climate and energy realm. For more on this subject, see Bolesta (2017) and Zasuń (2017).

7 These legislative pieces have not been included in the case study description, because they are not responsible directly for RES development; however, they can be treated as complementary, like all proposals presented in the Winter Package.

8 It should be clarified that such an argument had been raised at the time of the data collection, when in the years 2015 and 2016 there was indeed a slight annual growth

of GHG emissions in Germany, in comparison only to 2014. However, in general, Germany is consistently reducing its GHG emissions.

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## 5. Model-based policymaking or policy-based modelling? How energy models and energy policy interact.

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| Abstract | As energy models become more and more powerful, they are increasingly used to support energy policymaking. Although modelling has been used for policy advice for many years, there is little knowledge about how computer-based models actually influence policymaking, and to what extent policymakers influence the modelling process. Here, we empirically investigate (i) whether, how and when models influence the policymaking process, and (ii) whether, how and when policymakers influence the design, use and results of energy modelling. We analysed modelling and policy documents and conducted thirty-two interviews with different stakeholder groups in five different European jurisdictions. We show that models are used and have an impact on policymaking, especially by assessing impacts and supporting target setting, and sometimes by exploring policy options to reach these targets. We also show that policymakers influence models and modellers, especially by affecting data and assumptions, as well as the study scope, and by deciding how the modelling results are used. Hence, energy modelling and policymaking influence each other. In their exploratory mode, models can help investigate policy options and ambitious target setting. However, models can also be instrumentalised to justify already decided policies and targets. Our study implies that greater transparency, including open-source code and open data, and transdisciplinary elements in modelling could increase model legitimacy and impact in policymaking. |

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Original research article

# Model-based policymaking or policy-based modelling? How energy models and energy policy interact

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ABSTRACT

As energy models become more and more powerful, they are increasingly used to support energy policymaking. Although modelling has been used for policy advice for many years, there is little knowledge about how computer-based models actually influence policymaking, and to what extent policymakers influence the modelling process. Here, we empirically investigate (i) whether, how and when models influence the policymaking process, and (ii) whether, how and when policymakers influence the design, use and results of energy modelling. We analysed modelling and policy documents and conducted thirty-two interviews with different stakeholder groups in five different European jurisdictions. We show that models are used and have an impact on policymaking, especially by assessing impacts and supporting target setting, and sometimes by exploring policy options to reach these targets. We also show that policymakers influence models and modellers, especially by affecting data and assumptions, as well as the study scope, and by deciding how the modelling results are used. Hence, energy modelling and policymaking influence each other. In their exploratory mode, models can help investigate policy options and ambitious target setting. However, models can also be instrumentalised to justify already decided policies and targets. Our study implies that greater transparency, including open-source code and open data, and transdisciplinary elements in modelling could increase model legitimacy and impact in policymaking.

## 1. Introduction

To achieve the commitment under the Paris Agreement and the Energy Union (EU) Strategy, the European energy system must be greatly transformed and made entirely carbon–neutral [1]. Renewable energy, as a major component of the transition, brings new dynamics to the current fossil-based energy systems, including supply fluctuations and geographically more decentralised production. Although the way ahead is full of uncertainties, decisions are urgent: policymakers must now make the decisions that put us on track for renewables-dominated energy systems by mid-century. This has multiple dimensions, from designing policies for deployment of new generation assets [2], dealing with the integration of different sector policies [3], or balancing interests of involved actors [4].

Because real-world experimentation with system transitions is impossible, computer-based models can function as tools to allow policymakers to explore different decarbonisation options and policies in virtual ‘laboratories’ and generate an understanding of the policy domain [5]. As such, models can support designing policies for an uncertain future. Models can, however, also defend and justify already existing political views by providing “convenient arguments” based on “science”. With increasing model complexity, such “policy-based evidence-making” [6] is increasingly hard to detect, as model complexity often comes with reduced transparency.

Despite the growing relevance of models for ambitious climate and energy policymaking [3], we know little about the impact of computer-

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based models in policymaking and almost nothing about the impact of policymakers on energy models. The interaction between modelling and policymaking in specific policy processes has not been investigated empirically. Our research aim is to generate empirical insights about the interaction between energy modelling and energy policymaking. In particular, we investigate (i) whether, how and when models influence policymaking processes, and (ii) whether, how and when policymakers influence the design, use and results of energy modelling.

Overall, our research makes three main contributions: (i) we expand the knowledge about how computer-based modelling tools and policymaking interact along the policy cycle and modelling process; (ii) we add to the literature on stakeholder-informed modelling by investigating forms of collaboration between modellers and policymakers, and (iii) we draw implications for the continued development of both energy models themselves and scientific policy advice in the energy sector to support ambitious national and EU climate and energy policies.

## 2. Background: Energy modelling and policymaking

Models are purposeful, mathematical simplifications of reality – "smaller, less detailed, less complex, or all together" [7], but they are also shaped by, and potentially shaping, the social world in which they are embedded [8]. They can function as 'discursive or negotiation spaces', bringing together different social worlds – such as represented by scientists and policymakers. This way, models can enable scientists and policymakers to explore and create a shared understanding about unknown futures and options, and to improve knowledge and inform policy [8–11]. In such best case usage, energy models inform governmental decision-making processes and help policymakers navigate an uncertain future [12], although model results are not the "final decision for the policy process to simply implement" [5].

Energy models have been used to advice and support policymaking processes in Europe by exploring potential energy futures, alternative socio-technical pathways and scenarios [11,13–15]. Some governments have their own in-house modelling units [16], but most of them commission model-based studies, both to consultancies [17] and scientific institutions [18,19]. Often, scientific authors strive to create "policy impact" to inform and shape energy policy, while also pursuing their curiosity-driven research. Silvast et al. [20] observed that modellers have a widely shared interest in supporting decision- and policymaking, and the 'appropriate' use of models by decision-makers. A recent survey by Chang et al. [21] found that among 48 investigated energy system modelling tools, almost two-thirds had a direct or indirect policy impact. However, over a third of the modelling tools did not have any identifiable policy effect, often because they were rather new developments, mainly used within academic research, or because their application scope was too limited [21]. While this provides an interesting perspective from the modelling teams, we furthermore explore how and when models actually impacted policymaking.

The application of models in policymaking is characterised by several challenges from the perspective of modellers and (policy) users [22–24]. These problems include the inability of models to answer specific questions that users need answered [22], low transparency of models [25], lack of trust in models by policymakers, inability of models to deliver timely support for decision-making, missing capacities in institutions to make use of complex modelling, the diversity of stakeholder involvement in the decision-making or changes, and uncertainties inherent in the policy environment [26].

Engaging policymakers and other stakeholders in the modelling process increases the chance of the model's impact on policy output [26–28]. As a result, many formats of stakeholder-informed modelling such as participatory modelling, group model building, or participatory simulation exist. In such processes, policymakers and other stakeholders can participate at different stages of the model development, from data collection, through model construction and validation, to interpretation of model results and model use [29]. While such engagement can increase the chance that models answer the precise questions of involved policymakers, it also increases the possibilities for policymakers to influence the modelling process and move modellers towards producing the results policymakers need to confirm their pre-existing beliefs [14], or to justify already made decisions and proposals.

There is very little knowledge about the influence of policy on modelling. From science-policy relations research, we know that politics can generally shape research, especially in commissioned work [30]. Policymakers commission modelling, which implies that policymakers and modellers interact in some way [5,23], but how and to what extent policymakers influence modelling must be further explored.

## 3. Analytical framework

To conceptually structure our analysis, we use the policy cycle model [31,32]. The stages of the policy cycle include: agenda setting, policy formulation and adoption, policy implementation, and policy evaluation. The cycle then starts again, as new circumstances or needs generate new policy demands [31]. Along the policy cycle, different actors provide different means and carriers of information – like models – to policymakers with different policy impact [33]. The interactions between public policies and actors, contexts, events, and outcomes are complex, and they encompass different sources of pressures and information [33,34], such as interests groups or advocacy coalitions [35]. Since policymakers have only limited temporal, organisational and economic resources available to evaluate information and to base their decisions on them, they need to prioritise some information over others [36]. This raises the question about the influence of models within this process.

We apply the policy cycle model not to make a deep analysis of energy policymaking as such, but to structure *how* models support political decision-making processes, and at *what* stage of the policy cycle: to set their agenda/target (exploring), develop policies (ex-ante assessment), justify implementation of policies (validation), and/or evaluate targets and specific policies (ex-post assessment) (Fig. 1). We acknowledge that the policy cycle is a highly simplified description of policymaking, perhaps overly simplistic [31,32]. As we do not analyse how policies are made or what their impacts are, but how and when models and policies interact, it is sufficient for our purposes: it allows us to identify distinct ways in which models and policy may affect each other.

Further, we analyse *how* policymakers affect modelling and modellers and with *what* effect. The modelling process can also be viewed as a cycle, a sequence of steps. Based on Refsgaard et al. [37], we distinguish between five steps: (1) model study plan, (2) design and data, (3) model set-up, (4) calibration and validation, and (5) simulation and evaluation. Step one involves the definition of the problem, modelling requirements and aims. In the second step, modellers conceptualise how the energy system should be modelled in sufficient detail to meet the

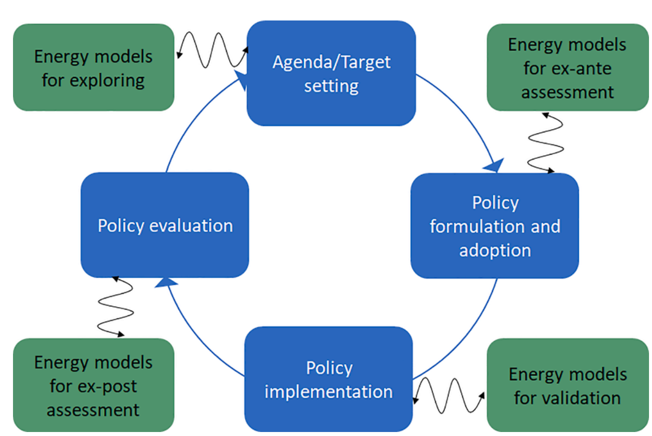


**Fig. 1.** The policy cycle and potential use of models in the different stages.

requirements of the model study plan, and prepare the input data. Then, the model is developed or improved, and calibrated or validated. Finally, in step five, simulations are run to meet the objectives and requirements of the model study. The results can be then discussed and evaluated with policymakers, and the results used to base decisions on it. Each step holds different possibilities for policymakers to affect the modelling, with the largest effect possible in the initial steps, especially in problem definition and data/assumptions, as it can affect the technical modelling steps in between [37]. Especially when the model study plan is developed, it could imply that modelling assumptions and data sources are openly discussed, but it could also strongly guide, or determine, the possible modelling outcomes.

### 3.1. Case study selection

We empirically investigate model-policy interactions in five different European cases: the EU, Germany, Greece, Poland, and Sweden. We selected these cases as representatives of different policy traditions – including the use and function of energy models in policymaking – different types of energy systems, as well as different views on the necessity and urgency of climate protection and the energy transition. For these cases, we focused on specific policy processes in which strong policy changes were proposed and the options or impacts were investigated with energy models (Table 1). Note that we do not attempt to comprehensively analyse all different cases of model-policy interactions in each country. Table 2 shows the different models that were applied in the specific cases of interest, during the time under study. For other policy processes, other models may have been used: our findings refer to the specific models and the way they were used in the specific policy processes.

### 3.2. Method

To empirically study the interaction between energy modelling and energy policymaking, we apply a multi-method approach [68], examining events leading up to major energy-political decisions in the recent past.

First, we analysed policy documents, such as legislative acts, position papers, assessment reports, and (government-commissioned) model-based studies, as well as secondary literature describing policy processes. Thus, we tracked and created a first timeline of policymaking steps [69], identified the policy-relevant model-based studies, and whether models informed policy decisions and identified relevant actors involved in these processes.

Second, we interviewed key actors involved in the specific policy and modelling processes. We interviewed four different stakeholder groups, including both ministerial staff and energy modellers (Table 3). Not all stakeholder groups have been interviewed for each case study, but were selected based on their relevance in each individual case study context. The classification of stakeholders represents groups to which an interviewee belonged at the time of conducting the interview, whereas in reality some interview partners have gained rich modelling experience, from changing their working environment between policymaking, industry, and research. To reveal how the energy models influenced the policy process, we asked about the role of modelling in policymaking generally and in specific policy processes, and how and to what extent modelling affected policy decisions. To identify how policymakers influenced modelling, we also asked about the collaboration between policymakers and modellers, and explicitly discussed whether, how and when policymakers influenced modellers and the modelling exercises.

The interviews followed a semi-structured guideline. Interviews were conducted in English or the national language of the case study country, and the presented quotations have been translated by the authors. The interviews were recorded and transcribed. We carried out a content analysis to derive evidence on with *what purpose* and *how* energy models have been used, using *what form* of collaboration, as well as how policymaking and modelling affected each other [68]. In addition, we used the interviews to complete the process-tracing, by adding specific aspects of *when* different actors commissioned or developed models for each case study [46] (the investigated processes are summarised in Figs. 2–6 in Section 4). To structure both the interviews and the analysis, we guided the work with the two cycles outlined above: For model-policy effects, we structured our work along the stages of the policy cycle, whereas for policy-model effects, we followed the modelling process. By using the policy cycle and modelling steps as analytical categories, we ensured a rigorous style in the interview analysis [70].

**Table 1**
Case study selection and focus.

| Case study | Description | Focus |
|---|---|---|
| EU | • Global ambition to be climate change mitigation leader [38]<br>• Strong influence in national energy policies of Member States [39]<br>• Diverse modelling commissioned by EU | EU's 2030 renewable energy target revision (2016–2018), and along with respective controversies [40], also around the modelling accompanying this process [41] |
| Germany | • One of the most influential EU Member States<br>• Pivotal role in pushing the "*Energiewende*" and renewable energy policies (EU and globally) [42,43]<br>• Relevance of German Renewable Energy Source Act as main regulation supporting the ambitious and dynamic renewable energy deployment | Germany's renewable energy feed-in tariff reform (2009), focusing on the photovoltaic (PV) tariff reduction and its national controversies, involving numerous political actors and modelling exercises |
| Greece | • Large potential in renewable energy [44] and active promotion of renewables in the energy policy agenda over the past ten years [45]<br>• Nevertheless, major part of indigenous lignite in the electricity generation in all scenario analysis and policies formulated until 2019<br>• 2019 political decision of phasing-out lignite-fired power plants in a short time horizon (by 2028), called for extensive modelling | Greece' decision to phase-out coal (2019), and extensive modelling work to analyse its effect on the upcoming transition of the energy system |
| Poland | • An extreme or exceptional case for its anti-climate and energy transition policies [46,47]<br>• 2008 modelling study over the 2020 climate and energy package [48] defended its position of being reluctant towards ambitious climate and energy policies [49]<br>• Continued non-ambitious policy-change approach [50] | Poland's obstruction of stricter European and national climate targets (2008–2020), and the support of modelling results for weak renewable energy targets |
| Sweden | • Strong national climate policy<br>• Highest share of renewable energy in its gross final energy consumption (55%) among EU members [51], with decarbonised electricity and heat sectors<br>• Large natural resources for use of hydro energy and biofuels, and vast development of wind and solar energy projects over last decade<br>• Ambitious climate law as further policy signal towards net zero greenhouse-gas emissions by 2045 | Sweden's development of the climate policy framework and beyond (2015–2020), and extensive modelling supporting its development |

**Table 2**
Models used in specific policymaking contexts of the case studies.

| Case study | Model | | | |
|---|---|---|---|---|
| | **Name** | **Applied by [Source]** | **Modelling type / approach** | **Geographical scale in the case study** |
| EU's renewable energy target revision (2016–2018) | PRIMES* | E3MLab (NTUA) [52] | Energy system and market simulation | Europe |
| | GEM-E3 | E3MLab (NTUA) [53] | Applied general equilibrium model | Europe |
| | E3ME | Cambridge Econometrics [54] | Macro-econometric model | Europe |
| | REmap tool | IRENA [55] | Assessment of renewable energy in terms of costs, investments and its contribution to climate and environmental objectives | Europe/ Global |
| Germany's renewable energy feed-in tariff reform (2009) focusing on the PV reduction rate | ARES | DLR [56] | Excel-based simulation model | Germany |
| | PowerACE | Fraunhofer ISI [57] | Agent-based electricity market simulation model | Germany |
| Greece's decision to phase-out coal (2019) | TIMES-GR | CRES [58] | Energy system optimisation model | Greece |
| | Dispa-SET | CRES [59] | Power system simulation model | Greece |
| | ANTARES | IPTO [60] | Power system simulation model | Regional (Greece + neighbouring countries) |
| | PRIMES | NTUA | Energy system and market simulation | Greece |
| Poland's obstruction towards decarbonised future (2008–2020) | CGE-PL | EnergSys [48] | General equilibrium model for analysis of the impact on the economy and employment | Poland |
| | PROSK-E | EnergSys** | Energy demand simulation model | Poland |
| | EFOM-PL | EnergSys** | Optimisation model for the whole energy system in the country | Poland |
| | STEAM-PL | Energy Market Agency** | Set of Tools for Energy Demand Analysis and Modelling | Poland |
| | MESSAGE-PL | ARE [61] | Model for Energy Supply Strategy Alternatives and their General Environmental Impacts | Poland |
| | CALPUFF | ATMOTERM [62] | Advanced and integrated Lagrangian puff modelling system for the simulation of atmospheric pollution dispersion | Poland |
| | GAINS | ATMOTERM [63] | The Greenhouse Gas and Air Pollution Interactions and Synergies | Poland |
| | DCGE PLANE 2.0 | WiseEuropa** | Dynamic computable general equilibrium model | Poland |
| | PRIMES | WiseEuropa | Energy system and market simulation model | Poland |
| Sweden's development of the climate policy framework and beyond (2015–2020) | TIMES-Sweden | LTU [64] | Energy system optimisation model | Sweden |
| | EMEC | NIER [65] | General equilibrium model of Sweden | Sweden |

* We refer here to the PRIMES modelling set as indicated in previous research [66]. The PRIMES modelling suite applied in this case study encompassed also other models dealing with various aspects of the energy system, coupled with each other. These models were: Prometheus, CAPRI (agriculture), GLOBIOM/G4M (land use change and forestry), GAINS (non-CO2 emissions, pollutants) and different "elements" of PRIMES: PRIMES-Energy systems, PRIMES-TAPEM (transport activity modelling), PRIMES-TREMOVE, PRIMES-Biomass supply and PRIMES-Gas supply. For more details see [67].
** Model documentations are not publically available.

**Table 3**
Stakeholder groups interviewed in the different case studies.

| Stakeholder groups interviewed (abbreviation for citation): | Policymakers ("policy") | Scientists and consultants (modellers) ("modellers") | Energy industry ("industry") | Non-governmental organisations ("NGO") |
|---|---|---|---|---|
| Country: | | | | |
| European Union (EU) | 3 | 1 | 2 | 2 |
| Germany (GER) | 2 | 1 | – | – |
| Greece (GR) | 1 | 2 | 1 | – |
| Poland (PL*) | 1 (2) | 4 (5) | 1 | 3 |
| Sweden (SWE) | 4 | 4 | – | – |

Remarks: *Two interviews were conducted with more than one person. Numbers in brackets show a total number of interviewees, which represented the same institution or stakeholder group.

## 4. Results

We find that three main categories are underlying the mutual influence between computer-based modelling tools and energy policymaking: *influence sources* – who are different actors involved, and what is the relevance of models in relations to other sources; *model purpose* – what models have been used and why; and *modelling process* – how and when are models used along the policymaking process. Below, we elaborate on the results of each case in detail.

### 4.1. *EU's renewable energy directive 2018: Model-backed revision of the renewable energy target*

In 2018, the EU defined its energy and climate targets for 2030. Here, we focus on the process of defining the renewable energy target, which was a long and arduous process [40]. Several modelling studies were commissioned to define and revise targets [66]. These model results supported the decision about the 32% of the EU's 2030 renewable energy target (Fig. 2).

The renewable energy target setting process for 2030 was initiated in October 2014, as the European Council decided a 27% target by 2030. This was a political decision, not supported by any modelling (EU_policy2). In November 2016, the European Commission presented the 'Clean Energy for all Europeans' package [71], which held proposals for several energy sector reforms, including a proposal for the new Renewable Energy Directive. To support this, the Directorate-General for Energy carried out an impact assessment, which included results from model analyses. The Energy- Economy- Environment Modelling Laboratory (E$^3$MLab) of the National Technical University of Athens (NTUA) carried out analyses with the PRIMES modelling suite [52], a set of models organised around PRIMES Energy System [67], and coupled it

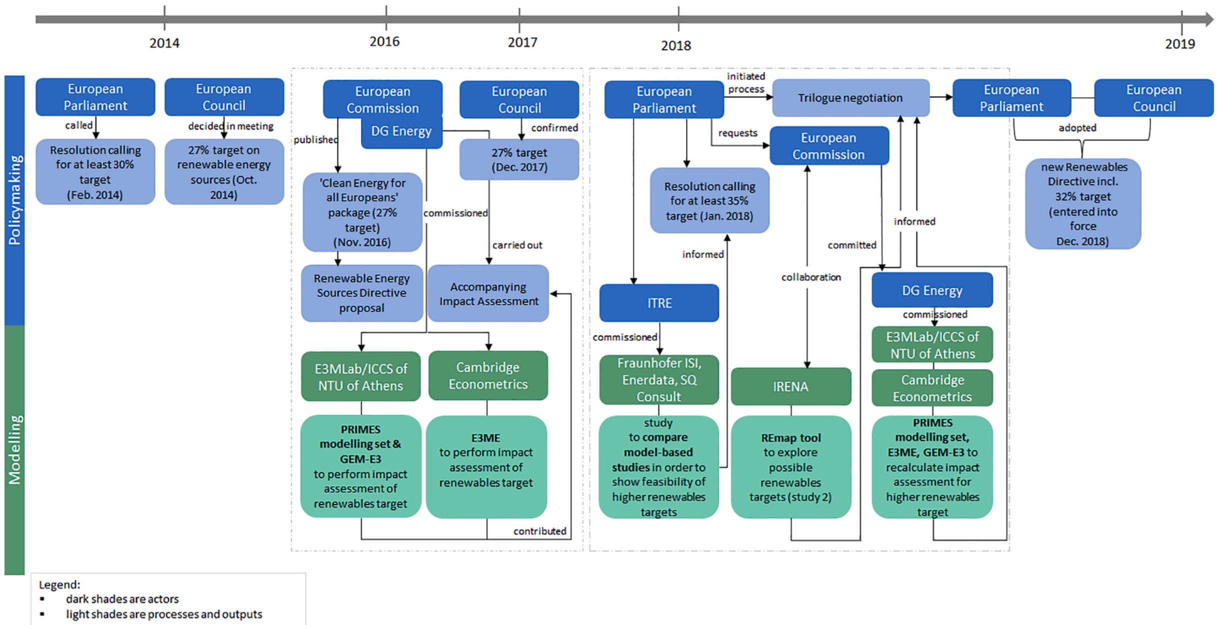


**Fig. 2.** Timeline of policymaking and modelling processes for the European Union's renewable energy target 2030.

with the macroeconomic model GEM-E3 [53]. Furthermore, Cambridge Econometrics conducted an analysis with the E3ME model [54]

The impact assessment showed that the 27% target was feasible to be achieved by 2030, and the European Commission did not propose a higher target, because of its political mandate coming from the Council (EU_policy3). Experts and the European Parliament criticised the impact assessment for its conservative and high cost assumptions of both renewable energy and $CO_2$ prices (EU_NGO2; [41]), especially since the European Parliament had already in 2014 called for at least a 30% target [66]. Once the European Parliament took over the responsibility for the directive's text and the accompanying impact assessment and prepared their own report [72], a group of the Industry, Research and Energy (ITRE) committee's parliamentarians investigated the proposal and the accompanying impact assessment, guided by the idea of re-defining and increasing the renewable energy target (EU_modeller1; EU_policy2; EU_NGO2). For that purpose, they commissioned Fraunhofer ISI, Enerdata and SQ Consult to do an analysis comparing various model-based studies concerning the feasibility of higher renewable energy targets, but conducting no modelling themselves [73]. In the meantime, in December 2017, the European Council reached an agreement on a negotiating position prior to the trilogue, confirming the 27% target. In January 2018, the European Parliament voted for a binding 35% renewable energy target and gave the start for trilogue negotiations [72].

During the trilogue negotiations, Member States such as Italy and Spain advocated for a higher target (EU_modeller1; EU_policy2). A large-scale model study financed by the European Commission, but published by the International Renewable Energy Agency (IRENA) shortly before the trilogue [74], played an important role in the negotiations. This study showed that a higher EU renewables target by 2030 is feasible, and IRENA's institutional credibility only strengthened this argument (EU_modeller1; EU_policy2). Against this background, the Parliament requested the Commission to recalculate its impact assessment and include higher renewables targets (EU_policy1; EU_policy2). In response to this, DG-Energy commissioned the same institutions to carry out additional scenario analysis with PRIMES, E3ME and GEM-E3, confirming the feasibility of a higher renewables target. This new, more ambitious scenario was a pivotal input to achieve a political agreement between parties involved in the trilogue negotiations. In November 2018, the European Parliament adopted the final text of the Renewable Energy Directive recast with a 32% renewable energy target by 2030, and a month later, the European Council did the same.

We find that policymakers had a strong influence on which ambition-levels were modelled in the EU's 2030 renewable energy target setting, which indicates policy's influence in the stage of the development of the study plan. Models had a strong influence in the reform of the target, not only the PRIMES framework prominently used by the Commission for over two decades (EU_NGO1), but also other model studies commissioned to other organisations. Hence, we see clear evidence that models were used to generate results supporting already existing positions, be it less (Council) or more (Parliament) ambitious renewables target. However, we also see that the models were used to explore and increase knowledge about policy options (EU_policy1). In particular, the long and model-heavy discussion enabled an informed, science-based debate about the renewables target. For this, models were highly influential, but "*it doesn't mean, however, that whatever comes from the modelling is automatically endorsed as proof by policymakers, but that's the ground. That creates […] a battlefield and based on that, different opinions can be exchanged. But everything starts with the modelling*" (EU_policy2). Nevertheless, although modelling had a meaningful influence on policymaking beforehand, "*in the end, of course, it's always a very political decision*" (EU_policy2) and it "*is not the models that fix the target*" (EU_policy3).

### 4.2. *The German photovoltaic support reform in 2009: Model assumptions under fire*

In 2009, Germany implemented the second reform of the Renewable Energy Sources Act (EEG). In the course of the amendment of the Act, the reduction rate of the photovoltaic (PV) feed-in tariff, the so-called 'degression factor', was a main point of discussion. Over almost two years, a heated scientific and political debate took place between an environmental and an economic coalition. The environmental coalition was supported by energy models (Fig. 3). The final reformed EEG contained an increased degression factor from 5%/year to approximately 10%/year as a compromise – up to 50%/year have been demanded [75]. This 10%/year degression made PV generally less attractive but still the declining costs for PV led to an explosion of PV installations in subsequent years.

The political processes around the EEG are characterised by

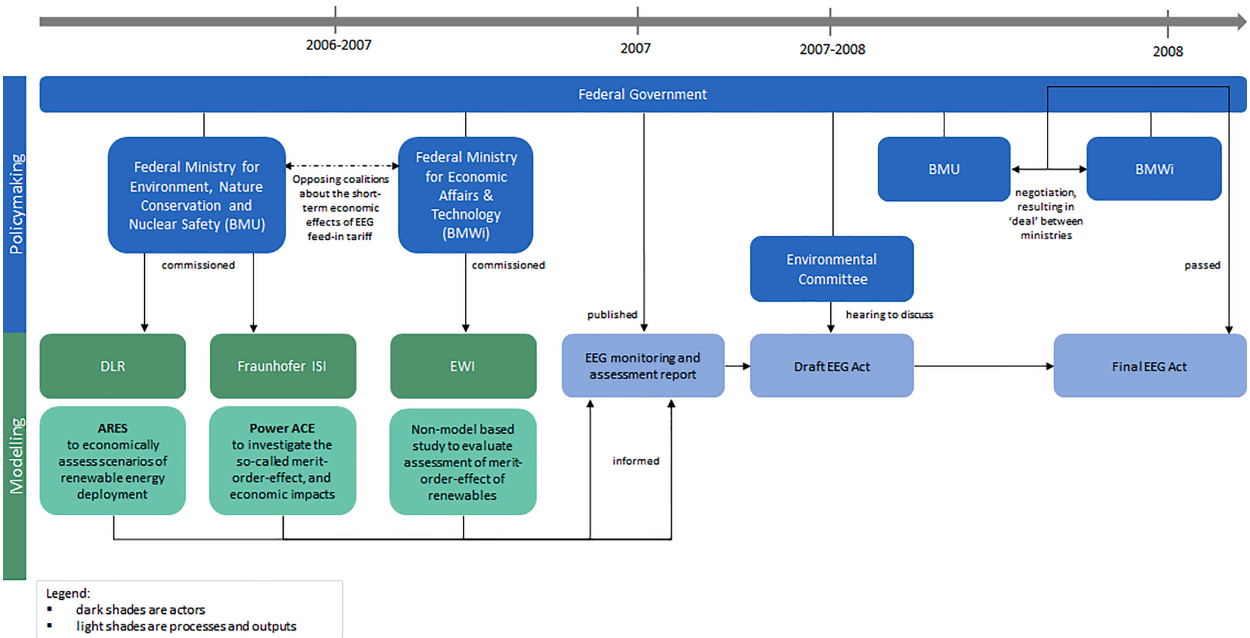


**Fig. 3.** Timeline of policymaking and modelling processes for the German Renewable Energy Sources Act 2009.

disagreement between two opposing political coalitions: the Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), in charge of climate policy including renewables, and the Ministry for Economic Affairs and Technology (BMWi), in charge of all other energy policy. This intra-governmental disagreement is reflected in two sets of studies, commissioned by the two Ministries, giving contradictory recommendations (GER_modeller1; GER_policy1; GER_policy2; [75]) in the context of the EEG monitoring and impact assessment report[1].

In 2006, the BMU commissioned two model-based scientific studies for the impact assessment and adjustment recommendations of the EEG [57,76]. The first was conducted by the German Aerospace Center (DLR). DLR used the ARES model [77] for a scenario-based economic assessment of renewable energy deployment in Germany [76], showing that immediate ambitious renewables expansion would increase short-term costs but pay off for Germany's welfare in the long-run. The modellers were asked by the commissioning Ministry to use *reliable and plausible* data, but what data was used was left to the modellers to decide (GER_modeller1). Due to the difficulty to obtain up-to-date and empirically grounded input data in the rapidly evolving renewables sector, the modellers worked with scenarios for deployment pace and investment costs based on past trends (GER_modeller1). Still, the scenario assumptions were quickly outpaced by the actual development, limiting the usefulness of the study for long-term projections. The modellers communicated the uncertainties to the Ministry, and thus, as a modeller stated "*we always emphasised that the model is poor, because […] we don't have the market dynamics in it […]*" (GER_modeller1). In the following debate, the argument about the long-term economic benefits was, however, overshadowed and alienated by the debate about the short-term costs (GER_modeller1).

The discussion about short-term cost originated from the second BMU-commissioned study, conducted by Fraunhofer ISI. Fraunhofer ISI used the electricity market simulation model PowerACE, to investigate the so-called merit order effect [57]. The scientists concluded that, in 2006, the prioritised feed-in of renewables by the EEG lowered the prices on the electricity exchange more than they caused total additional expenses for society. As a result, renewables made economic sense not only in the medium or long-term, which supported the arguments of the environmental coalition [75].

In response, the BMWi commissioned a study to the Institute for Energy Economics (EWI) at the University of Cologne [78]. Their theory-based study strongly criticised the PowerACE analysis, because of its assumed static power plant portfolio. Thus, the EWI argued, the Fraunhofer study neglected the external market costs of inflexible renewable energies compared to controllable plants, and severely lowered the overall importance of the merit order effect [75,78]. Consequentially, the studies started a dispute about the net costs or benefits of the merit-order-effect *"that has not really been resolved to the present day"* (GER_policy2).

The opposing perspectives made it into the official assessment report of the EEG [79], on which the German Government's EEG reform draft was based [80]. The governmental draft was published, containing a 'medium' degression factor. Despite this compromise proposal, the conflict between the Ministries continued (GER_policy2), both calling for further data about the economic impacts of the different options [75]. The environmental committee of the Parliament scheduled an expert hearing, including one PowerACE modeller as a scientific expert, to provide further information about the EEG draft and facilitate a solution [75]. Energy models were not part of the hearing; however, the model expert used the model results to build his arguments [81], speaking in favour of the ecological coalition [62,56]. In the subsequent coalition-level negotiations, science, including models, did not play an important role anymore, as there was no direct connection made to scientific models or scientific results (GER_policy1). Experts representing both coalitions emphasised the global strategic importance of PV and expressed a will not to endanger the German solar industry by a too radical degression [75]. Eventually, the Ministries agreed on the final reform after intense negotiations between leaders at the two Ministries [75].

Overall, models played an important role in the EEG's reform process, informing policymakers and Ministries about the effects and costs of different policy options. However, we also find evidence that the Ministries commissioned modelling studies with a clear assignment to support their respective policy positions and, not only to explore options and impacts — wherewith they defined the model study scope. We do not see any evidence that the Ministries prescribed "acceptable" results. Still, already the selection of institutions, models and framings strongly

[1] This report is ex-post-evaluation report of the EEG Act, the so-called 'experience report' (German: *Erfahrungsbericht*) [79].

indicate that the Ministries knew what type of results would be produced. In the final negotiations, the science base played no significant role, as the reform was re-politicised.

### 4.3. Phase-out of lignite in Greece: Modelling the 'wind of change' towards the 2030 & 2050 targets

During the preparation of the draft version of the Greek National Energy and Climate Plan (NECP) in 2018, indigenous lignite continued to play a major part in the electricity generation in all scenario analyses and policies formulated until 2019. However, in the second half of 2019, following a government change, the newly-elected Government of "New Democracy" took the political decision of completely phasing out lignite-fired power plants by 2028. This called for extensive modelling work to evaluate and justify the decision (Fig. 4), and to update the NECP accordingly. During both development stages of the Greek NECP, several sets of energy system models were important in the design of the 2030 energy policy to achieve a simultaneous expansion of renewables and the gradual phase-out of lignite.

In 2018, the Ministry of Energy and Environment established a committee for the preparation of the NECP, and commissioned the Centre of Renewable Energy Sources (CRES) to support the development with scenario analysis, using TIMES-GR [58] as well as the WASP model [82] and another in-house power system simulation model. Prior, the Government only applied an ad-hoc use of models, though; in this case; the models used for the scenario analysis were an integral part of the planning process. In these scenarios, Greece continued to rely on lignite power, and the draft NECP submitted to the European Commission in January 2019 consequentially contained lignite generation.

After the change of government in June 2019, the newly-elected government announced the complete phase-out of lignite by 2028. "*Shutting down the lignite-fired power plants was a political decision taken before modelling exercises took place. However, it is very likely that the target was set after non-official meetings between the Ministry and sectoral experts*" (GR_policy1). Models did not affect the decision for the lignite phase-out. Instead, the decision was aligned with the phase-out decisions in other EU Member States, especially Germany, and reflected an increased ambition, as well as the support of clean energy investments in Greece following the government change (GR_policy1).

Following the political announcement, in September of 2019, the Ministry of Energy and Environment again commissioned CRES to perform scenario analysis using the TIMES-GR energy system model, to explore and evaluate how the lignite phase-out can be implemented, and what should be the alternative options to ensure capacity adequacy, including the estimation of investment requirements. Furthermore, CRES used the Dispa-SET model [59] to study the operation of the power system until 2035, and examine potential operational limitations after the decommissioning of the lignite-fired power plants. In parallel, a more detailed analysis of the power system operation under high renewables penetration was performed by the Greek Independent Power Transmission Operator (IPTO), using the ANTARES model [60]. The models, thus, provided ex-post justifications of the technical and economic viability of the lignite phase-out, and explored options to maintain system stability during and after the phase-out.

In addition, the ANTARES model was highly influential when applied to the transport sector, focusing on the introduction of electric vehicles and possible effects to the power system: "*The decisions taken for the renewable energy target in the transport sector was explicitly based on the results of the modelling work done in this study*" (GR_industry1). The open-source nature of the models used increased the acceptance of the studies and their results (GR_policy1). In parallel, the Ministry commissioned the E$^3$MLab to develop the national Long-Term Strategy to 2050, 'Energy Roadmap 2050', using PRIMES to explore the expansion of the NECP modelling scenarios (with 2030 being the reference year of the model) towards climate-neutrality pathways. Finally, once the final version of the NECP was prepared by the modelling teams, and before it was submitted to the European Commission, it "*was included in a public consultation to consider the views of the wider public, lobbies, and others*" (GR_modellers1).

Overall, over the past decade, energy modelling has been effectively applied at all stages of national energy and policy planning in Greece. As modelling teams are repeatedly commissioned to support the Ministry, a long-term relationship and trust continues to build between Ministry and modellers (GR_industry1). Especially in 2018–2020, the

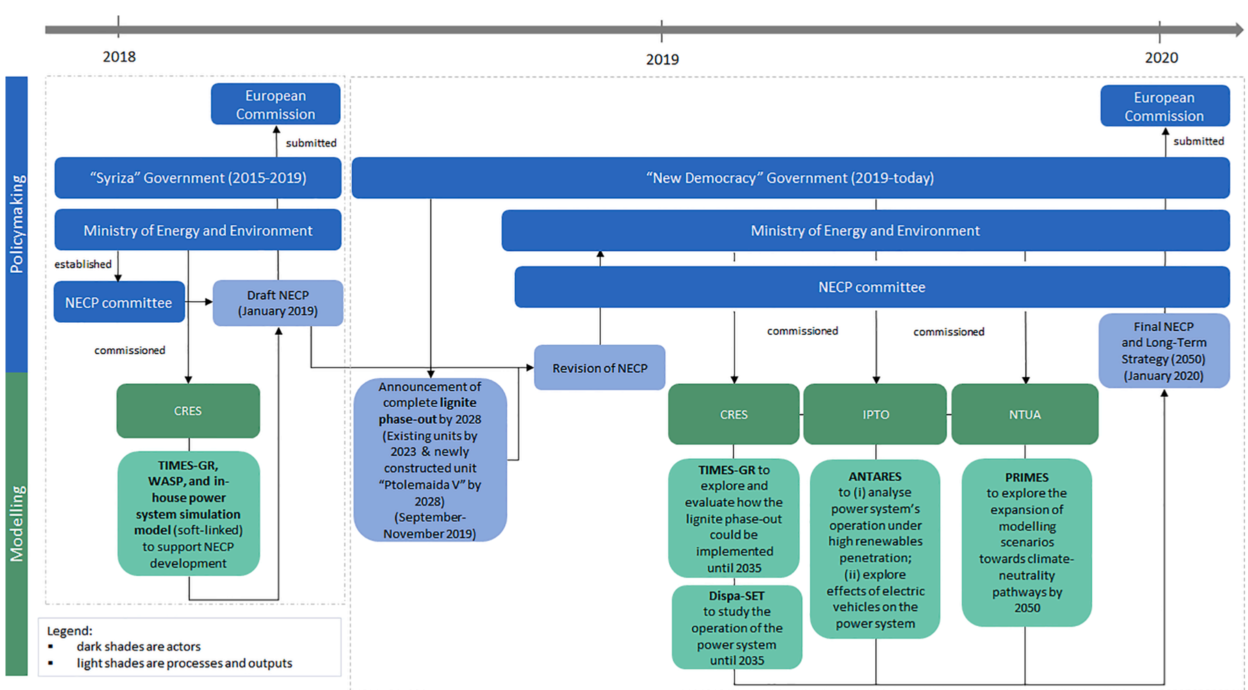


**Fig. 4.** Timeline of policymaking and modelling processes for the development of the Greek National Energy Climate Plan for 2030 and of the Long-Term Strategy for 2050.

collaboration between modellers and policymakers was intense, bidirectional and trust-building: "*The collaboration involved different stages of communication such as meetings purely of modelling purposes and data verification, as well as the participation in a wider roundtable with the Greek Ministry and the panel on the Greek NECP*" (GR_modellers2). Policymakers influenced the design and data stage of the modelling process, as they ensured that data inputs/assumptions aligned with official projections, especially for key technology costs and performance characteristics. Moreover, the collaborative procedure is important to ensure continuity/consistency between the outcomes of the different modelling teams (GR_policy1). Finally, although the decision to phase out lignite was made before the modelling, models were used to explore options for *how* to phase out lignite, and to support the revision process of a lignite-free NECP. The current trend of modelling will be strengthened further with the introduction of a set of monitoring and verification procedures to foster credibility and trust in modelling activities and outcomes, and support upcoming decision-making (GR_policy1).

### *4.4. Energy policymaking in Poland for 2030, 2040 and 2050: Modelling into or out of the carbon lock-in?*

Energy models played an important role for the Polish Government in the context of the EU climate and energy frameworks: to define, substantiate and back up its positions for European-level negotiations in 2008, and to prepare its NECP for 2030 and the Long-Term Strategy for 2050 (Fig. 5). The models were however used in very different ways.

During the European Council negotiations in late 2008, Poland was opposing the 2020 climate and energy targets (PL_NGO3) [49,83]. In contrast to the EU's decarbonisation paradigm, Poland has prioritised (and prioritises until today) national energy security, epitomised mostly by domestic coal resources (PL_modeller1; PL_NGO3; PL_policy1; [47]). It was also a result of the powerful position of the energy system incumbents (utilities and the mining sector) in Polish energy policy (PL_NGO1-2; PL_modeller2; PL_modeller4; [84]). Poland built its argument around the results of a model study by the consultancy EnergSys', based on variants analysis using the CGE-PL [85], PROSK-E and EFOM-PL models. The results of this study, which was not commissioned by the Government but by the Polish Electricity Association, showed that ambitious energy and climate targets by 2020 would be harmful for the Polish economy and energy security [48]. This argument remained a reference point for policymakers for many years [49,83], and cemented a conviction that ambitious decarbonisation policies are 'unachievable' (PL_policy1).

Ten years later, in the context of fulfilling the EU's Governance Regulation's requirements, models played an even more important role (PL_modeller2; PL_policy1). Two different processes took place in parallel: the Ministry of Energy (which in November 2019 split into the Ministry of Climate and the Ministry of State Assets) worked on the Polish Energy Policy (PEP) for 2040 and the Polish NECP for 2030, whereas the Ministry of Economic Development defined the Long-Term Strategy for 2050. Each Ministry commissioned their own modelling studies. For the NECP and the PEP, three consultancies – the Energy Market Agency (ARE), ATMOTERM and (again) EnergSys – modelled the impacts on the economy, the energy system and health, mainly with the STEAM-PL, MESSAGE [61], CGE-PL [85], CALPUFF [62] and GAINS [63] models. The input generated through formalised public consultations and bilateral meetings with selected industries, contributed to the second draft of the PEP, and the final NECP submitted to the European Commission (PL_NGO3; PL_modeller3; PL_policy1). The results of these model runs co-shaped the final Polish NECP and indicated that development of decarbonisation policies in Poland will depend on additional financial support of the EU [50].

For the 2050 Long-Term Strategy, the Ministry of Economic Development commissioned the WiseEuropa Institute to assess the economic impacts of the energy transition, using PRIMES and DCGE PLANE 2.0. At the time of writing in January 2021, the 2050 Long-Term Strategy was not publicly available. Although the three documents and the accompanying modelling are complementary (PL_modeller3), the attitudes represented by institutions that prepared them differed: the Ministry of Energy was conservative in the overall levels of decarbonisation ambitions, while the Ministry for Development was more ambitious in that matter (PL_NGO2; PL_modeller2). In the process of the documents' preparation, the Centre for Climate and Energy Analyses (CAKE) supported and consulted the Ministries in understanding complex details of modelling on a day-to-day basis; at the same time developing its own modelling tool (PL_NGO1; PL_modeller1; PL_modeller4).

Overall, we find two main effects of modelling in Polish climate and energy policymaking. First, and most significantly, models were used to validate governmental positions, providing arguments supporting climate inaction. This was particularly strong in 2008, but is also clearly visible in the PEP and NECP processes. The Ministry of Energy selected the modelling consultants not only based on their credibility (PL_modeller1; PL_policy1), but also, in some cases, on conservative positions on decarbonisation policies (PL_modeller1-2; PL_NGO3). In all cases, policymakers strongly influenced modelling study plan, assumptions and limitations (PL_modeller4). As one of the involved modellers admitted: "*for example, the assumptions in terms of targets on the share of energy from coal, were generally dictated by this contracting authority of ours* [Ministry of Energy]" (POL_modeller3). Second, models have contributed to opening up the policy space and negotiation options to show that there are strategic and economically attractive options for radical decarbonisation in Poland (PL_modeller2; PL_policy1). Nevertheless, the impact of models on decisions was limited (PL_modeller2-4), both because the strategic direction was determined before the models results were finished, and because "*a political decision can be made regardless of what the model shows*" (PL_NGO2). Therefore, our analysis shows that the influence of policy on energy models was larger than the other way around.

### *4.5. Sweden's climate policy: Modelling for net-zero emissions by 2045*

In 2017, the Swedish Government passed the Climate Act, decided with the approval of seven parties and the energy industry (SWE_policy3). This Act holds Sweden's net-zero target for 2045. To assist in target setting as well as exploring and evaluating measures (SWE_policy1), the Government and governmental agencies commissioned three energy modelling exercises – one before deciding on the Climate Act, and two after, to explore and evaluate policy measures during the implementation of the Climate Act (Fig. 6).

In December 2014, the Government set up a cross-party committee to propose a new climate policy framework [86] and a climate and clean air strategy [87]. For this, the Luleå University of Technology (LTU) was commissioned to support the process with the energy system optimisation model TIMES-Sweden [64,88] "*to identify which kind of climate targets Sweden should have and to analyse the consequences of different targets*" (SWE_modeller1). To do so, modelling teams used official projections for input data and assumptions in an iterative process: "*We tried to be open with what kind of assumptions we make and presented and discussed it*", described one modeller, adding that also the governmental organisations expressed their needs: "*and then they* [policymakers] *have been communicating with us that we should use this or that kind of source or we should use this…*" (SWE_modeller1).

Furthermore, the TIMES-Sweden model investigated the consequences of different sectoral targets in the non -trading sector, assessing "*scenarios with or without the sectoral goals*" (SWE_policy1). In this process, TIMES-Sweden was soft-linked to the general equilibrium model EMEC [65] of the National Institute of Economic Research (NIER), which has repeatedly been used to supported the Government's decision-making process in the past [89]. Using EMEC output data in TIMES-Sweden allowed for more transparent and consistent energy demand assumptions, which created a new picture of the economy and the energy system for 2035 [89]. However, the macroeconomic analysis

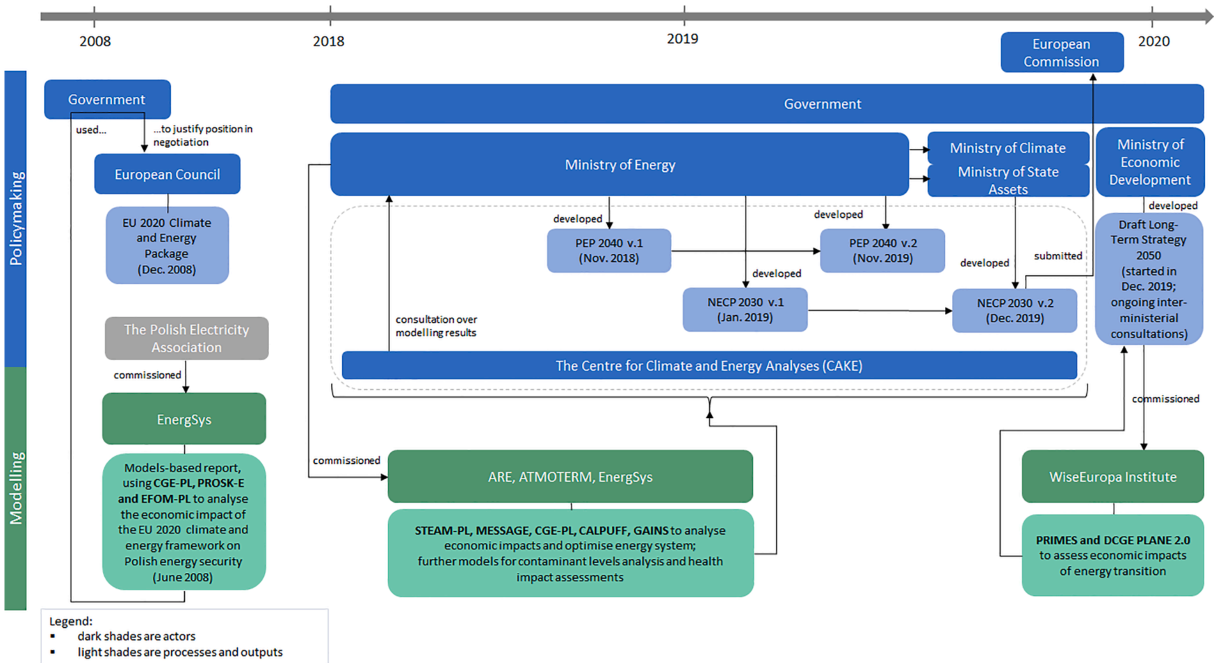


**Fig. 5.** Timeline of policy and modelling processes for the Polish national energy and climate policy, and the Polish position in the EU climate and energy negotiations.

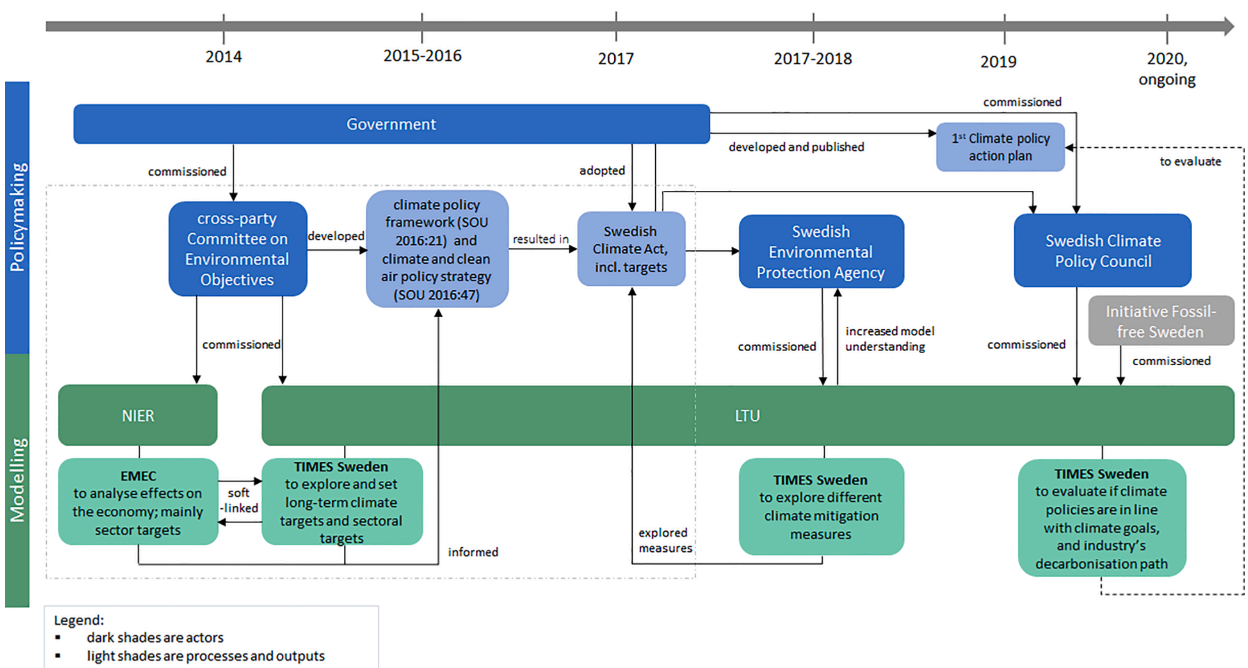


**Fig. 6.** Timeline of the energy modelling tools applied to support the Swedish climate policymaking.

faced challenges, as the model could not fully consider long-term targets and new technologies. Besides the technical modelling challenges, the EMEC model also caused politically difficult situations as it was partially seen to *"create more problems than it solves"*, and as further one interviewee said: *"It is not useful for me and it actually creates the opposite, […] a feeling of problem with the energy transition"* (SWE_policy3). The scenario analysis with TIMES-Sweden worked well and the final decision explicitly draws on the modelling results, and the decision documentation contains a description of the model and limitations [86,87]. Thus, the modelling of emission scenarios succeeded in supporting the policy formulation: *"the results were showing* [what] *to reduce when in which sector. […] And what I just recently got feedback on is, that this graph was in the end important to agree on the target"*, confirmed an involved modeller (SWE_modeller4).

In 2017–2018, LTU used the TIMES-Sweden model again, commissioned by the Environmental Protection Agency (EPA), to explore measures to meet the climate targets, as well as to investigate the role of modelling as a policy support tool and how they *"can be useful when steering towards those climate goals"* (SWE_modeller1). This process concluded that models must answer three central decision-making questions: What measures are needed; where; and when (SWE_policy1; SWE_modeller1). In 2020, LTU was commissioned by the Swedish

Climate Council to use TIMES-Sweden once more, to evaluate the Swedish Government's first climate policy action plan. The plan, presented every fourth years, describes measures towards the achievement of the climate goals of the Climate Act. The scenario analysis is currently ongoing, together with the industry-initiative Fossil Free Sweden, to also assess the industry's decarbonisation roadmaps.

Overall, we found that models play a significant role in the climate policy process: *"Models have generally a large impact on policymaking in Sweden […] It's not the only tool but it is a very important tool"* (SWE_policy1). Swedish agencies, including EPA and the Swedish Energy Agency, have strong in-house modelling capacities and commission much modelling – and let the results have a meaningful influence on the agencies' support to the Government (SWE_policy1; SWE_modeller1; SWE_policy4). Nevertheless, the decisions are made at Ministries and in Parliament, so that *"much is steered by what politicians think themselves"*, and as one modeller further states *"I think a part disappears due to other considerations, which have then more weight than the results from our models"* (SWE_modeller3), thus reducing the actual impact of models in policymaking (SWE_modeller4; SWE_modeller1; SWE_policy2; SWE_policy3).

All model runs in the climate policy process were characterised by a close collaboration between governmental institutions and scientists along the modelling process, from defining research questions and model assumptions to designing scenarios and discussing and interpreting results (SWE_policy1; SWE_policy2; SWE_modeller1). Here, models have facilitated discussions and contributed to a mutual learning process (SWE_modeller4). But as the influence of policymakers on the modelling was limited, their role in interpreting the findings is stronger: *"We can't influence them* [modellers] *but we can influence what we do out of these results"* (SWE_policy3).

## 5. Discussion and conclusions

Our results, summarised in Table 4, show that energy models are used to support and inform policymakers at all different stages of the policy cycle. They are most often used to assess impacts of different targets (including feasibility and costs), but also to explore policy options. The exploratory role seems to be particularly pronounced in jurisdictions with high climate protection ambitions, as found in the EU and Swedish cases, as well as in the Greek case after 2019. We also show that policymakers sometimes influence the modellers and modelling at different stages of the modelling process cycle, especially by expressing demands for data sources and assumptions, and by constraining or prescribing the exploration space and possible results. The latter seems to be particularly the case in jurisdictions with low climate protection ambition (e.g. Poland), or in highly conflict-laden policy processes (e.g. German case).

We conclude that energy modelling and policymaking influence each other, but the main direction of that influence depends on the context and the particular case: models may support ambitious and well-informed policy changes and target setting but modelling and modellers can also be instrumentalised to justify already made policy decisions. We discuss these findings and their implications below.

### 5.1. Modelling affects policymaking

We observe in several cases, in line with previous research [5,13,90], that models have helped policymakers to explore unknown futures, set appropriate targets and assess policy options for reaching these targets (see Table 4). In some cases, the use of models go beyond being mere "number generators" [3], towards 'negotiation tools' for policymaking processes. However, we, also observe that in most investigated cases the models support decisions, but the decisions are made using model results as one of several inputs, especially during the later negotiation phases. Therefore, models inform but do not make decisions.

We demonstrate that the influence of models on policymaking depends on the countries' experience in using energy models, as well as on the context of the processes in which the models are applied. Whereas in Brussels, Germany and Sweden, energy modelling for policy advice has been conducted for many years, it is a rather new and still not standard approach in Greece and Poland – although this has changed in the context of the preparation of the NECPs. Such differences in tradition of using models to support policymaking very likely explain parts of the differences in the model use and impact.

In addition, it seems that differences in the use of models are based on general policy preferences. At least among our cases, modelling is more used as an exploratory, supporting tool for target setting and impact assessment in the more climate-ambitious jurisdictions. In Sweden, Germany, Greece, and in the EU, models were used to help determine "appropriate" targets and their impacts. In Sweden and Greece, models were also applied to evaluate different measures for meeting the targets. In contrast, the long-standing attachment to coal in Greece (before 2019) and Poland did not require the use of models investigating options for a low-carbon transition (because the systems were not to change strongly) and if energy modelling was used at all, it was mainly to legitimise the status quo in the existing energy system.

Similarly, at least among our cases, policy processes with a lower internal conflict-level tend to rely more on models as exploratory tools for target setting and instrument evaluation, as shown in the Greek and Swedish cases. Although these cases saw debates about the "right" target, most political and societal actors agreed that strong action was needed. In the more conflict-afflicted processes, we observe that models were rather used to justify existing positions than to explore new options. This is clearly illustrated by the German and Polish cases, where divergence between ministries (Germany) and between the EU and national government (Poland), respectively, let each side commission its own studies in support of its arguments.

### 5.2. Policymaking influences modelling

We also find empirical evidence of policy influencing models, especially regarding "acceptable" questions, scenarios to be investigated, and output to be produced. In all investigated cases, and presumably in general, policymakers retain control over exploitation and political use of the results. Therefore, models do not dictate policies (see Table 4). Our results show that policymakers influence modelling, especially at the early modelling stages, such as the definition of the model study plan, by (co–)defining problems, objectives and assumptions, including input data. In almost all of our case, modelling has been commissioned by governmental entities, and this commissioned work may be generally more at risk of being influenced by policymakers [see also: 14].

The European Commission has analytical units performing modelling, but it also commissions modelling to external subcontractors. Such in-house modelling and internal capacities to understand its details increase the likelihood that results are turned into policy action, but the open-endedness and a pluralistic perspective of such work is questionable. As in the case of the EU's 2030 target-setting process, the controversies about which ambition-levels to model are an indication of the constraining effect of policymakers on the modelling process.

In all national case studies, the modelling was commissioned by the responsible ministries to external contractors from both consultancies and academia. Nevertheless, we find clear evidence of policy influence on modelling in the German and Polish cases. In the German case, opposing ministries sought model results to support their existing, conflicting positions, although they did not interfere in the modelling as such. In the Polish case, in contrast, we observed that modelling carried out by some consultancies linked to the state, raised questions about a privileged position of such entities and data monopoly, impacting the legitimacy and credibility of modelling.

Based on our cases, we find that governments tend to commission known and acknowledged modelling teams and, thus, well-established modelling tools. This may be grounded in the acceptance of models by

**Table 4**
Synthesis of identified interactions between policymaking and modelling

| Case study | Aim of the policy-model interaction process | Models used and what is modelled | Use and impact of modelling on policymaking | Influence and impact of policymaking on modelling |
|---|---|---|---|---|
| **EU's renewable energy target revision (2016–2018)** | Define and set EU 2030 renewable energy target | PRIMES modelling set, E3ME, GEM-E3: Impact assessment: energy system costs, net employment, net growth, air pollution and health effects, fossil fuel import reduction, impact on energy prices, investment requirements | Models used mainly to inform **target setting:** Exploration and impact assessment of higher renewable energy target setting. Modelling results supported negotiations over the final higher renewables target. *Impact:* Modelling informed the **policy debate about a higher renewable energy target,** and **led to a more ambitious target**. | Policymakers defined **model study plan**: The European Parliament requested the European Commission to conduct a new, model-based impact assessment to examine more ambitious targets, but did not intervene into this process. *Impact:* European Parliament used modelling results to **support its demand** for a higher renewable energy target. |
| **Germany's renewable energy feed-in tariff reform (2009) focusing on the PV reduction rate** | Assess scenarios of renewable energy deployment, and their economic impact | ARES: Medium- and long-term impacts of renewable energy deployment (including PV), on installations, energy production, $CO_2$-mitigation, investments, and societal costs; degression factors are not explicitly modelled but indirectly relate to the deployment pace | Model used mainly to inform **policy formulation:** Scenario-based medium- and long-term economic assessment of renewable energy deployment, supporting further deployment for long-term benefits. *Impact:* Modelling **informed the EEG assessment report**. But underestimated and neglected real market dynamics, limiting the reliability and impact of the model results. We could not identify any influence of the model in final policy negotiation phase. | Policymaking defined **model study plan, design and data:** Ministry for the Environment commissioned model-based study, with collectively defined research question and few instructions on model **assumptions**. Ministry demanded for reliable **data** and robust results, but modellers could decide about the data basis. *Impact:* Ministry of Environment used the modelling results to **support its argument** of medium- and long-term benefits. |
| | Investigate the so-called merit-order-effect, and its economic impacts | PowerACE: Modelling of market actors behaviour in electricity markets (power plant operation and electricity trading); investigation of short-term influence of renewable energy deployment (including PV) on market prices; degression factors are not explicitly modelled but indirectly relate to the deployment pace | Model used mainly to inform **policy formulation:** Short-term economic impact assessment of renewables-based merit-order-effect, supporting further deployment also in short-term.<br>*Impact:* Modelling **resulted in a scientific dissent** caused by the model assumptions, which caused controversy between Ministries and **heated up the political debate**. We could not identify any influence of the model in final policy negotiation phase. | Policymakers defined **model study plan**: Ministry for the Environment **commissioned** model-based study. *Impact:* Modelling **verified the Ministries' idea** of a renewable energy-based merit-order-effect. |
| **Greece's decision to phase-out coal (2019)** | Define energy objectives and set targets for NECP | TIMES-GR: Least-cost solution until 2035 to: a. evaluate the alternatives for implementing the decision of shutting down the lignite-fired power plants, the RES potential on a regional level (i.e., NUTS2 level), electricity interconnections with neighbouring countries, and interconnections of islands to the mainland, b. Estimate investment requirements on the supply-side, as well as areas of intervention and respective investments on the demand-side | Model used to inform **policy evaluation**: Impact assessment under which conditions the Government's political decision to phase out coal could be feasible. *Impact:* Modelling results **supported feasibility of the lignite phase-out.** Results made it into the final policy document of the NECP. | Policymakers defined **model study plan, design and data, and simulations**: Government commissioned several specific model runs. Policy influence was significant especially during initial stages for the definition of the specific **input assumptions and constraints** that needed to be considered. Coordination between modelling teams of the NECP and the Long-Term Strategy for 2050 was almost daily during **simulations and the results preparation phase**, and a communication loop between the modelling teams and representatives from the Ministry the panel on the Greek NECP was established. *Impact:* Government used modelling results **to justify its already made decision** to phase out lignite. |
| | Evaluate the operation of the power system after decommissioning of lignite-fired power plants | Dispa-SET: Analysis of the operation and stability of the power system in selected years (<2035) for lignite power phase-out | Model used mainly to inform **policy formulation:** Assessment to show feasibility to phase-out lignite by 2028. *Impact:* Modelling results-supported policymakers within negotiation processes. Modelling results **supported feasibility of the lignite phase-out**. | |
| | Assess technical aspects of the power system operation under high renewable energy penetration, incl. introduction of electric vehicles | ANTARES: (a) Analysis of the operation and stability of the power system under high renewables shares, verify feasibility of the political decision and show the limits for its implementation. (b) Study of impacts of electric vehicles deployment on the power system and hydrocarbons consumption | Model used mainly to inform **target setting:** Support decision on energy targets for the NECP. Exploration and decision of long-term renewables target in the transport sector. *Impact:* Modelling **informed decision for renewables target in the transport sector**. | |
| | Explore and set long-term climate and energy targets until 2050 | PRIMES: Long-term analysis to investigate options of decarbonisation of the energy | Model used mainly to inform **target setting:** Support decisions on energy targets until 2050. *Impact:* Modelling | Policymakers defined **model study plan, data** and **simulation:** Government required modelling |

(*continued on next page*)

Table 4 (*continued*)

| Case study | Aim of the policy-model interaction process | Models used and what is modelled | Use and impact of modelling on policymaking | Influence and impact of policymaking on modelling |
|---|---|---|---|---|
| | | system, towards climate neutrality by 2050 | results **informed long-term climate and energy targets** of the Long-Term Strategy by 2050. | results consistent with the NECP and path consistent with temperature **targets** (1.5 °C and 2 °C), to highlight the range of the available solutions. Coordination between modelling teams of the NECP and the Long-Term Strategy for 2050 was almost daily during **simulations and the results preparation phase**, and a communication loop between the modelling teams and representatives from the Ministry the panel on the Greek NECP was established. *Impact:* Government used modelling results **to justify its already made decision for** climate-neutrality by 2050. |
| **Poland's obstruction towards decarbonised future (2008–2020)** | Analyse impact of the 2020 EU's climate and energy package on the Polish economy (2008) | CGE-PL: Impact of energy price changes on the economy; PROSK-E: Decrease in the final demand for electricity and heat; EFOM-PL: Marginal costs of electricity supply. | Models used mainly to inform **policy formulation:** Impact assessment of EU climate and energy package on the Polish economy. *Impact:* Results of the modelling-based study **presented decarbonisation policies as an expensive burden** to economic development, and **cemented the carbon-lock in** energy policymaking for many years. | *Not enough information to evaluate* |
| | Define and set targets for NECP and Energy Policy of Poland by 2040 | STEAM-PL and MESSAGE-PL: Different aspects of energy demand and supply; CGE-PL: Impact on economy and employment; CALPUFF: Impact of the implementation of energy policy on the air quality; GAINS: Co-benefits reduction strategies from air pollution and greenhouse gas sources | Models used mainly to inform **target setting:** Exploration of target set for NECP and Energy Policy of Poland 2040. *Impact:* Modelling results **did not play a decisive role** in final decisions about the main directions and targets of energy policy in Poland for decades to come. | Policymakers defined **model study plan, design and data**: Ministries commissioned modelling mostly to well-known external entities. Ministries had a final voice in determining the overall direction of both strategic documents and limiting space of assumptions and data. Policymakers **determined the area of results that they are able to accept**. *Impact:* Government included non-ambitious targets of decarbonisation policies in strategic documents. |
| | Preparation of the 2050 Long-term strategy | DCGE PLANE 2.0: Macroeconomic aspects; PRIMES: Different aspects of energy demand and supply | *Not enough information to evaluate, since the 2050 Long-Term Strategy has not been published at the time of writing this paper.* | *Not enough information to evaluate, since the 2050 Long-Term Strategy has not been published at the time of writing this paper.* |
| **Sweden's development of the climate policy framework and beyond (2015–2020)** | Explore and define climate targets; define and evaluate policy measures | TIMES-Sweden: Modelling of different emission scenarios – when to reduce what in which sector; EMEC: Economic costs of climate policy measures | Models used to inform **target setting:** Exploration of possible long-term targets, Impact assessment of different targets; assessment of the economic feasibility. Same models used to inform **policy evaluation:** Ex-post assessment of implemented climate action plan (measures); scenario for alternative further measures. *Impact:* Modelling was decision-support for which climate target to commit to, supporting an ambitious climate target. First round of modelling results are included in the final documents of the climate policy framework. | Policymakers defined **model study plan, design** and **data**: Government and governmental agencies commissioned modelling. Policymakers reviewed **data** and expressed demands for sources to be used. Research questions, assumptions and scenarios were collectively defined between policymakers and modellers. *Impact:* Government used the model results **to negotiate an ambitious climate target** among all parties and with energy industry. |

governmental entities, which takes time, as Ittersum and Sterk [23] found. Nevertheless, this is an important informal bias, as ministries typically know what kind of results each model is able to produce. This does not suggest foul play or question the independence of the involved modellers, but rather shows the impact of the socially constructed nature of mathematically complex models. Because they describe perceived realities differently and answer different questions, their results will naturally differ [6] and be politically useful for different political camps.

Given this, the strongest influence of policymakers on modelling is their power over how model results, especially in commissioned works, are used politically. This is both legitimate and expected: naturally, political actors will use model results to support their position. However, taking the findings from the models and considering them scientific law can be problematic, as in the case of Poland in 2008 where the EnergSys model study underpinned the national energy policy inaction for many years: such a result may be technically correct in the context in which it is produced, but hardly corresponds to the climate and energy reality of the past decade.

### 5.3. Limitations, implications and outlook

Our study shows that energy modelling and policymaking affect each other. Our study is a snapshot of the complex interaction between energy modelling and policymaking in five European case studies. We do not know whether other effects or types of interactions can be observed in other cases. As our findings indicate that the interaction is highly context-specific, we expect that other types of interaction exist, and call for further research on this topic, for further countries and times, so as to improve generalisability of findings. We expect that, with increasing complexity of policymaking, model-based climate and energy policy advice will gain importance over time. In this study, we demonstrate that policy and modelling interact in different ways and at different stages of the policy and modelling cycles. However, because of the case study nature and complexity of policymaking processes, we can neither say to what extend models influenced final policy decisions, nor draw strong generalised conclusions for the conditions under which models are particularly impactful. Because "policy impact" is increasingly called for in modern research, we call for dedicated research for when and under which conditions models affect policy – but also for studies to generate a systematic understanding of how (and how to avoid that) modelling is instrumentalised by policymakers.

Despite the case study-related limitations, our findings have implications for modelling practices and legitimacy, also beyond our specific cases, and for the role of science in policymaking and what is seen as "good (open) science".

First, we show that there are multiple ways in which policymakers use modelling, both including the optimal exploration of options (supporting evidence-based policy-making) and the less optimal instrumentalisation (policy-based evidence-making). This implies that modellers must be aware of how their models are used and can be used. Modellers must continuously reflect on their role in the political arena and be fully open and transparent about their study aims, constraints and assumptions. We are aware that modellers cannot be 'neutral', if they strive for policy relevance, and models are never 'objective', but it is nevertheless important that models openly explore different energy futures and not only steer towards pre-defined policies.

Second, scientists, including modellers, are under increasing pressure to generate findings that are immediately useful and have a practical "impact" on policy or society [30]. Researchers have a strong incentive to produce modelling results that stay within the current mainstream, because findings suggesting minor modifications of actions with the prevailing governance paradigm have better chances of achieving practical "impact". In contrast, models generating 'radical' results, or results strongly diverging from the political agenda of the current government, are less likely to be heard and achieve practical "impact". Such incentives are problematic because they may reduce the quality of policy-relevant modelling by limiting the acceptable explorative space of policy-relevant models. However, precisely these 'radical' insights are likely needed to bring the magnitude and speed of the transformation required to achieve the objectives of the Paris Agreement and the EU. Nikas et al. [91] recently added to this point by discussing that modelling needs to expand its comfort zone, such as by exploring extreme scenarios and disruptive innovations, drawing from the COVID-19 pandemic. As a result, ambitious political agendas need to be manifested in the modellers' and policymakers' mental models in order make their way into computer-based modelling tools.

Third, models are and *should* be only one of several inputs serving to inform policy decisions. While policymaking is complex and involves different actors, the decisions themselves are made by ministries and, eventually, by parliaments. A strong and direct link from models to specific policies is neither to be expected nor would it be desirable. Finding traces of the model results, but not the results verbatim in the final policy output, is a sign that the model had an impact. That model findings are not exactly represented in policy output is a sign of functioning democracy – whereas an overly strong link would signify technocracy and a weakening of democracy.

Fourth, the legitimacy of model-based policy advice stands and falls with the model's credibility. With the rise in computational power, the number of sophisticated energy models available has increased strongly, decreasing the usefulness of the "black-box" models of the past [25]. Transparency of models is absolutely imperative for creating trust and is supported by the involvement of different stakeholders in the modelling process. Publishing open code and data can be challenging, for example due to issues of data ownership, privacy and security concerns (see [19,92]). Nevertheless, modellers can take different strategies when opening code and data, including: establishing who owns the intellectual property; choosing a well-known licence; using tools to support the creation of reproducibility, even if you cannot go fully open; distributing code and data; and providing support [25]. Whereas there is a growing open modelling community[2], and policy increasingly funds only or mainly open modelling frameworks (e.g. the Horizon 2020 projects SENTINEL[3] and openENTRANCE[4]), openness is still not adequately rewarded within academia. Yet, the benefits of openness go beyond improved model legitimacy, and help to improve work efficiency and quality of models through community efforts. Further-reaching changes, in academia, among research funders and study-commissioning institutions are needed to trigger a change in culture and reward openness in models stronger than today, both for scientific and policy use.

Last, building on the previous point, open-access models and platforms, such as intended within our SENTINEL project, are essential components towards more model transparency, more diversity in model use, and the availability of more comparable and credible results. The simultaneous use of several models, ideally by different teams, can additionally ensure not only diversity, but also disparity among the used models and make these powerful instruments truly useful for decision-making. At the same time, open-source models and platforms create opportunities for more transdisciplinary modelling. Co-creative approaches could bring modellers, policymakers and other stakeholders closer together in the modelling process, to best support sound and inclusive European and national policymaking.

## Author contributions

D.S. led the work; D.S., A.C., H.G., V.S. and J.L. designed the study; D.S. performed the empirical research and analysed data for Sweden, A. C. for EU and Poland, H.G. for Germany, V.S, A.F and G.G. for Greece; D. S., J.L., A.C., H.G., and V.S. wrote the paper with inputs from all authors.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[2] For example https://openmod-initiative.org/

[3] https://sentinel.energy/

[4] https://openentrance.eu/

on the SENTINEL Deliverable 1.1 by the same authors.

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# 6. Conclusion, Discussion and Outlook

## 6.1 Summary of the publications and the argument

In the view of the accelerating climate change and challenges related to decarbonisation of the energy systems and phasing-out fossil fuels, the main objective of this thesis was to answer the questions: what are the reasons that hinder the energy transition and how and why these different constraints affect the energy transition's implementation. In order to address this question, throughout literature review the term energy transition was conceptualised, presenting its three different dimensions (technological, environmental and socio-political) and discussing its multi-levelness. These considerations allowed to extract several auxiliary questions, which guided the research presented in each of the papers contributing to this thesis. These questions were as following:

- How does the public's engagement and deliberation impact upon energy transition implementation?
- What explains climate denialism and how has it impacted decisions on energy policy? How the factors determining climate denialism vary from place to place?
- How and to what extent can different visions and perceptions influence energy transition governance formats (approaches)?
- How to coordinate and govern the implementation of energy transition? What are the relevant tools and methods, which would enable to plan better the energy transition implementation process and foresee its potential effects? How and to what extend are these tools used?

These auxiliary questions were addressed through analysis of different energy transition implementation constraints: (1) Downstream and upstream engagement, (2) Changing the dynamics of engagement, (3) Climate denialism and competing problem constructions, (4) Imaginaries, (5) Storylines and frames, (6) Governing processes and (7) Governing outcomes, which were extracted from the study of Sovacool et al. (2020). These constraints corresponded with different energy transition implementation elements, such as: technologies, policies/system coherence, partnerships, and methodologies, extracted from the framework analysing the implementation of Sustainable Development Goals (Caiado et al., 2018). The relations between the energy transition implementation constraints and elements were presented in the scientific papers contributing to this thesis. By application of different theoretical and methodological approaches, each of the publication-based Chapters explored, described, and explained different aspects related to the energy transition and its implementation process.

Chapter 2 (P – 1) described the process of public engagement in power lines development projects in Norway. It explored the role of trust experienced by the participants of the decision-making processes at three different levels: institutional, general, and interpersonal, which was essential for a successful investment into electricity transmission lines. In that context, the phenomenon of trust was discussed as a necessary condition leading to the acceptability of the public engagement process which in consequence can lead to acceptability of new electricity power lines. To conclude, public engagement and deliberation approaches can positively influence the implementation of the energy transition, however, the scale of this impact can be context-dependent and related to external prerequisites. There are formal and informal measures that can lead to increase of trust and improvement of the public engagement process, such as sensitising the project managers, involving regulatory authorities, or enabling the participants of the engagement process to have open and transparent debates and enough room and time for discussion.

Chapter 3 (P – 2) explored climate denialism in Poland and Norway by describing how climate contrarian approaches are embedded in the national political-economic systems of both countries and, in result, how they can influence the implementation of policies driving the energy transition. This Chapter tried to explain universal determinants driving climate contrarianism. The comparison of Poland and Norway showed that the presence and strength of the contrarian movements are different in both countries (much stronger in Poland), although there are factors determining contrarianism similar in both cases, such as a strong position of fossil fuel actors in political-economic systems. These findings call for more comparative research across different cases to find out the universal determinants of denialism and signal an added value in exploring new national contexts.

Chapter 4 (P – 3), based on the case of climate and energy cooperation between Poland and Germany, showed that asymmetries present in visions, imaginaries, and perceptions of key actors responsible for the energy transition implementation have an impact on governing the energy transition in different partnerships' formats. The more stable and formalised relationships, involving resources from expert and working levels (operating especially at the European, instead of the national level), can ease the perceived imbalance of the bilateral relationships and contribute to a constructive cooperation. This, in consequence, can have a positive impact on the implementation of the energy transition as it can lead to establishment and development of trustworthy relationships and, as the next step, projects, initiatives or programs on the ground.

Chapter 5 (P – 4) explored methodologies and tools of the energy modelling, which contribute to the coordination and governance of the energy transition. More specifically, research presented in this Chapter described the interactions between the processes of energy modelling and energy policymaking in five different cases. This paper explained how the investigated processes of energy modelling and policymaking – taking place in parallel – can influence each other, but to different extent and with a different scope. Energy models can support ambitious policies and target setting, but at the same time the results obtained using energy models can also be instrumentalised to justify already decided directions of the energy policy. The results of energy modelling that present different alternatives, pathways and options of the energy transition can have a substantial impact on the energy transition's implementation. Thus, a greater transparency of the modelling process, including data, the selection of assumptions and open-source codes could increase legitimacy of results and its impact in the policymaking process.

The implementation of the energy transition is more than a technical issue. As presented in this thesis, the energy transition is a complex, multi-dimensional process taking place at many levels simultaneously and involving different actors, markets, institutions, regulations, technologies, and infrastructures. Thus, in order to progress with the energy transition, it is essential to identify and then investigate the factors constraining its implementation. A nuanced understanding of the challenges and determinants that hinder the energy transition's implementation can help relevant actors to identify measures, solutions and approaches that could ease the implementation process. Selection of these measures requires a caution and consideration of all the energy transition dimensions: technological, environmental, and socio-political. This is because solutions addressing one aspect related to one of these dimensions can have unintended effects in the other dimensions. In that sense, there are no "one-size-fits-all" solutions that would allow to address all the factors constraining the energy transition's implementation. At the same time, consideration of all the energy transition's dimensions (instead of one) can allow to find the linkages between them and come up with the potential approaches and measures to address the energy transition's implementation constraints in a synergistic and complementary way.

The findings presented in this thesis, encompassing the multidimensionality and the multi-levelness of the energy transition, lead to a twofold reflection: on the one hand, the energy transition in its complexity should be considered holistically to capture its different facets and aspects. On the other hand, the generalisation of the results presented in this thesis can be challenging, because of context-specific features of each of the implementation processes, constraints' categories, and the implementation elements, described in the four empirical Chapters.

## 6.2 Critical discussion and research implications

The main objective of this thesis was to identify the reasons that hinder the energy transition and how they influence the energy transition's implementation. This objective has been completed, but not all possible constraints affecting the energy transition's implementation were presented, described, and discussed. This thesis provided a framework that allowed to structure and analyse the politics behind a specific constraint's category in regard to a concrete energy transition's implementation element. It means that each of the implementation elements (technologies, policies/system coherence, partnerships, and methodologies) could be investigated and analysed through the prism of one of seven identified constraints' categories: (1) Downstream and upstream engagement, (2) Changing the dynamics of engagement, (3) Climate denialism and competing problem constructions, (4) Imaginaries, (5) Storylines and frames, (6) Governing processes, and (7) Governing outcomes[9]. That gives, potentially, twenty-eight alternative variations from which the obstacles in implementing the energy transition could be scrutinised.

In reality, there can be much more (possibly endless) such alternative variations that will depend on the description and operationalisation of other constraints' categories, which can affect the energy transition's implementation process. The research of Sovacool et al. (2020), that served as a basis for selection of the seven constraints' categories applied in this thesis, identified altogether thirty-nine different topics and issues, which could be utilised as the constraints' categories. Next to the categories described in this study, they listed also, for example, gender and patriarchy, justice and elites, constructive technology assessment, risk and resilience, or asymmetry and marginalisation (ibid.). Similarly, a recent report dealing with barriers related to the implementation of the specific energy transition technologies (solar and wind power) in the European Union, identified and structured thirty-seven different

[9] For clarity, in this thesis these seven categories were assigned into four, simplified groups of the constraints' categories, if they were complementary. In that way "Downstream and upstream engagement" was assigned together with "Changing the dynamics of engagement", "Imaginaries" together with "Storylines and frames" and "Governing processes" together with "Governing outcomes".

constraints' categories, organised into five different groups: "political and economic frameworks", "market", "administrative processes", "grid regulation and infrastructure", and "others" (Banasiak et al., 2022).

A different modification of the proposed analytical framework could include the application of the combined energy transition's implementation elements. For example, the energy transition technologies (e.g., the electricity grid or wind power) could be combined with partnerships or methodologies. Furthermore, the implementation elements could be expanded or operationalised across different classifications. For example, the recent United Nations' report on the global energy transition, proposes a four-layer enabling policy framework for a just energy transition (United Nations, 2021). Each layer represents a different kind of polices: the most central one focuses on policies directly supporting the renewable energy deployment (e.g., the feed-in tariffs), the second layer concerns policies supporting the integration of renewables into the energy system (e.g., system flexibility), the third layer deals with policies enabling energy transition (e.g., research, innovation, and development), and the outermost layer concentrates on policies for structural change and just transition (e.g., labour marker and social protection) (see also: Kettner and Kletzan-Slamanig, 2020). A dedicated focus on different energy transition policies could also broaden the proposed framework, as it would allow to investigate and analyse other stages of the policymaking process, beyond the implementation, such as: agenda-setting, policy formulation, policy adoption or evaluation (Knill and Tosun, 2017).

The openness of the definitions and meanings behind the terms: *"constraints"* and *"implementation elements"* can give flexibility in applying the framework proposed in this thesis across different cases and levels. This can ensure a wide spectrum of the framework's applicability as well as further development and possible adjustment of the terms: *"constraints"* and *"implementation elements"*, depending on cases and contexts. The research presented in this thesis was embedded within the European context, providing evidence regarding (mostly) three countries: Poland (P – 2, P – 3, P – 4), Norway (P – 1, P – 2) and Germany (P – 3, P – 4). The implementation of the energy transition is different in each of these countries and is determined by unique social, cultural, economic, political, and historical factors. Therefore, that the implementation of the energy transition is highly contextualised, depending on where in the world it is taking place. This holds true not only for individual countries but can also depend on regional or local contexts. This uniqueness is further enhanced depending on which *"implementation element"* is considered. For future research, this offers many opportunities to further explore for each of the countries analysed in this dissertation what influences the implementation of specific elements of the energy transition and why. For example, for Norway, future research could look at how partnerships and methodologies work and are implemented, as illustrated by the case of Nordic Clean Energy Scenarios, which are based on intensive energy and climate cooperation between the five Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) (Wråke et al., 2021). Similarly, in the case of Poland and Germany, future research could focus on the development of electricity grids. While the issues of the lack social acceptance and conflicts around the development of electricity grids in both countries are the subject of research (Kamlage et al., 2020; Puka and Szulecki, 2014; Schweizer and Bovet, 2016; Steinbach, 2013; Witajewski-Baltvilks et al., 2018), the issue of trust in these processes has not yet been adequately addressed. Furthermore, in future research, the application of the proposed conceptual framework can be extended to other countries, beyond Europe, which, together with North America, is predominantly represented in social research on energy (Sovacool et al., 2020). A different possibility to apply the proposed framework would be to keep the definitions of *"constraints"* and *"implementation elements"* strict, collect and analyse the empirical evidence from different cases and provide a comparative perspective on the interrelations of these variables in different countries.

From a methodological standpoint, different approaches and methods to collect and analyse data, such as transdisciplinarity, literature review, qualitative research (encompassing semi-structured interviews) and case studies were applied in the scientific papers contributing to this thesis. The diversity of methodological techniques and instruments proved to be useful to understand what are the reasons that hinder the energy transition and how and why these different constraints affect the energy transition's implementation. For future research, other methods, such as surveys or longitudinal studies could be applied to enrich the understanding behind the factors impeding the energy transition implementation. To increase the quality of the analysed data, scientifically more rigorous approaches, such as the systematic review (Sovacool et al., 2018), could also be applied. The qualitative understanding of the energy transition's implementation constraints could also be enriched by the application of the quantitative energy modelling (Süsser et al., 2022).

Considering the complexity and multidimensionality of the energy transition, the scientific papers contributing to this thesis concentrated on socio-political and technological dimensions. The environmental dimension of the energy transition was not explored and elaborated. For future research the thematic scope of the cases could be extended to integrate the environmental dimension of the energy transition to better understand the interactions and interconnections between human, technical and ecological systems (cf., IPCC, 2022a; Pörtner et al., 2021). This is relevant for all the energy transition implementation elements included in the proposed framework and the potential research questions could touch upon the topics of biodiversity, water scarcity, raw materials' depletion, use, and circularity.

As this thesis is based on scientific papers and a book chapter published between 2017-2021, the presented findings rely on the empirical evidence collected and analysed without an exposure to disruptive events and external shocks, which in the last years heavily affected the European energy transition's implementation, namely: the COVID-19 pandemic and the Russia's aggression against Ukraine (Mišík and Nosko, 2023; von Homeyer et al., 2022). In that context, scholars started addressing the effects and interdependencies of the coronavirus pandemic on the energy transition, concluding, for example, that in a global comparison the COVID-19 crisis can make the gap between countries considered as the energy transition leaders and laggards bigger (Quitzow et al., 2021). Other research pointed out to the importance of designing the response and recovery policies that would guarantee stable investments into renewable energies and other measures needed for the energy transition implementation, which in a long-time horizon, would make the energy transition shock-proof (Cazcarro et al., 2022; Kuzemko et al., 2020; Mišík and Oravcová, 2022; Steffen et al., 2020). In that sense, the political response to the COVID-19 pandemic has been perceived as an opportunity to accelerate with the EU's climate and energy transition (Dupont et al., 2020; von Homeyer et al., 2022). In general, there is more research available focused on the consequences of the COVID-19 crisis on the energy transition, considering that it broke out about two years before the Russian armed attack on Ukraine (with some exceptions, see for example: Nerlinger and Utz, 2022; Szulecki and Overland, 2023). Nevertheless, both events have significant implications for the energy transition implementation in Europe and, as such, could be classified among the constraints categories.

The Russia's invasion of Ukraine in February 2022, in particular, caused a strong paradigm-shift in global politics and markets (Benton et al., 2022) and significantly affected the development and implementation of the European energy transition (Mišík and Nosko, 2023; Osička and Černoch, 2022; Siddi, 2022). Disrupted natural Russian gas supplies to many EU's member states, have brought the energy security concerns high on the European political agenda (Mišík, 2022; von Homeyer et al., 2022), what in some countries (such as Germany, the Czech Republic or Austria) has translated into a shift towards coal as a guarantee of energy security (Mišík and Nosko, 2023). The revival of the energy security concerns in Europe does not mean that the decarbonisation will not remain one of the main drivers of the EU's energy transition. In May 2022, the European Commission proposed the REPowerEU Plan – a set of measures that should allow to reduce dependence on the Russian fossil fuels. Accelerating deployment of renewable energy sources – whose target has been increased to 45% by 2030 – was also included among the actions listed by the European Commission as a mean to increase the independence of the European energy system (European Commission, 2022; Siddi, 2022; von Homeyer et al., 2022). In that context, the aftermaths of the Russia's aggression in Ukraine on the European energy transition's implementation require scientific reflection and investigation and the topics addressed in this thesis are relevant for adjustment to the current political developments and trigger other research questions.

For example, the REPowerEU Plan introduces the idea of so-called 'go-to' areas for renewable energy, where the needed infrastructure should be put in place with "shortened and simplified permitting processes in areas with lower environmental risks" (European Commission, 2022). Does that mean that such strong political push to accelerate with renewable energy sources will lead to a worse quality of public engagement and deliberative approaches around the implementation of the energy transition technologies (cf. Campos et al., 2022)? Does it mean that the conflicts around the implementation of the energy transition infrastructure in the local contexts will intensify? Does it mean that methodologies and tools used to plan and govern the energy transition's implementation will be simplified? Furthermore, the implementation of the European energy transition to be successful in responding to the Russia's invasion of Ukraine requires more coordination and resource mobilisation between the EU's member states (Osička and Černoch, 2022). That leads to another research questions: what are the key areas of climate and energy partnerships between different member states that would effectively contribute to the EU's strategic response? How these partnerships could be strengthened? To what extent an upgraded Polish-German climate and energy partnership could contribute to diminishing "the historically established East-West conflict line in EU climate policy" and the "two speed-decarbonisation approaches" in the EU (Ćetković and Buzogány, 2019; Gaventa, 2019; von Homeyer et al., 2022). Furthermore, as many of the expert discussions after the Russia's attack on Ukraine focused on the cut of the Russian natural gas supplies to Europe (see for example: Flanagan et al., 2022; IEA, 2022a; McWilliams and Zachmann, 2022) that could temporally be replaced by coal, will that give a solid argument to climate delayers about the coal's revival in Europe? Further studies could deal with these questions.

Research on the energy transition implementation constraints shall be continued. The energy security concerns and the aftermaths of the Russia's invasion of Ukraine should not, however, be the only reason for that. Climate change accelerates, intensifies, and its consequences negatively affect societies and economies around the globe (IPCC, 2023). Hence, for the next decades both: climate and security concerns will continue to make the need to understand the reasons that hinder the energy transition's implementation important and relevant. At the same time the existence of the implementation's constraints does not have to be a negative thing, because identifying these constraints can improve existing processes and policies, bringing additional benefits in terms of social and technological innovation and development (cf. Biresselioglu et al., 2020; Wittmayer et al., 2020). Even if it is not possible to come up with a complete list of all potential energy transition implementation constraints and applying the relevant countermeasures might be a challenging task, any action undertaken to ease the energy transition's implementation process will help to address the climate- and energy security-needs. Hopefully, the theoretical and empirical contributions of this thesis will support the energy transition's implementation process, independently what kind of element it concerns: technologies, policies, partnerships, or methodologies. The process of the energy transition's implementation can be complex, messy, costly, and conflictual, but the consequences of not taking any action to progress with the energy transition and mitigate climate change can be even more damaging for the entire humanity.

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# Appendix 1.: Interviews' guidelines

## INTERVIEW GUIDELINES

**Informing P – 1:** "Understanding the role of trust in power line development projects: Evidence from two case studies in Norway"

### Part I: The interview guide in Bamble-Rød case study

**Private stakeholders**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>How long have you been living here?<br>What is your occupation? What do you do?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new power line between Bamble and Rød? (providing more information about the project, for instance decommissioning of 132 kV lines) | Do you think that this line is needed here? Why? |
| 2 | Affectedness | Complementary question |
| | How were you affected by the project? | |
| 3 | Information/ Network | Complementary question |
| | Where did you get the information about the project from? | With whom did you talk about it? |
| 4 | Action, involvement and behavior | Complementary question |
| | How were you engaged into the project?<br>Have you been invited to participate in consultation (decision-making process)? When? | What kind of action did you undertake to support/oppose it?<br>What participation opportunities were possible? Was it enough, in your opinion? |
| 5 | Stakeholder characteristics: past experience, concerns | |
| | Do you have any experience with these kinds of projects? | What kind of experience is it? |
| 6 | Attitude, Behavior (NIMBY) | Complementary question |
| | Have your attitude/ opinion towards the project changed since you first heard about it? | What factor was the most important in determining your attitude towards the project: its |

| | | |
|---|---|---|
| | | type, the participatory process, your interests? |
| 7 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | Complementary question |
| | Why, do you think, the decision about project was taken?<br><br>Who, in your opinion, made a decision about it?<br><br>Do you support such a decision-making process?<br><br>How do you think such a decision-making process should look like? | At which level such a decision should be made (European/ national/ regional/ local)?<br>Who would you trust to take an acceptable decision (supranational institutions, governments, local authorities, others)?<br>What was the role of the local authorities in decision-making process? |

**Officials**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>What were (are) your duties regarding the project?<br>How long have you been working in your position?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new power line between Bamble and Rød? (providing more information about the project, for instance decommissioning of 132 kV lines) | Do you think that this line is needed here? Why? |
| 2 | Stakeholder characteristics: past experience, concerns | |
| | What was your role in the project?<br><br>Do you have any experience with these kinds of projects? What kind of experience is it? | Did you have any concerns regarding the realization of the project? |
| 3 | Information/ Network | |
| | Had your institution the duty/task to inform some category of stakeholders about the project and/or about the decision making process? How did you perform this task? Was there interest from the stakeholders' side?<br><br>Did someone try to influence your position about the project? How? | |

| | | |
|---|---|---|
| 4 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | |
| | What do you think about the participation of different stakeholders in decision-making process?<br>Was the engaging process organized in a sufficient way?<br>Do you personally support such a decision-making process?<br>How do you think such a decision-making process should look like? | At which level, do you think, such a decision should be made (European/ national/ regional/ local)?<br>Who, do you think, people would trust, to take an acceptable decision (supranational institutions, governments, local authorities, others)? |
| 5 | Attitude, Behavior (NIMBY) | |
| | Have your attitude/ opinion towards the project changed since you first heard about it? | |

**NGO's**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>What do you do in your organization?<br>What were (are) your duties regarding the project?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new power line between Bamble and Rød? (providing more information about the project, for instance decommissioning of 132 kV lines) | Do you think that this line is needed here? Why? |
| 2 | Affectedness | |
| | How were you affected by the project?<br>What are the effects of the project on environment/ landscape (etc., depending on the representative of specific organization) | |
| 3 | Information/ Network | Complementary question |
| | Where did you get the information about the project from? | With whom did you talk about it? |

| 4 | Action, involvement and behavior | Complementary question |
|---|---|---|
| | How were you engaged into the project?<br>Have you been invited to participate in consultation (decision-making process)? When? | What kind of action did you undertake to support/oppose it?<br>What participation opportunities were possible until now? Was it enough, in your opinion? |
| 5 | Stakeholder characteristics: past experience, concerns | |
| | Do you have any experience with these kinds of projects? | What kind of experience is it? |
| 6 | Attitude, Behavior (NIMBY) | Complementary question |
| | How was your attitude regarding the project?<br>Has it changed since you first heard about it? | What factor was the most important in determining your attitude towards the project? (its type, the participatory process, your interests) |
| 7 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | Complementary question |
| | Why, do you think, the decision about project was taken?<br>Who, in your opinion, made a decision about it?<br>Do you support such a decision-making process?<br>How do you think such a decision-making process should look like? | At which level such a decision should be made (European/ national/ regional/ local)?<br>Who would you trust to take an acceptable decision (supranational institutions, governments, local authorities, others)?<br>What was the role of the local authorities in decision-making process? |

**Part II: The interview guide in Aurland-Sogndal case study**

**Private stakeholders**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>How long have you been living here?<br>What is your occupation? What do you do?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new transmission line between the Aurland hydropower station and the Sogndal substation? | Do you think that this line is needed? Why?<br>What do you think about replacing the existing power line between Aurland, Fardal and Sogndal as the part of the whole project? |
| 2 | Affectedness | Complementary question |
| | How may/will you be affected by the project? | |
| 3 | Information/ Network | Complementary question |
| | Where have you got the information about the project from? When was it for the first time?<br><br>What does this information say about the project? Is it relevant for you? Have you wanted to discuss other aspects, too? If yes, which? | With whom have you talked about it? |
| 4 | Action, involvement and behavior | Complementary question |
| | How have you been engaged into the project so far?<br>Have you participated in the decision-making process until now? How?<br>What engagement opportunities have been possible so far? Has it been enough, in your opinion?<br>So far, do you think that responsible bodies have provided all information about the project, which you wanted to know? Have there been any other aspects you wanted to discuss/ tackle with? Was it possible to do it? | What kind of action have you undertaken to support/oppose it? |

| | | |
|---|---|---|
| | Have you had a close and direct contact to any person from the side of Statnett? How would you describe it? How would you evaluate it? | |
| 5 | Stakeholder characteristics: past experience, concerns | |
| | Do you have any experience with these kinds of projects?<br>Do you support building new transmission lines? Do you support it if it aims to connect more electricity produced from renewables and to transform the energy system? | What kind of experience is it? |
| 6 | Attitude, Behavior (NIMBY) | Complementary question |
| | Has your attitude/ opinion towards the project changed over the time since you first heard about it? | What factor has been the most important in determining your attitude towards the project: its type, the participatory process, your interests? |
| 7 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | Complementary question |
| | Why, do you think, the decision:<br>- to build a power line<br>- that a power line is needed<br>could be made?<br>Who, in your opinion, makes a decision about the need of building the transmission line?<br>Who, in your opinion, makes a decision about which of the different transmission line's alternatives will be selected?<br>Who, in your opinion, makes a decision about where to site the transmission line?<br>Do you support the decision-making process which is being used in this project and the way you have been involved/expected to be involved?<br>How do you think such a decision-making process should look like? | At which level such a decision should be made (European/ national/ regional/ local)?<br>Who would you trust to take an acceptable decision (supranational institutions, governments, local authorities, others)?<br>What has been the role of the local authorities in decision-making process until now? |
| 8 | Landscape issues | |
| | How do you feel about the potential landscape impacts of the Aurland-Sogndal project?<br>Do you feel that you will have an influence on the decision regarding the potential landscape impacts? | Do you think that the project will change the landscape to a large extent? |

**Officials**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>How long have you been living here?<br>What is your occupation? What do you do?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new transmission line between the Aurland hydropower station and the Sogndal substation? | Do you think that this line is needed? Why?<br>What do you think about replacing the existing power line between Aurland, Fardal and Sogndal as the part of the whole project? |
| 2 | Stakeholder characteristics: past experience, concerns | |
| | What has been your role in the project so far?<br>Do you have any experience with these kinds of projects? What kind of experience it is? | Did you have any concerns regarding the realization of the project? |
| 3 | Information/ Network | |
| | Has your institution the duty/task to inform stakeholders about the project and/or about the decision making process?<br>Where do you take the information about the project, which you share later with stakeholders, from?<br>How have you performed your task? Has there been a big interest from the stakeholders' side?<br>Has someone tried to influence your position about the project? How? | |
| 4 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | |
| | What do you think about the participation of different stakeholders in decision-making process until now?<br>Do you think that affected citizens have participated to a large extent and eagerly? Why?<br>Has the engaging process so far been organized in a sufficient way? In your opinion have there been enough engagement opportunities possible so far? | At which level, do you think, such a decision should be made (European/ national/ regional/ local)?<br>Who, do you think, people would trust, to take an acceptable decision (supranational institutions, |

| | | |
|---|---|---|
| | Do you think that you have provided all information about the project which stakeholders wanted to know about? During the process until now, did stakeholders expect even more information?<br>Do you personally support the decision-making process used in this project?<br>How do you think such a decision-making process should look like?<br>Have you had a close and direct contact to any person from the side of Statnett? How would you describe it? How would you evaluate it? | governments, local authorities, others)? |
| 5 | Attitude, Behavior (NIMBY) | |
| | Has your attitude/ opinion towards the project changed since you first heard about it?<br>Do you support building new transmission lines? Do you support it if it aims to connect more electricity produced from renewables and to transform the energy system? | |
| 6 | Landscape issues | |
| | How do you feel about the potential landscape impacts of the Aurland-Sogndal project?<br>Do you feel that you will have an influence on the decision regarding the potential landscape impacts? Do you think that other stakeholders involved will be empowered to co-decide about it? | Do you think that the project will change the landscape to a large extent? |

**NGO's**

| | | |
|---|---|---|
| | **About you:**<br>Short information about the interviewee.<br>How long have you been living here?<br>What is your occupation? What do you do?<br>The interview and all information provided will be used only for our research purposes. We will use it in an anonymized way. Would you mind if we record it? | |
| 1 | General question | Complementary question |
| | What do you think about the project of building the new transmission line between the Aurland hydropower station and the Sogndal substation? | Do you think that this line is needed? Why?<br>What do you think about replacing the existing power line between Aurland, Fardal |

| | | |
|---|---|---|
| | | and Sogndal as the part of the whole project? |
| 2 | Affectedness | |
| | How may/will you be affected by the project?<br>What will be the effects of the project on the environment? | |
| 3 | Information/ Network | Complementary question |
| | Where have you got the information about the project from? When was it for the first time?<br><br>What does this information say about the project? Is it relevant for you? Have you wanted to discuss other aspects, too? If yes, which? | With whom did you talk about it? |
| 4 | Action, involvement and behavior | Complementary question |
| | How have you been engaged into the project so far?<br>Have you participated in the decision-making process until now? How?<br>What engagement opportunities have been possible? Has it been enough up until this stage in the process, in your opinion?<br>Do you think that responsible bodies have provided all information about the project, which you wanted to know? Have there been any other aspects you wanted to discuss/ tackle with? Was it possible to do it?<br>Have you had a close and direct contact to any person from the side of Statnett? How would you describe it? How would you evaluate it? | What kind of action have you undertaken to support/oppose it? |
| 5 | Stakeholder characteristics: past experience, concerns | |
| | Do you have any experience with these kinds of projects?<br>Do you support building new transmission lines? Do you support it if it aims to connect more electricity produced from renewables and to transform the energy system? | What kind of experience is it? |

| 6 | Attitude, Behavior (NIMBY) | Complementary question |
|---|---|---|
| | How was your attitude regarding the project at the very beginning?<br><br>Has it changed since you first heard about it? | What factor has been the most important in determining your attitude towards the project: its type, the participatory process, your interests? |
| 7 | Democratic understanding and identity/ values/ attitudes/ beliefs/ behavior | Complementary question |
| | Why, do you think, the decision:<br>- to build a power line<br>- that a power line is needed<br>could be made?<br><br>Who, in your opinion, makes a decision about the need of building the transmission line?<br><br>Who, in your opinion, makes a decision about which of the different transmission line's alternatives will be selected?<br><br>Who, in your opinion, makes a decision about where to site the transmission line?<br><br>Do you support the decision-making process which is being used in this project and the way you have been involved so far/expected to be involved?<br><br>How do you think such a decision-making process should look like? | At which level such a decision should be made (European/ national/ regional/ local)?<br><br>Who would you trust to take an acceptable decision (supranational institutions, governments, local authorities, others)?<br><br>What has been the role of the local authorities so far in decision-making process? |
| 8 | Landscape issues | |
| | How do you feel about the potential landscape impacts of the Aurland-Sogndal project?<br><br>Do you feel that you will have an influence on the decision regarding the potential landscape impacts? How do you see your role? | Do you think that the project will change the landscape to a large extent? |

**INTERVIEW GUIDELINES**

**Informing P – 3:** “Untapped Horizons and Prevailing Domestic Beliefs. Bilateral climate and energy relations from a Polish perspective”

<table>
<tr><td></td><td>Introduction:<br><ul><li>Focus of the research</li><li>Research questions</li><li>Why a comparative perspective</li><li>The Renewables Directive vs. The Winter Package</li></ul>Technicalities: recording + inclusion in the tables with all interview-partners</td></tr>
<tr><td>1</td><td>GENERAL QUESTIONS</td></tr>
<tr><td></td><td>How would you assess Germany's climate and energy policy? How do you view the activities of the German government in the European context/ at the EU level in relation to climate and energy policy?<br><br>How would you assess Poland’s climate and energy policy? How do you view the activities of the Polish government in the European context/ at the EU level in relation to climate and energy policy?</td></tr>
<tr><td>2</td><td>GOALS AND OBJECTIVES</td></tr>
<tr><td></td><td>In the context of The Winter Package what would you assess as the most important goals of:<ul><li>The Polish government?</li><li>The German government?</li></ul>In the context of The Winter Package what would you assess as the most important demands of the coal/ conventional sector:<ul><li>From Germany?</li><li>From Poland?</li></ul>In the context of The Winter Package what would you assess as the most important demands of the renewables sector:<ul><li>From Germany?</li><li>From Poland?</li></ul></td></tr>
</table>

| | |
|---|---|
| | In your opinion, have these goals/demands changed during the whole policy-making process (starting from the agenda-setting by the Commission, throughout more detailed negotiations, up to final announcement, e.g., the RES goal up to 2030). |
| 3 | THE INSTITUTIONAL/ GOVERNANVE CONTEXT |
| | In your opinion, regarding the Winter Package, which level of governance: the national or the European, has been more important to mediate the interests:<br>• for the representatives of the coal/conventional sector:<br>o from Poland?<br>o from Germany?<br>• for the representatives of the RES sector:<br>o from Poland?<br>o from Germany?<br><br>Why has it been so?<br><br>In this context, which of the EU institutions involved in the decision-making process have been the most important? For the conventional sector (PL/GER), for the RES sector (PL/GER)? Why these institutions?<br><br>How, in your opinion, the interest groups treat these institutions? As open, transparent, responsive? Are there any differences between them? [please describe, give examples]<br><br>How, in your opinion, these institutions treat different interest groups from the energy sector? What is their attitude to received information: neutral, positive, negative? What is their reaction to lobbing activities: positive, negative, negotiable, constructive? In this manner, is there a difference between the conventional and the RES sectors?<br>Is there any difference between interest groups that have different countries of origin?<br><br>In your opinion, how and to what extent the domestic situation in both countries (PL & GER) determines the activity of the energy interest groups at the EU level?<br>Is it the same for the representatives of both sectors (conventional & RES)? Or are there any differences?<br><br>To your knowledge, do you know whether the German interest groups from any of these both sectors are trying to exert influence on the Polish government?<br>If yes – how? Any examples?<br>If no – why?<br>To your knowledge, do you know whether the Polish interest groups from any of these both sectors are trying to exert influence on the German government?<br>If yes – how? Any examples?<br>If no – why? |

| | | |
|---|---|---|
| | To your knowledge, do you know whether the interest groups from both sectors (either conventional or RES) cooperate/ work together?<br>If yes – on what issues? How? Any examples?<br>If no – why?<br><br>To your knowledge, do energy interest groups from opposing sectors (conventional/ RES) cooperate to negotiate a common position? If yes, then in regard to which regulations? If no, why is it so?<br><br>To your knowledge, do you know whether the Polish and German governments cooperate/ work together in the context of the Winter Package?<br>If yes – on what issues? How? Any examples?<br>If no – why? | |
| 4 | MEANS/ TOOLS & COMMUNICATION | |
| | Do you see a difference in a way how the energy interest groups intermediate their needs and demands? If yes, what are these differences?<br>Please indicate: conventional/ RES and PL/ DE…<br>How intense they organize their activities; attempts to establish a direct contact; send policy briefs, studies, etc.?<br><br>Is there a difference in their behaviour?<br><br>What kind of argumentation/ rhetoric/ narrative they use in their lobbying activities: environmental, social (acceptance), economic/ profitability? Any others?<br><br>Would you say that any of these interest groups: conventional/ RES and/or PL/ GER is more successful (influential) in their demands/ intermediation in comparison to the others?<br>If yes/ no – why?<br>What, in your opinion, determines this success? | |
| 5 | **Goodbye** | |
| | Would you like to add something more to yourself/recommend someone? | *Thank you for the interview.* |

**INTERVIEW GUIDELINES**

**Informing P – 4:** ”Model-based policymaking or policy-based modelling? How energy models and energy policy interact”

*Introduction*

Quick intro of yourself and your organisation to the interviewee.

*Information on the project*

The project Sustainable Energy Transitions Laboratory (SENTINEL) is a European research project funded under the Horizon 2020 Research and Innovation programme. The SENTINEL project aims to develop and test new energy system models and make them widely available to decision-makers. The computer models will be developed specifically to enable different actors to obtain information on all sorts of aspects of the energy system transformation and to make decisions for climate-neutral energy system. The special feature of the SENTINEL project is that the needs of the users are at the centre of the model development. In order to identify what future energy models should do, we conduct interviews with different experts, which influence or make decisions about this system.

*Data protection*

With the conduction of the interview, you agree with the SENTINEL consent for collection and processing of personal data for research purposes, which I sent you beforehand. Do you have any questions regarding that?

| Main research question: How do scientific energy system modelling and policy(-making) affect each other? | | |
|---|---|---|
| **POLICYMAKERS / OTHER DECISIONMAKERS** | | |
| **Area of investigation/ *Remarks*** | | **Question** |
| *Energy policy decision-making* | 1. | Introductory question:<br>Could you please briefly state what do you think are key events that have determined the energy policy in [country/EU] in the last 20 years? |

| | | |
|---|---|---|
| | 1.1 | What are key aspects for you, such as information sources and events, that determine your choices and decisions in the energy policy? (such as tools, models, events, or powerful actors/lobbies) |
| *Questions regarding energy model use (model → policy)* | 2. | Do you use energy models and/or results of energy modelling, while making decisions in the energy policy field?<br>No: Why not?<br>Yes: What for? How do you use them? (policy instruments, strategic policy objectives, political positions, negotiations etc.- policy design, policy justification, policy evaluation?)<br>Which models do you use? Why do you use those models?<br>To what extent did past energy model advances in terms of model complexity influence your use of energy models in policy-making / in your work? (endogenised learning and high-resolution models)<br>Is there a specific procedure how models are involved in the development of policy documents / position papers? If yes, how does this process look like? |
| *Case study* | 2.1 | Following I would like to focus on the specific process of [the introduction of XX / decision about XX / XX ].<br>In your opinion, what were the key reasons that have led to the political decision? Who were relevant actors involved?<br>*[potential other specific case study question(s)]*<br>In the framework of the process XX, different model-based studies [from XX] have been completed. In your opinion, to what extent did these (energy) models/ their results impact the outcome of the policy-making process in this concrete example?<br>To what extend did these energy models influence you/ your positioning in the decision-making process? |
| *Question regarding energy model development (policy → model)* | 3. | Have you been involved in the development of energy models by the scientific community?<br>*If yes:* What was the goal of the collaboration?<br>What was your role in the development process of the energy model?<br>How did the collaboration between you and researchers look like? |
| *Case study* | 3.1 | In the framework of the process XX model-based studies have been commissioned/implemented by the government/association/… With what aim have been those implemented? |

| | | |
|---|---|---|
| *Question about energy model demands* Preferences and priorities of stakeholders regarding the model's scope[10] | 4. | What are the current and future challenges or aspects of the energy transition, which should be integrated in future energy models? |
| These questions to be treated as dealing with the model's output | 5. | In your opinion, what kind of information should an energy model deliver to make good decisions about the energy policy? |
| *Design development process of energy models* | 6. | What conditions[11] must be given that increase the chance that you would use the models or the results, respectively, in future policy-making / your work? |
| *Finalising questions* | 7. | Did we miss to talk about anything relevant to the research context? |
| | 8. | Would you be interested to be updated about the further process of the SENTINEL project? If yes, how? We will organise a workshop on prioritising user demands for SENTINEL. Would you be interested in participating? |
| | 9. | In the backdrop of the interview, can you recommend any other interview partner who could provide valuable input to our research? |

[10] See framework 2 for examples

[11] Possible answers: open source, transparency, trustworthiness, credibility, legitimacy, reproducibility and replication…

| Main research question: How do scientific energy system modelling and policy(-making) affect each other? | | |
|---|---|---|
| **MODELLERS (SENTINEL + EXTERN)** | | |
| **Area of investigation/ *Remarks*** | | **Question** |
| *Energy policy decision making* | 1. | Introductory question:<br>Could you please briefly state what do you think are key events that have determined the energy policy in [country/EU] in the last 20 years? |
| | 1.1 | What do you think are key aspects, such as information sources and events, which determine decisions and positioning in energy policy? (such as tools, models, events, or powerful actors/lobbies) |
| *Question regarding energy model use (model → policy)* | 2. | To what extent, do you think, energy models and/or their results are being used in energy policymaking?<br>To what extent do you think did past energy model advances in terms of model complexity influence the use of energy models in policy-making? (endogenised learning and high-resolution models)<br>Is there a specific procedure how models are involved in the development of policy documents / position papers? If yes, how does this procedure look like? |
| *EXTERN: Case study* | 2.1 | Following I would like to focus on the specific process of [the introduction of XX / decision about XX / XX ].<br>In your opinion, what were the key reasons that have led to the political decision? Who were relevant actors involved?<br>*[potential other specific case study question(s)]*<br>Could you describe how the energy model XX and its results have been used in energy policy-making? (policy design, justification, evaluation/monitoring[12])<br>Do you know by whom it has been used?<br>Have you been consulted to give advice on the model usage? |

[12] See framework 1 below

| | | |
|---|---|---|
| *INTERNAL SENTINEL Modellers* | 2.2 | Could you provide concrete examples of models and their use in policy-making? (policy design, justification, evaluation/monitoring[13]).<br>Do you know by whom it has been used?<br>Have you been consulted to give advice on the model usage? |
| *Question regarding energy model development (policy → model)* | 3. | Have you ever participated in a work dedicated to designing energy policies, where you have used energy models/ results of energy models?<br>What was the aim of the model integration?<br>How was this process designed? Who did commission this work?<br>Has anyone else been involved? If yes, who? |
| *Case study* | 3.1 | In the framework of the process XX model-based studies have been commissioned/implemented by the government/association/… With what aim have been those implemented?<br>Did you have the feeling that the political decision was already made? |
| *Question about energy model demands*<br>Preferences and priorities of stakeholders regarding the model's scope[14] | 4. | What are the current and future challenges or aspects of the energy transition which should be integrated in future energy planning models? |
| These questions to be treated as dealing with the model's output | 5. | In your opinion, what kind of information should an energy model deliver to inform decision-making (processes) in energy policy? |
| *Design development process of new energy models* | 6 | In your opinion, how should the process of model development be designed to increase the chance of the later model use in policy-making? |
| *Finalising questions* | 7. | Did we miss to talk about anything relevant to the research context? |
| | 8. | *If non-SENTINEL modellers:* |

[13] See framework 1 below
[14] See framework 2 for examples

| | | |
|---|---|---|
| | | Would you be interested to be updated about the further process of the SENTINEL project? If yes, how?<br>We will organise a workshop on prioritising user demands for SENTINEL. Would you be interested in participating? |
| | 9. | Can you recommend any other interview partner who could provide valuable input to our research? |

NOTES:

- Questions included in **square brackets** “**[ ]**” should be treated as follow up questions or clarification questions to be asked directly during the interview, depending on the interviewee’s response.
- Questions will be slightly adjusted depending **on the character of stakeholder** (especially among energy industry, NGOs and policymakers) – there might be differences depending on which level a given stakeholder is active (local/ municipal/ regional/ national/ European).

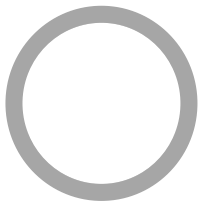
TERMS USED IN QUESTIONS:

- **Issues** are understood here as: decentralisation, need for flexibility, sector coupling, short- and long- term market dynamics, social drivers/constraints and societal reactions to energy trajectories, non-economic determinants and barriers for the necessary investments, techno-economic uncertainty and, potentially, others. This selection has been made according to the nomenclature included in the proposal (and in the following research plan).
- **Type of model/ its scope** – corresponds with the distinction of modules as indicated in the proposal: Social and Environmental Transition Constraints; Energy Demand; System Designs; Economic Impacts.
- **Information** – is used here as a “model output” and is directly linked to the 2$^{nd}$ question under point no. 4 “In your opinion, which questions an energy planning model should answer”?
- **Variable** – is used here as a “model input”. An open question is whether we use “variable/parameter” interchangeably. A “variable” varies under certain conditions, whereas “parameter” remains constant. I suppose that this distinction would be relevant depending on the model, which an interviewee would have in mind.
- **Dimensions**: ecological, social, cultural, political, economic, technical – have been extracted from the research plan and we could use them as categories to evaluate interviewees’ answers regarding the type of model, inputs and outputs.

*The "frameworks" are understood to help for orientation and classification of potential answers by the interview partners.*

**Framework 1**

*Note:* Simplistically we can state that models can be potentially used to develop, justify or evaluate energy policy. In the interview, we will ideally derive information on when and how models have been used by our different stakeholders.



*policy cycle*

| **When in the policy cycle?** | **What for?/How? - Model…** |
|---|---|
| Agenda Setting | …defined ambition |
| Policy formulation | …informed choice of policy instrument |
| Policy implementation | …justified policy decision |
| Policy evaluation | …assessed policy impact |

**Framework 2**

*Note:* The interviewees aim to identify specific energy model needs be different stakeholders. Interviewees might state dimensions of the energy transition or refer to specific energy planning issues. All dimensions are interlinked and some planning issues don't belong to one main category necessarily! Moreover, many planning issues involve more than one system dimension.

| **'D' dimensions of the energy transition** | **Energy planning issues** (based on proposal, p. 142) | **Main affected system and cross-system dimension** |
|---|---|---|
| Decentralisation | Fluctuations in supply | Technology |
| | Cost minimisation | Economy |
| | Prosumers | Society, Economy |
| | Land use | Environment |
| Digitalisation | Flexibility | Technology |
| | Sector coupling | Technology |
| Democratisation | Social acceptance/opposition | Society, Technology |
| | Market dynamics | Economy |
| | Energy policy design | Policy |
| | Spatial planning | Policy |
| Decarbonisation | Emissions of the energy system | Economy, Society, Policy |
| | Integration and mix of renewables | Technology |
| | Resource use (over life cycle) | Environment |
| | Investment volumes needed | Policy, Economy |
| | Role of Uncertainties | |
| | Impact of shock events | |

# Appendix 2.: List of prior publications

## Peer-reviewed articles

Kleanthis, N., Stavrakas, V., **Ceglarz, A.**, Süsser, D., Schibline, A., Lilliestam, J., & Flamos, A. (2022). Eliciting knowledge from stakeholders to identify critical issues of the transition to climate neutrality in Greece, the Nordic Region, and the European Union. *Energy Research & Social Science,* 93. https://doi.org/10.1016/j.erss.2022.102836

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**Ceglarz, A.** (2020). De-growth. In M. Schreurs, & E. Papadakis (Eds.), *Historical Dictionary of the Green Movement*, Third Edition (pp. 103-104). Lanham, Boulder, New York, London: Rowman & Littlefield.

**Ceglarz, A.** (2020). Poland. In M. Schreurs, & E. Papadakis (Eds.), *Historical Dictionary of the Green Movement*, Third Edition (pp. 247-248). Lanham, Boulder, New York, London: Rowman & Littlefield.

Battaglini, A., **Ceglarz, A.**, & Schneider, T. (2019). The Power of Collaboration: the Case of the Renewables Grid Initiative. In S. Nies (Ed.), *The European Energy Transition: Actors, Factors, Sectors* (pp. 455-462). Deventer and Leuven: Claeys & Casteels Law Publishers.

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## Discussion and position papers and other publications

Battaglini, A., & **Ceglarz, A.** (2022). *No time to lose: Short-term measures to minimise impacts of the severe energy crises in Europe and Germany. Some thoughts on indicative pathways*. Discussion Paper. Paris Agreement Compatible (PAC) Scenarios for Energy Infrastructure Project, July 2022, Berlin.

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**Ceglarz, A.** (2021). Umweltbewusstsein in Polen: historische Entwicklung und aktuelle Trends. *OST-WEST. Europäische Perspektiven*. OWEP 2/2021.

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Süsser, D., **Ceglarz, A.**, Gaschnig, H., Stavrakas, V., Giannakidis, G., Flamos, A, Sander, A. & Lilliestam, J. (2020). *The use of energy modelling results for policymaking in the EU*. Deliverable 1.1, SENTINEL Project, Sustainable Energy Transitions Laboratory, WP1, Horizon 2020 programme. Institute for Advanced Sustainability Studies (IASS). Potsdam, Germany. DOI: 10.48481/iass.2020.058. 54 pp.

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