

Hullmann, Charlotte Marie

Research Report

Case study on the German discourse of industry decarbonisation: A discourse network analysis

Wuppertaler Studienarbeiten zur nachhaltigen Entwicklung, No. 31

Provided in Cooperation with:

Wuppertal Institute for Climate, Environment and Energy

Suggested Citation: Hullmann, Charlotte Marie (2023) : Case study on the German discourse of industry decarbonisation: A discourse network analysis, Wuppertaler Studienarbeiten zur nachhaltigen Entwicklung, No. 31, ISBN 978-3-946356-34-9, Wuppertal Institut für Klima, Umwelt, Energie, Wuppertal, <https://doi.org/10.48506/opus-8476>

This Version is available at:

<https://hdl.handle.net/10419/282983>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

Case Study on the German Discourse of Industry Decarbonisation

A Discourse Network Analysis



Charlotte Marie Hullmann

Publisher:

Wuppertal Institut für Klima, Umwelt, Energie gGmbH
Döppersberg 19
42103 Wuppertal, Germany
www.wupperinst.org

Author:

Charlotte Marie Hullmann
E-Mail: charlotte.hullmann@wupperinst.org

This master's thesis was written in collaboration between the Wuppertal Institute and Radboud University.

Please cite the publication as follows:

Hullmann, C. M. (2023). Case Study on the German Discourse of Industry Decarbonisation (Wuppertaler Studienarbeiten zur nachhaltigen Entwicklung no. 31). Wuppertal Institute.

Wuppertaler Studienarbeiten zur nachhaltigen Entwicklung

The Wuppertal Institute undertakes research and develops models, strategies and instruments to support transitions to sustainable development at regional, national and international level. This work focuses on challenges related to resources, climate and energy and their interactions with business and society. Special emphasis is placed on analysing and stimulating innovations that decouple economic growth and wealth from the consumption of natural resources.

In this series – which translates as Wuppertal student research papers on sustainable development – outstanding academic bachelor's, "Diplom", master's or state examination theses are published that were written as part of sustainability research at the Wuppertal Institute. These projects were supervised in cooperation with universities (of applied sciences), accepted by the universities and awarded excellent marks.

The Wuppertal Institute regards publishing such papers as a means of adding scientific depth to public discourse relating to the transition to a sustainable economic system and way of life.

Wuppertal, December 2023
ISBN 978-3-946356-34-9

This work is licensed under Creative Commons Attributions 4.0 International license (CC BY 4.0).
The license is available at: <https://creativecommons.org/licenses/by/4.0/>



1 Summary

The adoption of the Paris Agreement in 2015 and the passing of the Climate Action Law in Germany in 2019 established the legal need for the basic material industry in Germany to decarbonise. For the industry sector, the target is set at a 49-51% GHG reduction by 2030 compared to 1990. Even though the sector specific targets are likely to become obsolete, a Hydrogen Strategy, Industry Strategy and Climate Protection Contracts are currently being developed or elaborated on. These are to further ensure and enable the basic material industry in Germany to decarbonise. These developments are emphasising the relevance of studying the industry decarbonisation at the time of conducting this research.

As the institutionalisation of the industry decarbonisation is influenced by discourse, the analysis of the discourse is an important tool for studying the power effects produced by and built into the discourse. This is the first research aiming to provide a structured analysis of the discourse on industry decarbonisation in Germany. Drawing on discourse analysis and the Multilevel-Perspectives framework, this research investigated the power and dominance of storylines to influence the discourse of the industry transformation towards decarbonisation. In this research insights were obtained into the storylines used in this discourse, the actors who are part of this discourse, the frequency of storylines used and the percentage of actors making use of these storylines. Additionally, insights were generated into the discursive network and potential coalitions.

This research made use of the Discourse Network Analysis software in combination with Visone and Excel for data collection, analysis, and visualisation. Based on 117 documents of various categories from the years 2012 to 2023, the discourse on German industry decarbonisation is discovered to be dominated by storylines of mainly technological or economic nature. The general sentiment discovered by the different actors is positive with the storylines focusing on establishing the conditions for the industry to decarbonise and no resistance being communicated. The discourse is furthermore dominated by most storylines. 18 out of 27 storylines are being used by more than 56% of all actors. The high overlap in storyline indicates discursive homogeneity. The homogeneity is further indicated through the lack of emerging discourse coalitions and the therewith connected lack of struggles for discursive dominance. One coalition can be defined with some actors being deeper involved and some being less involved in the discourse.

As decisions on the transition path for Germany's industry to decarbonise are still to be taken the lack of discursive struggles has come to my surprise. In the discussion I reflect on how the positive sentiment, the discursive homogeneity and the great number of dominant storylines may come about.

2 Preface

Until a couple of years ago, few people were talking about climate-neutral industry. For actors concerned about climate protection, industry was a problem child, given the sector's high greenhouse gas emissions, the lack of technological solutions, and the widespread resistance in energy-intensive firms and their strong lobby organisations against ambitious climate policy.

Today, this appears to have changed. Transforming industry, in particular the energy-intensive industries that produce steel, cement, plastics, glass etc., is still an enormous challenge. But in recent years, technological solutions and circular economy concepts have emerged that make it seem feasible. Scenario-based research has generated a much better knowledge about the solution space and the conditions, infrastructure and financing needs that are required to succeed. The industry transformation debate is characterised by an intensive exchange of arguments and knowledge between industry, science, policymakers, and civil society organisations that often takes place in stakeholder dialogue formats.

Against this background, it is highly interesting to look at industry transformation from a discourse perspective. The structure of discourse can be an indicator for conflict or cooperation potential. By dissecting the framings and storylines of different actors it can help disentangle their interests, strategies, and power relations. Charlotte Hullmann's master thesis is a highly valuable contribution here, being the first analysis of industry transformation discourse in Germany. Most notably, it shows that the discourse is much less polarised than what has been found in discourse research on earlier environmental policy issues. And it generates intriguing follow-up questions: does this character of the discourse extend to wider society beyond the expert debate? Can similar discourse structures be found in other countries? The thesis provides ample starting points for further exploring discourse and the role it plays in industry transformation. At Wuppertal Institute we very much welcome the inspiration from this work.

Dr. Anna Leipprand

Senior Researcher

Research Division Future Energy and Industry Systems

Wuppertal Institute for Climate, Environment and Energy gGmbH

Table of Contents

1	Summary	3
2	Preface	4
	Table of Contents	5
	Table of Tables	7
	Table of Figures	8
3	Introduction	9
	3.1 Introduction of the Research Topic	9
	3.2 Study Overview	11
4	Theoretical Foundation	14
	4.1 Introduction to Relevant Theoretical Frameworks	14
	4.1.1 <i>The Multilevel-Perspectives Framework</i>	14
	4.1.2 <i>Discourse Theory</i>	15
	4.1.3 <i>Integrating Narratives in the MLP Framework</i>	17
	4.2 Theoretical Framework	19
	4.3 Scientific Relevance	21
5	Critical Review of Academic Literature	22
	5.1 Steel Decarbonisation in the Netherlands analyzed through the MLP Framework	22
	5.2 European Discourse on Industry Decarbonisation	22
	5.3 Discourse Network Analysis in Related Topics	24
	5.4 Other Research	25
6	Methodology	26
	6.1 Data Collection	27
	6.1.1 <i>Actor Base Generation</i>	27
	6.1.2 <i>Corpus Creation</i>	28
	6.1.3 <i>Codebook Generation</i>	29
	6.2 Data Analysis and Visualisation	31
	6.2.1 <i>Storyline Frequency and Percentage of Actor Use</i>	31
	6.2.2 <i>Insight into the Discourses' Institutionalisation</i>	31
	6.2.3 <i>Identification of Discourse Coalitions</i>	32
	6.2.4 <i>Comparison of Discourse Coalitions Over the Years</i>	34
	6.2.5 <i>Changes in Storyline Frequency and Percentage of Actor Use Over the Years</i>	34
	6.3 Validity and Reliability of this Research	34
	6.3.1 <i>Validity</i>	34
	6.3.2 <i>Reliability</i>	35
7	Background – The Industry Decarbonisation Process in Germany presented within the frame of the MLP	37

7.1	The Landscape	37
7.2	The Industry Regime	37
7.3	The Niche	38
7.4	Case Selection	39
8	Findings	40
8.1	Identified Storylines	40
8.2	Discourse Structuration	42
8.3	Discourse Institutionalisation	47
8.4	Discourse Coalitions	49
8.5	Discourse Coalitions Over the Years	51
8.6	Discourse Structuration Over the Years	53
8.6.1	<i>Connecting Storylines</i>	54
8.6.2	<i>Storyline Use Over the Years</i>	56
9	Discussion	59
9.1	Interpretation of the Findings	59
9.1.1	<i>The Positive Sentiment</i>	59
9.1.2	<i>The Discursive Homogeneity</i>	59
9.1.3	<i>The Dominant Storylines</i>	61
9.2	Reflection on the Conducted Research	62
9.2.1	<i>Limitations</i>	62
9.2.2	<i>Societal Relevance</i>	63
9.2.3	<i>Future Research</i>	63
10	Conclusion	66
11	Acknowledgements	69
12	REFERENCES	70
13	APPENDIX	80
13.1	Appendix A – Actor Base	80
13.2	Appendix B – Corpus Calculation	82
13.3	Appendix C – Storylines and Narratives	83
13.4	Appendix D – Positionality	90

Table of Tables

Table 1 Research Questions -----	12
Table 2: Conceptualisation of Key Concepts -----	20
Table 3: Exemplary Storyline with Narratives -----	30
Table 4: Aggregated Codebook -----	41
Table 5: Actors at the Heart of the Discourse -----	53
Table 6: Top 10 Storylines Over the Electoral Periods -----	56
Table 7: Recommendations -----	67
Table 8: Overview on Actors -----	80
Table 9: Overview on Storylines and Narratives -----	83

Table of Figures

Figure 1: Illustration of Narratives in the Structuration Cycle (Hermwille, 2016, p.240) -----	18
Figure 2: Theoretical Framework Visualised by the Author -----	19
Figure 3: Conceptual Model as Visualised by the Author -----	20
Figure 4: Electoral Periods Covered with this Research-----	26
Figure 5: Type of Documents Used -----	29
Figure 6: Explanation Girvan-Newman Algorithm -----	33
Figure 7: Storylines Frequency-----	43
Figure 8: Percentage of Actors Using Storylines -----	44
Figure 9: Institutionalisation of decarbonisation in law-making in comparison to energy efficiency (visualisation by the author based on the search results in the DIP until the 31.05.2023)-----	48
Figure 10: Institutionalisation of decarbonisation in research in comparison to energy efficiency (visualisation by the author based on the search results in the Journal of Cleaner Production until the 06.06.2023)-----	48
Figure 11: Institutionalisation of the discourse based on the number of documents coded in this research. -----	49
Figure 12: Co-Occurrence Normalised Actor Congruence Network-----	50
Figure 13: No Threshold Merkel Cabinet 2-----	51
Figure 14: No Threshold Merkel Cabinet 3-----	51
Figure 15: No Threshold Merkel Cabinet 4-----	52
Figure 16: No Threshold Added Scholz Cabinet-----	52
Figure 17: No Threshold Full Time Period -----	55
Figure 18: Percentage of Actors' Use of Storylines Over the Years -----	58

3 Introduction

3.1 Introduction of the Research Topic

The German industry is known to be characterised by large-scale industrial processes, reliance on fossil fuels, and traditional business models. According to the World Bank industry made up a share of 26,61% of the German GDP in 2021. Only the industries of China, Russia and Japan contribute a higher share to their countries' GDP (Statista, 2023a). Of special relevance for German prosperity is the energy-intensive basic material industry. It includes the steel, basic chemicals, cement, aluminum, glass, and paper production. While the basic material industry is an important pillar of the economy, it is also a great challenge for decarbonisation. The basic material industry is responsible for a great percentage of global energy and resource turnover and for global greenhouse gas emissions (Wuppertal Institute, n.d. a). Globally, about 40 percent of greenhouse gas emissions are caused by the basic material industry directly and indirectly (Günter, 2022). The industry sector in Germany makes up for 7,9 percent of national emissions in 2020 (Umweltbundesamt, n.d.) of which in 2021, 73,1% are emissions caused by the basic material industry (Statista, 2023b). Guaranteeing value generation and the provision of more than 550,000 high-quality jobs, the basic material industry is understood to be essential to Germany's future. Despite efficiency improvements, emissions from the basic material industry have not fallen in recent years. Concerns to be addressed for the decarbonisation of the industry are the availability of innovation, technical feasibility, cost-effectiveness, the need for an enabling policy environment, and the insurance of enabling social equity in the decarbonisation process (Rissman, et al., 2020). Countering these concerns is research that identifies policy measures and technologies that, employed together, should reach net zero industrial emissions within the required time (Rissman, et al., 2020). It is national and international climate protection targets that are increasing the pressure for effective measures to be taken. The industry's emissions must fall by a quarter by 2030 and to near zero by 2050, while the industry's emission reduction has stagnated over the last ten years (Agora Energiewende and Wuppertal Institute, 2019). In this research, the term "industry" refers to the basic material industry. This study evaluates the situation in Germany since the industry greatly contributes to the national wealth generation while it is a key emitter of greenhouse gasses. To overcome this dilemma the decarbonisation of the industry is of particular relevance for this country.

"Without the key industries, we will not manage the transformation"

-Prof. Dr. Stefan Lechtenböhmer

Scientist and head of division for "Future Energy and Industrial Systems" at the Wuppertal Institute (citation translated from German to English with Deepl.com) (Günter, G., 2022).

Global issues such as climate change, resource scarcity, the digitisation of the economy and society, and demographic change demand a high degree of willingness to change and adapt the German industry. To secure prosperity in Germany, the OECD recommends greater collaboration between actors, comprehensive structural reforms, and the acceleration of the decarbonisation to be indispensable (OECD, 2023). The Federal Ministry for Economic Affairs and Climate Action of Germany attributes a prominent role to industry actors in coping with the economic consequences of climate change, increasing resource and energy efficiency, and using renewable energies (BMWK, n.d.b). According to the Federation of German Industries (BDI), German industries understand the urgent need for action in several policy areas to counter the current developments of climate change, increasing resource and energy efficiency, and using renewable energies (BDI, 2019).

After having focused on policy measures focusing on energy efficiency, the government now turns to instruments aimed at deeply decarbonising industrial production processes aimed at long-term transformation of the industrial sector (Fleiter et al., 2021). This shift from a focus on energy efficiency towards instruments supporting a deep decarbonisation manifests itself by recent legal developments in Germany. Important milestones for the industrial decarbonisation are the publication of the Hydrogen Strategy in June 2020 and the Climate Action Program 2030 in October 2019. These have contributed to the initiation of several major technology development programs. With these programs investment support is provided for the industrial-scale market introduction of production technologies contributing to the industrial decarbonisation (Fleiter et al., 2021). The goal of decarbonising the industries has been even further emphasised by the ratification of the Climate Action Law in 2019 (BMWK, n.d.a). From this law emerged the reduction target for the industry to a sum of 118million tons CO₂ by 2030 (Deutschlandfunk, 2021). This legally demands for the reduction of emissions by another third in comparison to emissions caused in 2021 (BMWK, n.d.a). For the industry sector, the target is set at a 49-51% GHG reduction by 2030 compared to 1990. Achieving the sectoral target is only possible by implementing substantial mitigation efforts which go beyond measures to reduce emissions. Rather these efforts need to increase large-scale investments in CO₂-neutral production technologies. It is the sectoral targets and the clear commitment to GHG neutrality which are stimulating private and public-sector actions to decarbonise the industry (Fleiter et al., 2021). Anyhow, the current government wants to modify the Climate Law and eliminate the sector-specific targets (Zeit, 2023). Next to the Hydrogen Strategy, the Industry Strategy, which is currently under revision, will provide measures for industry decarbonisation (DGB, 2023). Additionally, are under development by the federal ministry of economy

and climate action a Carbon Management Strategy (BMWK, 2023a) and a funding program based on Climate Protection Contracts (BMWK, 2023b). In the finding section of this research figure 9 is presented indicating the increase in laws passed in Germany which mention the industry decarbonisation.

The policy measures to decarbonise the industry reflect an understanding that Co₂ emissions are threatening the existence of a climate that is safe to humanity now and in the future. Discourse analysis has contributed to the understanding that [climate and] environmental impacts are not “objectively” given but their representation is given through discourse, implying the discussion of their impacts as a result of power and knowledge structures enabling their discussion (Feindt, Oels, 2005, pp. 168-170). The benefit of conducting a discourse analysis is that it allows studying the power effects produced by and built into [climate and] environmental discourse. The discourse itself defines a problem and thereby enables and constrains policy options and the range of legitimate actors for its resolution. At the time of writing no systematic analysis exists of the discourse on industry decarbonisation in Germany. This is problematic seen that discourse contributes to the processes of institutionalisation. It is discourse analysis that can show characteristics of institutions which are not liable to democratic practices. Thereby, discourse analysis can help to reflect on the preconditions and limitations of justice and democracy (Feindt, Oels, 2005, pp. 168-170).

3.2 Study Overview

The aim of this research is to understand and systematically analyze the discourse on industry transformation in Germany with a special focus on discursive power and dominance. To study the power and dominance Hajer’s (2006) conceptual understanding of discursive power and dominance is applied. Hajer (2006) suggests two different approaches to study the concept of discursive power and dominance. The concept focused upon in this research is the discourse structuration. With this concept the discursive power and dominance is understood to emerge based on the dominance of storylines being used in a discourse. The main research question addressed has been formulated to address the lack of systematic analysis of the discourse on industry decarbonisation, benefit from the theory of discourse analysis to dismantle the influence of institutions on democratic processes as well as to implement the conceptual understanding provided by Hajer (2006) on discursive power and dominance. Thus, the main research question addressed in this research is “How is the discourse on German industry decarbonisation structured by discursive power and dominance?”. This question is aimed to be addressed by the sub-questions presented in Table 1. The dominance of storylines is analyzed based on the frequency and percentage of actors by which they are used in the discourse and the percentage of actors making use of them. Hajer (2006) points out that actors use storylines to impose their views on others. Actors grouping together in discourse coalitions (ensemble of storylines uttered by a group of actors) is a pre-condition for discourse structuration. Whether a storyline is successful or not does not only depend on the discursive content, but also on the network of actors articulating them (Raven et al., p.175, 2015). Additional insight into discursive structuration is thus generated by looking into the emergence and development of coalitions over the entire period analyzed within the years 2012 to 2023 and

for each of the electoral periods covered during this span of years. Following, the emergence and development of storyline use is analyzed. In the discussion I aim at providing answers on how the current structuration may be explained.

Table 1 Research Questions

Main research question: How is the discourse on German industry decarbonization structured by discursive power and dominance?	
Sub-question N°1	Which are the storylines dominating the discourse?
Sub-question N°2	How do discourse coalitions group together based on these storylines?
Sub-question N°3	How did the structuration evolve over the period of the past 11 years?
Sub-question N°4	How can the current discourse structuration be explained?

While transitions and transformations are complex and uncertain, they do pursue specific patterns such as path-dependency and emergence (Feola, 2015). In recent years, transition and transformation theories have gained significant attention as valuable frameworks for analyzing the necessary changes to shift socio-technical regimes to become more sustainable. Scholars like Markard, Rinscheid, Widdel, (2021) have highlighted the need and usefulness of these perspectives. Among these theories, the Multilevel Perspectives Framework (MLP) has emerged as a central theoretical framework in transition studies. This theory has often been researched in combination with discourse theory (Markard, et al., 2021). In regards to the analysis of competing storylines which are associated with the destabilisation of regimes, this theory has been proven useful (Lowe et al., 2020; Roberts, 2017; Rosenbloom, 2018; Turnheim and Geels, 2012; Markard, et al., 2021): It moreover, has been proven useful in the analysis of the innovation uptake from the niche in the regime (Rosenbloom et al., 2016) as well as to analyze the formation of landscape pressure (Falcone et al., 2018). The theoretical foundation of this research revolves around the theories of discourse analysis and the Multilevel-Perspectives (MLP) Framework. The connection of the two theories is central to this research. It is through the positioning of narratives in the MLP that struggles for discursive power and dominance to influence the transition pathway of the industry decarbonisation can be analyzed. The literature review conducted in the context of this research highlighted the need for an analysis of German industry decarbonisation discourse. While a case study already existed on the discourse of steel industry decarbonisation in Upper Styria, Austria (Spiesberger, et al., 2022) an analysis on the discursive strategies of the AfD to engage in the regional extractive-industry decarbonisation discourse (Yazar, Haarstad, 2023) and finally an analysis on the discourse of German hydrogen use (Ohlendorf, et al., 2023), insights into the industry decarbonisation discourse in Germany were still lacking. The literature review was useful to establish research for comparison in the discussion and for the accumulation of theoretical and methodological approaches relevant to this research. To collect data on the discourse of industry decarbonisation this research makes use of expert interviews, defines relevant actors, storylines, and documents for analysis. By conducting a discourse network analysis (DNA), the structure and dynamics of the industry decarbonisation discourse can be analyzed. The DNA is a combination of content analysis and dynamic network analysis (Leifeld, 2017). The data set generated with the DNA is further analyzed in the software of Visone which proved useful in the evaluation of

discourse coalitions. Further analyzed is the data set in Excel for the evaluation of storyline frequency and percentages of actors making use of the storylines.

Subsequently, a detailed insight into the theoretical foundation of this research is provided. It includes a presentation of the theories, the theoretical model, an operationalisation of the concepts and the scientific relevance of this research. Then the literature review is presented, followed by the methodology. Before proceeding to the analysis of the discourse on industry decarbonisation, a background on the case study is given and the rationale for choosing Germany as the case for this research. This is done by elaborating on the case and its context through the lens of the Multilevel-Perspective framework. Findings are presented and finally discussed. Part of the discussion is also a reflection on limitations, societal relevance, and potential need for future research. In the conclusion the main research question is answered, and recommendations are presented.

4 Theoretical Foundation

In this chapter the relevant theoretical frameworks are presented, followed by the theoretical framework used in this research. Finally, the concepts are conceptualisation and operationalised.

4.1 Introduction to Relevant Theoretical Frameworks

To present relevant theoretical frameworks first, an introduction to the Multilevel-Perspectives framework is provided, followed by the presentation of discourse theory. As stated by Rosenbloom et al. (2016), transitions are inherently political with different transition pathways being possible. Strategies by actors to influence the choice in transition path taken can well be analyzed through discourse theory. With this theory insights can be generated on the actors' competing problem definitions and narratives to compete for discursive dominance (Fischer and Forester, 1993; Hajer, 1995; Stone, 2001, Rosenbloom et al., 2016). The integration of the concept of narratives in the MLP theory is further elaborated upon in the third part of this chapter.

4.1.1 The Multilevel-Perspectives Framework

The Multilevel-Perspectives framework (MLP) provides a conceptual understanding of socio-technical transitions. Considered are three analytical levels: niches, sociotechnical regimes, and the socio-technical landscape (Geels, 2004). This theory is used to classify the industry decarbonisation as a socio-technical transition with the industry regime being influenced by the landscape as well as the niches. The theory is first described here under and then applied in the background chapter of this report to present the context of this analysis.

The regime represents the dominant configuration of rules and institutions, practices and cognitive routines, technologies and infrastructures, meanings, and logics (Geels, 2004). Socio-technical regimes are thus made up of material, structural, and agential forces (Geels, 2010). The regime is characterised by stability resulting from the forces' ability to constrain or enable actors' behavior for reproducing longstanding development trajectories. This stability is seen as a challenge for decarbonisation by Unruh (2000) and Rosenbloom et al. (2016) seen that certain regimes need to change to enable decarbonisation. Same as regimes, niches also consist of rules, technologies, and actor groups (Geels, 2004). Other than regimes, niches are characterised to be of a far less stable nature with different innovations emerging and dissolving. The niches provide a protective space that shields novel innovations from harsh selection pressures, resulting in variation and experimentation (Smith, and Raven, 2012). The landscape refers to the broader external context: The context includes the broad cultural, environmental, economic, and political context impacting the niche and regime (Geels, and Schot, 2007, p. 403).

In the early days of transition research niches were viewed as the principal seeds of change (Geels, 2002; Kemp et al., 1998; Rotmans et al., 2001), with socio-technical transitions to be emerging from the connection of landscape pressures, problems within the regime, and the readiness of niche innovations for taking advantage of windows of opportunity. From more recent research the insight emerged that niche-

regime symbioses and even regimes themselves also play important roles in driving transformations (Geels and Schot, 2007; Verbong and Geels, 2010). Research by Turnheim and Geels (2013) elaborated on the way in which the external landscape can erode the legitimacy of the regime. Destabilisation of a regime can then be thought of as a process of political and cultural delegitimisation (Turnheim and Geels, 2012). In addition, Geels (2011) highlights that the readiness of niche innovations may have as much to do with building legitimacy as it does with the more material aspects of technology development.

4.1.2 Discourse Theory

Even though the MLP has proven useful, criticisms exist addressing the limited attention to agency, political differences, and political challenging during regime transformation (Genus, and Coles, 2008; Meadowcroft, 2011; Smith, et al., 2010, 2005). While some argue that the MLP already incorporates agency to some extent (Geels, 2011, 2010, 2004; Geels and Schot, 2007), there is a recognition that certain forms of agency could be further developed. The creator of the MLP, Geels (2011) suggests that greater attention is demanded to address power struggles and discursive activities, especially in empirical studies of transitions. This research project analyzes these aspects through the analytical perspective of discourse theory and more specifically the lens of discourse structuration and institutionalisation.

While narrative theory studies the distinctive nature of narratives and their structures (The Ohio State University, n.d.), it is discourse theory that proposes our daily activities, the way we speak and write to be shaped by the structures of power in our society. Because our society is defined by struggle and conflict our discourses reflect and create conflicts (Macdonell, 1986). Thus, narrative and discourse theory are interlinked. This thesis studies discourse while defining narratives and their use in networks to better understand power structures in play. Political discourses involve verbal exchanges among political actors regarding policy (Leifeld, 2017). Political discourses are in the case of this research understood to involve actors' communication concerning the policy topic of industry decarbonisation. Political actors include not only legislators, but also interest groups, agencies, and parties. Moreover, does the term include other organisations as well as individuals who make public statements about the issue of industry decarbonisation. These political actors publicly express their opinions about which policy measures they perceive as effective and which measures they oppose. Engaging in political discourse has multiple reasons for these actors. With their engagement actors may signal their position concerning policies to voters or allies. Therewith, they may convince other actors to take up their preferred positions. Moreover, may it lead to the reduction of their own uncertainty. The uncertainty may be reduced by learning from others when confronted with technical complexities (Leifeld, 2017). To further understand how discourse analysis will be useful in analyzing transitions, the concept definitions of discourse, storyline, narrative, and discourse coalition are presented. Moreover, theory on discursive power and domination structures is presented providing information on the concepts of discourse structuration and institutionalisation.

A clear definition on the concept of discourse is provided by Hajer (2006, p.66). He defines discourse as "an ensemble of notions, ideas, concepts and categorisations

through which meaning is allocated to social and physical phenomena, and which is produced and reproduced in an identifiable set of practices" (2006, p. 67). Thus, in the theory of discourse meaning is understood not to be objectively pre-given, but as socially constructed through our practical use of language (Bazerman, 1990). Discursive meaning focuses on the unnoticed linguistic context (Wagenaar, 2011, p. 111). Fairclough (1992) explains this context to be the discursive structures of the situation determining how people think, speak and act.

Linking together contextual and content-related claims are **narratives**. They provide reasoning for the short statements we refer to as storylines (Rosenbloom, D., 2018). According to Hajer (2006, p. 69), a **storyline** is "a condensed statement summarising complex narratives, used by people as 'short hand' in discussions". By selectively drawing together and condensing facts about reality, storylines simplify and help to express the meaning of social and physical phenomena which may be complex (Fischer, 2003; Hajer, 1995). In other words, storylines suggest a common understanding of an issue even though they encompass varied elements (Rosenbloom, et al., 2016). For further clarification an example is presented in table 2.

Storylines are not just repertoires of language for meaning making, they are also strategic tools that are used by actors to **frame issues** in a particular way. This is done for convincing the public and decision-makers of a favored course of action, of issues and solutions (Stone, 2001; Bacchi, 2000; Dryzek, 2013; Hajer & Versteeg, 2005). Storylines have an external function. They are aimed at the public and decision-makers and have implications for future choices about policy and planning. The storylines' internal function seeks to reinforce activities and orientations (Rosenbloom, 2016). Adopting a transition pathway perspective (Foxon, 2013; Foxon et al., 2013; Geels and Schot, 2007; Rosenbloom and Meadowcroft, 2014; Turnheim et al., 2015), storylines can be analyzed with respect to their implications for future socio-technical regime configurations (Rosenbloom, et al., 2016). Whether storylines are successful or not does, however, not only have to do with the discursive content, but also with the network of actors articulating them (Raven et al., 2015, p.175). Hajer (1993) uses the term **discourse coalition** for referring to an actor group sharing similar storylines about a particular issue. Discourse coalitions serve to primarily defend or suggest storylines to justify policy proposals (Leifeld, 2017).

Hajer (2006, p.70) further describes the success of storylines to be analyzable through the concepts of **discourse structuration and discourse institutionalisation**. With these concepts discursive power and dominance can be identified. **Discourse structuration** occurs when specific storylines dominate a social unit (Hajer, 2006, p.70). In the case of this research the social unit is the industry that is to be decarbonised together with the political and social discussion concerning its development. Rosenbloom (2018) refers to the competition of storylines for domination with the term "framing struggles". When a discourse solidifies, that is when **discourse institutionalisation** occurs. An example in our case is the enactment of policy mixes to enable the decarbonisation of the industry (Hajer, 2006, p.70). Out of time concerns, this research focuses on the structuration and not on the institutionalisation concept to analyze the power and dominance within the discourse. Nevertheless, an indication on the institutionalisation of the decarbonisation of the industry will be presented in the findings chapter. It is based on the number of laws mentioning decarbonisation in

connection to industry, the increase of research conducted over the years on the decarbonisation of the industry and the number of documents identified for analysis in this research. The systematic assessment of discourse structuration and institutionalisation processes, contributes to the evaluation of emergent momentum that may influence the transformation of socio-technical regimes (Späth, 2012, p.1270).

4.1.3 Integrating Narratives in the MLP Framework

More recent studies on the MLP framework have moved to research the strategies adopted by actors for building legitimacy for novelties and their niches (Smith et al., 2014; Smith and Raven, 2012; Rosenbloom et al., 2016). According to Turnheim and Geels (2013), the discursive interpretation of the external landscape can have a great influence on the legitimacy of the regime, even to the extent of eroding its legitimacy completely. Based on the discursive interpretations at play, the destabilisation of a regime can be thought of as a process of political and cultural delegitimisation (Turnheim, and Geels, 2012). To better understand the strategies adopted by actors for building legitimacy of a transition of one socio-technical regime towards another, Geels and Kemp (2011, p. 42) and Geels (2010, 2014) argue that Giddens' Structuration Theory provides an underlying model.

According to Giddens' Structuration Theory, individual behavior is influenced and influences in return the structures in which the individual operates. These influential structures are the rules, the cognitive, frames and cultural norms, as well as resources. Resources are made up of economic resources, authoritative as well as allocative power (Stones, 2005). The structures are reproduced by the individuals' behavior. It is through the completion of these steps that the cycle of structuration is closed. Giddens refers to resources as the structure of domination. Rules are referred to as the structures of legitimation (norms) and the structures of signification (meaning) (Giddens, 1984, Hermwille, 2016, p.239).

This foundation in Structuration Theory is where the understanding of the connection between narratives and the MLP framework emerges from (Hermwille, 2016, p.239). It is the structures of signification (meaning) in which narratives moderate between the individual and the social collective. The structures of legitimation build on the structures of signification. Without appropriate meaning making legitimation of a regime erodes. With the erosion of legitimation, the structures of domination will also erode. The erosion of structure is ensured to occur in a democratic system (Hermwille, 2016, p.239). These interactions between the structures facilitated by narratives are visualised by Hermwille (2016, p.240) in figure 1.

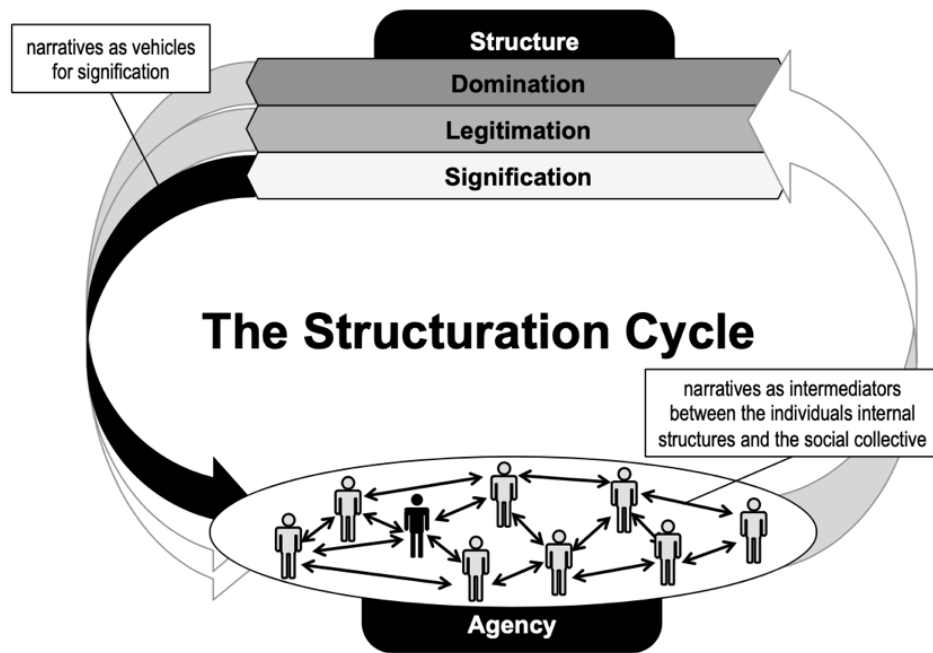


Figure 1: Illustration of Narratives in the Structuration Cycle (Hermwille, 2016, p.240)

The narratives in the structuration cycle are located in the MLP framework between the landscape and the regime level. The changes that occur at the landscape level, the external shocks or stresses which are influencing the socio-technical regime, do not have meaning by themselves. To obtain meaning these developments in the landscape level undergo “collective meaning-making’ exercise that use narratives [...] to tie everyday understandings and experiences with decision-making.” (Westerhoff, Robinson, 2013, p. 205). It is the change in narratives that can erode the legitimacy of the industry regime and create legitimacy for a new regime (Hermwille, 2016, p.239; Rosenbloom et al.,2016).

4.2 Theoretical Framework

Combining the Multi-Level Perspectives Framework with the Structuration Theory and Discourse Theory the following theoretical framework as presented in figure 2 is used in this master thesis. Presented is the Landscape, Regime and Niche level as known from the MLP framework. Seen is the struggle for dominance of narratives to be either legitimising or delegitimising the certain technologies, policy development or entire regimes. Narratives give importance to landscape developments or innovation developments. Narratives can be interpreted as a translation of the developments in the landscape level, to legitimise transition pathways from one regime towards another. Influences from the niche to the regime also exist. Narratives may also be used by actors for building novelties' legitimacy and their niches to be taken up in regimes. It is through narratives that legitimacy for a regime can be generated or disrupted (Hermwille, 2016, p.239; Rosenbloom et al., 2016). It is between the storylines aiming to impose opposing developments for the regime that framing struggles occur. This framework functions as a first draft and is open for improvements in the future.

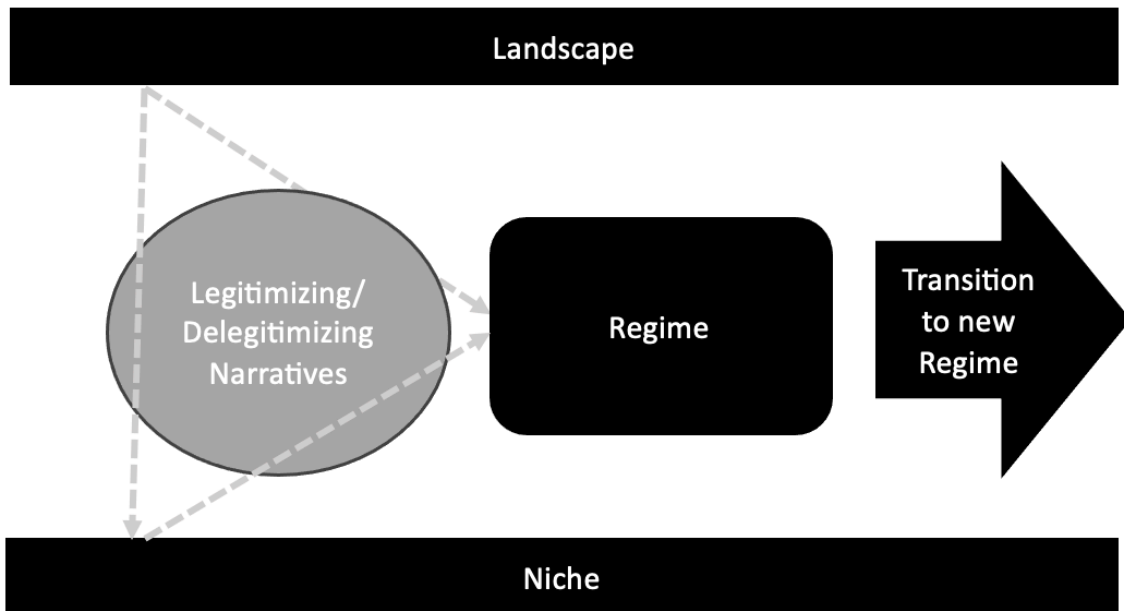


Figure 2: Theoretical Framework Visualised by the Author

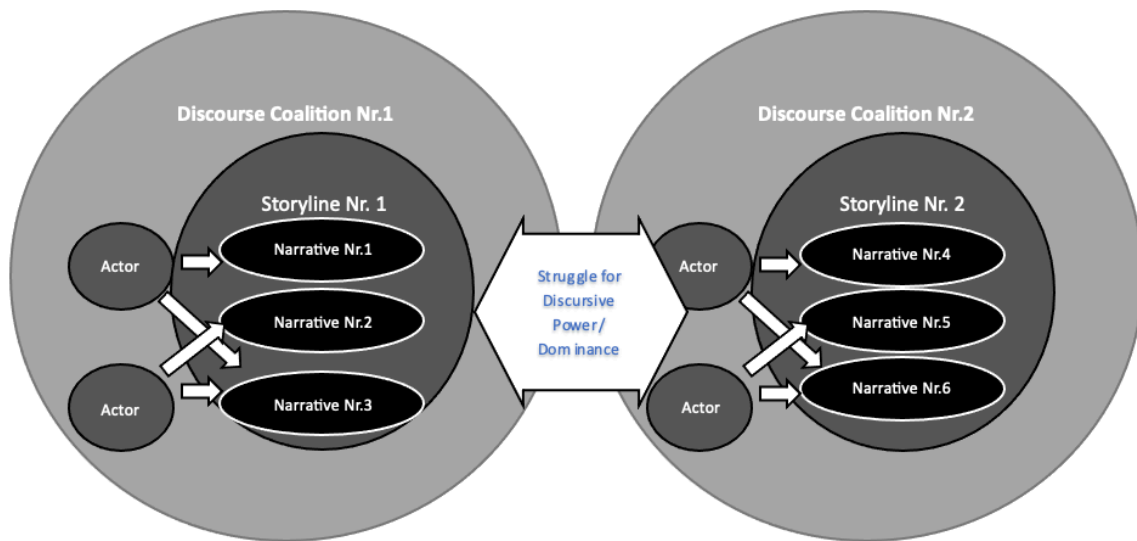


Figure 3: Conceptual Model as Visualised by the Author

Figure 3 provides a visual explanation of the connection between the concepts. It shows that actors make use of narratives which can then be grouped into storylines, based on which the actors can be grouped into discourse coalitions. For visualisation, only a small number of narratives, storylines, actors, and coalitions are shown. A struggle for discursive power and dominance is visualised between the different storylines. In table 2, I provide an overview on the concept definitions.

Table 2: Conceptualisation of Key Concepts

Concept	Definition
Narrative	Link together contextual and content-related claims providing reasoning for short statements we refer to as storylines (Rosenbloom, 2018).
Storyline	Suggest a common understanding of an issue even though they encompass varied elements (Rosenbloom et al. 2016).
Political Actor	They range from legislators, interest groups, agencies, parties, and other organizations to individuals who make public statements about an issue (Leifeld, 2017).
Discourse Coalition	A group of actors who share similar storylines about a particular issue (Hajer, 1993). Together, they defend or suggest storylines as justifications for policy proposals (Leifeld, 2017).
Discourse Structuration	Occurs when specific storylines dominate a social unit. It is a concept to access discursive struggle for power and dominance (Hajer, 2006, p.70).

The above-described concepts are operationalised as follows. The definition of political actors is used to establish the actor base. It is the concept of narratives according to which the codes of the first coding rounds are defined. Text sequences are coded according to these defined narratives. In the second coding round, the narratives are grouped together according to more abstract storylines they share (an example is given in table 3). Coalitions are operationalised as groups emerging through the process of visualisation in Visone. Visone operationalises these coalitions by presenting circles around coalitions. The concept of structuration follows like a red thread throughout this study. It is the concept used to define power and dominance. It is operationalised through the frequency of storylines as well as the share of actors making use of them.

Further insights into the concepts' operationalisation is provided in the methodology chapter.

4.3 Scientific Relevance

The literature review has proven no research to exist addressing the discourse on industry decarbonisation in Germany yet. It therewith may provide a steppingstone for future research to be built upon and is a contribution to the existing academic knowledge on transformation. Moreover, does it provide ground for comparison to other case studies, such as the case study on the steel industry in Upper Styria, Austria (Spiesberger, et al., 2022). In this specific case it allows comparison on storylines used. Together with the research providing discursive strategies of the AfD to counter decarbonisation of the extractive-industries (Yazar, Haarstad, 2023) and the research on the hydrogen discourse in Germany (Ohlendorf, et al., 2023).

The power and politics involved in the transition towards a decarbonised industry are not well researched yet as can be seen in the literature review. The method of discourse network analysis (DNA) is especially well suited to analyze the structure and dynamics of discourse. This method furthermore allows to generate insights into micro-level processes governing political discourse (Leifeld, 2017). The concept of discourse structuration by Geels (2011) have at the time of writing rarely been applied to analyze power in discourse. Thereby this lack of knowledge on power and politics is addressed in this research. Hajer (2006) points out that it would be helpful to “develop the relational perspective on narratives and [...] disclose how narratives are used within the actor-networks of different discourse-coalitions”. With the application of the theoretical connection of discourse theory with MLP theory, as provided by Hermwille (2016), this research contributes to a better understanding and application on how narratives may be positioned in transformation theory. With this research the narratives are grouped into storylines and further analyzed based on their relational interactions in discourse coalitions and influence on the transformation of the industry decarbonisation. Room for future research to dive into the theoretical elaboration is identified in the future research sub-chapter of this thesis.

5 Critical Review of Academic Literature

To put the research conducted on the discourse of industry decarbonisation into the scientific context, a literature review is presented with a focus on research applying the Multilevel-Perspectives Theory and Discourse Theory in the context of industry decarbonisation. When searching for literature on discourse analysis in German industry transformation no research has been discovered so far addressing these concepts jointly. For this thesis the following search terms were used: “discourse analysis”, discourse, discursive, narratives, fram*, storyline*, “discourse coalition*”, “industry transformation”, decarboni*ation and Germany. Most **social science research** available on **industry transformation** concerns **policy and technology** analysis. Exemplary research therefore is Rissman, et al. (2020) and Fleiter et al. (2021). These two studies are incorporated especially in the introduction and background of this study as perceived relevant, while not being elaborated on in detail leaving space to the elaboration on discourse and MLP theory related research instead.

5.1 Steel Decarbonisation in the Netherlands analyzed through the MLP Framework

A master thesis has been conducted for the Tu Delft addressing the **branch of steel industry** in the **Netherlands** and applying the **Multilevel-Perspective Framework** (Bot, 2022). The Multi-Level Perspective (MLP) framework is used to identify forces and dynamics leading to the stabilisation and destabilisation of the Dutch steel-making industry in the IJmond region. Nevertheless, most of the abstract findings clearly focus on the (de-)stabilisation of the steel industry as such instead of concentrating on the decarbonisation of the industry. Stabilisation was shown by the multitude of policy power struggles concerning information and framing, organised pressure, as well as direct lobbying strategies. The regime’s destabilisation was identified across different concepts. The interaction between landscape, niche and the regime were judged to be disruptive and competitive. The niche-technologies of DRI and EAF are judged to be ready to be taken up by the regime. The different landscape developments are made up of different forces which add to the socio-technical transition in the region. This research shows that the regime actors can produce radical innovation routes. This thesis is helpful as it provides insights into how to group context within the MLP framework. Similar as done in this study, in the background chapter I will present the context of the German industry decarbonisation within the frame of the MLP.

5.2 European Discourse on Industry Decarbonisation

When searching for literature on discourse analysis in German industry transformation research has been discovered addressing the **industry decarbonisation in Europe** with the method of **discourse analysis**. One of these is the case study on the decarbonisation discourse regarding the steel industry in Upper Styria Austria, conducted in the context of the ENTRANCES project (Spiesberger, et al., 2022). The other identified research addresses the “Populist far right discursive-institutional tactics in European regional decarbonisation” (Yazar, Haarstad, 2023) analyzing the

tactics of three populist far-right parties across Europe—the Conservative People's Party of Estonia (EKRE), Alternative for Germany (AfD), and Poland's Law and Justice (PiS). To generate a contextual understanding and to obtain a basis for comparison these two studies are presented below.

In the context of the ENTRANCES project a **case study on the Upper Styria region in Austria was conducted, addressing the discourse on decarbonisation of the steel industry** (Spiesberger, et al., 2022). Identified in the case of Upper Styria were how local actors and key stakeholders are aggregating around different “constituencies” for regulating, adapting, or opposing the clean energy transition. The main finding is that discourse related to the energy transition is found to be particularly technology driven. This research points out that the question is not whether the transition is necessary in this case study, but how it should be implemented and how challenges can be overcome. The research identifies the discourse to be closely related to expert debates on emerging technologies. Only few media reports covered potential negative economic consequences of the decarbonisation strategies. Negative outcomes of the transition are discussed in connection to migration of companies to low-wage countries, job losses and an increase of electrical energy costs. A concentration on topics of Regional, International and Global Competition is detected. Controversies over greenwashing strategies and climate delay discourses are not often found in this discourse. A deeper discussion of, for example, possible barriers in the implementation or effects of the transition process on societal levels is missing in the media. Representatives of Austrian Peoples Party (ÖVP) and Greens (Die Grünen) both claim to be in favor of the transition. Political statements are to a large extent comparable to the statements of industry actors or economic experts. The researchers obtained the impression of convergence and commitment, both from politicians as well as on side of the industry actors. Future effects on the employment situation or labor market effects due to the decarbonisation process are rarely discussed in the public media. The researchers of this case study assume the transition process to follow a top-down strategy, strongly guided by industry actors themselves. In conclusion the media narratives currently draw an overall positive picture of the challenges but miss a deeper discussion of for example possible barriers in the implementation or effects on societal levels (Spiesberger, et al., 2022). The case study is suited for comparison of identified storylines, impressions on the storylines’ and actors’ influence on the discourse of industry decarbonisation.

The paper by Yazar, M. and Haarstad, H. (2023) covers part of the discourse on industry decarbonisation by a specific actor group which is not the focus of this research. Nevertheless, the focus of this research seems to be on the carbon-intensive industries, being carbon-intensive because of extraction-emissions and not being carbon-intensive based on process-emissions primarily, as applies to the steel, cement, and chemical industry. The petrochemical industry is touched upon, as well as the steel industry, while these industries are not included in the study’s regional profiling (Yazar, and Haarstad, 2023, p.4). Thus, the findings can be taken as an indication, while not being fully applicable for comparison. Anyhow, following I present the main findings for the discursive strategies of the AfD, the right-wing party from Germany. Addressed by the populist far right parties are often the politics of retro effect against progressive public policies that are imposed from the EU governance level and anti-democratic rhetoric.

These are used to mobilise counternarratives against regional decarbonisation and climate change at large. The AfD specially makes use of the regional identity for mobilising civic engagement against decarbonisation. All three far-right parties work to delegitimise key decarbonisation institutions. The findings suggest carbon-intensive regions to be particularly vulnerable to be targeted by populist far-right parties with discursive tactics and institutional work. It is thus these regions that may provide opportunities for the far-right parties' ambitions. The following tactics are employed by the AfD. To politicise the decarbonisation the populist far-right narratives of Xenophobia and climate denialism are linked to the discourse of climate change and energy transition. This party moreover reframes cultural values with the ambition to create an alliance with anti-decarbonisation movements and mobilising protests countering low carbon mobility and wind turbines. Finally, the AfD engages in the dismantling of institutions by delaying decisions on opposing climate policy recommendations with the ambition to spread disinformation (Yazar, Haarstad, 2023).

5.3 Discourse Network Analysis in Related Topics

Research has already been conducted ***applying a discourse network analysis in related fields*** such as the hydrogen discourse in Germany (Ohlendorf, et al., 2023) and on coal phase-out in Germany (Markard, J., et al., 2021). Following this research is presented to provide build on the knowledge of how these analyses have been executed and to provide a base for comparison of how discourse may be structured based on emerging coalitions.

In the research “**Actors in multi-sector transitions - discourse analysis on hydrogen in Germany**” (Ohlendorf, et al., 2023) the discourse on hydrogen in Germany is analyzed. Most actors are found to generally support hydrogen deployment. Nevertheless, conflicts on use, production method, and imports arose. While policy-makers highlight economic opportunities and role for climate change mitigation, especially NGOs argue that hydrogen is expensive, inefficient, and overestimated in its potential. The positions range between a restricted use of exclusively green hydrogen, and a wide use which also includes non-green hydrogen (Ohlendorf, et al., 2023). The research on hydrogen is relevant as it shows a different analysis level, zooming into a specific storyline addressed during this research project. It is fit for comparing the findings to see what kind of discursive structural differences or similarities occur between these analytical levels.

The research “**Analyzing transitions through the lens of discourse networks: Coal phase-out in Germany**” (Markard, et al. 2021) is of interest to this study as it conducted a discourse network analysis in the related topic of coal phase-out. Identified was an anti-coal discourse coalition. This coalition was stable over time. The dominant storyline to delegitimise coal was climate change. It is the pro-coal coalition that was more dispersed and less consistent in their arguments than the anti-coal coalition. The research on coal phase-out, is relevant for comparison regarding coalition development.

5.4 Other Research

Other research has been conducted on topics connected to the decarbonisation of the industry. Nevertheless, these research topics are in my understanding too distant from this research interest to be shared in detail. For the reference the different topics and research examples are presented here below.

Increasing numbers of **discourse analyses** have been carried out in a field close to the industry decarbonisation, namely in the field of **energy systems** (Isoaho, Karhunmaa, 2019). Examples are research on regional energy transition processes (Späth, Rohrachner, 2010; Späth, 2012, also several case studies which are part of the Entrance Project as presented above), **energy scenarios** (Laugs, Moll, H. C., 2017), **energy policies** (Leipprand, et al., 2016; Hake, et al., 2016; Smeets, 2018) and **conflicts about energy infrastructure** (Weber, et al. 2017).

Research that addresses **other industries**, focuses on **other countries**, and includes a **discourse analysis** has been published for example by the Heinrich Böll Foundation “Decarbonisation Discourse in Russia - A stocktaking paper” (Lanshina, 2021). Another example of such research is the case study of the emergent discourse in UK policy on industrial decarbonisation - the concept of ‘Super Places’ (Devine-Wright, 2022).

Moreover, research has been carried out on how the **framing of policy problems and related solutions** can influence the **formation of coalitions** in support of and in opposition to **decarbonisation** of clean energy (Aklin, Urpelainen, 2013; Ansolabehere, Konisky, 2016; Hess, 2019) and climate (Bernstein, Hoffmann, 2018).

Finally, research has already been conducted looking into **discourse analysis** and **corporate decarbonisation strategies**. An example of such research is the research “The clean energy claims of BP, Chevron, ExxonMobil and Shell: A mismatch between discourse, actions and investments” by Mei Li, Gregory Trencher, Jusen Asuka (2022). Their focus is on one specific actor category and on their corporate strategies to transform/decarbonise. The industry is the **oil and gas industry**.

In conclusion, various relevant research has been conducted touching upon investigative elements of this research, while to the best of my knowledge no research has been conducted yet providing a discourse analysis overarching the different branches (cement, steel, chemistry) of the industry transformation regarding decarbonisation with the geographical frame being Germany. A great lack of knowledge is generally found to be concerning political power dynamics in the transition towards a decarbonised industry as no research was found addressing these concepts in combination. The methodology will be inspired by presented research and the findings will be discussed within the context of available literature.

6 Methodology

This study applies the abovementioned theoretical framework and conceptual model to investigate discursive power and dominance structures in the industry decarbonisation in Germany. The temporal scope captured by this analysis is 01.01.2012–31.05.2023. It encompasses four electoral period (2009-2013; 2013-2017; 2017-2021; 2021-now) as presented in figure 4. The research period was extended to April 2023 to capture a larger extent of the fourth covered legislative period.

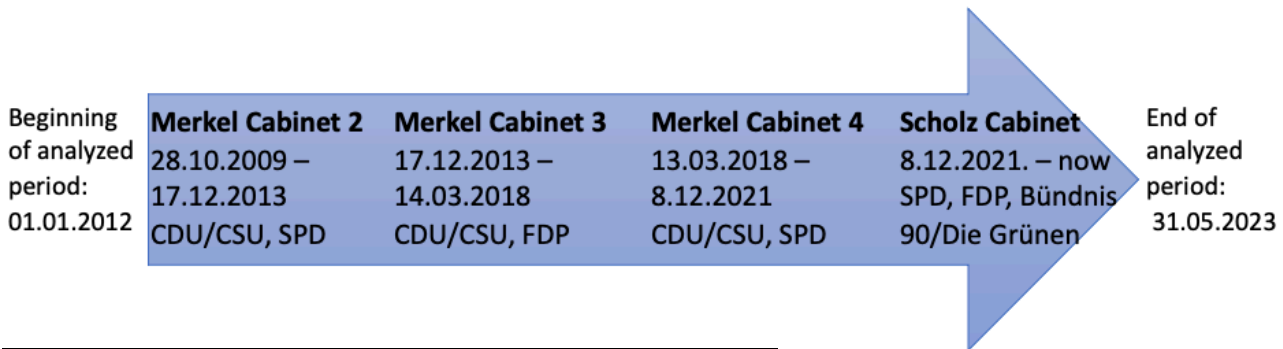


Figure 4: Electoral Periods Covered with this Research

Keeping in mind the complexity of the topic of industry decarbonisation, the use of discourse analysis with a focus on storylines is intriguing, as the more complex an issue is the more likely the drawing on storylines becomes instead of using specific narratives (Hajer, 2006, pp.70-71). The focus of this study is on the concept of discourse structuration to understand discursive power and dominance. First and foremost, to study the discourse a corpus of documents is generated. This corpus is then coded with narratives and storylines. These codes of narratives and storylines are derived from expert interviews and further exploratory development of the codebook based while going through the coding process. Once the entire corpus of documents is coded the dominance of storylines is analyzed. This is done by looking into frequency of storyline use and the percentage of actors making use of them. Findings are presented by using Excel and graph visualisation options. To analyze discourse coalitions the Discourse Network Analyzer software is used. This tool has been developed by Philip Leifeld and enables a qualitative content analysis in combination with an actor network analysis (Leifeld, 2017; Markard, J., et al., 2021). The data base is then exported to Visone to visualise the findings on discourse coalitions. Additional insight into discursive structuration is generated by looking into the emergence and development of storyline use over a period of about 11 years. To obtain this comparison the networks are visualised with Visone over the different electoral periods. Covered is the frequency of storylines used, the percentage of actors narrating the storylines, potential coalitions, and the impact of storylines to connect actors in their discursive strategies over these years. This leads to the discussion in which I aim at making sense of the identified discourse structuration.

6.1 Data Collection

6.1.1 Actor Base Generation

The first step to the data collection process is to understand which actors are engaging in the discourse on industry decarbonisation. Therefore, I drew on the report “Klimaneutrale Industrie” by Agora Energiewende and the Wuppertal Institute (2019) which includes a list of actors to inform the selection of core actors involved in the discourse of industry decarbonisation in Germany. This actor base is additionally built upon during eight semi-structured expert interviews. The actor base can be found in the appendix A and the interview guide, transcripts and the compared notes on the interviews are found in the zip file which is handed in with the thesis. The interviews were conducted in the period of 03.03 until 21.03.2023. Experts were interviewed to reduce bias as well as to leverage the research process by speeding up the process of becoming familiarised with the topic of industry decarbonisation. This method of knowledge triangulation is inspired by Ohlendorf et al, 2023 who also used expert interviews for this purpose. Interviewed were eight researchers from the Wuppertal Institute and one member of the regional parliament (Landtag). The researchers were contacted based on the recommendation of my supervisor Dr. Anna Leipprand. Researchers all worked at the Wuppertal Institute and are involved in research studying the decarbonisation of the industry from different angles. Out of the eight interviewees three are female.

Moreover, was this actor base worked on in parallel to the corpus creation. This was done by researching the contribution of actors appearing in connection to the actors which were already part of the actor base. Only when contributing at least four documents of any sort to the discourse were the actors taken up in the preliminary actor base. The preliminary actor base constituted of 90 actors. I decided that a maximum of 30 actors were feasible to be included in this research project. This decision is based on the given time frame, the limited resources of only one researcher working on this thesis and how much time I would spend on the coding process (calculation can be found in the zip file). Thus, 26 actors were selected based on having contributed the largest number of publicly accessible documents retrievable online. Additionally, the industry corporations were taken out of the research to reduce the scope. Their inclusion will be relevant for future research, while having the industry associations included is judged to represent the contribution of industry actors sufficiently for this research project. Actors were grouped into actor categories inspired by the research from Agora Energiewende and Wuppertal Institute (2019). Based on this grouping, I chose to include at least two different actors from each of the actor categories to achieve a balanced representation of each actor group in the discourse analysis. The final list of actors included in this research can be seen Appendix A. Comprised by this research are thus the following actor categories. Trade unions and NGOs are covering the opinion of civil society, political parties are showing insights into the interests of the groups aiming to acquire and exercise political power, associations are presenting the industry perspective, the relevant ministry and subordinate agencies are presenting the political perspective, think tanks and scientific institute are providing insight into the scientific perspectives, the media is showing their influence on the entirety of actors and finally the intermediaries perspective are already representing a bridged positioning between political, economic and scientific perspectives.

6.1.2 Corpus Creation

The corpus of documents was generated based on a google search on each of the actors with the key words *cement OR zement OR chemie OR chemistry OR stahl OR steel decarbonisation OR dekarbonisierung OR defossilisierung OR "low-carbon" OR "climate neutral" OR klimaneutral OR "klima neutral" OR "klima-neutral" OR green OR grün OR "klimaneutrale wirtschaftsweise OR net zero OR netzero*. A google search was considered appropriate as the ambition of this research is not to do a media analysis or a literature review alone of relevant research on the topic of industry decarbonisation in Germany. Instead, the ambition of this research is to capture outward-oriented narrative work by the identified range of actors generally aimed at the public and decision-makers. A maximum of 10 pages per actor were transposed into the Discourse Network Analyzer software for coding. Without limiting the number of pages, the coding process would have exceeded the time frame given for this project. To avoid overrepresentation of actors in the analysis, for each actor one document was analyzed per year. In the case that an actor only published in less than two years the exemption was made to take up a max of three documents for a year to avoid underrepresentation of this actor. The retaining of relevant passages was inspired by the process in Rosenbloom et al. (2016, p.1280). The retaining is based on three criteria: (1) the decarbonisation, also referable to as climate neutrality, of the industry or specifically the steel, chemical or cement branch was explicitly mentioned; (2) the passages conveyed an argument or value judgment related to the decarbonisation of the industry; and, (3) for each actor a maximum selection of ten pages was decided to be permitted for qualitative analysis. Ten pages are the limit of content coded per year to keep the scope of this research manageable within the given period. The total number of coded documents is 116 and can be seen in the zip file handed in together with the thesis document. The query yielded information on whitepapers, research reports, news articles, annual reports, and industry roadmaps and other document types. In the pie chart of figure 5 the different document types used in the analysis are shown. Most documents used are either whitepapers or research reports.

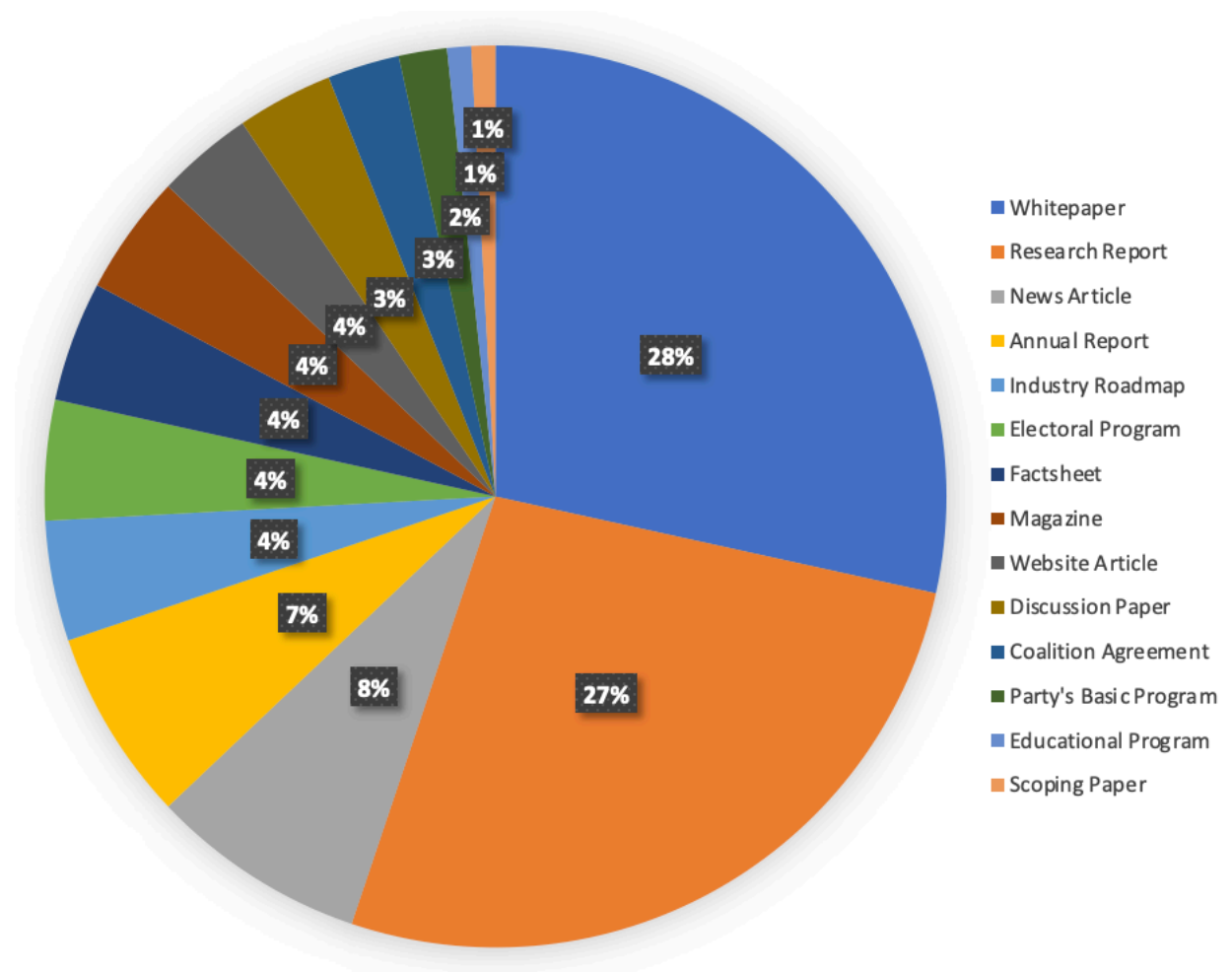


Figure 5: Type of Documents Used

6.1.3 Codebook Generation

To comprehensively cover the discourse during this period, a combination of deductive and inductive coding was applied. The generation of the codebook and the application of the coding process involved two phases. Next to the actor definition, the expert interviews helped me in identifying the initial coding scheme. The first coding scheme evolved around the narratives of the discourse which were grouped under storylines in the second coding phase. In these expert interviews the experts were questioned for the most relevant narratives that came to their minds. With the different viewpoints, backgrounds and experiences insights were gained going beyond my own knowledge, perceptions, and potential biases. To be mindful of potential biases within a specific group of experts (in this case the group of researchers), one more expert from a different expert group (the interviewee from the parliament) was consulted. This interviewee was asked for an interview as the decarbonisation of the industry is one of their expertise. Nevertheless, a certain bias may be given seen that most of the interviewees are researchers from the Wuppertal Institut. The narratives as relevant to the interviewees were listed and compared in a table which has been included in the Appendix C. Triangulation of findings increases the objectivity and reliability of this analysis. Following the interviews an in-depth review of the documents was carried out. The

narratives identified during the interviews were tested for deductive application. The codes were then inductively built upon, completed, and refined inspired by the coding process by Rosenbloom (2018). Instead of identifying emerging themes and categories as done by Roesenbloom (2018), I directly identified narratives. When new narratives seemed to be of relevance, I first noted them down. Each code represents a narrative in the first coding phase. The list of codes was thus the list of narratives. When seeing a narrative reoccur in a document by another actor, I applied the code and took it up in the coding list. Each code was only applied once for each document, to avoid over representation of one actor’s opinion in the overall analysis of the discourse. When applying the narratives, as well as the storylines in the second coding phase, binary information of support or opposition was coded for. Either an actor agrees or disagrees with a concept. This option for specification is given in the Discourse Network Analyzer software in which the coding was applied.

After having completed the first coding round over 100 codes had been identified. After this coding round the data on narratives had already been analyzed in the Discourse Network Analyzer software. No coalition structure emerged. The hypothesis for this result was that with this large number of narratives the likelihood of actors sharing the same narratives was high. This would reduce the possibility for coalitions to emerge. This is not a given, as in other context the large number of narratives may also be resulting in actors sharing fewer narratives because specific groups may have their own specific narratives. With the lack of coalition networks appearing at the narrative level the decision was taken to apply a second coding phase to reduce the number of codes. For this purpose, existing codes consisting of narratives were grouped into “top codes” which are referred to as storylines. Following, I provide an example of a storyline and the narratives which were grouped under the storyline in table 3. Before the narratives Role Employment, Location, Fair Pay, Ensure Retraining and Employment Quality existed as codes. After the second coding phase only the storyline *Employment Security* existed as a code.

Table 3: Exemplary Storyline with Narratives

Storyline: EMPLOYMENT SECURITY – Fair, good quality employment should be ensured in Germany	
Narrative	Explanation
Role Employment	Well skilled and motivated workers are needed to ensure the transformation
Location	The employment location needs to be ensured
Fair Pay	Fair pay needs to be ensured for the employees of the industry
Ensure Retraining	Retraining employees should be ensured in case of industry migration
Employment Quality	Employment quality needs to be ensured

A total of 27 storylines have been identified. This complete list of “top codes” was then added to the existing database by manually looking into each of the existing narrative codes and grouping them under storyline codes. Also, in the second coding phase attention was paid not to code a storyline twice to avoid over representation. This decision is also inspired by the research from Rosenbloom (2018, p.132). By coding a

storyline only once per document overweighting individual documents (or authors) is avoided. It is needed as some sources use narratives in multiple instances invoking a single storyline. Resultingly, the evolving frequency of storylines across documents rather than within documents. This approach is a more accurate way to measure how actors struggle for discursive dominance (Rosenbloom, 2018 p.132). After the completion of each of the coding phases, I checked on the code's frequency. Codes which had been coded in less than five instances were deleted from the code list to contribute to the reduction in code number. To further reduce bias the codebook on narratives and storylines was shown to the supervisors and two colleagues for feedback. The final overview on storylines can be seen in the findings chapter in table 4.

6.2 Data Analysis and Visualisation

After having completed the two coding rounds the storylines are intuitively categorised into groups such as technological, or economical to obtain a more structured overview. They are then used for the data analysis and visualisation. With 27 storylines identified, the chance is lower for actors to share storylines than with over 100 identified narratives. The Discourse Network Analyzer (DNA) software is used as it enables a qualitative content analysis in combination with an actor network analysis (Leifeld, 2017; Markard, J., et al., 2021). With this software the opportunity is given to generate a database tracing the presence of storylines and actor networks that evolve around these storylines over multiple periods of time. Thus, it converts actors' storylines into network data. It, moreover, enables text data to be imported and storylines of actors to be manually coded. The outcome is an actor or concept map that can be exported as several network types (Leifeld, 2013).

6.2.1 Storyline Frequency and Percentage of Actor Use

After having gone through the two coding periods (first period coding for narratives, second period grouping the narratives with storyline codes), the DNA allows for different options to export the data base was exported through into a csv file. This file type is possible to be opened with Excel. With the help of excel the storyline frequency and percentage of actor was analyzed and visualised. The insight into percentage of actor making use of storyline is another measure to reduce overweighting individual documents (or authors). This is why the further analysis on the development of structuration over the years also includes insight into percentage of actors using storylines. Translations of multiple sentences or paragraphs are in this study provided by Deepl.com and then controlled for correctness by me. The reason for using Deepl.com is that multiple times jargon is used which is faster to be translated via the Deepl website and then corrected by me, than being directly translated by myself.

6.2.2 Insight into the Discourses' Institutionalisation

While the focus of this research project lies on the discourse structuration concept to understand power and dominance, a brief insight is generated into discourse's institutionalisation. This brief insight consists of a presentation of how much the industry decarbonisation is thematised in German law making, in research of the Journal of

Cleaner Production and finally the increase in documents identified by this research for analysis. Evaluation and visualisation of the data occurred in Excel.

6.2.3 Identification of Discourse Coalitions

To identify the discourse coalitions the data base generated with the Discourse Network Analyzer was exported as a graphml file. This type of file can be opened in Visone. Visone is a software for the visual creation, transformation, exploration, analysis, and representation of network data (Visone, n.d.). As stated during the explanation of the codebook generation, storylines were coded in combination with the binary information about support or opposition of this storyline. This provides the option for Visone to visualise the relations between actors and the storylines of the discourse on industry decarbonisation. It is possible to visualise the relation between all actors and all storylines (affiliation network), while this graph may become very complex (Leifeld, 2013). To obtain a less complex visualisation of the relationship between actors this research primarily makes use of congruence networks. Congruence networks present only the actors or only the storylines. By only indicating the actors this network visualisation may also indicate coalitions emerging from the discursive structures. In this presentation actors are connected to other actors. The presented edge weight between these actors represents the number of common storylines. The higher the number of shared storylines of two actors, the higher their edge weight. Accordingly, cohesive subgroups in the graph can be interpreted as coalitions (Leifeld, 2013). With this network visualisation an intuitive way is provided for the conceptualisation and measurement of coalitions at the ideational level (anyhow ignored are material aspects such as the information exchange relationships as was analyzed by Leifeld & Schneider, 2012) (Leifeld, 2013).

Wrong data presentation as a result of errors in coding or random behavior or noise of actors regarding their statements should be treated with special attention and should be avoided. One way to reduce these potential inferences is to ignore the lowest edge weights during the analysis. The lowest edge weights are the connections between actors with the lowest number of storylines shared. To ignore these weights threshold values can be applied to the edge weights. The threshold value can be adapted identify the discourse network structure. A compromise between too much noise, with the result of drowning in too much complexity, and filtering out too much relevant information, which would result in underrepresenting complexity, needs to be found. Leifeld (2013) points out that the best threshold value is usually found in an explorative way. The reason why it is found exploratively is that the degree of noise much depends on the size of the time frame, the number of narratives and storylines, and other factors that vary between data sets (Leifeld, 2013).

An additional measure taken in this research project to contribute to the clear visualisation of discourse networks is the application of normalisations to the edge weights. This methodological approach to contribute to a clearer visualisation of discourse networks is inspired by Leifelds' research published in 2017. The reason for additional measures to be taken in this research project is that clear visualised network structures did not emerge with the measures presented before alone. The normalisation is important as actors making use of many storylines causes these actors to be connected to most actors. Resultingly, a core-periphery structure may emerge without coalitions

being able to be easily identified. Leifeld (2017) recognises that this structure can be judged as either an artifact resulting from discursive similarity being confused by “institutional roles of actors”, or as a characteristic instead of a flaw (Leifeld, 2017). Nevertheless, with the aim of finding coalitions additional measures are recommended to be taken by Leifeld (2017). Leifeld presents different normalisation strategies. The option applied as standard in the Discourse Network Analyzer software is the “average” normalisation, also referred to as co-occurrence. Each edge weight is divided by the average number of different storylines which two actors use (Leifeld, P., 2017). The two other options named Jaccard and Cosine normalisation are based on vector similarities. More information on these normalisation strategies can be found in the research from Leifeld from 2017. The Co-Occurrence normalisation was chosen through exploratory analysis. Compared to the Jaccard and Cosine strategy it resulted in visually better-defined network structure.

For the visualisation of discourse coalitions in Visone, two different algorithms are provided as options. One is the Girvan-Newman algorithm and the other is the Louvain algorithm. By applying divisive procedures, the Girvan-Newman algorithm systematically removes the edges between the actors that belong to different coalitions (or in network science referred to as communities). The edges with the highest edge betweenness are removed step by step. Edge betweenness captures the role of each link in information transfer. It calculates the paths between all node pairs that run along the link. As a result, the links between different coalitions (inter-community edge) have a high edge betweenness. The edges having the largest information transfer between two coalitions would consequently be the first ones removed by the Girvan-Newman algorithm (Barabási and Pósfai, 2016, p.334). An example is shown in figure 6. The highest link betweenness would be the link between C and E. This would be the first one to be removed when applying this algorithm (Sulistianingsih, et al., 2022, pp.273-274).



Figure 6: Explanation Girvan-Newman Algorithm

As the Girvan-Newman algorithm is recommended by Leifeld (2017) this algorithm is chosen to be applied instead of the Louvain algorithm. The other algorithm that is usable for the evaluation and visualisation of the discourse coalitions in Visone is the Louvain algorithm. A great explanation of the algorithms is presented in the book “Network Science” by Barabási and Pósfai for more information (2016, pp.339, 371).

The above-mentioned methods are brought together as follows to identify the discourse coalitions within the industry decarbonisation: With Visone the normalised actor congruence network is computed for the entire period researched. The coalitions are then visualised with the use of the Girvan-Newman Algorithm. For clarity, edges with a weight that is lower than a certain threshold are removed. This threshold value filtering out the lower edges is set in an exploratory way. Resulting is an improved visual interpretation of the network diagrams.

6.2.4 Comparison of Discourse Coalitions Over the Years

To compare the discourse coalitions over the years the networks are identified for each of the electoral period following the above presented steps. Possible emerging coalitions are evaluated based on actors involved in coalitions. The resolution, restructuring or new emergence of coalitions, including some actors leaving the previous coalition and joining the opponent were expected to be visualised through this inspection over time.

6.2.5 Changes in Storyline Frequency and Percentage of Actor Use Over the Years

As a result of no coalitions emerging further insights into the structuration were looked for by applying affiliation networks which show not only the actor's connection to each other, but also the storylines. Changes in discourse structuration over the period analyzed are presented by showing the networks for each of the electoral periods. The software Visone allows for the network visualisations by presenting node area of the actors to be bigger the greater their use of storylines. The same applies to the node area of storylines. The more a storyline is used by actors the larger their node area is visualised. Additionally, the actors and storylines being more prominent in use are linked with an edge that is increased in width. Presenting these affiliation networks for each of the electoral periods was expected to result in changes in prominence of actors and storylines. Based on the coalition presentation and affiliation network presentation another expectation to derive in detail was when and how changes came about. As a result of no clear structures emerging from these two types of network visualisations (congruence and affiliation networks) additional insights into the discourse structuration were obtained. Therefore, the top 10 most used storylines (percentages of actors) are listed as well as the share of storylines use over the electoral periods by analyzing and presenting the data in Excel through the graph visualisation option.

6.3 Validity and Reliability of this Research

6.3.1 Validity

The validity of a research is subdivided into internal validity and external validity. Internal validity refers to the question if the researcher has measured what she intended to measure. External validity refers to what extent the research results of a research can be generalised. To measure the discursive power and dominance in the German discourse on industry decarbonisation I thoroughly conceptualised and followingly operationalised the theoretical framework into a codebook. The codebook creation process was based on expert interviews and reviewed and approved by the thesis

supervisors. Furthermore, meetings with fellow students were conducted for feedback. Feedback was received on the codebook and the coding process itself. Some coded documents were sampled by the supervisor from the Wuppertal Institute and from fellow students. I taught myself how to make use of the software Discourse Network Analyzer and Visone. When discovering that no discourse coalitions exist in this given discourse, but rather one singular coalition, I went the extra mile and further analyzed the data in Excel to discover structures of discursive power and dominance. For the given condition that only one researcher worked on this project, the number of documents (117) coded were large in comparison to other research projects. In the Upper Styria case study (Spiesberger, et al., 2022) 50 documents were coded with four researchers involved, in the study covering the discursive strategy of the AfD (Yazar and Haarstad, 2023) 15 documents were coded with two researchers involved, while on the research on hydrogen use (Ohlendorf, et al., 2023) 179 news articles were coded with three researchers involved. As mentioned in the previous sub-chapter, key limitations regarding the possibility to measure what was intended to be measured exist regarding the bias in narrative and storyline identification, the not fully complete identification of documents via google and of media documents via google and Lexis Nexis, the underrepresentation of certain actors also based on time limits, the limitation of having read the corpus of documents only once out of time limits.

The external validity refers to what degree results can be generalised. The research aims at being generalisable for the German industry transformation discourse. Thus, this research may function as a means of comparison for other case studies but may not be generalisable beyond the geographic area of Germany. To ensure generalisability in Germany, multiple measures were taken. Many of them were just mentioned to ensure the intended measuring for internal validity. To enable generalisability a large bandwidth of documents was covered during this research process. As just stated, a total of 117 documents were covered, which is comparably much for the time given and only one researcher being involved in the coding. To ensure all relevant actors were covered in this research, the experts were asked to share with me the most important actors to be covered in this research. As stated before, out of the time limit not all actors nor all the documents were able to be analyzed. Additionally, a focus on elite actors was discovered. This focus may suggest that the discourse's analytical level that is primarily discussed in elite circles. To establish generalisability of this research, further research may be needed to understand whether there are other groups which may have been underrepresented because of the type of medium or analytical level chosen for analysis.

6.3.2 Reliability

The reliability of a research refers to whether the results obtained in this research can be reproduced under the same conditions (Middleton, F., 2019). The reliability of this research depends to a great extent on the thoroughness of the codebook and its application. Creating the codebook in collaboration with other researchers would have added to the reliability of this research (Leifeld, 2013; McBeth et al., 2005). Nevertheless, by basing the codebook on expert interviews and engaging in feedback processes with the supervisors and colleagues on the codebook generation and application the reliability of the process was increased. There are always multiple

interpretations, depending on the position of the researcher, the context of the research, and the fact that it is only one researcher allowed to conduct this research. Nevertheless, the issues of reflexivity of the study, the attempt to approach the topic from different perspectives and the richness of the description produced are essential to be highlighted (King, 2004). To add to the reliability of the research a positionality is added in the Appendix D.

7 Background – The Industry Decarbonisation Process in Germany presented within the frame of the MLP

7.1 The Landscape

The term “landscape” refers to external factors and broader trends shaping the transition. External factors in the context of German industry decarbonisation include climate change, resource scarcity and the digitalisation of the economy and society. They demand a high degree of willingness to change and adapt from the industry, while at the same time offering great opportunities (BMWK, n.d.b). According to the Federation of German Industries (BDI), the industry actors see the need for change. Concerning the first landscape development of climate change, industry actors have been attributed a prominent role to play in overcoming its economic consequences by the BMWK (n.d.b). This role entails the industry’s need to increase resource and energy efficiency and using renewable energies. While environmental protection comes with a cost factor that should not be underestimated, it also offers new market opportunities (BMWK, n.d.b). The sustainable management of resource use, including the use of energy, is especially important in Germany as it is one of the largest consumers of raw materials globally and is highly dependent on imports. Security of supply, the protection of natural resources, the economical and efficient use of raw materials and their recycling are vital for the economy (BMWK, n.d.b). The need for action to ensure the supply of energy has especially increased because of the energy crisis caused by the Russian war of aggression on Ukraine (OECD, 2023). Another landscape development which is worth mentioning is the digitalisation of the industry. Its digitalisation may be referred to as in Industry 4.0. By digitalising the industry, production is interlinked with information and communication technology. This enables tailor-made products which are in accordance with individual customer requirements. An increase in cost-efficiency and reaching high quality is an expected benefit (BMWK, n.d.b).

7.2 The Industry Regime

These just described landscape developments are driving the need for innovative solutions and changes in industrial practices. For taking action, the German government relies on a mix of market-based instruments (in particular CO₂ pricing and the ETS), targeted funding instruments and a reliable regulatory framework (BMWK, n.d.c). Traditionally, the policy mix to decarbonise the German industry sector focused primarily on policies encouraging audit schemes with energy efficiency measures at its heart or grants for efficiency improvements. Mostly addressed by these measures and grants were SMEs and lighter industries. For a long-time, it was the EU ETS that was the main policy used to address decarbonisation in the basic material industry. Nevertheless, low CO₂-prices below 10 euros/t CO₂ as well as free allocation of allowances to most industries, did only have a small effect on investment decisions in energy-intensive industry. A change emerged when allowance prices augmented to 20 euros and higher in 2018. While energy taxes and the EEG-levy are part of the mix they are primarily relevant for small companies, with large energy consumers receiving great tax exemptions (Fleiter et al., 2021). According to Fleiter et al. (2021) the policy mix of 2021 is to be judged to be insufficient for enabling decarbonisation of the industry by

2050. Multiple suggestions exist on instruments to be included in a policy mix to support industry decarbonisation. Both Fleiter, et al. (2021) and Rissman, et al. (2020) suggest such a policy mix to support the development of green lead markets, carbon pricing. Fleiter, et al. (2021) emphasise the need to further increase OPEX support, while Rissman, et al. (2020). rather emphasise the need for carbon pricing with border adjustments and government support for research, development, and deployment, and energy efficiency or emissions standards on various products or processes. Also mentioned by Fleiter, et al. (2021) is the need to ensure a just transition during the implementation of these suggested measures.

Based on the recognised need for change within the regime it can be expected to undergo a great transition towards decarbonisation. The old regime can be interpreted to have been destabilised based on the need for energy-efficiency and industry decarbonisation to become institutionalised in the policy making. The inflection point after which the old regime was no longer the dominant orientation may be interpreted to be the setting of the Paris Agreement and the ratification of the Climate Action Law in Germany. The destabilisation of the old regime is further supported by the finding that 85% of actors perceive the need for change (see figure 8 in the findings section). The definition of the current development of additional policies for industry decarbonisation can be understood as a new regime being currently in the making. Also, this understanding is further supported by the storylines that are presented in the findings section of this research. The relational system defining the identities of the regime has undergone a process of weakening which is expected to result in the proliferation of floating elements of discourse and a (hegemonic) crisis of signification (Hajer, M. A., 2003, p.260). The regime is currently in a contested space, being subject to many uncertainties. It is for example difficult to estimate how quickly costs of new technologies will fall, how the government will change their subsidy policies, or which innovations will be taken up within the new regime. Green energy and sustainable products will inevitably be part of the new industry regime. While green energy and sustainable products may be a monopoly factor and bring benefits at first, they will eventually penetrate the global mass market leading to the disappearance of previous solutions (Huber, F., 2021). This in turn leads to the estimation that it will take time for the stabilisation of a new regime.

7.3 The Niche

Within the niche there are various advancements in technologies which are waiting and argued to be taken up within the future decarbonised industry regime. These innovations aim to reduce carbon emissions, enhance energy efficiency, and explore alternative production methods. They often face challenges such as high costs, technological uncertainties, and limited scalability. Great examples for the niche developments are provided in the research conducted by Rissman, et al. (2020) on the policy mix and technologies required for the decarbonisation globally. Exemplary for the niche are that supply-side technologies will require various energy efficiency measures, carbon capture, electrification in certain industries, and the use of zero-carbon hydrogen as a heat source and chemical feedstock. Specific technologies are suggested by the authors for the three top-emitting industries: cement, iron and steel, and

chemicals and plastics. Crucial demand-side approaches include measures to deliver equal quality services with less material use and waste, for the substitution of low-carbon for high-carbon materials, and interventions for circular economy (Rissman, et al., 2020). The technologies' niche innovations are already playing a role in German industry's transition ambitions:

“The goal of climate neutrality by 2045 is extremely ambitious, but technologically feasible in principle. [...] For industry, the greatest challenge is not only the capital costs, but above all the significantly higher operating costs of climate-friendly technologies on a day-to-day basis. challenge” - BDI, 2021

“The expansion of industrial sites to include future technologies (e.g., CCU, CCS, P2X, storage, H2, use of biogenic raw materials) opens up important interfaces to parallel energy systems and thus contributes to flexibilisation and system stability.” - VIK, 2017

While the influences in the landscape create a sense of urgency, the developments in the niche and the transition that is already happening within the regime set the stage for potential transition pathways towards a decarbonised economy.

7.4 Case Selection

The case of Germany is chosen for this study as the decarbonisation of the industry is of particular relevance. The relevance emerges from the industry's great responsibility in the German wealth generation while also being a key emitter of greenhouse gases. As has been described in the theoretical foundations chapter, it is the storylines framed by actors which are translating the landscape developments into needs to act. The urgency to act in Germany is known and a great responsibility is given to the industry to change and adapt according to landscape issues, while maintaining the wealth generation for the nation. The case of Germany is pertinent given that the pathway according to which the regime is to change is still to be defined. From a discourse theory perspective, a struggle for discursive dominance and power is expected as different actors may advocate for different transition paths to see their needs being met. As pointed out in the previous sub-chapters the industry is in need to act under constraints of time and resources. Key opportunities are seen in technological development, while the many uncertainties increase my scientific curiosity into the framing struggles for discursive power and dominance that may emerge within the case of German industry decarbonisation. Additional relevance for this research and this case study is shared in the societal and scientific relevance parts of this research.

8 Findings

In this chapter the findings are presented to answer the sub-research questions. First, the storylines discovered in this analysis are introduced, accompanied by insights on frequency and percentage of actors using these storylines. Resultingly, the storylines' structuration of the discourse for the entire period analyzed is presented. Then an indication on the institutionalisation of the discourse is provided. For more insight into the structuration, the formation of discourse coalitions is presented for the entire period analyzed and for each of the electoral periods. Then the structuration over the years is demonstrated based on the relevance of storylines to tie together specific actors in the discourse, as well as by providing the top 10 most used storylines and an insight into the percentage of actors having used the storylines over the electoral periods.

8.1 Identified Storylines

With the first coding round the narratives used in the discourse were established. These were then aggregated in the second coding round into storylines. A total of 27 storylines have been identified (seen in table 4). To structure the overview of the storylines they are intuitively grouped in categories. These categories are general, economic, specific support, sustainability standards, Germany technology leader, collaboration, technological and societal. Some codes have been adopted as their own category as they were not able to be grouped otherwise. What can be seen is that most storylines are either of technical or economical nature, as they together make up about 65% of the storylines (18 out of 27).

Table 4: Aggregated Codebook

Category	Storyline Code	Full Storyline
General	NEEDED	Industry decarbonization is needed for society to thrive.
	CHALLENGE	Challenges need to be faced for the industry to become decarbonized.
Economic	INDUSTRY ROLE	A strong industry is vital for the German society to be prosperous.
	INTERNATIONAL	The government needs to ensure an international level playing field and not decarbonize Germany in isolation.
	INDUSTRY STRENGTHENING	The industry needs to be strengthened through an attractive, well managed policy mix.
	MARKET	The competitiveness of the decarbonized industry needs to be ensured through policy strengthening the market position.
	FINANCIAL SUPPORT	The government/public should provide financial support to decarbonize the industry.
	ETS	The policy mix should include ETS.
	BARRIERS AND DISINCENTIVES REMOVAL	Barriers and disincentives of all sorts opposing the transition need to be removed.
Specific Support	SUPPORT OTHER COUNTRIES	Germany needs to support other countries in the decarbonization process
	REGIONAL SUPPORT	Special attention should be put on the support of regions most affected by change.
	SME SUPPORT	Special attention should be put on the support of SMEs (KMU in German, including Mittelstand).
SUSTAINABILITY STANDARDS		Ambitious sustainability standards and laws need to be ensured to reach climate neutrality.
GERMANY TECHNOLOGY LEADER		Germany should take up the role of a technology leader in the decarbonization of the industry.
COLLABORATION		For industry decarbonization to be successful collaboration between different actors is key.
Technological	RESOURCE USE	Contributing to the industry decarbonization is the use of resources in sparingly manners in systems of circularity (ranging from recycling to full circle circular economy).
	CCS/CCU	Carbon capture and utilization technology will be necessary to reach industry decarbonization.
	ENERGY ADAPTATION	Contributing to the decarbonization of the industry is the needs for the industry for adapting to energy availability.
	MEET ENERGY DEMAND	The government needs to ensure that the industry's energy demand is met with renewable energies.
	HYDROGEN NEEDED	The use of hydrogen is needed in the decarbonization process.
	SYNFUELS	The use of synfuels is needed in the decarbonization process.
	BIOMASS	The use of biomass is needed in the decarbonization process.
	DIGITALIZATION	Digitalization can be a key enabler for industry decarbonization.
Societal	EMPLOYMENT SECURITY	Fair, good quality employment should be ensured in Germany.
	SOCIETAL CHANGE	Society will need to change in many ways.
	ACCEPTANCE RELEVANCE	Societal acceptance is relevant for the decarbonization of the industry.
	JUSTICE	Social justice and fairness need to be ensured in the industry decarbonization

Generally, sustainability transitions are understood to be highly contested (Markard, J., et al., 2021) with different actors holding different views on the transition path to be decided for. Framing struggles are often over public policies or over technologies (Binz et al., 2016; Markard et al., 2016; Rosenbloom et al., 2016). Looking at table 4, none of the storylines is delegitimising the transformation of the regime, nor taking a stand against a specific storyline or technology to be applied. The storylines are rather providing conditions under which the transition may be possible.

8.2 Discourse Structuration

Following, the frequency and percentage of actors using storylines are compared to provide insights into the storylines influence on the discourse. This is done to provide insight on the structuration of the discourse. There is only one disagreement towards a storyline detected in the data set. Namely the AfD (populist, right-wing party in Germany) disagrees with the storyline that the industry decarbonisation is needed. In figure 7 the frequency in which storylines have been coded for the entire analyzed period is presented. It shows that the storylines used the most are that the government/public should provide financial support to decarbonise the industry (*Financial Support*), that the government needs to ensure that the industry's energy demand is met with renewable energies (*Meet Energy Demand*) and third that challenges need to be faced for decarbonising the industry (*Challenge*).

To look at the impact of storylines on the discourse of industry decarbonisation from a different angle the percentage of actors using certain storylines is presented in figure 8. Further evaluation will be based on the storylines' use by percentages of actors to avoid overweighting individual documents (or authors). In Figure 7, the three most frequently used storylines on meeting the energy demand (used by 93% of actors), the *Financial Support* (93%) and *Challenge* (93%) are reconfirmed to have the highest dominance in the discourse by also being the three most used in percentage of actors. Also, one of the most used storylines regarding actors' percentage is the storyline on *Employment Security*. In the ranking based on percentages of actors it is on the third rank (see figure 7), while in the ranking on storyline frequency it is only on the 11th place (see figure 8). A total of 18 out of 27 storylines are used by more than 56% of all actors. The high overlap in storyline usage may be a first indicator for discursive homogeneity. 13 out of the 27 storylines have been used by more than 85% of the actors.

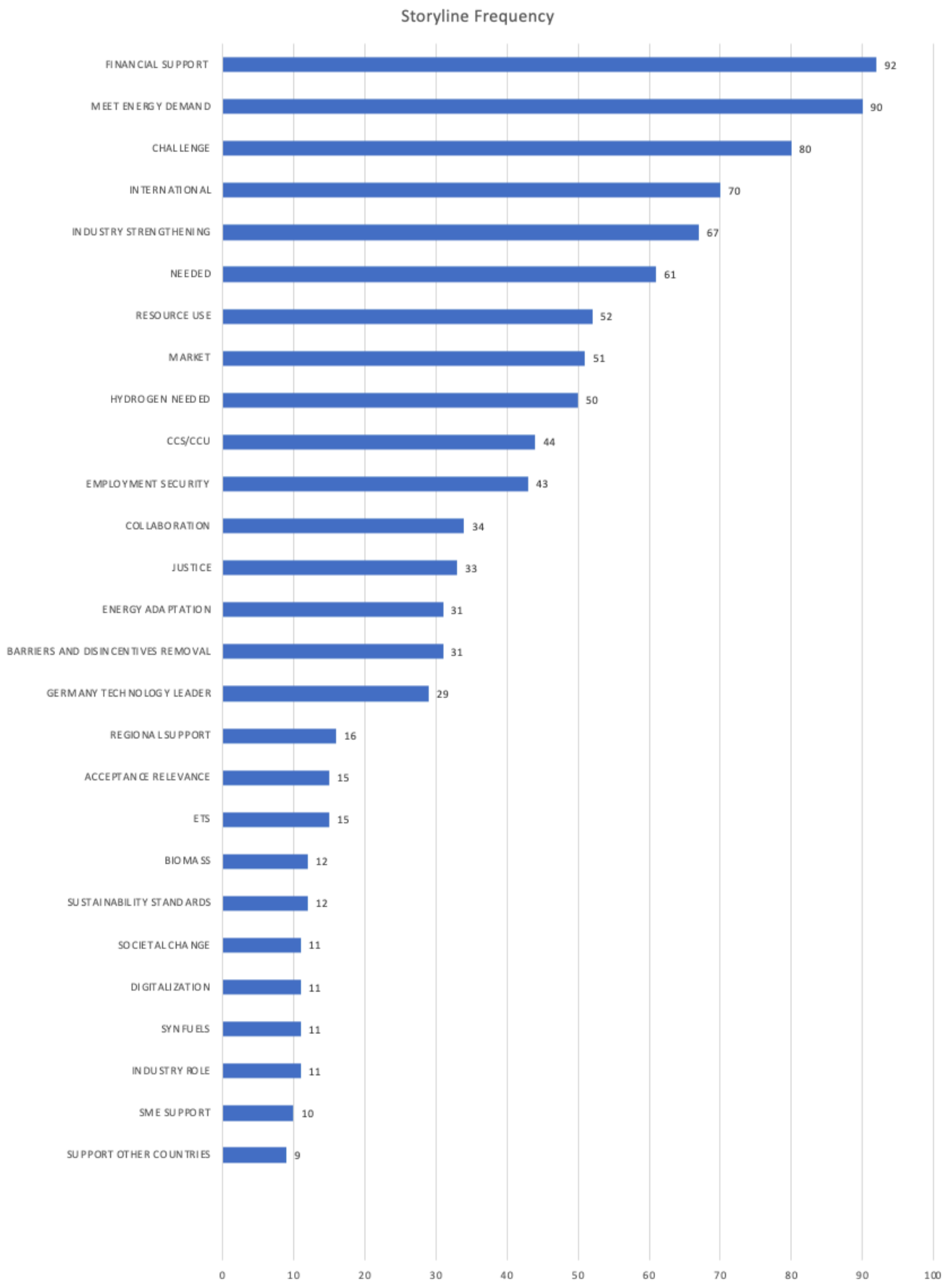


Figure 7: Storylines Frequency

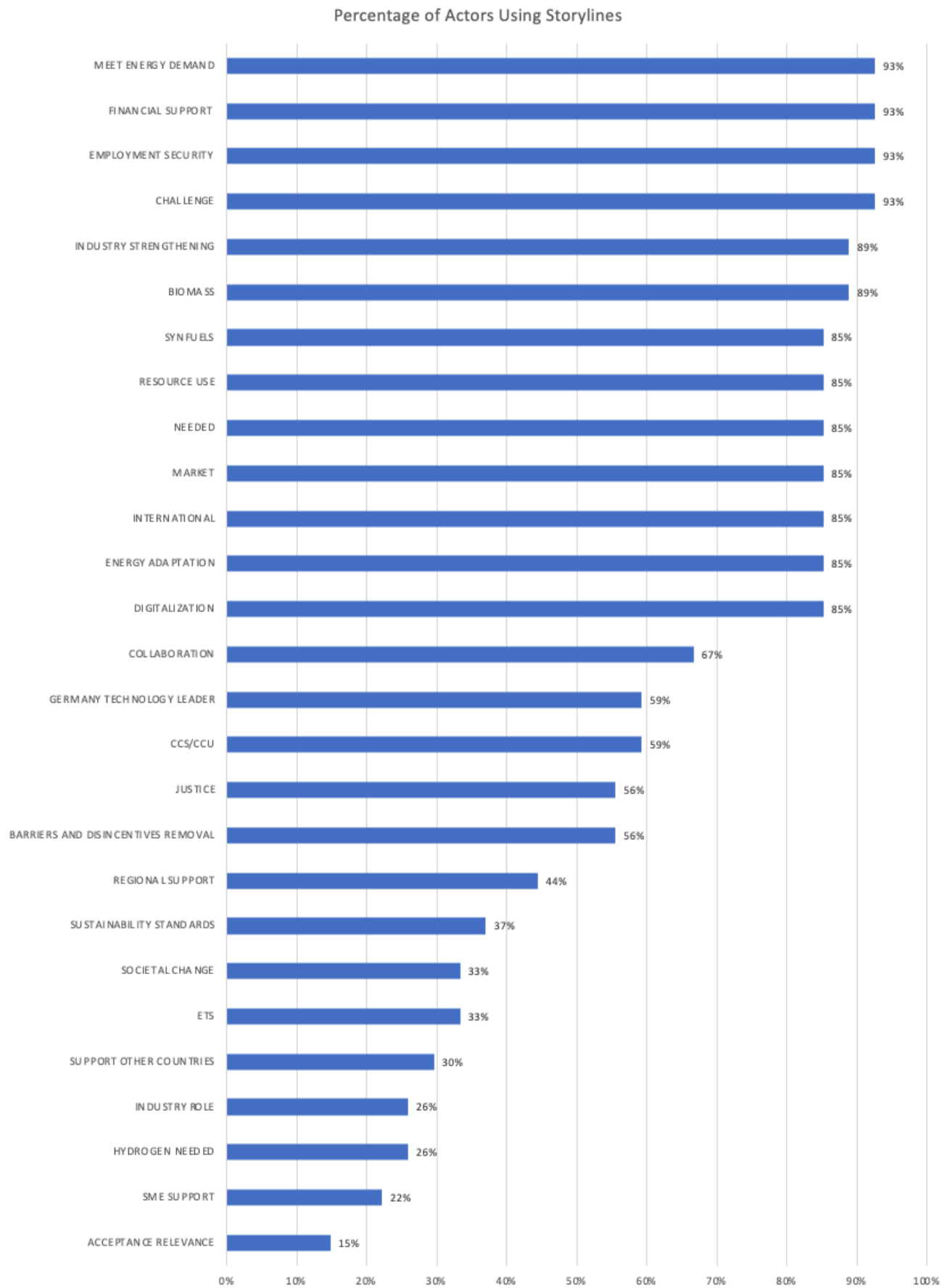


Figure 8: Percentage of Actors Using Storylines

To provide some context to the storyline use some quotes from the different documents and actors are presented for the four storylines used by the highest percentage of actors: *Meet Energy Demand*, *Financial Support*, *Employment Security* and *Challenge*.

Meet Energy Demand – used by 93% of actors

Definition: The government needs to ensure that the industry's energy demand is met with renewable energies.

“Indispensable for achieving a climate-friendly economy and society is the question of sufficient clean energy. It is not for nothing that the traffic light coalition is placing a focus of its political action on the accelerated expansion of renewable energies.” - Green Party - Bündnis90/Die Grünen Bundestagsfraktion, 2023

“12 REQUIREMENTS FOR THE SMART TRANSFORMATION [...] Reliable energy supply for industry” - in the context of their whitepaper stating requirements for industrial policy 2030, - Trade Union - IGBCE, 2023

*“For the steel industry, the use of hydrogen is indispensable in regards to the completion of decarbonisation. The steel industry can use climate-neutral hydrogen at an early stage. To this end, the expansion targets of the National Hydrogen Strategy should be raised significantly, and industrial sites should be connected to the hydrogen networks as quickly as possible, initially promoting electrolysers also in regional proximity to industrial transformation projects. If green hydrogen is not available in sufficient quantities and at affordable prices, natural gas will play a decisive role in the ramp-up as a flexibility option.”
– Industry Association - Wirtschaftsvereinigung Stahl, 2021*

*

Financial Support – used by 93% of actors

Definition: The government/public should provide financial support to decarbonise the industry.

*“Since the entire society, including the industry, is held accountable for financial assistance (structural aid, industrial promotion, private capital) via the support, it also has a right to ensure that the transformation is tackled with all its might.”
– Intermediary - KEI Cottbus, 2023*

*“The path to climate neutrality remains a mammoth task for society as a whole. The transformation will require major investments, which companies, private households, and the state will have to make together.”
- Federation of German Industries – BDI, 2022*

“Given the high capital intensity of emissions-intensive processes and the long service life of plants, the framework conditions must ensure long-term planning security for investments in climate-neutral technologies. This can be achieved through a combination of the following: [...] Funding for investments in climate-neutral technologies [...]” – WWF, 2019

*

Employment Security – used by 93% of actors

Definition: Fair, good quality employment should be ensured in Germany.

“Nothing is gained by tightening targets alone; instead, policymakers must also create the necessary framework conditions to ensure that the climate targets set are actually achieved, taking into account good work and inclusive prosperity.”- German Trade Union Federation - Deutscher Gewerkschaftsbund, 2022

“We want to achieve full employment with good work and fair wages. We want to remain a center of industry and innovation [...]” – Social Democrats – SPD, 2021

“In this way, we will reach the goal of climate neutrality by 2045 at the latest, together, without job losses and with a robust industrial base, with co-determined, collectively bargained jobs at modernised locations and in new production sectors.” - WWF, Germanwatch, IGBCE, DNR, 2022

*

Challenge – used by 93% of actors

Definition: Challenges need to be faced for the industry to become decarbonised.

“Not only the electricity supply, but also all transport, heating and as many industrial processes as possible are to be converted to green electricity according to the “Climate Protection Plan 2050”. The only problem is that Germany cannot produce that much renewable energy itself. The German government's energy transition planners now openly admit this.” – Newspaper “Welt”– Wetzels, D., 2017

“The challenges in implementing the goals of the Paris Climate Agreement are great. Over the next three to four decades, a fundamental transformation of industrial production will take place in Germany.” – Trade Union – IG Metall, 2017

“The RESCUE study highlights that GHG-neutrality in Germany together with a significant reduction of primary raw material consumption is possible through bold and ambitious actions.” – Federal Environmental Agency “Umweltbundesamt” – Günther, et al., 2019

These quotes shown above highlight the similarity in statements by different actors in which storylines were coded. The general sentiment conveyed by the storylines is that actors generally see the need to decarbonise the industry, while understanding there to be great challenges ahead to succeed. Consequently, the financial support is emphasised and other conditions under which the transition should take, such as the ensuring of employment. No opposing storylines are identified nor disagreement with storylines (except for the AfD's disagreement of the decarbonisation's need). Thus, key framing struggles have not been identified in this discourse. When going through the

first coding round codes were developed based on actors calling for natural gas being used as a transition energy. However, these codes appeared to be used less than 5 times and were therefore taken out of this analysis. Storylines address the general need for the transformation, its challenges, and the needed economic framework conditions for the change to be not at the expense of economic wealth generation and international competitiveness. Furthermore, the technologies needed for the transition are discussed. Only few of the actors make use of storylines invoking social support e.g., regarding acceptance generation and a just transition, while the focus lies on the economic and technical support needed within the transition. This is not surprising as the table “Overview on Storylines” already indicated most storylines being able to be categorised as of economic or technological nature. To answer the first sub-question shortly, it is most of the storylines of mostly economic or technological nature which are dominating the discourse at this analytical level. As stated above, 18 out of 27 storylines are used by most actors (more than 56%).

8.3 Discourse Institutionalisation

While to contribute an understanding on discursive power and dominance the focus on the concept of structuration is chosen, some indications are shared on the discursive institutionalisation. The indication on the institutionalisation of the decarbonisation of the industry is presented. This presentation is based on the number of laws mentioning decarbonisation in connection to industrial policies, the increase of research conducted over the years on the decarbonisation of the industry and the number of documents which have been identified for the coding process of this research. The institutionalisation of decarbonisation is compared to the institutionalisation of energy efficiency. While policymaking for climate protection first focused supporting and measuring energy efficiency, it is now turning to instruments aimed at deeply decarbonising industrial production processes and at long-term transforming the industrial sector (Fleiter et al., 2021).

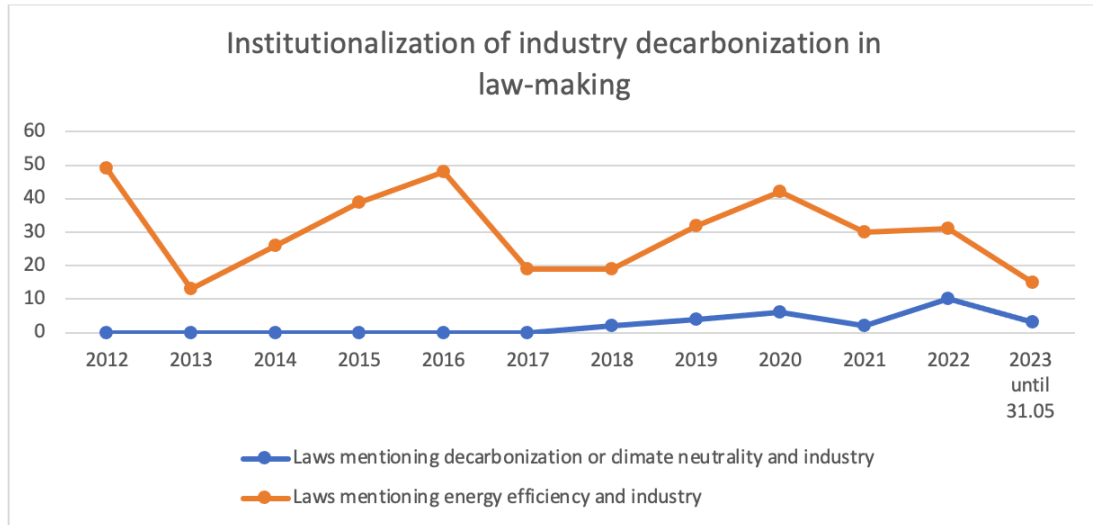


Figure 9: Institutionalisation of decarbonisation in law-making in comparison to energy efficiency (visualisation by the author based on the search results in the DIP until the 31.05.2023)

In figure 9, can be seen that while in Germany laws on the industry's energy efficiency have been adopted over the past 11 years, laws on decarbonising the industry have only emerged since 2017. The drop in 2023 should be viewed within the context that this year is only partially covered in this analysis. As law making in consideration of decarbonisation has only emerged so recently it will be of interest to see the number of laws adopted at the end of the year 2023.

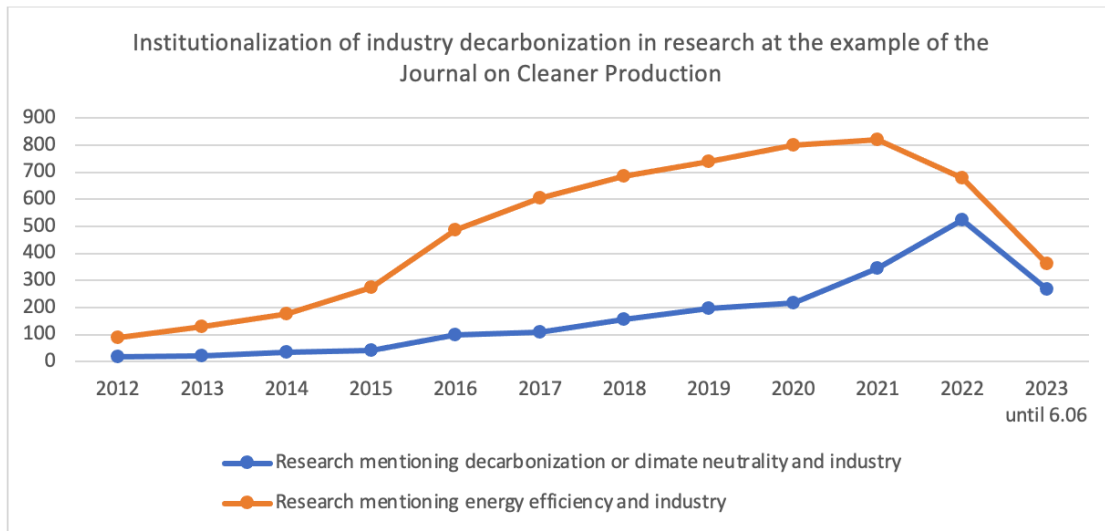


Figure 10: Institutionalisation of decarbonisation in research in comparison to energy efficiency (visualisation by the author based on the search results in the Journal of Cleaner Production until the 06.06.2023)

At the example of the search results in the Journal of Cleaner Production in figure 10 can be seen that globally research on industry decarbonisation is also increasing. Also, in this case must be considered that the year 2023 is only covered partially, which may be the reason for the drop of the curve. Moreover, this example is illustrating the institutionalisation in internationally without having a focus on Germany. The Journal of Cleaner Production has been chosen as its focus is on cleaner production,

environmental, and sustainability research (Journal of Cleaner Production, n.d.). Moreover, it has an impact factor of 11.072 for the years 2022-23 (Academic Accelerator, n.d.).¹

Finally, the example of the number of documents coded in this research is presented. Documents were only coded when specifically referring to the industry decarbonisation. Figure 11 shows that the number of documents increased sharply over the years. Documents discovered for analysis are even greater in number than represented in this visual but were not able to be included in the analysis out of time concerns.

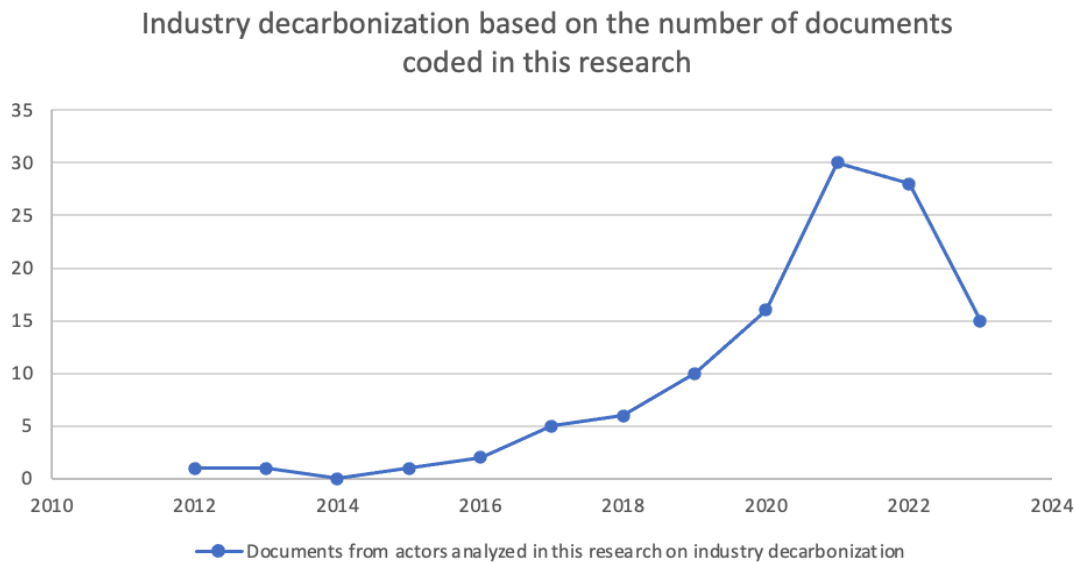


Figure 11: Institutionalisation of the discourse based on the number of documents coded in this research

All three examples give an indication for the discourse on decarbonisation to become institutionalised, with the example on the global research giving a stronger indication than the previous. While the increase of the focus on decarbonisation in law-making, research and through the data base established in this research, is merely an indicator for discourse institutionalisation. More research is needed. Based on the increase of research being conducted, laws being passed, and number of documents discovered for analysis on industry decarbonisation, can be argued that the emergence of the discourse has been discovered in this research to be around 2017.

8.4 Discourse Coalitions

The contribution of discourse coalitions to the structuration of discourse is given as the dominance of storylines does not only have to do with the discursive content, but also with the network of actors articulating them (Raven et al., p.175, 2015). Before diving into the presentation of the network visualisations it is important to understand

¹ An impact factor is a measure of the number of times an average paper in a journal is cited, during a year (Elsevier, n.d.). With a score of 10 or greater a Journal is considered excellent while a score of 3 is flagged as good and the average score is less than 1.

how to read them. Coalitions are presented by the formation of circles around them which may also be referred to as “bubbles”. The nodes (dots) are representing the actors and the edges (lines) are representing their connection to each other based on the number of storylines shared. The width of the node area depends on the actors’ quantitative contribution of storyline use, while the width of the edge depends on the normalised number of storylines shared between two actors. The more storylines are shared the thicker the edges become.

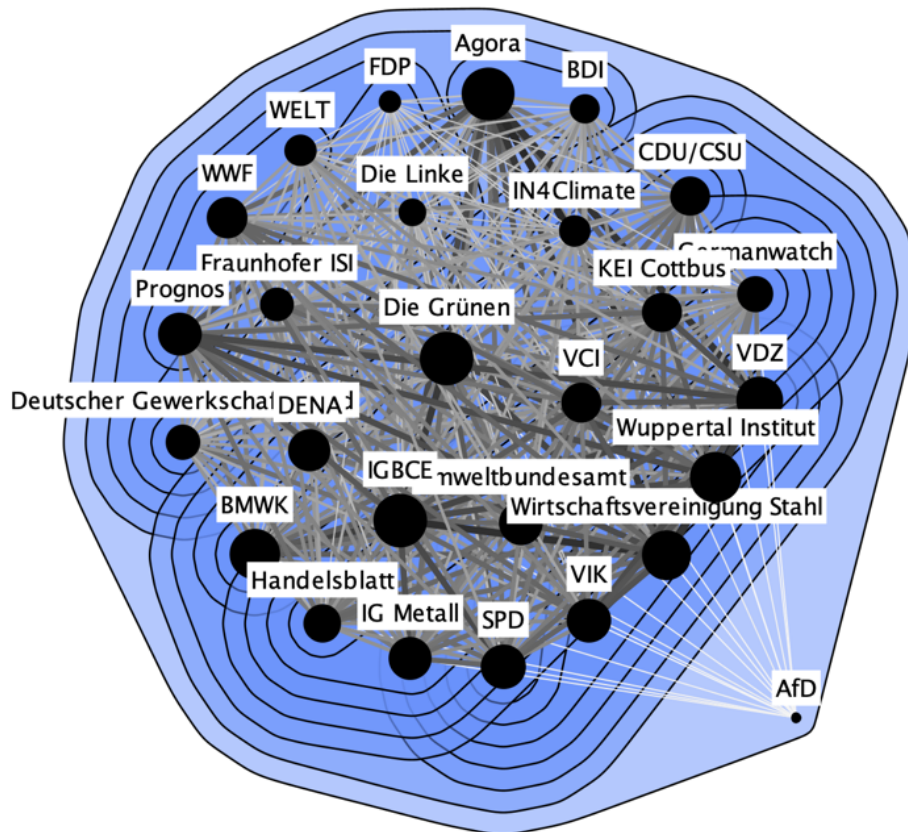


Figure 12: Co-Occurrence Normalised Actor Congruence Network

As can be seen in figure 12, no clear coalitions can be identified in the discourse on industry decarbonisation. The finding is another indicator for a homogenous discourse structure. There are not specific groups aiming to influence another with a concrete framing struggle involving storylines opposing each other. Rather the actors all share a similar position, with specific actors being more involved than others, with the less involved actors being excluded from the network visualisation at higher thresholds. Thus, one could define one single coalition to emerge.

The figure shows the without having removed any edges. Almost every actor seems to relate to another. The coalitions are seen to have multiple smaller coalitions within them. In an exploratory way the threshold values were adopted aiming to discover the appearance of discourse coalitions opposing another and not being stacked into one another. With an edge weight of above one the AfD is the first one to be excluded from the network. This indicates that it is the actor with the least similarity in position to the other actors. Other than was expected the increased threshold value did not result

in clearer coalition formation. It did result in more and more actors being excluded from the network. While at some threshold value coalitions were formed, at another level they merged again. This is an indication for the differences between the coalitions' positions to be marginal.

8.5 Discourse Coalitions Over the Years

To acquire a better understanding on the current discursive network the coalition formation over the different electoral periods is examined. Even though specific coalitions cannot be defined over the full period the following section analyzes whether there are coalitions which emerged in specific periods and which changed over time.

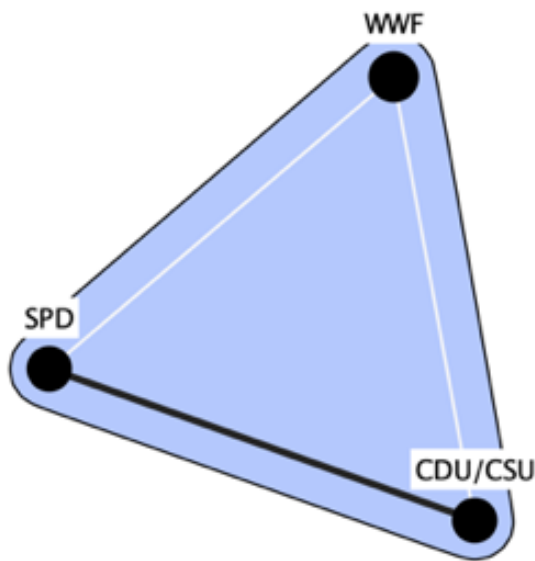


Figure 13: No Threshold Merkel Cabinet 2

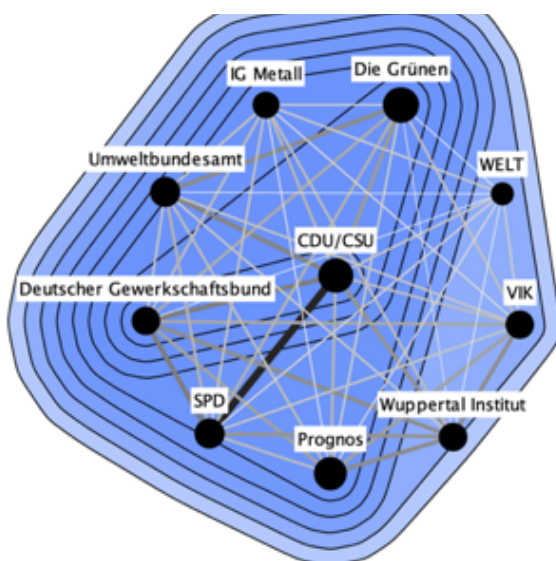


Figure 14: No Threshold Merkel Cabinet 3

The **second Merkel Cabinet** lasted from the 28th of October 2009 (while this research coded from the 1st of January 2012 onwards) until 17th of December 2013. During the coded period only two documents have been coded. One document is from the WWF on the potential of CCS to be used in industrial processes and the other one is the coalition contract from the SPD and the CDU/CSU. Presented in figure 13 is the one coalition that emerged with no threshold added.

During the **third Merkel cabinet** from the 17th of December 2013 until 14th of March 2018 more actors have joined the discourse. Moreover, documents from Prognos, Wuppertal Institute, VIK, WELT, Die Grüne, IG Metall, Umweltbundesamt and Deutscher Gewerkschaftsbund have been coded. The network is shown in figure 14. Also, here the coalitions are nested one inside the other. When looking for the emergence of coalitions in an exploratory way the same trend appeared as when looking at the entire period researched. Coalitions did not become clearer but only emerged, remerged, and regrouped.

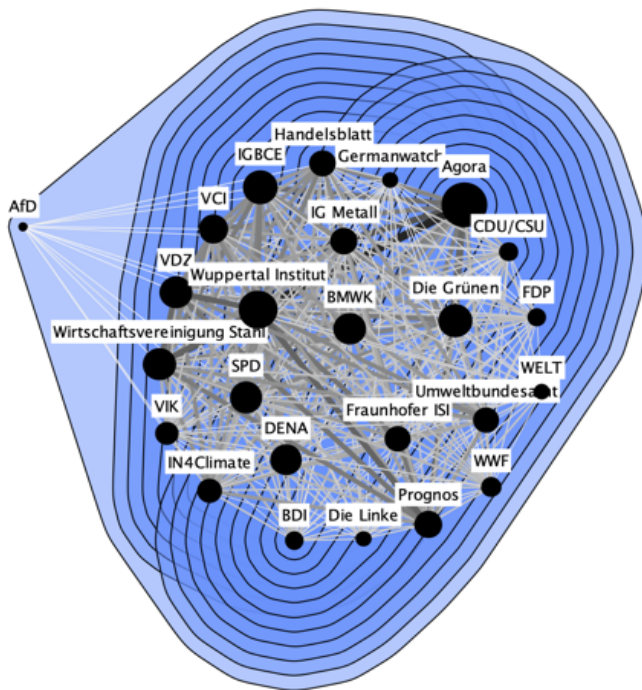


Figure 15: No Threshold Merkel Cabinet 4

Similarly, the **fourth Merkel cabinet** which started on the 14th of March 2018 and lasted until the 8th of December 2021 shows coalitions nested one inside the other. This can be seen in figure 15. Also, during this electoral period coalitions did not become clearer when increasing the threshold level but only emerged, reemerged, and regrouped. Compared to the previous period, many more actors have joined the discourse.

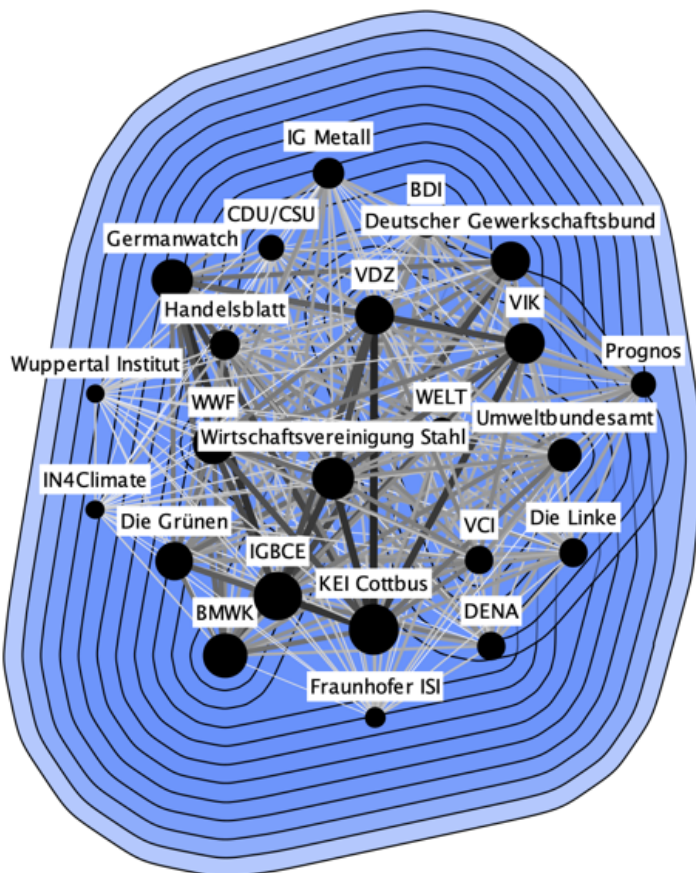


Figure 16: No Threshold Added Scholz Cabinet

The last cabinet and the one which is currently in government is the **Scholz Cabinet**. Its governance started on the 8th of December 2021. The coding of documents includes documents until the 31.05.2023. In consideration of the short period coded compared to the other periods, the number of actors and edges connecting them is astonishing. The discourse around the decarbonisation apparently has increased in actors participating and in storylines being mentioned. The same pattern as described for the Merkel Cabinet 3 and 4 can be seen in this period. Coalitions are nested one inside the other, while no clear coalition structure is emerging neither at higher threshold levels.

No clear discourse coalitions can be identified for neither one of the electoral periods. Also, with the examination of the different electoral periods there are no groups of actors making use of a clearly different sets of storylines compared to another group. Instead, also in these time frames one coalition can be defined with some actors being deeper involved and some being less involved in the discourse. Resultingly, no clear framing struggle emerged. Over the period the discourse seems to have been homogeneous according to the data. A finding that emerges from the comparison of the electoral periods is that the number of actors involved in the discourse increased over the years with the storylines shared between the actors increasing as well. A judgement to be taken from this visual change is that the discourse around the decarbonisation has increased in actors and storylines engaged.

An additional insight that was generated when looking for the emergence of discourse coalitions, the seven actors that remained at a high threshold level were noted in the following table 5. These are the actors with the highest edge weight levels, thus being the closest in position to each other and being the actors being very active in contributing to the discourse. These especially relevant actors are highlighted for the period of the second and third Merkel cabinet in green, for the third and fourth Merkel cabinet in blue, for the fourth Merkel cabinet and the Scholz cabinet in yellow and the actor appearing to be relevant for both the third Merkel cabinet and the Scholz cabinet in orange. To be discovered in this comparison is that there is not one actor that has been part of the most relevant actors throughout the entire period of analysis, while certain actors have been especially relevant over a larger period in shaping the discourse. These are the Wirtschaftsvereinigung Stahl, VDZ, BMWK, IGBCE, Bündnis 90/Die Grünen, SPD, CDU/CSU, Agora, Wuppertal Institute, Deutscher Gewerkschaftsbund, Umweltbundesamt, Prognos, KEI Cottbus, Germanwatch and VIK.

Table 5: Actors at the Heart of the Discourse

Cabinet	Key Actors
Entire Period Analyzed (W>3.1)	Wirtschaftsvereinigung Stahl, VDZ, BMWK, IGBCE, Die Grünen, Agora, Wuppertal Institute
Merkel Cabinet 2 (no threshold)	SPD, CDU/CSU, WWF
Merkel Cabinet 3 (W>0.63)	SPD, CDU/CSU, Deutscher Gewerkschaftsbund, Die Grünen, Umweltbundesamt, Wuppertal Institute, Prognos
Merkel Cabinet 4 (W>2.2)	Wirtschaftsvereinigung Stahl, VDZ, Die Grünen, Agora, Wuppertal Institute, Prognos
Scholz Cabinet (W>1.5)	Wirtschaftsvereinigung Stahl, VDZ, IGBCE, KEI Cottbus, Germanwatch, Deutscher Gewerkschaftsbund, VIK

8.6 Discourse Structuration Over the Years

The structuration is further analyzed in this section regarding the dominance of storylines over the years. Therefore, an affiliation network is provided showing the power of storylines to connect different actors in the network, then a ranking of the top 10 storylines is presented based on percentage of actors making use of these storylines.

8.6.1 Connecting Storylines

In figure 17 the power of storylines to connect actors is presented. The round squared nodes represent the storylines, while the round shaped nodes represent the actors. The green edges present agreement of an actor to a storyline, and a red edge presents disagreement. The network shows the storylines which are central to the discourse to be *Industry Strengthening, Challenge, Meet Energy Demand, Hydrogen Needed, Needed, International, Employment Security, Collaboration, Market, Energy Adaptation, Barriers and Disincentives Removal* and *Financial Support*. Especially active actors are according to the largest nodes presented Agora, VDZ, Wirtschaftsvereinigung Stahl, WWF, Wuppertal Institute, CDU/CSU, IG Metall, Prognos, Umweltbundesamt, Die Grünen, DENA, BMWK, SPD, IGBCE and VIK. From this visualisation can be seen that there are a couple of storylines and actors which are seemingly of great relevance, while also here no group structure is emerging. The emergence of structure was tested based on different thresholds, as elaborated on in the previous networks. For the affiliation networks for each of the time periods have been created. Neither did structures emerged by looking into the specific electoral periods. The main finding is as expected that concerning the development of the affiliation network over the years the complexity in storylines and actors' engagement increased.

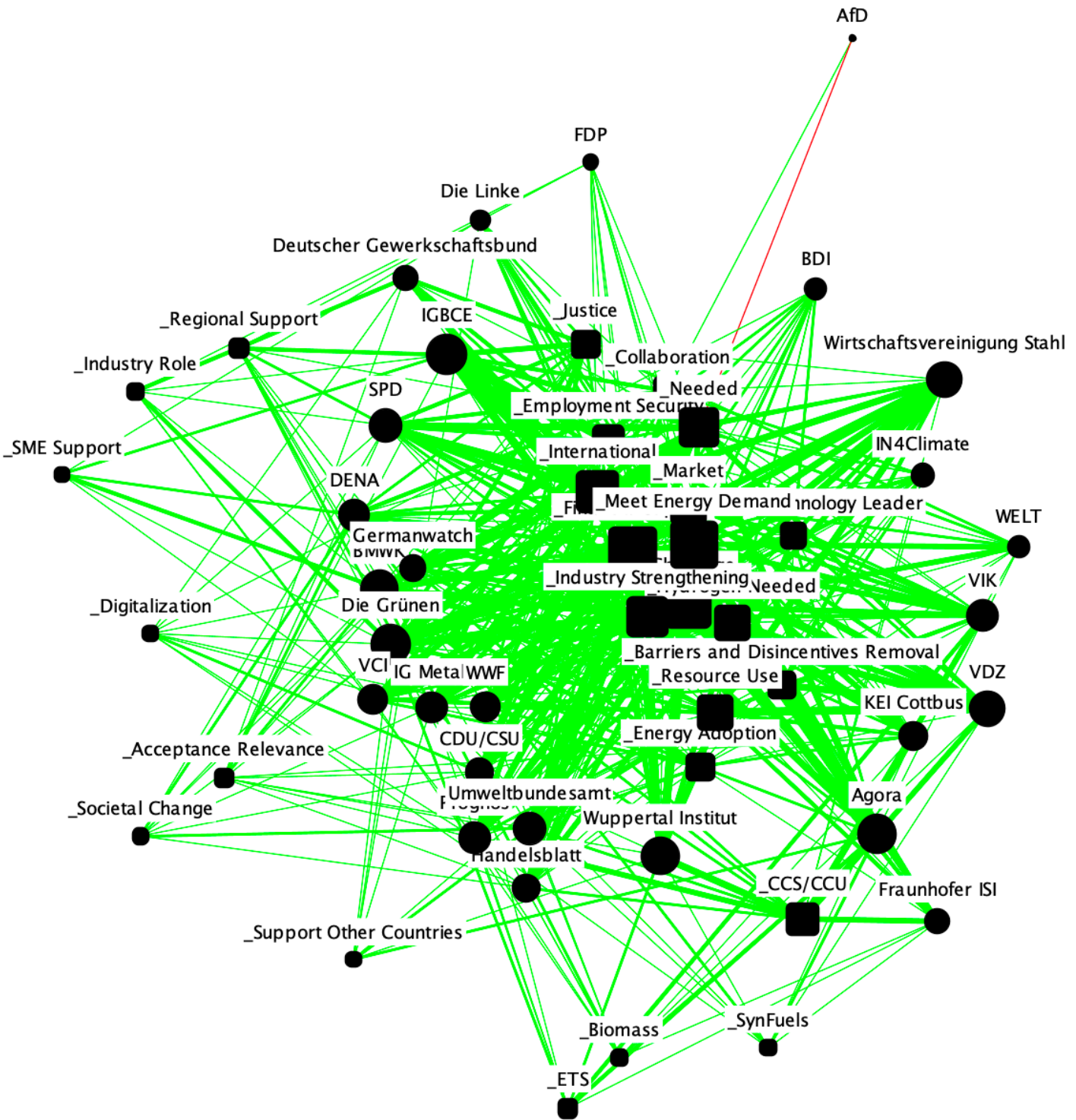


Figure 17: No Threshold Full Time Period

8.6.2 Storyline Use Over the Years

For a more straightforward understanding of storyline relevance a top 10 ranking is presented in table 6. Highlighted in green are the storylines that are part of the top 10 for at least three out of four periods. In the first table less than 10 storylines are presented, as it is less than 10 storylines that have been coded in the three documents identified for this period. For the second and third top 10 presentation there are more than 10 storylines presented as many storylines are used by the same share of actors. To be taken from table 6 is that five out of the storylines used already from the first electoral periods onwards are still being used in the last electoral period. These are the storylines *Needed*, *Challenge*, *International*, *Meet Energy Demand* and *Resource Use*. The storyline of *Financial Support*, *Employment Security*, *Industry Strengthening*, and *Energy Adaptation* have entered the discourse in the second period analyzed and are still being used in the latest period. The additional storylines which entered the top 10 in the third period are not part of the fourth period. The storylines dominating the discourse over these four periods are the storylines highlighted in green: *Meet Energy Demand*, *Financial Support*, *Employment Security*, *Challenge*, *Industry Strengthening*, *Energy Adaptation*, *Resource Use*, *Needed*, *International*.

Table 6: Top 10 Storylines Over the Electoral Periods

Merkel Cabinet 2 - Top 10 Storyline		Percentage Used
1.	Needed	100%
2.	Challenge	100%
3.	International	64%
4.	Meet Energy Demand	64%
5.	Resource Use	33%
6.	CCS/CCU	33%
7.	Biomass	33%

Merkel Cabinet 3 - Top 10 Storyline		Percentage Used
1.	Challenge	80%
2.	Financial Support	80%
3.	International	70%
4.	Meet Energy Demand	70%
5.	Needed	60%
6.	Justice	60%
7.	Collaboration	50%
8.	Digitalization	50%
9.	Employment Security	40%
10.	Industry Strengthening; Germany Technology Leader; CCS/CCU; Energy Adoption	30%

Merkel Cabinet 4 - Top 10 Storyline		Percentage Used
1.	Meet Energy Demand	92%
2.	Financial Support	88%
3.	International	84%
4.	Industry Strengthening	80%
5.	Hydrogen Needed	80%
6.	Needed	76%
7.	Challenge	76%
8.	Resource Use	76%
9.	Germany Technology Leader	56%
10.	Barriers and Disincentives Removal; Employment Security; Energy Adoption	48%

Scholz Cabinet - Top 10 Storyline		Percentage Used
1.	Meet Energy Demand	87%
2.	Financial Support	83%
3.	Challenge	83%
4.	International	70%
5.	Industry Strengthening	70%
6.	Employment Security	70%
7.	Needed	76%
8.	Market	61%
9.	Resource Use	57%
10.	Energy Adoption	48%
11.	Justice	48%

Finally, an overview on all storylines used over the period analyzed are provided in figure 18 to obtain an insight into storylines emerging or maybe also disappearing. An increase in storyline use can be seen for the storyline *Employment Security*, not being used at all in the first period, being used by 40% in the second period, by 48% in the third period and by 70% in the last period. The *Meet Energy Demand* storyline was first used by 64%, then by 70%, then by 92% and finally by 87%. The *Financial Support* storyline increased over the periods from not being used at all in the first period, to

80%, 88% and finally dropping in use again at the final period to 83%. No storyline has been found that seems to be phased out. No great structural changes have become visual in this figure.

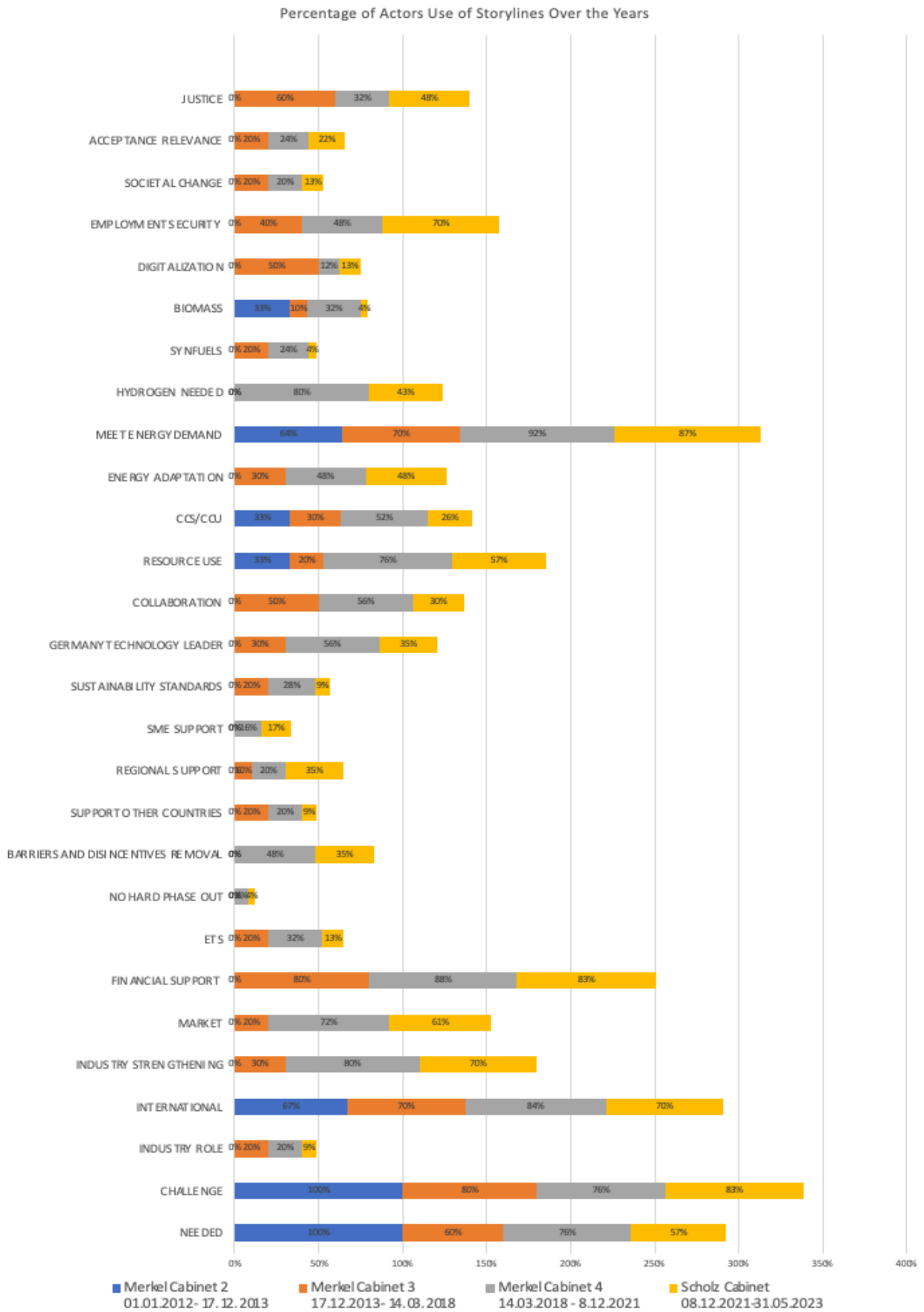


Figure 18: Percentage of Actors' Use of Storylines Over the Years

9 Discussion

With this chapter I interpret how the findings may have come into being and what their implications may be. To put the findings of this research into context I critically reflect on the limitations, the societal relevance and end this chapter with a positive outlook on future research.

9.1 Interpretation of the Findings

9.1.1 The Positive Sentiment

The general sentiment of the industry decarbonisation discourse shows that the actors understand the need for transformation, the challenges and rather engage in the discourse to communicate the conditions to enable industry decarbonisation. Thus, the sentiment is generally positive, with none of the storylines judged to be delegitimising. Instead, the storylines are legitimising the transformation of the regime, taking a stand for specific policies and technology to be made use of. This is in line with the case study on Upper Styria, Austria (Spiesberger, et al., 2022) which discovered that the discourse on decarbonising the (steel) industry does not question the necessity of the transition, but how it can and should be implemented. A generally positive sentiment was also discovered in the research on hydrogen by Ohlendorf, et al. (2023). Therefore, similar results have been discovered in all three studies. The reason for this positive sentiment may be that the actors have already accepted the need for transformation. This may be a result of the policy context that has already clarified the need for transformation. Especially relevant laws creating this decisive policy environment are the Paris Agreement and the Climate Law decided for in Germany (WWF, 2019). As the decade of 2020 to 2030 is expected to be accompanied with great reinvestments in factories of the basic material industry, especially the industry actors may decide to embrace the change and rather ask for the conditions under which they are willing to transform (Agora Energiewende, 2020).

9.1.2 The Discursive Homogeneity

The next key finding of this research is that no framing struggles emerged nor a structure of diverse coalitions. Rather, one coalition may be defined. The discourse is judged to be rather homogenous with most storylines dominating the discourse. This is a rather atypical finding. Rosenbloom et al. (2016) also researched the transformation towards PV through the analytical perspective of discourse analysis. According to the authors, innovation debates are in one sense about the prospects of particular technologies but in a more fundamental sense they are about the appropriate allocation of policy support and external resources. Multiple struggles have been identified in their research. Markard et al. (2021) analyzed the coal phase-out in Germany. Also, here specific struggles for legitimacy were identified. Other than in these just mentioned examples. An explanation for the discursive homogeneity in this case study may be the level of analysis applied. The policy context has already decided for the transformation from the current industry regime to a decarbonised regime. This higher policy context may be the ideational level covered by this thesis. There may rather be struggles for more practical transition paths. Research that is supporting this

hypothesis is the research by Ohlendorf, N., et al. (2023) in which the German discourse on hydrogen implementation has been analyzed. In the research by Ohlendorf, N., et al. conflicts arose. While policymakers highlighted economic opportunities and role for climate change mitigation, especially NGOs argued that hydrogen is expensive, inefficient, and overestimated in its potential. Thus, on a different analytical level conflicts and coalitions may emerge.

The discursive homogeneity may additionally be explained by the type of actors that have been covered. Actors which have been of great relevance in shaping the discourse over the period analyzed are industry actors: Wirtschaftsvereinigung Stahl, VDZ, VIK; the Federal Ministry for Economic Affairs and Climate Action (BMWK) and Federal Environmental Agency (Umweltbundesamt); the parties Bündnis 90/Die Grünen, SPD, CDU/CSU; the trade unions: German Federation of Trade Unions (Deutscher Gewerkschaftsbund), IGBCE and the scientific institutes and think tanks Agora and Wuppertal Institute Prognos; as well as the intermediary KEI Cottbus. Even though all actors engaged in the discourse were aimed to be covered, the medium analyzed was online accessible documents. This may lead to the exclusion of some actors who may primarily engage in the discourse through other media.

Moreover, may the actors be political or technological elites as the public may not be aware of the topic. As listed in the previous paragraph the actors engaged are the industry actors, federal ministries, political parties, scientific institutes, intermediaries, and trade unions. Trade unions may be understood to be closest in representing the public. NGOs are not part of actors' greatly contributing to this debate. Also, in the case study on Upper Styria, Austria (Spiesberger, et al., 2022) the discourse is identified to be in line with expert debates. Especially political statements were identified to be comparable to the statements of industry actors or economic experts. Geels and Verhees (2011) point out that a hegemonic discourse is often articulated by technical and political elites. According to Hajer and Wagenaar (2003), it is the stabilised position of the elite that results in a hegemonic discourse about policy issues. As a result of the discourse being dominated by the elite, certain groups whose lives will be affected by the decisions are marginalised. This is why it is important to capture the marginalised groups' engagement in discourses. Hajer and Wagenaar contest that in some cases, enlightened administrators may be able to avoid this discursive dominance (2003, p.28). Thus, a reason for the discursive homogeneity may be most of the actors to be classified as technical and political elites.

Supporting the hypothesis that certain actors' discursive contributions may not have been extensively covered is the research on "Populist far right discursive-institutional tactics in European regional decarbonisation" (Yazar, Haarstad, 2023). While these researchers identified 15 documents for analysis for the AfD, only one document was discovered with a focus on industry decarbonisation in Germany for this research project. The findings can be taken as an indication, while not being fully applicable for comparison as their research focus seems to have been on extractive-industries instead of the basic material industry's decarbonisation. Additionally, the reason why the researcher has found more information on this actor may not only be because of the type of medium analyzed, as the research by Yazar, M. and Haarstad, H. (2023) covered comprehensive academic literature and a corpus of issue-specific policy documents, but mainly because of the regional instead of national focus. The research on regional

level discovered discursive strategies by this party to delegitimise decarbonisation, while on a national level only general disagreement was discovered. Resultingly, a reason to not have extensively covered specific actor groups may be a result of these actor groups communicating on a different level than the national level analyzed in this research.

9.1.3 The Dominant Storylines

Another key finding to be discussed is that the dominant storylines have not been changing significantly over the four electoral periods. With five identified storylines being in the top 10 of most used storylines in the first electoral period and still being part of the top 10 in the last electoral period, the question emerges why the discourse has been comparably stable in content. These five dominant storylines are *Needed*, *Challenge*, *International*, *Meet Energy Demand and Resource Use*. Content wise the identified storylines are resembling the key topics identified in the case study on Upper Styria (Spiesberger, et al., 2022). In that case study the content is identified to revolve around the Regional, International & Global Competition. While in the German case study the regional level is not dived into, it is especially the international/global competition that is addressed through the storyline of *International*. Neither the case study on Upper Styria (Spiesberger, et al., 2022) nor the research on the discursive strategy of the AfD (Yazar, Haarstad, 2023) captured changes in discourse over time. My unproven hypothesis is that the needs and challenges which are communicated through these storylines have already been known for long. The specific struggles for which technologies and policies to implement may happen at another analytical level. Furthermore, the period analyzed spans over about 11 years which may be another reason for the storylines to maintain the same, while the discourse increases in complexity with new storylines and actors joining. These hypotheses are subject to future research.

Over the four electoral periods some additional storylines to those just presented have been identified to be of dominance. These are the storylines *Financial Support*, *Employment Security*, *Industry Strengthening and Energy Adaptation*. Also, for this finding no research for comparison has been identified. My hypothesis is that storylines have become more specific over the years regarding actors' demands, while the social dimension is being addressed through the storyline of *Employment Security* which has been less prioritised before. This hypothesis is subject to future research. The priority within the discourse stays within the technological and economic dimension. This focus was also discovered in the case study of Upper Styria, Austria (Spiesberger, et al., 2022). The researchers explained the phenomenon based on the close connection of the discourse to expert debates on emerging technologies (Spiesberger, M., et al., 2022, p.61).

9.2 Reflection on the Conducted Research

9.2.1 Limitations

To start the reflection of the conducted research the limitations are presented. Thereby, I present the obstacles encountered which are directly relevant to achieve my research aim.

Limitation Storyline Formation

A limitation to this research is the approach to storyline formation. Two coding rounds were gone through, with the second round evolving around the regrouping of the previous codes into storylines. Resultingly, some storylines are aggregating a larger number of narratives than other storylines. If a larger number of narratives are grouped under a storyline, the storylines chance to be made use of by actors may increase. As a result, certain storylines may appear to be especially relevant, for example in the top 10 ranking, also because they aggregate many narratives. Nevertheless, to counter over representation in the second coding round, also here each storyline was coded only once per document. A second limitation concerning narratives and storyline formation is that these storylines have been decided on by one researcher. Having worked on establishing the narratives and storylines in collaboration with another researcher may have led to different, less biased storyline formation. However, to counter my own bias, I engaged in expert interviews and discussed my narratives and storylines with colleagues and my two supervisors.

Corpus Creation

During the corpus creation process it became apparent that the google search did not show all documents from actors relevant for this research. This limitation was addressed by additionally going on some actors' websites searching for additional information. An advantage from searching via google search is that additionally relevant actors may be shown and are potentially added to the research scope.

To be considered in the representation of media actors is that those were included by which enough documents were accessible. Nevertheless, not all media actors' publications were accessible. First, articles were accessed over google search, which was then adapted to searching for more content on Lexis Nexis. Lexis Nexis did not enable a better access to all actors (e.g., FAZ).

Target Group

A limitation is found in the apparent focus on elite actors in this research. Certain actor groups were not well represented in this research. An indication for possible under representation of positions was shown by the availability insights on an actor in the research on the discursive strategies of the AfD on a regional level focusing on the extractive industries' decarbonisation (Yazar, Haarstad, 2023). The result may thus depend on the chosen focus on national level and topic of industry decarbonisation. The hypothesis for the focus on elite actors to be a result of the level of analysis on the industry decarbonisation in general has been mentioned also in the case study on Upper Styria (Spiesberger, et al., 2022).

Time Limit

A general limitation of this thesis process is given through the time limit applied. Resultingly, the scope in actors and documents analyzed needed to be adapted. Moreover, would it make sense to read twice through the entire corpus to ensure all relevant passages are coded, especially as some codes were added later in the process. New codes were added via search for related terms, e.g., when taking up ETS as a code the entire corpus was searched for ETS. Nevertheless, some codes may resultingly be underrepresented, as well as some documents read in the beginning may be coded with less codes.

9.2.2 Societal Relevance

With this thesis an understanding was generated that the most used storylines in the discourse are of positive sentiment. With an evaluation on the storylines that are most used by the actors, general policy recommendations can be derived to ensure the content of these actors. Actors working with a multitude of the represented actors may obtain valuable insight that the actors e greatly agree in storylines used and further understand which storylines lead to agreement. The discourse is astonishingly homogenous and has been homogenous for the entirety of the time frame analyzed. The communication of this insight may contribute to the feeling of certainty necessary for investors to invest in the key technologies needed for climate neutrality (Agora Energiewende and Wuppertal Institute, 2019). Of societal relevance is furthermore that actors representing society are comparably underrepresented, as well as storylines on societal impact or environmental impact (e.g., acceptance, biodiversity impact from technology decisions) are currently underrepresented. This research may be understood as a wakeup call to societal actors to become more engaged to represent their needs, as well as a wakeup call to political decision makers to emphasise engaging with societal actors. Finally, this research is contributing to the theoretical understanding of how transformations are influenced by power structures. This is beneficial to society when used by change agents to influence transformation to stay within the safe and just space for humanity as proclaimed by Kate Raworth in her Doughnut Economy theory (Raworth, K., 2017).

9.2.3 Future Research

I first present additional research that can be conducted on the identified data set, followed by research that may be relevant to further explore the topic from a methodological and theoretical point of view.

Further Use of the Data Set

With 18 out of 27 storylines being used by 56% of actors a high network density is expected. This calculation may be investigated in future research. The density may range from 0 to 1. = corresponding to networks with no relationships and 1 representing networks with all possible relationships (IBM, 2021). Such network density may then be analyzed over a span of years showing the ideational congruence of the networks (Markard, et al., 2021, p. 325).

Furthermore, could evaluations be conducted on each of the specific actors or specific actor groups. By profiling the actors an understanding on what is important to them in the transformation towards industry decarbonisation may be generated. A good understanding on concrete actors' position may support the ability for collaboration between the actors.

Even though opposing coalitions did not emerge in this research, the data set could be further analyzed through statistical software such as SPSS. Especially could be evaluated whether storyline use correlates with other storyline uses, as well as whether there may be correlations based on specific actor type with the use of certain storyline use.

Methodological Explorations

From a methodological point of view, it would be interesting to use natural language processing techniques, such as Topic Modeling in Python, as an alternative approach to identify storylines. Topic modeling allows the uncovering of hidden structure in a corpus of documents. Especially the function of dimension reduction may be relevant to use (Kapadia, 2019).

Moreover, could lower analytical levels be addressed as done in the research on hydrogen (Ohlendorf, et al., 2023). Specific arrangement of policy designs may be analyzed for example. They may be concerning the financial support of the industry or also the specific understanding of how to transform the industry in a just way. Nevertheless, researching these struggles concerning specific arrangements may be difficult as the number of actors involved in these practical discourses are expected to be on a higher expert level. The challenge may regard defining the medium of analysis. It may be an option to analyze governmental working papers, as well as recording and coding discussions when being granted access to them. The assumption is for these conversations to be for now primarily happening behind closed doors.

Such a lower analytical level could also be beneficial to study political perspectives from the groups which are "marginalised effectively" by the elite (Hajer and Wagenaar, 2003, p.28). These groups may contest the hegemonic discourse by engaging in framing struggles over specific issues. They may make use of non-institutionalised action such as protest marches and petitions to exert pressure (Geels, Verhees, 2011). Next to addressing a different analytical level, for these groups' analysis a different medium of analysis such as leaflets, petitions or communication on Twitter may be chosen. Another underrepresented group, due to the scope of this research, are the corporations involved in the basic material industry. Further research could address this lack of insight on this actor group.

For future research case studies should be conducted in different countries for comparison. It may be of relevance to analyze the discourse on a lower conceptual analytical level, for example on national policy mixes advocated for. By generating these case studies national specificities could become apparent and inspiration for other cases may be deducted, such as policy instruments to be use for decarbonisation.

As presented in the study "Populist far right discursive-institutional tactics in European regional decarbonisation" (Yazar, M., Haarstad, H., 2023) which analyzed the discursive tactics of the right parties on a regional level and with a focus on extractive-industries, an indication is provided that another level than the national level may

yield more insights into specific actor groups. In comparison, the researchers identified 15 documents to analyze the AfD's discursive strategy (Yazar, M., Haarstad, H., 2023), while I only identified one document in which the AfD discussed the industry decarbonisation on a national level.

From this research a focus in the discourse on economic and technical conditions for the industry decarbonisation emerged. Social and environmental conditions were barely touched upon. It may be of scientific interest to further analyze social topics, such as acceptance, climate justice regarding the industry decarbonisation, as well as environmental impact caused by economic and technical developments which focus on industry decarbonisation while barely if only considering other planetary boundaries to be protected.

Theoretical Explorations

As pointed out already in the beginning of this research, discourse institutionalisation is the other key concept suggested by Hajer (2006) to analyze discursive power and dominance. During this research the institutionalisation of the discourse was briefly touched upon in the findings chapter. Indications has been provided, that discourse institutionalisation is taking place while additional research on discourse institutionalisation could further dive into the laws that are being passed and whether and which storylines identified in this research already are being adopted in these laws.

Concerning theory analyzed in this research project the focus lay on storylines' power and dominance in shaping the discourse. What was not identified in this research is how certain actors make use of specific storylines to exercise specific power and dominance. Similarly, as done in the research on the discursive tactics of the AfD (Yazar, Haarstad, 2023), research on actors' tactics to use storylines for shaping the decarbonisation discourse may be further built upon.

In the book "Deliberative Policy Analysis – Understanding Governance in the Network Society" edited by Hajer, M. A. and Wagenaar, H (2003), a chapter was contributed by Gottweis in which he elaborates on discourse hegemony. Discursive hegemony is expected to be established once a regime has been restabilised (Gottweis, 2003, p.260). In the context of this research project, hegemony is indicated through the homogeneity in the discourse to be established during the transition itself. Further research may dive into the understanding of how the homogeneity may come about in a discourse on transition pathways and its impact on the transition pathways.

As already pointed out by Rosenbloom et al. (2016, p.1286) "the way in which the landscape is endogenised [...] is an important part of transitions that merits further attention". This understanding has been further elaborated on by Hermwille (2016), integrating the role of narratives in the MLP framework. I question whether it is only the discursive legitimisation and delegitimisation which is enabling the transition from one regime to another, and if not, how other factors contribute to the transitions. Future research may study factors which may explain why actors are not "walking the talk", such as stress, dependencies and uncertainties which had been addressed in the Upper Styria case study (Spiesberger, et al., 2022) which may lead to change or resistance to change.

10 Conclusion

The main research question of this thesis addresses how the discourse on industry decarbonisation is structured by discursive power and dominance. Other than expected, no coalitions have emerged in the discourse on industry decarbonisation over the entire researched period. In connection to this finding no struggles for power and dominance have been discovered. One coalition can be defined which comprises each of the actors, with some actors being more and some being less engaged. Out of 27 storylines, 18 are dominating the discourse as they are shared by 56% of actors. Also, over the period analyzed the most used storylines barely changed. Five storylines being in the top 10 of most used storylines in the first electoral period were still part of the top 10 in the last electoral period: *Needed*, *Challenge*, *International*, *Meet Energy Demand* and *Resource Use*. Therefore, the discourse can be judged to be highly homogeneous. The general sentiment is positive with most storylines being of either economic or technological nature. Actors (except for the AfD) agree with the need for industry decarbonisation and see the challenges. Their focus is on storylines to advocate for the conditions enabling the transformation. The discourse on industry decarbonisation becoming more complex over the time analyzed. More actors are being involved and more storylines are being discussed. In line with this increase, an institutionalisation of the industry decarbonisation has been indicated regarding laws, research, and increase in documents discovered for analysis in this research.

Based on the findings one may expect transformation to be decided on and no further obstacles to stand in its way. Nevertheless, the findings were put into the context of the transformation and the literature discovered in the literature review. A hypothesis is that the homogeneity of the discourse is a result of the analytical level. When researching the transformation in related fields such as with a focus on hydrogen (Ohlendorf, et al., 2023) or also at a regional level (Spiesberger, et al., 2022; Yazar, Haarstad, 2023) opposing storylines have been identified. Another possible explanation for the homogeneous discourse structure may result from the type of medium analyzed. By having used google search and Lexis Nexis, different types of documents, news and website articles were analyzed. The discourse delegitimising the decarbonisation may be discussed on a different medium. Connected with the choice of medium another hypothesis is that the homogeneity in discourse may be a result of some actors not having been covered or only partially. Many of the actors analyzed may be judged to be part of the elite. According to Hajer and Wagenaar (2003), it is the stabilised position of the elite that results in a hegemonic discourse about concrete policy issues. As a result, certain groups whose lives will be affected by the elite's decisions may be marginalised.

Thus, certain implications can be derived from this research. Those actors who are engaging with other actors may be well informed to know that at the higher analytical level, actors are likely to share their storylines. This may lead to better cooperation for industry decarbonisation. The finding that the certain groups and interests are currently underrepresented in the discourse may come as a concern to those who and who's interests are underrepresented. In table 7, recommendations are provided to each of the actors analyzed on how to address the implications derived from this research.

Table 7: Recommendations

Policy Makers	Policy makers should ensure a policy mix that enables actors to be part of the transformation. They should take into consideration those actors which have currently been underrepresented in the discourse on industry decarbonization while likely being impacted by the industry's development. Concretely, policy makers should take into consideration transparent communication on industry decarbonization processes especially to actors such as NGOs and other society. The ability should be provided to everyone to be well informed and thereby to advocate for their interests. Moreover, should policy makers pay attention to inviting and empowering actors to share their demands on the social and environmental aspects to be considered for the industry decarbonization. This is important as these aspects are currently underrepresented.
Scientists	Scientists engaged in the industry decarbonization should consider attributing their research on generating more knowledge on the industry decarbonization as elaborated on in the future research paragraph following the limitations paragraph.
Intermediaries	It is intermediaries which provide a platform for the connection of various actor groups. The facilitation of knowledge exchange and opinion exchange may be perceived as already having been fruitful in the sense that much common ground seems to exist already in the discourse on industry decarbonization between the different actors. Paying attention to power structures and emphasizing the empowerment of actors and ideas which have currently been less voiced is a key recommendation to this actor group.
Industry Actors	The next actor group for whom recommendations are formulated based on this research are industry actors. Similarly, as formulated regarding policy makers, industry actors should consider the influence of their actions contributing to the industry decarbonization to also be of social and environmental influence. They should enable marginalized groups and topics of interests to be included in decision-making processes and provide transparency on their actions to influence industry decarbonization for structures of power and dominance to be manageable in democratic manners.
Trade Unions	Trade unions are as of now the strongest representatives for civil society in the discourse on industry decarbonization. They may consider collaborating with other representatives of civil society such as NGOs to increase the power and dominance of storylines addressing social and environmental concerns within the discourse on industry decarbonization. Moreover, can they pass on valuable information obtained by being in closer connection to industry actors to NGOs to support their education on the industry decarbonization processes.
NGOs	As has been seen in this discourse analysis, NGOs are not much engaged in the industry decarbonization discourse in Germany. A recommendation to them is to become more engaged to ensure interests, which may currently be underrepresented to be better represented in the future. Knowing that for NGOs resources may be scarcer than for other actors, strategic partnerships, as for example with trade unions may be a good approach to increase their influence.

With this research the first analysis of the industry decarbonisation discourse in Germany has been conducted. Based on the increase of research being conducted, laws being passed, and number of documents discovered for analysis on industry decarbonisation, can be argued that the emergence of the discourse has been discovered in this research to be around 2017. By providing into the storylines, their frequency, the percentage of actors using them, the actors engaged in the discourse and the discovery of a high degree of homogeneity in the discourse, the problem of a lack of systematic analysis on German industry decarbonisation discourse was addressed. Discovering a

discourse without clear framing struggles is very rare, as can be seen in the literature review. While in the literature review research on the engagement of the AfD on the regional industry decarbonisation discourse with a focus on extractive-industries was discovered (Yazar, Haarstad, 2023), a case study on regional steel decarbonisation discourse in Austria (Spiesberger, et al., 2022) was provided and research on German discourse on the hydrogen use (Ohlendorf, et al., 2023) was discovered, this is the first research of its kind addressing the issue at this analytical level and on national level. With this research a base for further comparison of other case studies is provided and a data base was generated which can be further analyzed.

11 Acknowledgements

Without the great support I have experienced over the past six months, the quality of this research process would not have been the same. I would like to express my deepest gratitude for my knowledgeable, committed supervisors Dr. Adrian Rinscheid (Radboud University) and Dr. Anna Leipprand (Wuppertal Institute). This research has greatly benefitted from your experience and guidance.

Great insights collected during the research internship at the Wuppertal Institute were able to be incorporated in this research. I am thankful for this opportunity given by the institute to be in closer contact with researchers studying the field of industry decarbonisation. Special thanks go to the researchers and the member of the NRW parliament who participated in my expert interviews.

For proof reading, grammar and structure checking I am especially thankful to my partner, Jan Nold, but also to my friends from high school, Julia Jeguschke, Almina Husetovic and Ricardo Best, my friends from my studies, Tommaso Mondovì, Mathéa Debant, Femke Schootstra, Giulia Tegas and Bobby Steenbakkers and my colleague Meltem Erdogrul, from the Green Party.

Finally, I would like to recognise my family and those friends who feel like family, who are a daily inspiration to me. It is through their encouragement that I can work with great discipline and commitment on the projects I feel passionate about.

12 References

- Academic Accelerator. (n.d.). *Journal of Cleaner Production. Latest Journal's Impact IF - Trend · Prediction · Ranking · Key Factor Analysis*. Retrieved on June 6, 2023, from <https://academic-accelerator.com/Impact-of-Journal/Journal-of-Cleaner-Production>
- Agora Energiewende. (2020). Wie die europäische Stahl-, Zement- und Chemieindustrie CO₂-frei wird. Retrieved on July 23, 2023, from <https://www.agora-energiewende.de/presse/neuigkeiten-archiv/wie-die-europaeische-stahl-zement-und-chemieindustrie-co2-frei-wird/>
- Agora Energiewende and Wuppertal Institute. (2019). *Klimaneutrale Industrie Schlüsseltechnologien und Politikoptionen für Stahl, Chemie und Zement*. Agora Energiewende and Wuppertal Institute. Retrieved February 2, 2023, from https://static.agora-energiewende.de/fileadmin/Projekte/2018/Dekarbonisierung_Industrie/164_A-EW_Klimaneutrale-Industrie_Studie_WEB.pdf
- Bacchi, C. (2000). Policy as discourse: What does it mean? Where does it get us?. *Discourse: Studies in the Cultural Politics of Education, Volume 21(1)*, pp. 45–57, <https://doi.org/10.1080/015963000050005493>
- Barabási, A.-L., & Pósfai, M. (2016). *Network science*. Cambridge University Press.
- Bazerman, C. (1990). Discourse analysis and social construction. *Annual Review of Applied Linguistics, Volume 11*, pp. 77–83. <https://doi.org/10.1017/S0267190500001963>
- BDI. (2019). *Soziale Marktwirtschaft im 21. Jahrhundert*. Abteilung Research, Industrie- und Wirtschaftspolitik, BDI.eu. Retrieved on June 6, 2023, from https://issuu.com/bdi-berlin/docs/20190404_position_bdi_soziale_markt
- BDI. (2021). *Klimaneutralität 2045: Ehrgeisig, aber technologisch machbar*. BDI.eu. Retrieved on June 26, 2023, from <https://bdi.eu/artikel/news/das-klimaneutrale-industrieland-gibt-es-nicht-zum-nulltarif>
- BDI. (2022). *Energiekrise und Klimaneutralität: Industrie steht zu Klimazielen*. BDI.eu. Retrieved on July 21, 2023, from <https://bdi.eu/artikel/news/energiekrise-und-klimaneutralitaet-industrie-steht-zu-den-klimazielen>
- Binz, C., Harris-Lovett, S., Kiparskyd, M., Sedlak, D.L., Truffer, B. (2016). The thorny road to technology legitimation - Institutional work for potable water reuse in California. *Technological Forecasting and Social Change, Volume 103*, pp.249–263. <https://doi-org.ru.idm.oclc.org/10.1016/j.techfore.2015.10.005>
- BMWK. (n.d.a). *Dekarbonisierung der Industrie*. BMWK. Retrieved on May 22, 2023, from <https://www.bmwk.de/Redaktion/DE/Artikel/Industrie/dekarbonisierung-der-industrie.html>
- BMWK. (n.d.b). *Moderne Industriepolitik*. BMWK. Retrieved on May 23, 2023, from <https://www.bmwk.de/Redaktion/DE/Dossier/moderne-industriepolitik.html>

BMWK. (n.d.c). *Wohlstand klimaneutral erneuern - Werkstattbericht des Bundesministerium für Wirtschaft und Klimaschutz*. BMWK. Retrieved on June 6, 2023, from <https://www.bmwk.de/Redaktion/DE/Dossier/werkstattbericht.html>

BMWK. (2023a). *Beginn des Stakeholderdialogs zur Carbon Management-Strategie*. BMWK. Retrieved on July 19, 2023, from <https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2023/03/20230324-stakeholderdialog-zur-carbon-management-strategie.html>

BMWK. (2023b). *Deutschland kann grüne Industrie – Klimaschutzverträge für die Transformation*. BMWK. Retrieved on July 19, 2023, from <https://www.bmwk.de/Redaktion/DE/Schlaglichter-der-Wirtschaftspolitik/2023/07/04-deutschland-kann-gruene-industrie.html#:~:text=Um%20die%20Transformation%20zu%20einer, Juni%202023.>

Bündnis 90/Die Grünen Bundestagsfraktion. (2017). *Zukunft wird aus Mut gemacht. Bundestagswahlprogramm 2017*. Retrieved on July 23, 2023, from https://cms.gruene.de/uploads/documents/BUENDNIS_90_DIE_GRUENEN_Bundestagswahlprogramm_2017_barrierefrei.pdf

Bündnis 90/Die Grünen Bundestagsfraktion. (2023). *Fraktionsbeschluss Transformation gestalten*. Retrieved on July 21, 2023, from https://www.gruene-bundestag.de/files/beschluesse/Fraktionsbeschluss_Transformation_gestalten.pdf

CDU/CSU, SPD. (2018). *Ein neuer Aufbruch für Europa - Eine neue Dynamik für Deutschland. Ein neuer Zusammenhalt für unser Land Koalitionsvertrag*. CDU/CSU, SPD. <https://www.bundesregierung.de/resource/blob/974430/847984/0bad5cb7d094fa10ed58a431d2f907ce/2018-03-14-koalitionsvertrag-data.pdf?download=1>

DENA. (2018). *dena-Leitstudie Integrierte Energiewende Impulse für die Gestaltung des Energiesystems bis 2050*. DENA. Retrieved on July 23, 2023, from https://www.dena.de/fileadmin/dena/Dokumente/Pdf/9261_dena-Leitstudie_Integrierte_Energiewende_lang.pdf

Deutscher Gewerkschaftsbund. (2022). *Antrag COO1: Transformation gerecht gestalten, in die Zukunft investieren* [White paper]. Retrieved on July 21, 2023, from <https://apastyle.apa.org/style-grammar-guidelines/references/examples/white-paper-references>

Deutschlandfunk. (2021). *Auf dem Weg zur Klimaneutralität - Die neuen Klimaziele für Deutschland*. Deutschlandfunk. Retrieved on July 3, 2023, from <https://www.deutschlandfunk.de/auf-dem-weg-zur-klimaneutralitaet-die-neuen-klimaziele-fuer-100.html>

DGB. (2023). *Anforderungen des DGB zur Industriestrategie der Bundesregierung (BMWK) 2023* [White paper]. Retrieved on July 19, 2023, from <https://www.dgb.de/uber-uns/dgb-heute/struktur-industrie-und-dienstleistungspolitik/industrie-und-dienstleistungspolitik/++co++8cd89cbc-b425-11ed-8d7e-001a4a160123>

Dryzek, J. S. (2013). *The politics of the earth: Environmental discourses*. Oxford, Oxford University Press.

- Elsevier. (n.d.). *What is Journal Impact Factor?* Scientific-Publishing.Web-shop.Elsevier. Retrieved on June 6, 2023, from <https://scientific-publishing.web-shop.elsevier.com/research-process/what-journal-impact-factor/>
- Energy4Climate. (n.d.). *SCI4climate.NRW - Klimaneutrale Transformation der Industrie am Beispiel NRW*. Energy4Climate. Retrieved on July 19, 2023, from <https://www.energy4climate.nrw/industrie-produktion/in4climatenrw/sci4climatenrw>
- Entrances Project. (n.d.). *About the case study*. EntrancesProject. <https://entrancesproject.eu/case-studies/upper-styria-austria/>
- Fairclough, N. (1992). *Discourse and Social Change*. Cambridge, UK: Polity Press.
- Feindt, P. H., & Oels, A. (2005). Does discourse matter? Discourse analysis in environmental policy making. *Journal of Environmental Policy & Planning*, Volume 7(3), pp. 161–173. <https://doi.org/10.1080/15239080500339638>
- Feola, G. (2015). Societal transformation in response to global environmental change: A review of emerging concepts. *Ambio*, Volume 44, pp. 376–390. <https://doi-org.ru.idm.oclc.org/10.1007/s13280-014-0582-z>
- Fischer, F. (2003). *Reframing Public Policy: Discursive Politics and Deliberative Practices*. Oxford University Press, Oxford.
- Fischer, F., Forester, J. (Eds.) (1993). *The Argumentative Turn in Policy Analysis and Planning*. Duke University Press, Durham.
- Fleiter, T., Thurid Lotz, M., Arens, M., Schломann, B. (2021). *An overview of implemented and planned policy instruments to decarbonise basic material industries in Germany*. (Working Paper Sustainability and Innovation No. S 01/2021). Fraunhofer ISI. Retrieved on June 12, 2023, from <https://publica-rest.fraunhofer.de/server/api/core/bitstreams/b563380c-ccda-4764-91c9-f61bec6f4556/content>
- Foote, Mary Q., and Tonya Gau Bartell. (2011). Pathways to Equity in Mathematics Education: How Life Experiences Impact Researcher Positionality. *Educational Studies in Mathematics*, Volume 78 (1), pp. 45-68.
- Foxon, T. J. (2013). Transition pathways for a UK low carbon electricity future. *Energy Policy*, Volume 52, pp.10–24. <http://dx.doi.org/10.1016/j.enpol.2012.04.001>
- Foxon, T. J., Pearson, P. J. G., Arapostathis, S., Carlsson-Hyslop, A., Thornton, J. (2013). Branching points for transition pathways: assessing responses of actors to challenges on pathways to a low carbon future. *Energy Policy*, Volume 52, pp.146–158. <https://doi-org.ru.idm.oclc.org/10.1016/j.enpol.2012.04.030>
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, Volume 31 (8-9), pp.1257–1274. [https://doi-org.ru.idm.oclc.org/10.1016/S0048-7333\(02\)00062-8](https://doi-org.ru.idm.oclc.org/10.1016/S0048-7333(02)00062-8)

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems. *Research Policy, Volume 33 (6-7)*, pp.897–920. <http://dx.doi.org/10.1016/j.respol.2004.01.015>.

Geels, F. W. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy, Volume 39 (4)*, pp.495–510, <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2010.01.022>

Geels, F.W. (2011). The multi-level perspective on sustainability transitions: responses to seven criticisms. *Environmental Innovation and Societal Transitions, Volume 1 (1)*, pp.24–40. <https://doi-org.ru.idm.oclc.org/10.1016/j.eist.2011.02.002>

Geels, F. W., Kemp, R. (2011). The multi-level perspective as a new perspective for studying socio-technical transitions. In F. W. Geels, R. Kemp, G. Dudley, & G. Lyons (Eds.), *Automobility in transition? A socio- technical analysis of sustainable transport*. London: Routledge.

Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy, Volume 45 (4)*, p.900. <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2016.01.015>

Geels, F. W., Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, Volume 36 (3)*, p.414. <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2007.01.003>

Geels, F. W., Verhees, B. (2011). Cultural legitimacy and framing struggles in innovation journeys: A cultural-performative perspective and a case study of Dutch nuclear energy (1945–1986). *Technological Forecasting and Social Change, Volume 78 (6)*, pp. 910–930. <http://dx.doi.org/10.1016/j.techfore.2010.12.004>

Genus, A., Coles, A.-M. (2008). Rethinking the multi-level perspective of technological transitions. *Research Policy, Volume 37 (9)*, pp.1436–1445. <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2008.05.006>

Gottweis, H. (2003). Theoretical strategies of poststructuralist policy analysis: towards an analytics of government. In Hajer, M., Wagenaar, H. (Eds.), *Deliberative Policy Analysis - Understanding Governance in the Network Society* (pp.260–262). Cambridge University Press.

Grix, Jonathan. (2019). *The Foundations of Research*. Macmillan International.

Günter, G. (2022). *Wegen Umbau geöffnet. Das Magazin der Grünen (02/2022)*, pp. 5-13. Retrieved on January 7, 2023, from https://cms.gruene.de/uploads/documents/MdG_Magazin_2022_2_Transformation_web.pdf

Günther, J., Lehmann, H., Nuss, P., Purr, K. (2019). *Resource-Efficient Pathways towards Greenhouse-Gas- Neutrality – RESCUE: Summary Report*. Umweltbundesamt. Retrieved on July 21, 2023, from https://www.umweltbundesamt.de/en/rescue/summary_report

Hagedorn, G. and Kopecz, J. (2021). Industrie und Verbände können mehr gegen den Klimawandel tun – 5 Anregungen. *Handelsblatt Journal – Eine Sonderveröffentlichung von Euroforum Deutschland. Die Zukunft der Industrie*. Retrieved on July 23, 2023, from <https://veranstaltungen.handelsblatt.com/journal/pdf/P6200127.pdf>

Hajer, M. (1995). *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*. Press, Clarendon.

Hajer, M. (2006). Doing discourse analysis: Coalitions, practices, meaning. In M. A. van den Brink & T. Metzke (Eds.), *Words matter in policy and planning: Discourse theory and method in the social sciences*, Netherlands geographical studies (pp. 65–74). Amsterdam: Koninklijk Nederlands Aardrijkskundig Genootschap

Hajer, M., & Versteeg, W. (2018). Imagining the post-fossil city: Why is it so difficult to think of new possible worlds? *Territory, Politics, Governance, Volume 7(2)*, pp. 122–134. <https://doi.org/10.1080/21622671.2018.1510339>

Hajer, M., Wagenaar, H. (2003). Introduction. In Hajer, M., Wagenaar, H. (Eds.), *Deliberative Policy Analysis - Understanding Governance in the Network Society* (p.28). Cambridge University Press.

Hermwille, L. (2016). The role of narratives in socio-technical transitions—Fukushima and the energy regimes of Japan, Germany, and the United Kingdom. *Energy Research & Social Science, Volume 11*, pp. 237-246. <https://doi-org.ru.idm.oclc.org/10.1016/j.erss.2015.11.001>

Holmes, A. G. D. (2020). Researcher Positionality – A Consideration of Its Influence and Place in Qualitative Research - A New Researcher Guide. *SHANLAX International Journal of Education, Volume 8 (4)*, pp. 1-10. <https://doi.org/10.34293/>

Huber, F. (2021). *Warum die Klimakrise alle Unternehmen komplett verändern wird*. EY. Retrieved on June 6, 2023, from https://www.ey.com/de_de/decarbonisation/die-klimakrise-als-5-industrielle-revolution

IBM. (2021). *Network density*. IBM. Retrieved on July 23, 2023, from <https://www.ibm.com/docs/en/spss-modeler/18.0.0?topic=networks-network-density>

IGBCE. (2023). *Anforderungen an die Industriepolitik 2030 + für den Chemiestandort Deutschland und Europa* [white paper]. IGBCE. Retrieved on July 21, 2023, from <https://igbce.de/resource/blob/218846/cf3334d266e9f998160e85bb797ecd52/positionspapier-anforderungen-an-die-industriepolitik-2030-fuer-den-chemiestandort-deutschland-und-europa-data.pdf>

IG Metall. (2017). *Nachhaltig produzieren – Betriebliche Beispiele – Auf dem Weg zu einer klimaneutralen Industrie*. IG Metall Vorstand, VB 04, Ressort Industrie-, Struktur- und Energiepolitik (ISE). Retrieved on July 21, 2023, from https://www.igmetall.de/download/20170522_Nachhaltig_produzieren_final_5c124b7b12d42c18b901d2a546c43caf89bf0748.pdf

IG Metall. (2019). *Aussichten auf eine aktive Industriepolitik? – Was meinen die Parteien?* IG Metall Vorstand, FB Industrie-, Energie- und Strukturpolitik. Retrieved

on July 23, 2023, from https://duesseldorf-neuss.igmetall.de/w/files/fairwandler/20210910_2021_btw_industriepolitik_tt.pdf

Journal of Cleaner Production. (n.d.). *About the journal*. Sciencedirect. Retrieved on July 26, 2023, from <https://www-sciencedirect-com.ru.idm.oclc.org/journal/journal-of-cleaner-production>

Kapadia, S. (2019). *Topic Modeling in Python: Latent Dirichlet Allocation (LDA) - How to get started with topic modeling using LDA in Python*. Towardsdatascience. Retrieved on July 27, 2023, from <https://towardsdatascience.com/end-to-end-topic-modeling-in-python-latent-dirichlet-allocation-lda-35ce4ed6b3e0>

KEI Cottbus. (2022). *Auf dem Weg zur klimaneutralen Industrie: Stahl*. KEI Cottbus. Retrieved on July 23, 2023, from https://www.klimaschutz-industrie.de/fileadmin/kei/Dateien/Publikationen/KEI_Factsheet_Stahl.pdf

KEI Cottbus. (2023). *Akzeptanzstrategien in den energieintensiven Industrien – Aus der Praxis für die Praxis* (1st ed.).

Kemp, R., Schot, J., Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology Analysis and Strategic Management, Volume 10 (2)*, pp.175–198. <https://doi-org.ru.idm.oclc.org/10.1080/09537329808524310>

King N. (2004). Using templates in the thematic analysis of text. In Cassell C., Symon G. (Eds.), *Essential guide to qualitative methods in organisational research* (pp. 257–270). London, UK: Sage.

Leifeld, P. (2013). Reconceptualising Major Policy Change in the Advocacy Coalition Framework. A Discourse Network Analysis of German Pension Politics. *The Policy Studies Journal, Volume 41 (1)*, pp.169–198. <https://doi-org.ru.idm.oclc.org/10.1111/psj.12007>

Leifeld, P. (2017). Discourse network analysis: policy debates as dynamic networks. In: Victor, J. N., Lubell, M. N. and Montgomery, A. H. (Eds.), *The Oxford Handbook of Political Networks*. Series: Oxford handbooks. Oxford University Press: New York, pp. 301-326. <http://dx.doi.org/10.1093/oxfordhb/9780190228217.013.25>

Leifeld, P., Schneider, V. (2012). Information Exchange in Policy Networks. *American Journal of Political Science, Volume 53 (3)*, pp.731–44. <http://dx.doi.org/10.1111/j.1540-5907.2011.00580.x>

Lowes, R., Woodman, B., Speirs, J. (2020). Heating in Great Britain: an incumbent discourse coalition resists an electrifying future. *Environmental Innovation and Societal Transitions, Volume 37*, pp.1–17. <https://doi-org.ru.idm.oclc.org/10.1016/j.eist.2020.07.007>

Macdonell, D. (1986). *Theories of discourse: An introduction*. B. Blackwell.

Malterud, Kirsti. (2001). Qualitative Research; Standards, Challenges and Guidelines. *The Lancet, Volume 358 (9280)*, pp. 483-488. [https://doi-org.ru.idm.oclc.org/10.1016/S0140-6736\(01\)05627-6](https://doi-org.ru.idm.oclc.org/10.1016/S0140-6736(01)05627-6)

- Markard, J., Wirth, S., Truffer, B. (2016). Institutional dynamics and technology legitimacy: a framework and a case study on biogas technology. *Research Policy, Volume 45 (1)*, pp.330–344. <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2015.10.009>
- Markard, J., Rinscheid, A., Widdel, J. (2021). Analyzing transitions through the lens of discourse networks: Coal phase-out in Germany. *Environmental Innovation and Societal Transitions, Volume 40*, pp. 315-331. <https://doi-org.ru.idm.oclc.org/10.1016/j.eist.2021.08.001>
- Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transformation, Volume 1 (1)*, pp.70–75. <http://dx.doi.org/10.1016/j.eist.2011.02.003>
- Middleton, F. (2019). *Reliability vs. Validity in Research | Difference, Types and Examples*. Scribbr.com. Retrieved on July 27, 2023, from <https://www.scribbr.com/methodology/reliability-vs-validity/>
- OECD. (2023). *OECD-Wirtschaftsbericht 2023 für Deutschland fordert mehr Tempo beim Klimaschutz* (Schlaglichter_06|23_Wirtschaftspolitik 08). Referat: Internationale Wirtschafts- und Währungsfragen. Retrieved on July 27, 2023, from <https://www.bmwk.de/Redaktion/DE/Schlaglichter-der-Wirtschaftspolitik/2023/06/04-oecd-wirtschaftsbericht-2023.html>
- Ohlendorf, N., Löhr, M., Markard, J. (2023). Actors in multi-sector transitions - discourse analysis on hydrogen in Germany. *Environmental Innovation and Societal Transitions, Volume 47 (100692)*, pp. 1-30. <https://doi.org/10.1016/j.eist.2023.100692>
- Raven, R., Kern, F., Verhees, B., Smith, A. (2015). Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. *Environmental Innovation and Societal Transitions, Volume 18*, pp.164–180. <http://dx.doi.org/10.1016/j.eist.2015.02.002>
- Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st century economist*. Chelsea Green Publishing.
- Roberts, J. (2017). Discursive destabilisation of socio-technical regimes: negative storylines and the discursive vulnerability of historical American railroads. *Energy Research and Social Science, Volume (31)*, pp.86–99. <https://doi-org.ru.idm.oclc.org/10.1016/j.erss.2017.05.031>
- Rosenbloom, D., Meadowcroft, J. (2014). The journey towards decarbonisation: Exploring socio-technical transitions in the electricity sector in the province of Ontario (1885–2013) and potential low-carbon pathways. *Energy Policy, Volume 65*, pp. 670–679. <http://dx.doi.org/10.1016/j.enpol.2013.09.039>
- Rosenbloom, D., Berton, H., Meadowcroft, J. (2016). Framing the sun: A discursive approach to understanding multi-dimensional interactions within socio-technical transitions through the case of solar electricity in Ontario, Canada. *Research Policy, Volume 45*, pp. 1275–1290. <http://dx.doi.org/10.1016/j.respol.2016.03.012>

Rosenbloom, D. (2018). Framing low-carbon pathways: A discursive analysis of contending storylines surrounding the phase-out of coal-fired power in Ontario. *Environmental Innovation and Societal Transitions*, Volume 27, pp. 129–145.

<https://doi.org/10.1016/j.eist.2017.11.003>

Rotmans, J., Kemp, R., Van Asselt, M. (2001). More evolution than revolution: transition management in public policy. *Foresight*, Volume 3 (1), pp. 15–31. <https://doi.org/ru.idm.oclc.org/10.1108/14636680110803003>

Rowe, Wendy E. (2014). Positionality. In Coghlan, D. and Brydon-Miller, M. (Eds.), *The Sage Encyclopedia of Action Research* (pp.627-628). Sage.

Savin-Baden, M., and Howell Major, C. (2013). *Qualitative Research: The Essential Guide to Theory and Practice*. Routledge.

Smith, A., Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, Volume 41 (6), pp.1025–1036, <https://doi.org/ru.idm.oclc.org/10.1016/j.respol.2011.12.012>

Smith, A., Voß, J.-P., Grin, J. (2010). Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Research Policy*, Volume 39 (4), pp.435–448. <http://dx.doi.org/10.1016/j.respol.2010.01.023>.

Späth, P. (2012). Understanding the social dynamics of energy regions-the importance of discourse analysis. *Sustainability*, Volume 4(6), pp. 1256-1273. <https://doi.org/10.3390/su4061256>

SPD. (2021). *Aus Respekt vor Deiner Zukunft. Das Zukunftsprogramm der SPD*. SPD-Parteivorstand. Retrieved on July 21, 2023, from <https://www.spd.de/fileadmin/Dokumente/Beschluesse/Programm/SPD-Zukunftsprogramm.pdf>

Spiesberger, M., Lang, M., Otter, M., Landon, T., Schuch, K. (2022). *D4.4 Upper Styria Region Case Study Report*. Entrances Project, European Commission. Retrieved on July, 19, 2023, from https://entrancesproject.eu/wp-content/uploads/2022/12/D4.4_Upper-Styria-case-study-report.pdf

Statista. (2023a). *Internationale Länderdaten - Anteile der Wirtschaftssektoren am BIP in Industrie- und Schwellenländern im Jahr 2021*. De.Statista. Retrieved on July 19, 2023, from <https://de.statista.com/statistik/daten/studie/37088/umfrage/anteile-der-wirtschaftssektoren-am-bip-ausgewaehlter-laender/>

Statista. (2023b). *Treibhausgasemissionen des Industriesektors in Deutschland nach Branchen im Jahr 2021(in Millionen Tonnen CO₂-Äquivalent)*. De.Statista. Retrieved on July 26, 2023, from <https://de.statista.com/statistik/daten/studie/1078829/umfrage/treibhausgasemissionen-der-deutschen-industrie-nach-branchen/#:~:text=Der%20Industriesektor%20ostie%C3%9F%20im%20Jahr,%2C4%20Tonnen%20CO2%2D%C3%84quivalent.>

Stone. (2001). *Policy Paradox: The Art of Political Decision Making* (3rd edition). W. W Norton & Company, New York.

Stones, R. (2005). *Structuration Theory (Traditions)*. Basingstoke: Palgrave Macmillan.

Sulistianingsih, N., Winarko, E., Kartika Sari, A. (2022). GN-PPN: Parallel Girvan-Newman-Based Algorithm to Detect Communities in Graph with Positive and Negative Weights. *International Journal of Intelligent Engineering & Systems, Volume 15(6)*, pp.273-274. <https://dx.doi.org/10.22266/ijies2022.1231.26>

The Ohio State University. (n.d.). *What is Narrative Theory?* ProjectNarrative. Retrieved on June 9, 2023, from <https://projectnarrative.osu.edu/about/what-is-narrative-theory>

Turnheim, B., Geels, F. W. (2012). Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913-1997). *Energy Policy, Volume 50*, pp.35-49. <https://doi-org.ru.idm.oclc.org/10.1016/j.enpol.2012.04.060>

Turnheim, B., Geels, F. W. (2013). The destabilisation of existing regimes: confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967). *Research Policy, Volume 42 (10)*, pp.1749-1767. <https://doi-org.ru.idm.oclc.org/10.1016/j.respol.2013.04.009>

Turnheim, B., Berkhout, F., Geels, F.W., Hof, A., McMeekin, A., Nykvist, B., van Vuuren, D. (2015). Evaluating sustainability transitions pathways: bridging analytical approaches to address governance challenges. *Global Environmental Change, Volume 35*, pp.239-253, <http://dx.doi.org/10.1016/j.gloenvcha.2015.08.010>.

Umweltbundesamt. (n.d.). Emissionsquellen. Umweltbundesamt.de. Retrieved on July 26, 2023, from <https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen/emissionsquellen#energie-stationar>

Unruh, G.C. (2000). Understanding carbon lock-in. *Energy Policy, Volume 28 (12)*, pp.817-830. [https://doi-org.ru.idm.oclc.org/10.1016/S0301-4215\(00\)00070-7](https://doi-org.ru.idm.oclc.org/10.1016/S0301-4215(00)00070-7)

Verbong, G.P.J., Geels, F.W. (2010). Exploring sustainability transitions in the electricity sector with socio-technical pathways. *Technological Forecasting and Social Change, Volume 77 (8)*, pp.1214-1221, <https://doi-org.ru.idm.oclc.org/10.1016/j.techfore.2010.04.008>

VIK. (2017). *Unsere gemeinsame Jahrhundertaufgabe: Dekarbonisierung von Industrie und Gesellschaft* [White paper]. VIK. Retrieved on July 26, 2023, from https://www.vik.de/wp-content/uploads/2018/02/20170731_2018-VIK_Diskussionspapier.pdf

Visone. (n.d.) *Analysis & visualisation of social networks*. Visone.Ethz. Retrieved on June 23, 2023, from <https://visone.ethz.ch/html/about.html>

Wagenaar, H. (2011). *Meaning in Action: Interpretation and Dialogue in Policy Analysis*, Armonk, NY: M.E. Sharpe.

Westerhoff, L., & Robinson, J. (2013). *Practicing narratives: exploring the meaning and materiality of climate change*. Proceedings of Transformation in a Changing Climate, pp.19-21. Retrieved on July 27, 2023, from <https://www.researchgate.net/profile/John-Robinson->

8/publication/263314937_%27Practicing_narratives%27_Exploring_the_meaning_and_materiality_of_climate_change/links/56cdbod208aeb52500c33d61/Practicing-narratives-Exploring-the-meaning-and-materiality-of-climate-change.pdf

Wetzel, D. (2017). *Neue Studie stellt Deutschlands Effizienzerfolge infrage*. Welt.de. Retrieved on July, 21, 2023, from <https://www.welt.de/wirtschaft/artikel166726802/Neue-Studie-stellt-Deutschlands-Effizienzerfolge-infrage.html>

Wirtschaftsvereinigung Stahl. (2021). *Ein Transformationsprogramm für die Stahlindustrie in Deutschland - 10 Forderungen an eine neue Bundesregierung für die ersten 100 Tage* [White paper]. Wirtschaftsvereinigung Stahl. Retrieved on July 21, 2023, from https://www.stahl-online.de/wp-content/uploads/WV-Stahl_Positionspapier_Transformationsprogramm_2021-RZ_Web.pdf

Wirtschaftsvereinigung Stahl. (2023). *Brief an die Politik - Zehn politische Handlungsempfehlungen zum Green Deal Industrial Plan* [White paper]. Wirtschaftsvereinigung Stahl. Retrieved on July 23, 2023, from https://www.stahl-online.de/wp-content/uploads/BRIEF-AN-DIE-POLITIK_Green_Deal_Industrial_Plan_WVSTAHL.pdf

Wuppertal Institute. (n.d.). *Die Mission des Wuppertal Instituts*. WupperInst. Retrieved on July 19, 2023, from <https://wupperinst.org/das-institut>

WWF. (2019). *Klimaschutz in der Industrie - Forderungen an die Bundesregierung für einen klimaneutralen Industriestandort Deutschland* [White paper]. WWF Germany website. Retrieved on July 23, 2023, from <https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF-Klimaschutz-in-der-Industrie.pdf>

WWF, Germanwatch, IGBCE, DNR. (2022). *Transformation in der Zeitenwende: Jetzt in die Zukunft investieren* [White paper]. WWF Germany website. Retrieved on July 21, 2023, from <https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Klima/WWF-Transformation-Zeitenwende.pdf>

Yazar, M, Haarstad, H. (2023). Populist far right discursive-institutional tactics in European regional decarbonisation. *Political Geography, Volume 105 (102936)*, pp.1-10. <https://doi.org/10.1016/j.polgeo.2023.102936>

Zeit. (2023, June 21). Umweltverbände kritisieren neues Klimaschutzgesetz - Die Regierung will verpflichtende Sektorziele für einzelne Wirtschaftsbereiche abschaffen, das Kabinett hat das beschlossen. Umweltverbände sehen darin den falschen Weg. *Zeit Online*. Retrieved on July 19, 2023, from https://www.zeit.de/wissen/2023-06/klimaschutzgesetz-kritik-umweltverbaende-kabinett?utm_referrer=https%3A%2F%2Fwww.google.com%2F

13 Appendix

13.1 Appendix A – Actor Base

In table 8, the overview on the actors analyzed in this thesis are presented.

Table 8: Overview on Actors

Actor Group	Sub-Group	Actor
Associations	Cross-Industry Associations	Bundesverband der Deutschen Industrien (BDI)/ Federation of German Industries Verband der Industriellen Energie- und Kraftwirtschaft (VIK)/ Association of the Industrial Energy and Power Industry
	Steel Association	Wirtschaftsvereinigung Stahl
	Chemical Association	Verband der Chemischen Industrie (VCI)
	Cement Association	Verrein Deutscher Zementwerke (VDZ)
Trade Unions	Cross-Industry Trade Union	Deutscher Gewerkschaftsbund (DGB)
	Steel Trade Union	IG Metall
	Mining, Chemicals, Energy Trade Union	IG BCE
Relevant Ministry	Economic Affairs and Climate Action	Bundesministerium für Wirtschaft und Klimaschutz (BMWK)
Subordinate Agencies	Environmental Agency	Umweltministerium
	Energy Agency	Deutsche Energie Agentur (DENA)
Political Parties	Social Democrats	SPD
	Christian Democrats	CDU/CSU
	Greens	Bündnis 90/Die Grünen
	Free Democrats	FDP
	Right-Wing Populists	AfD
	Lefts	Die Linke
NGOs	NGO for wilderness preservation and the reduction of human impact on the environment	WWF
	NGO for trade, the environment, and relations between countries in the industrialized north and underdeveloped south	Germanwatch
Scientific Institutes	Research on the emergence and impact of innovations	Fraunhofer ISI

	Research on the building principles, strategies, and instruments for transitions to sustainable development	Wuppertal Institute
Think Tanks	Supporting the energy transition	Agora Energiewende
	Research on society, politics and economics	Prognos
Intermediaries	For a climate-neutral industrial future. Impetus for NRW and beyond	In4Climate
	Competence Centre on climate change mitigation in energy-intensive industries	KEI Cottbus
Media	Unternehmen, Finanzen, Politik und Technik	Handelsblatt
	Politik, Wirtschaft, Finanzen...	Welt

13.2 Appendix B – Corpus Calculation

To identify how great the corpus may be a calculation including various estimates is set up. About three weeks are estimated in this research process to be fully devoted to reading and coding. A week is made up of 40 working hours, resulting in 120h in total. Reading one page of about 500 words is estimated to take about five minutes (MindTools, n.d.). An unexperienced estimate is made that coding might take another generous 15minutes per page. In one hour thus three pages might be read and coded. Therefore, in **120h** an estimate of **360** pages can be read and coded.

This would in practice come down to, if 30 actors were to be identified, for each actor would be allowed to read and code about 12 pages (360 divided by 30). This calculation is intended for the purpose of getting a feeling on the corpus extent. This insight will be managed flexibly: if some actors will be understood to be more relevant, more pages may be read from them, while less pages will be read from those actors understood to have less relevance.

13.3 Appendix C – Storylines and Narratives

Table 9: Overview on Storylines and Narratives

Table 9 shows the complete overview of storylines with the narratives that have been grouped under them.

Storyline: NEEDED – Industry decarbonization is needed for society to thrive	
Narrative	Explanation
Larger Socio-Ecological Transformation	The industry decarbonization is needed to enable the larger socio-ecological transformation towards climate neutrality
Wealth Sustainability	Sustainability (/climate neutrality) is needed to ensure wealth
Needed to be Competitive	Industry decarbonization is needed to be competitive with other economies
Needed for Jobs	Industry decarbonization is needed to ensure jobs in the future
Economic Growth	Industry decarbonization leads/will lead to economic growth
Economic Thriving	Industry decarbonization leads/will lead to the development of new markets, innovative products and use, new jobs, modernization
Storyline: INDUSTRY ROLE - A strong industry is vital for the German society to be prosperous	
Narrative	Explanation
Employment	Industry is needed in Germany to ensure employment
Wealth Industry	(Primary) Industry is needed in Germany to ensure wealth
Storyline: CHALLENGE— Challenges need to be faced for the industry to become decarbonized.	
Narrative	Explanation
Feasible if Competitive	Industry decarbonization is challenging and feasible only if competitive with other economies, leading to economic growth
Feasible if Addressed Early On	Industry decarbonization is challenging and feasible only if addressed early on
Speed Up	Industry decarbonization is challenging and needs to be sped up
Primary Industry	The larger socio-ecological decarbonization is impossible without the primary industry
Technological Change	The technological change needed to decarbonize the industry is challenging

Storyline: INTERNATIONAL– The government needs to ensure an international level playing field and not decarbonize Germany in isolation	
Narrative	Explanation
European Collaboration for Resilience	Strong collaboration is necessary to create economic resilience needed for the transition
Pressure on European Level	The government should put pressure on the European level to enable good policy mixes for industrial transformation
Free Trade Agreements	Free Trade Agreements must be strengthened
Climate Club	A climate club is necessary
Sustainability Disadvantage	Policy mixes to enable sustainability shall not lead to competitive disadvantage for Germany vis-à-vis other countries (including effect of ETS)
Avoid Migration	Industry migration must be avoided
Supply Security	Supply security and independence needs to be ensured
Value Generation	Value generation needs to be ensured in Germany
Carbon Leakage	Industry migration needs to be avoided as a result of carbon leakage
Lower Standards' Advantage	Good policy mixes should avoid business opportunities to migrate to businesses/countries that have lower sustainability and social standards
Carbon Leakage Sustainability Impact	Migration of businesses due to carbon leakage may lead to higher CO2 emissions globally
Trade Protection Mechanisms	Policy mix should include Trade/Carbon-Leakage Protection Mechanisms (e.g., CBAM)
Insufficient TPM	Trade Protection Mechanisms are insufficient to avoid loss in competitiveness

Storyline: SUPPORT OTHER COUNTRIES– Germany needs to support other countries in the decarbonization process

Storyline: INDUSTRY STRENGTHENING – The industry decarbonization needs to be strengthened through an attractive, well managed policy mix	
Narrative	Explanation
Industry Strengthening	The industry transformation needs to be strengthened through an attractive policy mix.
Policy Mix Coordination	Policy Mixes need to be well coordinated between and within the different sectors and governance levels – EU, national, international WTO conformity

Storyline: MARKET – The competitiveness of the decarbonized industry needs to be ensured through policy strengthening the market position	
Narrative	Explanation
Green Lead Market → merge with Labels/Certificates and Public Procurement	The government should create/support a market for climate-neutral products (including green procurement and labels/certificates)
Carbon Contracts	The state should enter contracts with companies for the climate-friendly production of goods (e.g., Carbon Contracts for Difference CCfD) (Klimaschutzverträge)

Storyline: FINANCIAL SUPPORT - The government/public should provide financial support to decarbonize the industry	
Narrative	Explanation
Financial Support → merge with: Investment Stimulation (and Security for Investment?)	The government/public should provide financial support for the decarbonization of the industry
Financial Exemption	Financial exemption from taxes, levies and surcharges should be provided to support certain developments (in example power-to-gas plants)
Incentives	Wanted behavior should be incentivized (e.g., providing credits for emissions saved)
Subsidies	Policy mix should include subsidies
Fund	Funds must be created to provide financial support
Technological Development	The development of (additional) technologies needs to be supported

Storyline: ETS – The policy mix should include ETS

Storyline: REGIONAL SUPPORT – Special attention should be put on the support of regions most affected by change

Storyline: SME SUPPORT – Special attention should be put on the support of SMEs (KMUs in German, including Mittelstand)

Storyline: new storyline on focusing on the large companies that are responsible for the largest share of emissions?

Storyline: BARRIERS AND DISINCENTIVES REMOVAL – Barriers and disincentives of all sorts in the way of the transition need to be removed

Narrative	Explanation
Legal Barriers	Legal barriers in the way of industry decarbonization need to be removed (e.g., changing from one energy supply to another flexibly)
Reduced Bureaucracy	The planning, approval and funding procedures need to be speeded up

Storyline: SUSTAINABILITY STANDARDS – Ambitious sustainability standards and laws need to be ensured to reach climate neutrality

Storyline: GERMANY TECHNOLOGY LEADER – Germany should take up the role of a technology leader in the decarbonization of the industry

Narrative	Explanation
Germany Technology Leader	Germany (/EU) should take up the role to be a technological leader in the industry transformation

Storyline: COLLABORATION – In order for industry decarbonization to be successful collaboration between different actors is key

Narrative	Explanation
Communication for Collaboration	In order to become climate neutral/decarbonize many actors need to collaborate. Therefore, an emphasis should be on communication
Dialogue Society	A dialogue with society is needed on industry decarbonization

Storyline: RESOURCE USE – Contributing to the industry decarbonization is the use of resources in sparingly manners in systems of circularity (ranging from recycling to full circle circular economy)

Narrative	Explanation
Resource Use Reduction	Resource use needs to be reduced
Resource Use Efficiency	Resource use needs to become more efficient
Circular Economy Considered	Industry decarbonization should be implemented in consideration of a Circular Economy
Circular Economy Cooperation XX merge with cooperation	For the Circular Economy to be implementable sector and actor spanning cooperation is needed

Storyline: ENERGY ADAPTATION – Contributing to the industry needs to adapt to energy availability	
Narrative	Explanation
Energy Efficiency	Energy efficiency should be increased
Energy Flexibility	The coordination and use of energy needs to be flexible based on available sources.

Storyline: MEET ENERGY DEMAND – The government needs to ensure that the industry's energy demand is met with renewable energies	
Narrative	Explanation
Competitive Energy Pricing	Renewable energy should be affordable, <u>as</u> or less expensive than in other economies
Energy Quantity	Renewable energy should be available in the quantities needed
Energy Security	Germany should be energy secure (Versorgungssicherheit der Energie), including to become independent from countries which act politically incorrectly from the German perspective
Energy Import	Energy will be needed to be imported to meet energy demand
Industry Prioritization	The primary industry should be prioritized over other industries in the ensuring of energy supply
Infrastructure	Required infrastructure should be made available in time
Energy Storage System	Energy storage systems need to be made available
Green Electricity	Electricity generated from renewable energies should be used in the industry transformation
Green Hydrogen	Hydrogen generated from renewable energies should be used in the industry transformation
Alternative Hydrogen Sources	Alternative hydrogen sources may be used

Storyline: HYDROGEN NEEDED - The use of hydrogen is needed in the decarbonization process	
Narrative	Explanation
Hydrogen Steel	Hydrogen should be applied in the steel industry
Hydrogen Chemistry	Hydrogen should be applied in the chemical industry
Hydrogen Cement	Hydrogen should be applied in the cement industry

Storyline: CCS/CCU – Carbon capture and utilization technology will be necessary to reach industry decarbonization

Narrative	Explanation
CCS Needed	The use of CCS is needed in the decarbonization process
CCS Unavoidable Emissions	CCS should generally not be used. Only exception if there are “unavoidable emissions”
CCS Control	CCS/CCZ may only be used to the condition that it is strictly controlled by the government
CCS Steel	CCS should be applied in the steel industry
CCS Chemistry	CCS should be applied in the chemical industry
CCS Cement	CCS should be applied in the cement industry
CCU Needed	The use of CCU is needed in the decarbonization process
CCU Steel	CCU should be applied in the steel industry
CCU Chemistry	CCU should be applied in the chemical industry
CCU Cement	CCU should be applied in the cement industry

Storyline: SYNFUELS - The use of synfuels is needed in the decarbonization process
Storyline: BIOMASS - The use of biomass is needed in the decarbonization process
Storyline: DIGITALIZATION – Digitalization can be a key enabler for industry decarbonization
Storyline: EMPLOYMENT SECURITY – Fair, good quality employment should be ensured in Germany

Narrative	Explanation
Role Employment	Well skilled and motivated workers are needed to ensure the transformation
Location	The employment location needs to be ensured
Fair Pay	Fair pay needs to be ensured for the employees of the industry
Ensure Retraining	Retraining employees should be ensured in case of industry migration
Employment Quality	Employment quality needs to be ensured

Storyline: SOCIETAL CHANGE – Society will need to change in many ways

Narrative	Explanation
Mindset Change	A large societal change in mindset is needed
Action Change	A large societal change in actions is needed

Storyline: ACCEPTANCE RELEVANCE – Societal acceptance is relevant for the decarbonization of the industry	
Narrative	Explanation
Acceptance Changes	Society will need to accept changes in e.g., mindset, action, environment as a result of industry decarbonization
Acceptance Price Increase	Society will need to accept potential price increases as a result of industry decarbonization
Acceptance Political Financial Support	Society will accept political financial support provided to industrial corporations to decarbonize

Storyline: JUSTICE – Social justice and fairness need to be ensured in the industry decarbonization	
Narrative	Explanation
Burdens Distribution	The burdens coming from the socio-ecological transformation need to be fairly/justly distributed
Gains Distribution	The gains coming from the socio-ecological transformation need to be fairly/justly distributed
Demands Tied to Offers	Public co-financing of the industry decarbonization should be tied to demands such as of societal participation in decision making process, employment quality, job retraining, etc.
Economic Democratization	Economy democratization is needed to transform the industry in a socially just way (e.g., increase in social participation in decision making)
Political Democratization	Political democratization is needed to transform the industry in a socially just way (e.g., increase in social participation in decision making)

Deleted as mentioned less than five times:

Sufficiency, Sustainability Sensibility, Speed Policy Mix, Geographical Disadvantage, Electricity Based Energy System, Renewables Pull, Economical/Ecological/Technological Sensibility, Hydrogen Acceptance Direct/Indirect, CCS Acceptance Direct/Indirect, Full industry migration, ... Democratisation, Renewables Pull, Electricity-Based Energy System, Alternative Hydrogen Until, Alternative Hydrogen Control, Natural Carbon Sinks, Industry Role Acceptance, Entrepreneurial Freedom, Free ETS, Provide Plan, Financial Sector Democratisation, No Hard-Phase Out, Natural Gas Transition Technology

13.4 Appendix D – Positionality

The term positionality both describes the researcher's world view and the position adopted about a research task and its social and political context (Foote & Bartell, 2011, Savin-Baden & Major, 2013 and Rowe, 2014). I provide a reflection on positionality to increase reliability. My positionality influences both what I choose to investigate (Malterud, 2001; Grix, 2019), how I conduct research, its outcomes, and results (Rowe, 2014). To identify my positionality, I first locate myself about the subject. I am a student with a bachelor's degree in international development management, with a strong ambition in my master studies on Environment and Society Studies to obtain a more conceptual and analytical understanding on economic and political system change. During the COVID19-pandemic I moved back to my hometown Gelsenkirchen, in the industry-heavy Ruhr Area in Germany. Writing this sub-chapter on positionality is a result of my positionality already. My positionality may lead to a positivity and optimism bias in this research and the focus on solutions to be supported. This is why it was important to me to obtain feedback on my codebook and coding process to reduce personal bias. Furthermore, do I have great ambitions to continue after this master with a PhD in the field of industry decarbonisation. This may influence the elaborateness of this research project. Secondly, the positionality requires locating oneself about the participants. I view myself as a change agent, a researcher involved in transformative research, contributing to knowledge aiming to stimulate a transformation that is necessary for our society to stay within planetary boundaries. My research is necessarily influenced by me and the research context (Holmes, A. G. D., 2020).