

Towards a mission-oriented green industrial policy in the EU

Mission: Industrial decarbonisation of the EU steel, cement and chemicals industries by 2050

Emma Wikström

Supervisor

Sofie Sandin Lompar

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, May 2024



© You may use the contents of the IIIIEE publications for informational purposes only. You may not copy, lend, hire, transmit or redistribute these materials for commercial purposes or for compensation of any kind without written permission from IIIIEE. When using IIIIEE material you must include the following copyright notice: 'Copyright © Emma Wikström, IIIIEE, Lund University. All rights reserved' in any copy that you make in a clearly visible position. You may not modify the materials without the permission of the author.

Published in 2024 by IIIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiiee@iiiiee.lu.se.

ISSN 1401-9191

Acknowledgements

I would like to express my heartfelt gratitude to my supervisor, Sofie Sandin Lompar, for her invaluable guidance, feedback, and encouragement throughout the completion of this MSc thesis. Thank you for believing in my research idea in our first meeting and encouraging me to follow my genuine interests. It really has allowed me to thoroughly enjoy the thesis process. Thank you for teaching me about analytical framework building and that a pen, paper and scissors sometimes beats any other method. I truly could not have asked for a better supervisor.

A big thank you to Carl Dalhammar whose readings for a lecture on Green Industrial Policy inspired and laid the foundation for this thesis, as well as for early discussions on the topic. Similarly, I would like to thank Fredrik NG Andersson, my supervisor for my BSc thesis for introducing me to socio-technological paradigm shifts, transition theory and sparking my academic interest in transformative change. I am happy and proud that I through this MSc thesis could continue my academic journey in this field.

I would also like to thank Naoko Tojo for early feedback on the topic, Liu for invaluable comments which helped me crystallise my RQs and Yuliya Voytenko Palgan for central inputs to my methodology. In addition, I am immensely grateful to Lukas and Johan for their encouragement, support and fantastic help.

I extend my sincere appreciation to all the informants who generously shared their time and insights, contributing immensely to the richness of this study. The rewarding conversations I had with you were the true highlight of the thesis process.

Finally, I would like to thank Batch 29 for their kindness and friendship throughout this two-year journey at IIIIEE. I could not have asked for a sweeter and smarter group of people. I am incredibly thankful that I got to share these two years with you and cannot wait to see the wonderful ways you all will shape the world for the better.

Abstract

Decarbonising the energy-intensive industries is a pressing issue for the EU to reach its climate target of climate neutrality by 2050. To tackle this challenge green industrial policy will be needed. A growing number of scholars argue that a mission-oriented and transformative approach to green industrial policy is needed to achieve climate neutrality objectives. Mission-oriented policy is a 'transformation-oriented' branch within innovation policy that aims to tackle grand societal challenges and is growing in popularity. Despite this, no literature was identified analysing EU green industrial policy using a mission-oriented lens. This thesis therefore aims to contribute with knowledge on advancing transformative change within EU green industrial policy. The main research question the thesis aims to answer is: What are the current conditions to advance a mission-oriented approach to green industrial policy in the EU? To conduct the analysis, a mission-oriented framework for green industrial policy with twelve mission-oriented features was developed based on literature. Furthermore, 15 semi-structured interviews were conducted with EU stakeholders including EU institutions, trade associations and NGOs and were complemented by a quantitative survey which all interviewees filled in beforehand. Research results show that mission-oriented green industrial policy in the EU is motivated and that there is a gap between current green industrial policy and a mission-oriented approach in relation to all twelve mission-oriented features in the analytical framework. Various types of measures were suggested by the interviewed EU stakeholders to enhance the fulfilment of all twelve features indicating opportunities to advance a mission-oriented approach. The feasibility of the measures however varies and are impacted by various challenges and barriers such as the complex structure of EU policymaking hampering coordinated green industrial policy and wide stakeholder involvement. A key enabler identified to overcome these obstacles is political will, strong leadership, and courage.

Keywords: industrial policy, mission-oriented innovation policy, decarbonisation, industry, European Union

Executive Summary

Problem definition

To stay in line with the Paris Agreement, stay within the planetary boundaries and avoid detrimental environmental tipping points, global CO₂ emissions must reach net-zero by 2050 (IPCC, 2022; Rockström et al., 2009). This will have major implications for the energy-intensive industry which products are responsible for one third of annual global greenhouse gas (GHG) emissions (Bataille et al., 2018). In 2019, energy-intensive industries accounted for 17 % of EU greenhouse gas emissions (Chua & Garvey, 2021). At the same time these energy-intensive products such as steel, cement and chemicals serve essential functions to the society including for transportation, infrastructure and packaging (Material Economics, 2019). Transforming and decarbonising the energy-intensive sector is therefore an urgent challenge for the EU to reach its climate target of climate neutrality by 2050.

There is a growing consensus in literature that green industrial policy is needed to tackle this challenge (Criscuolo et al., 2023; De Ville, 2023; Mazzucato, 2018a; Nilsson et al., 2021; Rodrik, 2014; Tagliapietra et al., 2023). A growing number of authors also argue that a mission-oriented and transformative approach to green industrial policy is needed to achieve climate neutrality objectives (Altenburg & Rodrik, 2017; Criscuolo et al., 2022, 2023; Stöllinger, 2023; Wyns & Khandekar, 2019). Mission-oriented policy is a ‘transformation-oriented’ branch within innovation policy that aims to tackle grand societal challenges and is growing in popularity. Missions are characterised by having a well-defined bold and inspirational objective within a set timeframe. Missions typically require the involvement of a wide range of stakeholders across sectors and disciplines as well as significant innovation. They are also characterized by transformative ambition (Mazzucato, 2018a; Mazzucato & Kattel, 2023; OECD, 2020). Industrial decarbonisation in the EU by 2050 qualifies well as a mission: it aims to tackle a great societal challenge within a set timeframe, it will require the involvement of a large range of stakeholders and require significant innovation as well as transformative change. Despite this, no literature was identified analysing EU green industrial policy using a mission-oriented lens which indicate a research gap.

Aim, Research Questions and Research design

This thesis will explore the current conditions for mission-oriented green industrial policy in the EU. The possible mission explored will be industrial decarbonisation of the EU steel, cement and chemicals industries by 2050. The decarbonisation strategy in focus of this study is new low-carbon processes and specifically through the development and deployment of net-zero technologies fundamentally shifting the industrial production processes and feedstocks.

The master’s thesis aims to contribute with knowledge on advancing transformative change within green industrial policy to support the fulfilment of EU climate targets by exploring the main research question:

- What are the current conditions to advance a mission-oriented approach to green industrial policy in the EU?

To help answer this main question, more specific research questions are formulated as follows:

RQ1: What is the gap between the current EU industrial policy promoting the development and deployment of net-zero technologies to decarbonise the energy intensive sector and a mission-oriented policy approach to the same objective?

RQ2: What measures are needed to close the gap between current policy and a mission-oriented policy approach?

RQ3: What is the feasibility of the measures needed to close the gap?

To conduct the analysis a mission-oriented framework for green industrial policy with twelve mission-oriented features was developed. The analytical framework was built based on an extensive literature review and twelve mission-oriented features (A.1-C.3) related to three mission-oriented dimensions (A-C) were selected, see table 0-1. To answer the RQs, 15 semi-structured interviews were conducted with EU stakeholders including representatives from the EU institutions, trade associations and NGOs. The interviews were also complemented by a quantitative survey which all interviewees filled in beforehand. In the survey informants were asked to rate the fulfilment of all the features in relation to current EU green industrial policy from 1-5 (not fulfilled – mostly fulfilled). The data was analysed using thematic qualitative content analysis. The coding was mainly deductive with the use of pre-determined codes from the analytical framework, but a few codes were identified inductively. Coding was conducted using the qualitative data analysis software NVivo which was followed by more detailed analysis of the codes in analysis matrices in Excel.

Findings and conclusions

Research results show there is a gap between current green industrial policy and a mission-oriented approach in relation to all twelve mission-oriented features in the analytical framework, see table 0-1. The fulfilment of the mission-oriented features ranged from partially to mostly fulfilled, with five features assessed as partially fulfilled, four features assessed as moderately fulfilled and three features assessed as mostly fulfilled. The final assessment was based on both the survey assessments and the interviews. Furthermore, how large the gap between current EU green industrial policy and a mission-oriented approach in general is assessed to differ between the stakeholder groups. The EU Commission and the think tank stakeholder group in general indicated the smallest gap with an average rating of 3.0 based on all feature ratings. The NGO stakeholder group indicated the largest gap with an average rating of 2.2.

Table 0-1 Own framework: Mission-oriented framework for green industrial policy covering three policy dimensions, twelve mission-oriented features as well as the final assessment of the mission-oriented features.

Mission- orientation dimension	Mission-oriented feature	Final assessment
Strategic orientation (A)	A.1 - Ambition	4
	A.2 - Directionality	2
	A.3 - Legitimacy	3
	A.4 - Realistic	4

	A.5 - Stakeholder involvement	3
	A.6 - Multiple bottom-up solutions and experimentation	3
	A.7 - Flexibility	4
Mission-oriented policy (B)	B.1 - Diverse and coherent policy mix	2
	B.2 - Market shaping	2
Mission-oriented finance (C)	C.1 - Public finance mobilisation	3
	C.2 - Risks and rewards	2
	C.3 - Private finance mobilisation	2

Measures were suggested by EU stakeholders to enhance the fulfilment of all twelve features, covering a wide range of policy instruments. Key measures suggested in relation to the policy dimension *Strategic orientation* were 1) a more holistic broader common vision of the industry of tomorrow, 2) sectoral roadmaps to decarbonise the sectors, and 3) more opportunities for stakeholder involvement from non-industrial actors to ensure a balanced stakeholder approach. Central measures suggested in regard to the policy dimension *Mission-oriented policy* were 1) just transition policies, 2) green public procurement and 3) eco-design requirements for steel, cement and chemicals. Lastly, key measures in relation to the policy dimension *Mission-oriented finance* were 1) common EU borrowing, 2) more finance towards early deployment of net-zero technologies, 3) encourage risk-and reward sharing e.g. through Carbon Contracts for Difference and, 4) ensure that there is a business case e.g. through sufficiently high CO₂ price. Four measures were suggested by representatives from all or almost all stakeholder groups which could indicate a higher political feasibility for these measures: just transition policies, green public procurement, definitions for green steel, cement and chemicals and common EU borrowing. The feasibility of the suggested measures however varied from very low to high.

Several key conclusions emerge from the analysed in relation to the main research question about current conditions to advance a mission-oriented green industrial policy in the EU. Firstly, it is shown that there are rationales for mission-oriented green industrial policy but that the challenges for citizens to influence and engage with the EU is a caveat when it comes to governing an industrial mission on an EU level.

Secondly, when it comes to opportunities to advance a mission-oriented approach the study results show that there are measures that can be taken to narrow the identified gap. The opportunities to advance the features however vary due to their different degree of current fulfilment and feasibility of their related suggested measures. The results show that certain of the studied features, such as Market shaping, Private finance mobilisation, Directionality and Stakeholder engagement, exhibit low fulfilment levels but demonstrate high feasibility for improvement. These features represent significant opportunities for enhancement to advance a mission-oriented green industrial policy in the EU.

On the other hand, there are features such as Diverse and coherent policy mix, Risks and rewards, Legitimacy, Public finance mobilisation and Bottom-up solutions and experimentation

which display low or moderate fulfilment and generally lower feasibility of suggested measures. These measures might be particularly challenging to advance and may therefore require particular attention and effort to overcome existing barriers. Lastly, the features Ambition, Realistic and Flexibility exhibit lower feasibility of improvement yet are already largely fulfilled indicating that these features are already being largely addressed within the current framework. This group of measures require effort to maintain current level of fulfilment as well action to further enhance fulfilment to advance a mission-oriented approach.

To allow for these opportunities, however, substantial barriers need to be overcome. A key barrier identified is the complex structure of EU policymaking hampering coordinated green industrial policy and wide stakeholder involvement which risk to decrease the legitimacy of mission-oriented green industrial policy at an EU level. Other barriers include the growing focus of other industrial policy objectives than climate neutrality and political resistance against new environmental legislation. Two important enablers identified to overcome barriers to mission-oriented transformative change are that green industrial policy must be designed intertwined with other policy areas which might require more cross-departmental governance as well as a shift in narrative that competitiveness and climate neutrality objectives would be at odds with one another. The enabler identified as particular key to enable mission-oriented transformative change is political will, strong leadership, and courage.

Recommendations

Recommendations on actions and features to prioritise to advance a mission-oriented green industrial policy in the EU for practitioners working with green industrial policy in the EU:

- Directionality, Stakeholder engagement, Market shaping and Private finance mobilisation show particularly good opportunities to be enhanced and constitute a good starting point to advance a mission-oriented approach.
- Significant effort is needed towards producing more feasible measures and overcoming challenges and barriers to the suggested measures related to Legitimacy, Bottom-up solutions and experimentation, Diverse and coherent policy mix, Public finance mobilisation and Risks and rewards.
- In regard to the features Ambition, Realistic and Flexibility, the main priority should be to ensure that the current level of fulfilment is maintained.
- Overall, promoting the identified key enablers and taking actions aimed at overcoming the identified barriers and challenges should be prioritised. Actions include:
 - Convincing stakeholders outside of R&I policy about the need of certain mission-oriented aspects.
 - Ensuring sufficient finance for deployment.
 - Considering reviewing EU treaties to ensure a structure of EU policymaking which enables transformative change.

Table of Contents

ACKNOWLEDGEMENTS	I
ABSTRACT	II
EXECUTIVE SUMMARY	III
LIST OF FIGURES	VIII
LIST OF TABLES	VIII
ABBREVIATIONS	X
1 INTRODUCTION	1
1.1 PROBLEM DEFINITION	3
1.2 AIM AND RESEARCH QUESTIONS	3
1.3 SCOPE AND DELIMITATIONS	4
1.4 ETHICAL CONSIDERATIONS	4
1.5 AUDIENCE.....	5
1.6 DISPOSITION.....	5
2 LITERATURE REVIEW	6
2.1 GREEN INDUSTRIAL POLICY	6
2.1.1 <i>Green industrial policy rationales and critiques</i>	6
2.1.2 <i>Green industrial policy instruments</i>	7
2.1.3 <i>Strategic design principles for green industrial policy</i>	8
2.1.4 <i>EU green industrial policy</i>	9
2.2 MISSION-ORIENTED INNOVATION AND INDUSTRIAL POLICY	11
2.2.1 <i>Formulating and governing mission-oriented policy</i>	12
2.2.2 <i>Mission-oriented green industrial policy rationales and caveats</i>	13
2.2.3 <i>Mission-oriented green industrial policy in the EU</i>	13
2.3 CONCLUSIONS FROM LITERATURE REVIEW	14
3 ANALYTICAL FRAMEWORK	15
4 RESEARCH DESIGN, MATERIALS AND METHODS	19
4.1 RESEARCH DESIGN	19
4.2 METHODS FOR DATA COLLECTION	20
4.2.1 <i>Identification and Recruitment of Informants</i>	20
4.2.2 <i>Data collection methods</i>	20
4.3 MATERIALS COLLECTED	21
4.4 METHODS FOR DATA ANALYSIS	22
5 RESULTS AND ANALYSIS	24
5.1 FEATURE RESULTS	24
5.1.1 <i>Overview of Survey results</i>	24
5.1.2 <i>A.1 Ambition</i>	25
5.1.3 <i>A.2 Directionality</i>	26
5.1.4 <i>A.3 Legitimacy</i>	27
5.1.5 <i>A.4 Realistic</i>	28
5.1.6 <i>A.5 Stakeholder involvement</i>	29
5.1.7 <i>A.6 Multiple bottom-up solutions and experimentation</i>	30
5.1.8 <i>A.7 Flexibility</i>	31
5.1.9 <i>B.1 Diverse and coherent policy mix</i>	31
5.1.10 <i>B.2 Market shaping</i>	33

5.1.11	C.1 Public finance mobilisation	34
5.1.12	C.2 Risks and Rewards	36
5.1.13	C.3 Private finance mobilisation	37
5.1.14	Features outside of the analytical framework	38
5.2	KEY BARRIERS AND ENABLERS FOR TRANSFORMATIVE MISSION-ORIENTED CHANGE	38
5.2.1	Key barriers for transformative mission-oriented change	38
5.2.2	Key enablers for transformative mission-oriented change	39
5.3	RELATIONSHIPS BETWEEN FEATURES	40
5.3.1	Dependencies between features	40
5.3.2	Inherent tensions in the framework	41
5.4	ANSWERS TO THE RESEARCH QUESTIONS	42
6	DISCUSSION	46
6.1	TOWARDS A MISSION-ORIENTED GREEN INDUSTRIAL POLICY IN THE EU?	46
6.1.1	Rationale and caveats	46
6.1.2	Opportunities and challenges	47
6.1.3	Key enablers and barriers	48
6.2	SIGNIFICANCE OF THE ANALYTICAL FRAMEWORK	49
6.3	CRITICAL REFLECTIONS ON RESEARCH LIMITATIONS	50
7	CONCLUSIONS AND RECOMMENDATIONS	52
7.1	CONCLUSIONS ON MISSION-ORIENTED EU GREEN INDUSTRIAL POLICY	52
7.2	PRACTICAL CONTRIBUTIONS AND RECOMMENDATIONS	53
7.3	RECOMMENDATIONS FOR FUTURE RESEARCH	54
	BIBLIOGRAPHY	55
	APPENDIX A – CONSENT FORM FOR INTERVIEW	63
	APPENDIX B - CONSENT FORM FOR SURVEY	65
	APPENDIX C – COMPLETE INTERVIEW GUIDE	66
	APPENDIX D – SURVEY	69
	APPENDIX E – TABLES OF SUGGESTED MEASURES AND THEIR FEASIBILITY	75

List of Figures

Figure 5-1	Chord diagram of dependencies between features. The arrow from a feature indicates dependency on the feature the arrow is directed at	41
------------	---	----

List of Tables

Table 0-1	Own framework: Mission-oriented framework for green industrial policy covering three policy dimensions, twelve mission-oriented features as well as the final assessment of the mission-oriented features	IV
Table 3-1	Own framework: Mission-oriented framework for green industrial policy covering three mission-oriented dimensions, twelve mission-oriented features and their sources	16

Table 4-1 A list of the informants according to stakeholder group with associated informant code for in-text referencing and mission-oriented features discussed during the interviews (A.1-C.3).....	23
Table 5-1 Overview of survey ratings of the twelve mission-oriented features from all five stakeholder groups. The table also includes averages of rated features and averaged ratings within stakeholder groups.....	24
Table 5-2 Survey ratings of the feature Ambition. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure).....	25
Table 5-3 Survey ratings of the feature Directionality. Rating 1-5 (not fulfilled – fully fulfilled).....	26
Table 5-4 Survey ratings of the feature Legitimacy. Rating 1-5 (not fulfilled – fully fulfilled), number* (informant indicated that they wanted to rate it differently in the interview and rating was adjusted.).....	27
Table 5-5 Survey ratings of the feature Relastic. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure).....	28
Table 5-6 Survey ratings of the feature Stakeholder Involvement. Rating 1-5 (not fulfilled – fully fulfilled), number* (informant indicated different rating in the interview and rating was adjusted)	29
Table 5-7 Survey ratings of the feature Multiple Bottom-up Solutions and Experimentation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), number* (informant indicated different rating in the interview and rating was adjusted)	30
Table 5-8 Survey ratings of the feature Flexibility. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), * (data point was removed due to informant indicating it was incorrect or could not motivate their ranking in the interview)	31
Table 5-9 Survey ratings of the feature Diverse and coherent policy mix. Rating 1-5 (not fulfilled – fully fulfilled).....	32
Table 5-10 Survey ratings of the feature Market Shaping. Rating 1-5 (not fulfilled – fully fulfilled).....	33
Table 5-11 Survey ratings of the feature Public finance mobilisation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure).....	34
Table 5-12 Survey ratings of the feature Risks and rewards. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), * (data point was removed due to informant indicating it was incorrect or could not motivate their ranking in the interview).....	36
Table 5-13 Survey ratings for the feature Private finance mobilisation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure).....	37
Table 5-14 Survey assessment and final assessment of feature fulfilment as well as key findings on feature fulfilment informing the final assessments.	42
Table 0-2 Suggested measures by EU stakeholders and their assessed feasibility as well as their sources, in relation to the twelve mission-oriented features A.1-C.3.....	75

Abbreviations

CBAM	Carbon Border Adjustment Mechanism
CCfD	Carbon Contracts for Difference
CCS	Carbon capture and storage
CCUS	Carbon capture and utilisation or storage
CO ₂	Carbon dioxide
EIB	European Investment Bank
EU	European Union
EU ETS	EU Emission Trading System
GHG	Greenhouse gas emissions
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organisation
R&D	Research & development
R&I	Research & innovation
STI	Science technology and innovation
TRL	Technology readiness level

1 Introduction

To stay in line with the Paris Agreement, stay within the planetary boundaries and avoid detrimental environmental tipping points, global CO₂ emissions must reach net-zero by 2050 (IPCC, 2022; Rockström et al., 2009). This requires a rapid and far-reaching transformation of our societies within a short, limited time (IPCC, 2022). This will have major implications for the energy-intensive industry which products are responsible for one third of annual global greenhouse gas (GHG) emissions (Bataille et al., 2018). In 2019, energy-intensive industries accounted for 17 % of EU greenhouse gas emissions (Chua & Garvey, 2021). At the same time these energy-intensive products such as steel, cement and chemicals serve essential functions to the society including for transportation, infrastructure and packaging (Material Economics, 2019). Transforming and decarbonising the energy-intensive sector is therefore an urgent challenge for the EU to reach its climate target of climate neutrality by 2050.

So far, the energy-intensive industries are far from reaching the desired level of change. The industries have mostly focused on safety, competitiveness, local environmental impacts and energy efficiency issues and less on creating deep decarbonisation in line with the objectives of the Paris agreement (Nilsson et al., 2020). There is often also a heavy reliance on carbon capture technologies in the industries which obscures the need to discuss alternative ways to rapidly decarbonise the industry (Nilsson et al., 2021).

Challenges related to the decarbonisation of the energy-intensive industries include the high energy and emission intensity of current production processes, a strong lock-in due to large capital investments in current carbon-intensive technologies and infrastructures as well as long investments cycles meaning that all new investments must be aimed at climate neutrality (Bataille et al., 2018; Material Economics, 2019; Nilsson et al., 2021). Additional challenges include the symbolic and economic value to local communities and global competition (Nilsson et al., 2021).

To transform the energy intensive industries towards climate neutrality significant changes are needed across and between value chains, sectors and policy domains and there is no silver bullet solution (Nilsson et al., 2021). Multiple solutions based on technological, organizational and behavioural change, have to be pursued in parallel including energy efficiency, reduced demand, materials efficiency, circular material flows, electrification and fuel switching, and Carbon Capture Utilisation or Storage (CCUS) (Bataille et al., 2018). These measures can be categorised into three different decarbonisation strategies: circular economy, new low-carbon processes and carbon capture technologies (Bataille et al., 2018; Material Economics, 2019).

There are emerging and near commercial technologies for each sector that could make deep decarbonisation of the energy-intensive industries technically possible (Bataille et al., 2018; Material Economics, 2019). Potential routes for decarbonising the sectors include for steel switching from carbon to hydrogen; in cement new cementitious materials offering low CO₂-alternatives to conventional clinker; and within chemicals e.g. the use of non-fossil feedstocks such as biomass. In common for the industries are that the emerging innovations often are based on electricity to produce high-temperature heat which require a large amount of green electricity (Material Economics, 2019). Despite that various net-zero technologies are technically feasible; economic factors, including high capital- and risk intensity of investments, have kept them from reaching commercial scale (Material Economics, 2019; Wyns & Khandekar, 2019). To enable the much needed development and deployment of these net-zero technologies by 2050 and achieve

EU's climate neutrality target, carefully designed green industrial policy is necessary (Altenburg & Rodrik, 2017; Criscuolo et al., 2023; Material Economics, 2019).

Green industrial policy in the EU has accelerated after the launch of the European Green Deal Communication, the EU climate law and the update of climate legislation through the climate package FitFor55 (European Commission, n.d.-a, n.d.-c, 2019). In the last two years especially, green industrial policy has gained significant momentum in the EU with the EU Commission presenting the Green Deal Industrial Plan (GDIP) in February 2023. The Green Deal Industrial Plan aims to enhance the competitiveness of Europe's net-zero industry and accelerate the transition to climate neutrality (European Commission, 2023b). GDIP and its related legislative files indicated a clear step towards increasing use of green industrial policy in the EU. The industrial strategy was partly presented as a reaction the intensified use of green industrial policy measures in China and in the United States, most notably the Inflation Reduction Act presented in August 2022 enabling massive investments in clean tech (De Ville, 2023; European Commission, 2023b; von der Leyen, 2023; Yarmuth, 2022). In addition, geopolitical tensions, especially the Russian war in Ukraine, have given rise to open strategic autonomy as a new political priority in the EU (De Ville, 2023). Open strategic autonomy refers to the ambition to reduce one-sided dependencies through increasing domestic capacity and diversifying suppliers in critical areas e.g. critical raw materials and is a cornerstone in the GDIP (European Commission & Joint Research Centre, 2021).

In parallel to the intensified use and attention on green industrial policy, mission-oriented innovation policy is growing in popularity as an approach to tackle grand societal challenges. Mission-oriented innovation policy is a branch within innovation policy that is 'transformation-oriented'. The policy approach can however also be extended to industrial policy more broadly and be seen as an industrial policy approach aiming at transformative change to reach a certain objective (Criscuolo et al., 2022; Weber & Rohrer, 2012). Missions are characterised by having a well-defined bold and inspirational objective within a set timeframe. Missions typically require the involvement of a wide range of stakeholders across sectors and disciplines as well as significant innovation. They are also characterized by transformative ambition (Mazzucato, 2018a; Mazzucato & Kattel, 2023; OECD, 2020).

There is a growing number of missions globally with climate neutrality objectives. OECD has identified 83 net-zero missions globally of which most have been launched recently (OECD, 2023). Also, the EU has adopted a mission-approach under its Research programme Horizon Europe and have launched five missions of which four relate to environmental and climate challenges (European Commission, 2024). Despite mission-oriented innovation policy being straightforward to extend to industrial policy, current missions mainly take place within the Research & Innovation (R&I) sphere which also holds true for the EU (OECD, 2023).

This thesis will explore the current conditions for mission-oriented green industrial policy in the EU. The possible mission explored will be industrial decarbonisation of the EU steel, cement and chemicals industries by 2050. Industrial decarbonisation in the EU by 2050 qualifies well as a mission: it aims to tackle a great societal challenge within a set timeframe, it will require the involvement of a large range of stakeholders, significant innovation and coordination as well as transformative change. The decarbonisation strategy chosen is new low-carbon processes and specifically through the development and deployment of net-zero technologies fundamentally shifting the industrial production processes and feedstocks. This decarbonisation strategy is chosen due to two reasons: 1) the need to replace current highly fossil dependent industrial

processes with novel low-carbon processes and feedstock to create deep cuts of industrial CO₂ emissions (Material Economics, 2019; Nilsson et al., 2021) and 2) the decarbonisation strategy development and deployment of net-zero technologies may be particularly supported by a mission-oriented approach given the strategy's high need for accelerated innovation and investments (Material Economics, 2019; Stöllinger, 2023; Wyns & Khandekar, 2019).

1.1 Problem definition

Decarbonising the energy-intensive industries by 2050 is a pressing issue for the EU, as described in the introduction. There is a growing consensus in literature that green industrial policy is needed to tackle this challenge (Criscuolo et al., 2023; De Ville, 2023; Mazzucato, 2018a; Nilsson et al., 2021; Rodrik, 2014; Tagliapietra et al., 2023). Despite this, green industrial policy aiming at transforming energy and emission intensive industries is still a relatively unexplored field (Nilsson et al., 2021). Even less explored are mission-oriented green industrial policies to transform the energy intensive industries. There is literature applying a mission-oriented approach to green industrial policy (see e.g. Altenburg & Rodrik, 2017; Criscuolo et al., 2022) and literature arguing that a mission-oriented approach to green industrial policy in the EU is needed to achieve industrial decarbonisation (Stöllinger, 2023; Wyns & Khandekar, 2019). According to Stöllinger (2023) 'Net zero technologies in industrial production' is the most pressing industrial mission in the context of the European Green Deal. Despite this, no literature was found analysing the current EU green industrial policy using a mission-oriented lens which indicates a research gap. Current green industrial policy in the EU does not actively follow a mission-oriented-approach and neither is there any mission under Horizon Europe that deals with industrial decarbonisation (European Commission, 2024). The EU is however in urgent need of developing and deploying net-zero technologies to decarbonise its energy-intensive sectors by 2050. A mission-oriented approach to green industrial policy in the EU could help create the necessary transformative conditions for decarbonising the energy-intensive industries in the EU by 2050.

1.2 Aim and Research Questions

The master's thesis aims to contribute with knowledge on advancing transformative change within green industrial policy to support the fulfilment of EU climate targets. On this basis, it seeks to contribute to the transition of the energy-intensive industries cement, steel, and chemicals through providing recommendations on policy actions to EU stakeholders. Moreover, it seeks to make an academic contribution to the limited research field at the cross-section of green industrial policy and mission-oriented innovation policy. This is achieved by answering the research questions (RQs) below.

The main question for the master's thesis is:

- What are the current conditions to advance a mission-oriented approach to green industrial policy in the EU?

To help answer this main question, more specific research questions are formulated as follows:

RQ1: What is the gap between the current EU industrial policy promoting the development and deployment of net-zero technologies to decarbonise the energy intensive sector and a mission-oriented policy approach to the same objective?

RQ2: What measures are needed to close the gap between current policy and a mission-oriented policy approach?

RQ3: What is the feasibility of the measures needed to close the gap?

1.3 Scope and Delimitations

This research will focus on green industrial policy for the energy intensive sectors in the EU and more specifically the steel, cement and chemical industries which are selected due to their importance for society as previously outlined. This means that policy targeting other energy-intensive industries such as refining, ceramics, paper, glass, and non-ferrous metals industries in the EU will be excluded.

A specific focus will be placed on the decarbonisation strategy new low-carbon processes and specifically through the development and deployment of net-zero technologies fundamentally shifting the industrial production processes and feedstock. Green industrial policy promoting alternative decarbonisation strategies such as promoting circular economy or carbon capture technologies such as CCS will not be studied to the same extent despite their potential to contribute to industrial decarbonisation. Only decarbonisation strategy is chosen to enable a deeper analysis of the chosen strategy.

Since the focus of the thesis is the EU level, interviewed stakeholders will be EU stakeholders which include representatives from the EU Commission, EU Parliament, NGOs, trade associations, and think tanks mainly active on the EU level. Stakeholders that are impacted by the policy, but which are mainly active on a different level than the EU are excluded.

In the analytical framework for mission-oriented green industrial policy used for data analysis, three dimensions are highlighted: 1) *Strategic orientation*, 2) *Mission-oriented policy* and 3) *Mission-oriented finance*. Thus, there are elements from mission-oriented innovation policy such as mission-oriented organisation and evaluation, that are excluded. These topics were excluded in order to enable a deeper analysis of the three chosen dimensions and their respective features.

1.4 Ethical considerations

Ethical considerations always arise in research when collecting and dealing with data from informants. A central ethical consideration in relation to the study informants was to ensure their voluntary participation in both the survey and interview. To ensure voluntary participation in the survey the informants needed to agree to a consent form at the start of the survey before filling it in, see appendix A. In regard to the interviews, all informants signed a designated consent form for the interview data collection, see appendix B, which was sent prior to the interview. The informed consent forms cover information about the study project, how the collected data would be used and stored and that the results of the research will not be possible to trace back to the informant.

During the data collection informants were treated with respect and courtesy and the interviewee was reminded about the research aim, purpose of the interview and how data would be treated anonymously to avoid any misleading of participants. The final thesis will be shared with the informants after its finalisation.

Many informants were generous in sharing personal opinions and reflections that do not necessarily represent the official position of their organisations. The anonymity of participants was therefore important to ensure that the outcomes of the research could not have any harmful effects on the study participants and their organisations. Extra careful consideration in regard to ensuring anonymity was needed since the policy stakeholder landscape in Brussels is limited in size and the informants work on the same issues in the same policy environment.

To ensure GDPR-compliant treatment of the data, the AI transcription tool GoodTape was chosen for transcribing the interviews before manual editing was carried out. GoodTape ensures that the recordings are transferred fully encrypted, stay within the EU and are deleted immediately after transcription (GoodTape, n.d.).

1.5 Audience

The study has two main audiences: practitioners working with industrial policy and the scientific community. The outcome of the study is mainly of interest to practitioners in the EU working with green industrial policy including stakeholders from the EU institutions, EU Member States, industry, think tanks, NGOs and trade unions. Regarding the scientific community, the study is of interest to scholars researching on green industrial policy, mission-oriented policy and especially to those interested in the intersection of the two research fields.

1.6 Disposition

Chapter 1 (Introduction) provides an introduction to the research area and presents the research problem, aim and research questions. The chapter also describes the research scope, delimitations and ethical considerations as well as outlines the intended audience and disposition. Chapter 2 (Literature Review) presents the current state of research and knowledge around green industrial policy and mission-oriented innovation policy as well as conclusions from the literature review including research gaps. Chapter 3 (Analytical framework) presents the mission-oriented framework for green industrial policy developed based on previous knowledge on mission-oriented innovation policy and green industrial policy. Chapter 4 (Research design, materials and methods) describes the selected research design, including methods for data collection and data analysis. Chapter 5 (Results and Analysis) presents and analyses the main findings from the survey and interview in relation to the features in the analytical framework and provides answers to the RQs based on the results. Chapter 6 (Discussion) discusses the main question of the thesis, significance of the analytical framework as well as critical reflections on research limitations. Lastly, Chapter 6 (Conclusions) presents the main conclusions regarding the RQs and the main RQ, practical contributions and recommendations to practitioners as well as recommendations for future research to the scientific community.

2 Literature review

2.1 Green industrial policy

Industrial policy has been gaining traction around the world in the wake of multiple crises such as the 2008 Financial crisis, the COVID-19 pandemic, geopolitical crises and climate change (Criscuolo et al., 2022, 2023). The urgency to reach climate neutrality by 2050 has heightened the need for government intervention which has led green industrial policy to become increasingly central within climate policy debates (Criscuolo et al., 2023; Meckling, 2021).

In the last two years green industrial policy has gained significant momentum with the United States presenting the Inflation Reduction Act and the EU launching the Green Deal Industrial Plan and associated legislation the Net-Zero Industry Act. Green Industrial Policy is however not new. Most countries have adopted some type of green industrial policy since the 2000s and stimulus packages in response to both the 2008 Financial crisis and the COVID-19 pandemic included green investments (Meckling, 2021).

Green industrial policy can be defined as policies supporting specific sectors affecting the economic production structure with the aim of generating environmental benefits such as industrial decarbonisation (Hallegatte et al., 2013). Green industrial policy measures aims at re-directing technological innovation and deployment away from dirty production processes and towards low-carbon technologies to achieve decarbonisation goals (Criscuolo et al., 2022). Green industrial policy is also very closely related to innovation policy and refer to similar policy activities. A difference is that innovation policy tends to focus mostly on the development of technologies and R&D policies rather than deployment of technologies (Meckling, 2021).

In addition to environmental objectives, other common industrial objectives within green industrial policy include innovation, productivity, competitiveness and employment. In the context of the COVID-19 pandemic and the Russian war in Ukraine resilience and strategic autonomy has also become increasingly important policy objectives in the EU (Criscuolo et al., 2022; De Ville, 2023).

Lastly, four different types of industrial strategies can be delineated depending on what the target of the industrial policies is: sectoral, technology-focused, place-based strategies and mission-oriented strategies. Sectoral strategies target firms based on their sector, technology-focused strategies based on technologies, place-based strategies based on location - often regional level - and lastly mission-oriented policies based on reaching objectives related to a societal challenge, in a defined timeframe (Criscuolo et al., 2022). The conditions to advance the last type of strategy is what is explored in this study with the objective of industrial decarbonisation and climate neutrality by 2050 in the EU (see section 2.2).

2.1.1 Green industrial policy rationales and critiques

In recent literature there is a growing sentiment that green industrial policy is an appropriate and needed tool to tackle the societal challenge to transition to a net-zero industry (Altenburg & Rodrik, 2017; Criscuolo et al., 2023; De Ville, 2023; Mazzucato, 2018b; Nilsson et al., 2021; Rodrik, 2014; Tagliapietra et al., 2023; Wyns & Khandekar, 2019)

There are two main theoretical rationales for green industrial policy: market failure and a market-shaping approach. Green industrial policy is most commonly motivated by various market failures, most notably the large environmental externality of GHG emissions as it largely remains unpriced (Criscuolo et al., 2023). Rodrik (2014) and Tagliapietra et al. (2023) argue that there is a strong theoretical case for green industrial policy due to underinvestments in green technologies. This is driven by a wedge between private and social returns to investments in green technologies and hidden support provided to fossil-fuel products in different forms. Criscuolo et al. (2023), emphasise additional market failures such as significant knowledge spillovers of low-carbon technologies, reluctance to take on risk and lack of information leading to imperfections in the capital market limiting private capital for low-carbon technologies.

Criscuolo et al. (2023) also argue that green industrial policy is needed due to governmental failures such as preference for incumbents and regulatory barriers discouraging low-carbon innovation. Uncertainty in climate policy is also associated with statistically significant decreases in investment, particularly in pollution-intensive sectors that are most exposed to climate policies (Berestycki et al., 2022).

The market-shaping approach recognises the state's role as an active player in the innovation system and views it as the government's role to ensure that markets support public purposes. To address societal challenges such as climate change “the State must lead – not by fixing markets but by actively creating and shaping (new markets), while regulating existing ones”, (p. 6) (Mazzucato, 2018b, p. 6). Market failures are therefore not required to motivate green industrial policy using a market shaping approach.

The debate on the use of industrial policy has a rather polarised history and industrial policy has had a bad reputation due to various criticisms (Criscuolo et al., 2022). There are two main common arguments against industrial policy. The first is that governments do not have sufficient information to select the right technologies or industries to support. The second is that governmental support to industry risk to invite rent-seeking and political capture by lobbyists (Criscuolo et al., 2023; OECD, 2022; Rodrik, 2014). Therefore, even if economists acknowledge the existence of market failures many are hesitant about the efficiency of the industrial policy interventions and point towards unsuccessful past experiences). Additionally, some point out that industrial policies may be difficult to align with competition policy, e.g. related to the use of state aid compromising the level playing field (Criscuolo et al., 2022. Rodrik (2014) argues that the main two critiques can be resolved. The first is irrelevant - mistakes are a necessary element of industrial policy and that the second can be overcome with appropriate institutional design.

2.1.2 Green industrial policy instruments

To address the complex market failures and rapidly decarbonise the energy-intensive industries a green industrial policy strategy needs to be carefully designed. When it comes to industrial policy instruments a distinction can be made between supply and demand policies. Supply-side instruments affect production decision whereas demand-side instruments affect consumption decision. Supply-side measures can further be distinguished between ‘within’ supply-side instruments affecting firm performance and ‘between’ supply-side instruments which are framework conditions affecting industry dynamics. Industrial policy instruments can also be classified as either horizontal or vertical industrial policies which indicate the scope of the

instrument. Horizontal policies are available to all firms whereas vertical policies only are targeted to a subset of firms indicating the scope and target of the policy (Criscuolo et al., 2022).

Green industrial strategies require a mix of all of these categories of policy instruments to be effective (Altenburg & Rodrik, 2017; Criscuolo et al., 2023). A combination of market-based instruments, regulations, capacity building, subsidies and other elements is usually required in a green industrial policy mix (Altenburg & Rodrik, 2017). Innovation policy to foster the development of net-zero technologies need to be complemented with demand-side policies to promote their deployment and that they actually make it to the market (Criscuolo et al., 2023; Lechtenböhmer & Fishedick, 2020).

Large investment will be needed to replace existing carbon-intensive industrial processes with net-zero technologies (Wyns & Khandekar, 2019). Compared to ordinary industrial policy, there is a case for subsidizing net-zero technologies also beyond the point at which they break even with harmful technologies. Due to the urgent need of rapid decarbonisation it is in the public interest to speed up the deployment of net-zero technologies rather than waiting for markets to provide incentives to substitute harmful technologies (Altenburg & Rodrik, 2017).

Moreover, carbon pricing is an effective tool to promote the demand for net-zero technologies but is insufficient to drive transformative change since it is only promoting technologies that already are close to the market. Carbon pricing is therefore not sufficient on its own and must be complemented with other policy measures (Altenburg & Rodrik, 2017; Criscuolo et al., 2023). Other needed measures to complement these tools include extensive technology and infrastructure investments in the right areas, massive expansion of green energy supply, creation of demand through e.g. standards and green public procurement, creation and destruction policies as well as just transition policies (Lechtenböhmer & Fishedick, 2020; Nilsson et al., 2021)

2.1.3 Strategic design principles for green industrial policy

In literature many design principles for effective and comprehensive green industrial policy can be identified. In this section eight central design principles for green industrial policy will be described.

- 1) **Directionality** towards both environmental and socio-economic goals is highlighted as a key for green industrial policy (Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; Nilsson et al., 2021). This necessitates embracing the importance of not only generating new innovations efficiently but also steer them in a desired direction. The selected direction needs to be described in detailed plans and should be accompanied with a **coherent policy mix** in line with the selected direction, including **market shaping** policies. Directionality also require **bottom-up public-private partnerships** to support the development of both new technologies and techno-economic paradigms. (Nilsson et al., 2021)
- 2) Green industrial policy should be developed in coordination with other climate and industrial policies to maximise synergies and avoid conflicts between policies (Aiginger & Rodrik, 2020; Tagliapietra et al., 2023)
- 3) **Stakeholder involvement** of a variety of actors including citizens and are key when shaping and designing green industrial policy (Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; Rodrik, 2014; Tagliapietra et al., 2023)

- 4) To limit risk of rent-seeking and political capture of the third design principle, discipline and accountability is needed from government in terms of effective monitoring and evaluation, transparency about both successes and failures and political accountability (Nilsson et al., 2021; Rodrik, 2014; Tagliapietra et al., 2023). Government should also curb lobbying to extend the lifetimes of declining and dirty industries (Aiginger & Rodrik, 2020).
- 5) Strong operational governance needed to ensure proactive coordination among diverse stakeholders, policy areas and instruments (Altenburg & Rodrik, 2017; Tagliapietra et al., 2023).
- 6) **Experimentation, risk-taking and cross-sectoral collaboration** is key to **share risks**, costs and information which is especially central to green industrial policy given a high level of uncertainty about technologies, markets, policy and ecosystem dynamics (Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; Tagliapietra et al., 2023)
- 7) Sensitivity to socio-economic implication of phase outs is needed to maintain legitimacy and acceptance for the transition, as any major techno-economic transformation in the industrial sector is likely to create winners and losers among firms, workers, regions as well as countries (Nilsson et al., 2021).
- 8) Lastly, green industrial policy aiming at climate neutrality needs to be transformative and systems-oriented towards sustainability objectives (Aiginger & Rodrik, 2020; Criscuolo et al., 2023; Nilsson et al., 2021). Transformative green industrial policy is however still a relatively unexplored field and have only more recently gained the attention of more scholars (Nilsson et al., 2021).

2.1.4 EU green industrial policy

The aim of EU's industrial policy is to strengthen the competitiveness of EU industry and to promote a more sustainable, resilient and digitalised economy that creates jobs (European Council, 2024a). Its legal basis is found under Article 173 of the Treaty on the Functioning of the European Union (TFEU, Art 173). Green industrial policy in the EU has accelerated after the launch of the European Green Deal Communication, which covered actions on the energy-intensive industries aiming at mobilising industry to a clean and circular industry (European Commission, 2019). Since then, the EU has launched three industrial policy strategies. First in March 2020 the Commission presented the communication 'A New Industrial Strategy for Europe' focusing on climate neutrality and digital leadership (European Commission, 2020). The launch of the first strategy coincided with the COVID19-pandemic which led the strategy to be updated in May 2021 with a main focus on the resilience of the EU single market and open strategic autonomy (European Commission, 2021). Lastly, in February 2023 the European Commission presented the 'Green Deal industrial plan for the net-zero age' aiming to enhance the competitiveness of Europe's net-zero industry and accelerate the transition to climate neutrality (European Commission, 2023b).

The current green industrial policy landscape includes both horizontal and vertical policies and is regulated through competition policy, trade policy, EU single market rules, climate policy, research and innovation policy, EU public investment and regional development policy (Tagliapietra et al., 2023). The main green industrial policy instrument in the EU today is carbon pricing via the EU Emission Trading System (EU ETS) (Veugelers et al., 2024). The system is complemented by the

EU's Carbon Border Adjustment Mechanism (CBAM) which is a carbon pricing tool for carbon intensive imports to the EU. CBAM will be fully in effect in 2026. (European Commission, n.d.-b). An upcoming legislation in the policy mix is the Net-Zero Industry Act (NZIA) stemming from GDIP which seeks to scale up the manufacturing of clean technologies in the EU (European Commission, 2023a). The law has however at the time of writing yet to be published in the EU Official Journal and is therefore not a completed law yet.

When it comes to public finance within EU green industrial policy, the EU Member States account for the most public funding for both the development and deployment of net-zero technologies in the EU. EU level funding is however an important complement and leverage for Member States funding (Veugelers et al., 2024). Horizon Europe is the EU's main funding programme for research and innovation, and it has a strong focus on green technologies (Tagliapietra et al., 2023). In the current 2021-2027 Framework Program with a budget of €96.5 billion, €15.1 billion is earmarked for climate, energy and mobility projects (Veugelers et al., 2024). Under Horizon Europe, two relatively recently introduced elements are Knowledge and Innovation Communities (KICs) and Missions both of which are aiming to institutionalise the process of collaboration between the public sector, private sector and civil society in line with innovation policy recommendations.

When it comes to the deployment of net-zero technologies, key EU level funding instruments are the Innovation Fund, the European Investment Bank (EIB) and NextGenerationEU. The innovation fund is funded through the auctioning of carbon allowances under the EU emissions trading system. It is expected to provide around €38 billion of support to industrial decarbonisation efforts over the period 2021-2030 (European Commission, 2022). In 2022, the EIB allocated about €17.5 billion to the transport and industrial sectors with an estimate of that €3.3 billion targeting clean technology projects (Tagliapietra et al., 2023). EU Member States also have access to EU level public via NextGenerationEU's Recovery and Resilience Facility (RFF) for green investments including for the decarbonisation of industry and strengthening of clean-tech supply chains. Up to €338 billion of grants under the RFF will be financed through EU common borrowing operations (European Commission, n.d.-d).

An additional EU initiative to facilitate funding towards deployment is Important Projects of Common European Interests (IPCEIs) which was introduced in 2014 to facilitate State aid targeted at identified market failures and objectives of common EU interest. As of March 2023, the EU Commission has approved State aid to five IPCEI projects to support the development of an EU clean tech industry, amounting to almost €24 billion of public investments. Overall, state aid from Member States is however by far the most extensively used public finance in the EU. In 2020, State aid worth €61.41 billion was approved for objectives related to environmental protection, renewable energy and energy savings in the EU. (Tagliapietra et al., 2023)

State aid is defined in the EU as 'an advantage in any form whatsoever conferred by national public authorities to undertakings on a selective basis'. State aid is in general prohibited in the EU (TFEU, Article 107) as a company that receives State aid may gain an advantage over its competitors which would risk distorting the EU single market. State aid can however be approved by the EU if it is in line with certain policy objectives that are deemed necessary for a well-functioning and equitable economy (European Commission, n.d.-e).

One of the main goals of the GDIP is to improve the access to finance (European Commission, 2021). No extra EU funding is included in the GDIP but a plan to set up a new EU Sovereignty

fund for this cause is described. The Commission did however not follow up on this plan and it has instead been downgraded to the Strategic Technologies European Platform (STEP) which aims to coordinate funding efforts (European Council, 2024b). Instead of EU level funding, GDIP focuses mainly on speeding up and simplifying state aid rules by amending and revising EU competition law (European Commission, 2023b). In March 2023, the Commission adopted a ‘Temporary Crisis and Transition Framework’ (TCTF) to facilitate state aid support to e.g. net-zero technologies (European Commission, n.d.-f).

More relaxed State aid rules in the EU can enable important investments in net-zero technologies. Increased use of state aid does, however, risk fragmenting the single market and further enhancing disparities and inequalities in the EU with some Member States being able to provide more State aid than others, mainly Germany and France (Bourgery-Gonse, 2023). The Commission therefore face a difficult balancing act where they want to facilitate large investments in net-zero industry but at the same time avoid any kind of fragmentation of the Single Market (von der Leyen, 2023).

The current green industrial policy landscape is highly fragmented according to Tagliapietra et. al. (2023) who describe it as a scattered collection of energy, climate, innovation, and social policy initiatives, rather than a coherent industrial policy framework. A key factor impeding a coherent industrial policy framework at the EU level is the complexity of EU green industrial policy governance which include various level of governance at regional, national, and EU level each having different policy competencies related to green industrial policy. To overcome these challenges inherent to the EU policy-making machinery, strong leadership that is competent and accountable to clear goals and milestones is needed to coordinate the various level of governance responsible for different parts of EU green industrial policy (Veugelers et al., 2024).

2.2 Mission-oriented innovation and industrial policy

Mission-oriented innovation policy is a branch within innovation policy that is ‘transformation-oriented’ (Weber & Rohracher, 2012) in that it aims to address the direction of innovation rather than supporting all types of economic development (Criscuolo et al., 2022; Nilsson et al., 2021). The aim of contemporary mission-oriented policies is to tackle ‘grand societal challenges’ such as climate change, health and well-being. The contemporary missions are characterised by being both social and technological in nature and requiring the mission to be co-defined by many stakeholders. This differs from the archetypical historical mission of NASA putting a man on the moon, which solely had a technological focus and was defined by a small group of experts (Mazzucato, 2018a).

Missions are characterised by having a well-defined bold and inspirational objective within a set timeframe. Missions typically require the involvement of a wide range of stakeholders across sectors and disciplines as well as significant innovation. They are also characterized by transformative ambition (Mazzucato, 2018a; Mazzucato & Kattel, 2023; OECD, 2020). This definition is well supplemented by Laurre (2021) definition of mission-oriented innovation policy as:

a co-ordinated package of policy and regulatory measures tailored specifically to mobilise science, technology and innovation in order to address well-defined objectives related to a societal challenge, in a defined timeframe. These measures possibly span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors and disciplines (p. 11).

Despite the definition being designed for innovation policy it can directly be extended to industrial policies more generally (Criscuolo et al., 2022).

In recent years innovation and industrial policies are increasingly following a mission-oriented approach e.g. in the EU (Horizon Europe), in Germany (New HT Strategy 2025), in the Netherlands (Top Sectors) and in the United Kingdom (UK Industrial Strategy) (Criscuolo et al., 2022). In 2020, under EU's scientific research initiative Horizon Europe, the EU launched five missions to catalyse cross-sectoral investments to find solutions to pressing societal issues, which of four relate to environmental and climate challenges (European Commission, 2024).

When it comes to net-zero missions, the OECD has identified 83 net-zero missions globally. Most of these however has got stuck in the 'STI-only trap' indicating that the missions mainly is kept in the realm of research and innovation, both in terms of what authorities are leading the mission and in terms of focus leading to a too narrow focus on technological innovation (OECD, 2023). The STI-only trap also holds for e.g. the EU missions under Horizon Europe (European Commission, 2024). To accomplish the net-zero missions' transformative potential the missions need to exist the 'STI-only trap' (OECD, 2023).

2.2.1 Formulating and governing mission-oriented policy

According to Mazzucato, who popularised the concept through an expert report for the EU Commission in 2018, missions should have the following features: 1) **Be bold, inspirational, with wide societal relevance**; 2) Have a clear **direction**: targeted, measurable, and time-bound; 3) Have **realistic** research and innovation actions over a limited time; 4) Be cross-sectoral, cross-actor and cross-disciplinary; and 5) Involve **multiple competing solutions and bottom-up** (Mazzucato, 2018a; Mazzucato & Kattel, 2023).

In addition, drawing on heterodox economic thinking Mazzucato has presented a policy framework for mission-oriented policy in terms of the acronym ROAR: Routes of directionality, Organisations, Assessment and Risks and rewards (Mazzucato, 2016; Mazzucato & Kattel, 2023). Routes of **directionality** refers to setting a direction of change motivating innovation across different parts of the economy (Mazzucato, 2021). Organisations deals with how organisations should be structured and what public capabilities are needed to manage missions (Mazzucato & Kattel, 2023). Examples of needed public capabilities are capabilities for leadership and engagement, coordination, experimentation, and administration e.g. diversity of expertise and skills and organisational fluidity (Kattel & Mazzucato, 2018) Assessment deals with what new dynamic indicators and evaluation tools should be used to evaluate the missions going beyond static cost-benefit analysis and capturing the dynamic spillovers (Mazzucato, 2021; Mazzucato & Kattel, 2023). Lastly, **risks and rewards** deal with how public investments along the innovation chain result in the socialisation of risks and rewards i.e. both risks and rewards are shared by public and private actors (Mazzucato, 2016, 2021; Mazzucato & Kattel, 2023).

Many of the features highlighted above are also reflected in two identified frameworks for mission-oriented innovation policy from the EU Commission and the OECD, such as Directionality, joint coordination, multidisciplinary and involvement of stakeholders. Additional features highlighted in two frameworks are **Public and private investments, Legitimacy Flexibility and Policy mix consistency** (Danish Technological Institute et al., 2018; Larrue, 2021).

2.2.2 Mission-oriented green industrial policy rationales and caveats

Mission-oriented policy justifies active interventions from government in innovation and industrial policy based on a market shaping approach in contrast to the more common market failure approach as described in section 2.2.1 (Mazzucato, 2018a).

According to Criscuolo et al. (2023) transformative mission-oriented strategies are necessary to tackle the complex barriers currently hindering industrial decarbonisation. The urgency and large risks associated with escalating climate change provides a strong rationale for green industrial policy that is ambitious and leads to results quickly, which a mission-oriented approach could facilitate (Altenburg & Rodrik, 2017). Key rationales for the use of mission-oriented green industrial policies include: 1) Social benefits in terms of the benefits linked to the societal issue tackled, in addition to traditional knowledge spillovers of innovation policy, 2) addressing coordination failures which may be particularly severe when a mission requires large simultaneous investments in multiple industries and key technologies, 3) creating acceptability for public investments by providing a political vision around expenditures, and 4) lowering regulatory uncertainty and imperfect commitment from governments which hamper private investments needed to achieve the mission (Altenburg & Rodrik, 2017; Criscuolo et al., 2022).

In addition to the criticisms of industrial policy covered in section 2.2.1, a risk when a new policy approach becomes ‘fashionable’ is excessive optimism on what it can achieve and underestimation of its costs, risks, and limitation. A significant caveat to mission-oriented policy is that mission-oriented policies still have not proved their effectiveness to traditional policy approaches despite a growing number of number of countries experimenting with mission-oriented policies (OECD, 2023). In theory the effectiveness should be quite evident given that its logic is in line with STI ‘common wisdom’. To properly evaluate the effectiveness of mission-oriented policies evaluation methods adapted to their systemic nature need to be developed (Larrue, 2021). Up until now, most studies have focused on conceptualising and formulating mission-oriented policy. Less literature has focused on how missions operate within their environment, how missions lead to the changes they promise, and how to conduct and evaluate missions (Janssen et al., 2021).

2.2.3 Mission-oriented green industrial policy in the EU

Mission-oriented green industrial policy also seems to be motivated in the EU context. Stöllinger (2023) and Wyns & Khandekar (2019) argue that mission-oriented industrial policy is necessary to reach the goals set out in the EU Green Deal. To reach net zero emission in the industry three policy tasks need to be met: expanding renewable energy sources, raising energy efficiency across sectors and lastly the development of new technologies for industrial production processes where clean technologies are not available yet. The first two tasks can be met using already existing and cost-competitive technologies, the third task however constitutes such great technological

challenges that it needs to be tackled with mission-oriented green industrial policy (Stöllinger, 2023). 'Net zero technologies in industrial production' is therefore the most pressing industrial mission in the context of the European Green Deal according to Stöllinger (2023). Furthermore, the development and deployment of net-zero technologies require high capital investments and entails high risk. Private actors are hesitant or unable to cope with this risk which motivate mission-oriented public-private cooperation to enable significant needed investments (Wyns & Khandekar, 2019). Wyns & Khandekar (2019) further suggest that missions under Horizon Europe should focus on industrial challenges to make EU a hub for industrial and circular low-carbon technologies. No literature was however found analysing EU green industrial policy from a mission-oriented perspective which indicates a research gap.

2.3 Conclusions from literature review

The research problem and associated RQs are highly relevant to explore given the findings from the literature review. The reviewed literature indicates that there is a growing sentiment that green industrial policy is needed and justified. Many papers cover design principles considered important for a green industrial policy among which there is a substantial overlap with features related to the mission-oriented approach. EU green industrial policy today is described as fragmented and in need of a stronger governance model to ensure better coordination and longer-term commitment, aspects which a mission-oriented approach potentially could provide. Criscuolo et al. (2023), Stöllinger (2023), Wyns & Khandekar (2019) and Altenburg & Rodrik (2017) argue that a mission-oriented green industrial policy can be needed to reach industrial climate neutrality objectives. Despite this, no literature was identified analysing EU green industrial policy from a mission-oriented perspective which indicates a research gap. This is in line with the finding in Nilsson et al. (2021) that green industrial policy aiming at transforming energy and emission intensive industries is still a relatively unexplored field. Further, the mission-oriented approach is gaining traction within innovation and industrial policies for climate neutrality. Many of these however get stuck in the 'STI-only trap' focusing mostly on R&I actions hampering the strategies transformative potential. Therefore, in addition to exploring the current conditions to advance a mission-oriented green industrial policy in the EU, the analysis provides a valuable contribution on the feasibility of escaping the 'STI-only trap', by not only focusing on R&I policies but on all policies constituting green industrial policy in the EU.

3 Analytical framework

The development of a framework for mission-oriented industrial policy is necessary to assess the current level of mission-orientation in green industrial policy in the EU and answer RQ1. Two frameworks to assess the degree of mission-orientation of innovation policies were identified in the literature but no framework was found to assess specifically mission-oriented industrial policy (Danish Technological Institute et al., 2018; Larrue, 2021). Such a framework was deemed relevant to develop as the pre-existing frameworks put less emphasis on certain elements of particular importance to green industrial policy, e.g. on finance aspects and included aspects less relevant to green industrial policy e.g. too R&I focused features. Therefore, a mission-oriented framework for green industrial policy was developed as an initial step before further data collection and data analysis, see table 3-1.

The analytical framework was built based on an extensive literature review, see section 2, of mission-oriented innovation policy and green industrial policy. Features of mission-oriented innovation policy and related features in green industrial policy literature were identified and coded iteratively without any pre-determined codes from a sub-selection of papers identified as particularly relevant (Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; Danish Technological Institute et al., 2018; European Commission & Mazzucato, 2018, 2019; Kattel & Mazzucato, 2018; Larrue, 2021; Mazzucato et al., 2020; Mazzucato & Kattel, 2023; Nilsson et al., 2021). To delineate the scope, not all identified features were included in the final framework and e.g. mission-oriented features related to organisations and public capabilities and evaluation were excluded. These were excluded to allow a deeper analysis of the chosen features.

The remaining coded features could be grouped into the three mission-oriented dimensions: *Strategic orientation*, *Mission-oriented policy* and *Mission-oriented finance*, taking inspiration from Laurre (2021), and similar features were merged. Definitions of the dimensions are provided below.

Strategic orientation definition: Strategic orientation concerns the strategic approach to green industrial policy dealing with questions about both the formulation of mission objectives and strategies for implementation to reach the ambitiously set targets (inspiration from Laurre, 2021).

Mission-oriented policy definition: Mission-oriented policy concerns the ability to implement an integrated and coherent policy package which creates and reshapes markets to achieve the mission (inspiration from Larrue, 2021).

Mission-oriented finance definition: Mission-oriented finance implies creating and ‘shaping’ markets by channelling various types of finance to achieve the mission objective – all should aim at risk and reward-sharing between public and private actors (Mazzucato & Mikheeva, 2020).

The definitions of the mission-oriented dimensions and included features were polished iteratively as understanding for the features increased to accurately reflect the literature used. Mazzucato’s expert report to the EU from 2018 describing the mission-oriented approach and the OECD framework for mission-oriented innovation policy were particularly influential when it came to the wording of the definitions. Additional sources than the ones used for initial coding were also used when formulating the definition (including Mazzucato, 2021; Mazzucato & Mikheeva, 2020).

The features should be understood as an ideal-type of mission-oriented industrial policy. Few of mission-oriented initiatives, if any, tick all features. To what extent mission-oriented features needs

to be fulfilled to be characterised as mission-oriented is up for interpretation and debate (Larrue, 2021). The framework is however useful to benchmark the extent of mission-orientation of current green industrial policy. In this thesis the features are assessed on a scale of 1-5, from not fulfilled to fully fulfilled. The difference between the assessed level of fulfilment of each feature and their complete fulfilment constitute the gap between current green industrial policy and mission-oriented green industrial policy, as referred to in RQ1.

Table 3-1 Own framework: Mission-oriented framework for green industrial policy covering three mission-oriented dimensions, twelve mission-oriented features and their sources.

Mission-orientation dimension	Definition of mission-oriented feature	Sources
Strategic orientation (A)	A.1 - Ambition: The vision for industrial climate neutrality and its targets are bold, inspirational and have wide societal relevance.	(European Commission & Mazzucato, 2018)
	A.2 - Directionality: Green industrial policy has a clear and well-informed direction towards climate neutrality and specific, measurable and time-bound goals, with clear timeline and milestones.	(Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; European Commission & Mazzucato, 2018; Larrue, 2021; Nilsson et al., 2021)
	A.3 - Legitimacy: A consensus is found among a wide group of stakeholders regarding the need and relevance of action and mobilisation to reach industrial climate neutrality.	(European Commission & Mazzucato, 2018; Larrue, 2021)
	A.4 - Realistic: The research and innovation actions needed to achieve industrial climate neutrality are ambitious and realistically feasible within the given time period.	(European Commission & Mazzucato, 2018)
	A.5 - Stakeholder involvement: Stakeholders across scientific disciplines and sectors are involved in the policy processes, from the design to the revision of the green industrial policy and its climate neutrality target.	(Aiginger & Rodrik, 2020; Altenburg & Rodrik, 2017; European Commission & Mazzucato, 2018)

	<p>A.6 - Multiple bottom-up solutions and experimentation: The pathway to reach industrial climate neutrality targets is based on a bottom-up approach of multiple solutions encouraging cross-disciplinary and cross-sectoral collaboration and experimentation.</p>	(Altenburg & Rodrik, 2017; European Commission & Mazzucato, 2018; Nilsson et al., 2021)
	<p>A.7 - Flexibility: The industrial climate neutrality target and the means of intervention to meet said target both have mechanisms in place for revision to respond to changing circumstances if need be.</p>	(Altenburg & Rodrik, 2017; Larrue, 2021)
Mission-oriented policy (B)	<p>B.1 - Diverse and coherent policy mix: The green industrial policy mix encompasses a diverse and coherent set of policy interventions to support different disciplines, sectors and markets as needed to achieve industrial climate neutrality targets.</p>	(Altenburg & Rodrik, 2017; European Commission & Mazzucato, 2018; Nilsson et al., 2021)
	<p>B.2 - Market shaping: The green industrial policy creates new markets and reshapes existing ones to tilt the playing field in favour of the development and deployment of net-zero technologies to the extent needed to achieve its industrial climate neutrality targets.</p>	(Aiginger & Rodrik, 2020; Nilsson et al., 2021)
Mission-oriented finance (C)	<p>C.1 - Public finance mobilisation: Public finance is patient and is willing to take on higher risks and channel resources along the innovation chain of net-zero technologies as needed to achieve industrial climate neutrality targets. Further, public finance leverage other forms of finance, including private finance.</p>	(European Commission & Mazzucato, 2019; Mazzucato & Mikheeva, 2020; Nilsson et al., 2021)
	<p>C.2 - Risks and rewards: Public investments in the innovation chain of net-zero technologies aim at risk-sharing and public agencies reap some financial rewards of its investments to benefit citizens.</p>	(Mazzucato, 2016, 2021; Mazzucato & Mikheeva, 2020)

	C.3 - Private finance mobilisation: Private stakeholders are mobilised to commit resources along the innovation chain of net-zero technologies to the extent needed to achieve industrial climate neutrality targets.	(European Commission & Mazzucato, 2019; Larrue, 2021)
--	--	---

4 Research design, materials and methods

4.1 Research design

To study mission-oriented policy features in EU green industrial policy a qualitative explorative approach has been chosen. An explorative approach is suitable given the limited previous research on the subject and a qualitative design allows to describe and explore a topic that has not yet been extensively studied (Creswell & Creswell, 2018). Data was collected through semi-structured interviews and a quantitative survey. The quantitative survey was primarily designed to support the scoping of the interviews but also to provide additional data to RQ1. RQ2 and RQ3 are answered only with qualitative data. Therefore, even though quantitative data was collected the study remains mainly qualitative in its design.

Qualitative research tends to adopt an inductive approach to the relationship between theory and data collection. In inductive research theory is the outcome of the data collection, in contrast to deductive theory where data is collected to test a theory which is associated to quantitative research. This dichotomy is however somewhat of a caricature and in practice the relationship between theory and data can be more ambiguous and nuanced in qualitative research which is the case in this thesis (Clark et al., 2021, p. 357-358). There are benefits with conducting qualitative analysis using both deductive and inductive strategies including improved analytic transparency and it helps the researcher apply concepts from literature which in turn support the trustworthiness and applicability of the study (Bingham, 2023).

The thesis adopts a non-strict deductive approach with inductive elements. The study is deductive in that the research problem was deduced and inspired by the potential application of mission-oriented innovation policy on the green industrial policy domain. The aim of the thesis is however not to test how well mission-oriented innovation policy theory can be applied to green industrial policy but to contribute with knowledge on the feasibility of enhancing transformative features in the EU's green industrial policy, using mission-oriented innovation policy theory as a lens. To reach this aim a non-strict deductive approach with inductive elements is better suitable than a strictly deductive approach in order to better capture the richness of the qualitative data.

To specify, the analytical framework of mission-oriented green industrial policy features was built inductively from literature on mission-oriented innovation policy and green industrial policy with no pre-determined codes. The data collection process was designed to follow the analytical framework and therefore strongly influenced by existing theory. The data analysis was mainly deductive with the use of pre-determined main codes from the analytical framework. The pre-determined main codes were however open allowing the data to determine their boundaries and a few main codes were identified inductively. This last step was important to ensure that the richness of the collected qualitative data was not lost due to the mainly deductive approach and instead could be captured in the analysis.

The research design is congruent with the research paradigm pragmatism which does not subscribe to any one ontological and epistemological stance and instead draws elements from other research paradigm's philosophical assumptions. Pragmatist researchers are known to mainly focus on the research problem and then use pluralistic approaches to derive knowledge about the problem. Other relevant philosophical assumption for the thesis influencing the research design is that 1) research always occurs in social, historical, political, and other contexts in line with the pragmatist

research paradigm, 2) that narratives of the current situation and future scenarios are of importance which draws on constructivist assumptions and 3) there is an assumption that political action for rapid societal change is necessary to tackle climate change drawing on aspects of the transformative research paradigm. (Creswell & Creswell, 2018)

4.2 Methods for data collection

4.2.1 Identification and Recruitment of Informants

The informants to include in the study was narrowed down to stakeholders working with EU green industrial policy from organisations active in Brussels. Five different stakeholder groups were selected to provide a variety of perspectives and insights from politics, NGOs, academia and industry: the EU Commission, the EU Parliament, environmental NGOs, think tanks and trade associations. NGOs, trade associations and think tanks working on the EU level were chosen due to their in-depth knowledge on current EU green industrial policy and that they do not represent any individual EU member state but rather represent their stakeholder group on the EU level. A stratified sampling strategy was used for the selection of informants from the stakeholder groups.

Relevant representatives from the stakeholder groups were identified through desktop research and were approached to participate in the study by e-mail. Within the EU Commission representatives were approached in various Directorate-General working with green industrial policy. In the EU parliament, Members of the European Parliament (MEPs) and their political assistants were approached that have been working with green industrial policy in either the Committee on the Environment, Public Health and Food Safety (ENVI) or the Committee on Industry, Research and Energy (ITRE). A balance between the stakeholders' party group affiliation was ensured in the reach-out to the EU Parliament. For the NGO and think tanks stakeholder groups, the organisations approached were selected based on their prominence in Brussels and active work and/or research on green industrial policy were approached. Representatives from trade associations were approached based on the organisations' relevance to the steel, cement and/or chemicals sectors. In a couple occasions the approached stakeholder referred the request to a colleague within the same organisation which then could be recruited to the study.

4.2.2 Data collection methods

Two main methods were chosen to collect data from the EU stakeholders: qualitative semi-structured interviews and an online quantitative survey. The use of two methods to answer RQ1 entails that there was methodological triangulation which may allow for a more in-depth understanding of the studied phenomenon as each data collection method has inherent limitations (Denzin, 2015).

A semi-structured approach to the interviews was taken allowing the researcher to guide what questions are asked which enables a more targeted data collection than an unstructured approach. The flexibility of a semi-structured approach allowed for the order of planned interview questions to be rearranged during the interview to improve its flow and new follow-up questions were asked in some circumstances. Limitations of interviews as a data collection method is however that bias from the researcher in terms of the researcher's opinions or expectations may affect the data

collection. To mitigate this risk data triangulation was carried out through desktop research including reviewing relevant EU documents (Denzin, 2015).

An interview guide was also developed beforehand. The interview guide covers the twelve features in the analytical framework with three associated questions, each following the logic of the research questions. First, a question to motivate their rating of current fulfilment of the feature in the survey to identify if there is a gap. If a gap is identified a follow-up question is asked about what measures could be needed to enhance the feature fulfilment. Lastly, a question is asked about the feasibility of the measures suggested. An additional question on enabling conditions for transformative green industrial policy was added iteratively after the first four interviews had been conducted to provide additional information to RQ3. See complete interview guide in Appendix C.

In advance of the interview, informants were requested to fill in an online survey. The main aim with the survey was to inform which features were the most relevant to ask each stakeholder to allow for as comprehensive data collection about all twelve features despite the limited timeframe of the individual interviews. It also contributed with valuable data to answer RQ1 gathering the informants' assessments of the features' fulfilment in the current EU green industrial policy landscape.

In the online survey the informants were asked to rate the fulfilment of the features from 1-5 not fulfilled to fully fulfilled or not sure, see survey questions in Appendix D. The features selected for the interview were the ones the interviewee had rated having low fulfilment in the survey, features that the interviewee had rated relatively lower and/or substantially higher than other interviewees. When possible, still adhering to the previously stated selection criteria, features were selected to cover multiple mission-oriented dimensions and as a wide range of features as possible within the stakeholder groups. In the end most interviewees were asked about 4-6 features depending on how extensive answers were given and the time available. Furthermore, in most interviews 2-4 additional features were brought up by the interviewee and were therefore indirectly partially addressed. See table 4-1 for features covered by each informant during the interviews.

4.3 Materials collected

In total, 15 semi-structured interviews were conducted in the period of 4-18 March 2024 with representatives from all selected stakeholder groups: EU Commission (n=4), EU Parliament (n=3), trade associations (n=3), NGOs (n=3) and think tanks (n=2). The roles and positions of the informants included Senior Policy Officer, Director/Head of office, Political advisor and Associate Fellow. 13 interviews were conducted in person in Brussels at the organisations' offices and two interviews were conducted online over Zoom. The interviews ranged from 25-70 minutes, with most interviews being 50-60 minutes.

Other documents such as the EU Green Industrial Policy strategies, green industrial legislations and EU institutions websites on various green industrial policy were consulted when needed to provide additional information to complement and triangulate findings in the interviews.

4.4 Methods for data analysis

Thematic, qualitative content analysis was used to analyse the interview transcripts. Qualitative content analysis (QCA) is a method for describing the meaning of qualitative material in a systematic way. A key element of QCA is classifying materials as instances of codes of a coding frame. QCA is an appropriate method when dealing with rich data that requires interpretation e.g. interview transcripts (Schreier, 2012, p 1-4).

Thematic QCA is a particular type of qualitative QCA which in addition to systematically describing meaning of qualitative materials also focus on identifying patterns across data to capture themes in the collected materials (Braun et al., 2019; Schreier, 2012, p. 39). Thematic analysis (TA) itself should be understood as an umbrella term for several different approaches to identify themes across qualitative materials. For this thesis the school of TA adopted can best be described as 'codebook' which draws on elements from two other schools of TA, reliability TA and reflexive TA.

The 'codebook' approach used in this thesis draws on the more structured elements on reliability coding. The pre-determined coding frame was identified mainly deductively from previous knowledge and theory reflected in the analytical framework and related interview questions, so called concept-driven QCA. Sub-codes and a few main codes on the other hand were identified inductively from the collected data, so called data-driven QCA (Schreier, 2012, p. 84-90). The latter step allows for a less structured and more open and iterative coding process which enhances the depth of researcher engagement with the data materials emphasised in reflexive TA (Braun et al., 2019). Themes in this study are understood in line with reliability coding where themes are understood as domain summaries which summarises collected data in relation to a topic. This is suitable for this study which explored many aspects of an extensive analytical framework where a broad analysis of its application was prioritised over a deeper analysis of fewer aspects.

The interviews were transcribed using the AI transcription tool GoodTape and manual editing to prepare the data for data analysis. Coding was conducted for the interview transcripts using the qualitative data analysis software NVivo. Thereafter more detailed analysis of the codes was carried out in analysis matrices in Excel.

In addition to thematic QCA analysis of interview transcripts, RQ1 was answered by also analysing survey results to assess the fulfilment of the mission-oriented green industrial policy features, based on the developed analytical framework. In the survey the features were rated on a scale 1-5, where 1 indicated not fulfilled and 5 indicated full fulfilled. The final assessment of feature fulfilment was based on the researcher's judgement based on both the survey and interview results.

Table 4-1 A list of the informants according to stakeholder group with associated informant code for in-text referencing and mission-oriented features discussed during the interviews (A.1-C.3)

Mission-oriented green industrial policy feature (in code)		A.1	A.2	A.3	A.4	A.5	A.6	A.7	B.1	B.2	C.1	C.2	C.3
Stakeholder group	Informant code (for in text-referencing)	Features covered in interviews (X - selected as a primary topic, O - addressed indirectly)											
European Commission	EC1	X			X	O	O	O	X	X	X	X	O
	EC2	O				O			X		O		
	EC3	X		O		X	X		O	X	O		O
	EC4		X		X		O		X	O	X	X	X
European Parliament	EP1	O	X	O				X	X	X	X	X	X
	EP2	O	X			X		X	O	O	X		
	EP3		X	X	X	O			O			X	O
Environmental NGO	N1		X			O	X		X	X	X		O
	N2		X	X	O	X	X		O		X		X
	N3	X	X	X		X			O		O	X	O
Trade association	TA1	O	X		O	O	X		X	O	X		X
	TA2	X					X	X	X	X	X	X	
	TA3		X		O	X	X	X	X	X	X		X
Think tank	TT1	O	X	O		X		X	X	O	X	X	O
	TT2	X		X				X	X	X	X	X	X

5 Results and analysis

5.1 Feature results

5.1.1 Overview of Survey results

No feature is currently rated as corresponding to a fully mission-oriented approach; the features Legitimacy and Stakeholder Involvement is rated the highest with an average of 3.3, while Risks and Rewards received the lowest average of 1.7.

In table 5-1 averages of ratings for the features are provided for the stakeholder groups and feature averages based on all informants. In the last row, an average of all features assessment can be seen in each stakeholder group. The table indicates that the EU Commission and the think tank stakeholder group in general indicated the smallest gap between current EU green industrial policy and a mission-oriented approach followed by the EU Parliament, Trade Association and lastly the NGO stakeholder group indicating the largest gap. Deeper analysis of respective survey results for each feature will be presented below.

Table 5-1 Overview of survey ratings of the twelve mission-oriented features from all five stakeholder groups. The table also includes averages of rated features and averaged ratings within stakeholder groups.

	EU Commission	EU Parliament	NGOs	Trade associations	Think tank	Feature average
A.1 Ambition	3.8	4.3	2.7	1.5	3.0	3.2
A.2 Directionality	3.3	2.3	1.0	2.3	3.0	2.4
A.3 Legitimacy	3.7	3.3	2.7	3.3	3.5	3.3
A.4 Realistic	3.3	2.3	2.3	3.0	3.5	2.8
A.5 Stakeholder involvement	3.8	3.7	2.3	3.0	3.5	3.3
A.6 Multiple bottom-up solutions and experimentation	3.7	3.0	2.7	2.0	3.0	2.8
A.7 Flexibility	3.0	2.0	3.0	2.0	3.0	2.6

B.1 Diverse and coherent policy mix	2.8	2.3	2.3	2.0	2.5	2.4
B.2 Market shaping	2.8	2.7	2.0	2.0	2.5	2.4
C.1 Public finance mobilisation	3.5	2.0	2.7	2.3	2.5	2.6
C.2 Risks and rewards	1.0	1.5	1.3	2.5	3.0	1.7
C.3 Private finance mobilisation	1.5	2.7	2.0	2.7	2.5	2.3
Stakeholder average	3.0	2.7	2.2	2.4	3.0	2.6

5.1.2 A.1 Ambition

Feature definition: The vision for industrial climate neutrality and its targets are bold, inspirational and have wide societal relevance.

A majority of the informants rated the feature to be moderately to fully fulfilled, see table 5-2. Four informants rated the feature fulfilment to be lower and belonged to the stakeholder groups NGO, trade associations or think tanks. The stakeholder group EU Parliament rated the feature to have the highest feature fulfilment as a group followed by the EU Commission. The trade associations rated the feature fulfilment the lowest, followed by the NGOs.

Table 5-2 Survey ratings of the feature Ambition. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
3	4	5	3	5	4	4	3	3	2	1	2	-	4	2

In the survey the informants were only asked to assess the target itself and not the narrative around the target. In the interviews the definition was opened up to also include the narrative around the target. From the interviews it became clear however that some informants had adopted a wider definition of the feature definition when rating the feature including also the feasibility of reaching the climate neutrality target. This led to a lower assessment in the survey for some informants compared to how the informant motivated and assessed the feature in the interview.

Based on the interviews the informants generally agreed that current target of industrial climate neutrality by 2050 at the latest is bold and the correct target. According to T2 the ambition is “extremely high and probably close to the limits and to some extent you know, in some respects over the limits.”

EP1, EP2, N2 and TT1 however think that a broader common vision of what industry should look like in the future and how far-reaching the changes to get there will be is lacking and is urgently needed. N2 believes that narrative needs to change from only focusing on competition to rather look at what type of jobs and industries we want. N3 thinks that the vision needs to be more comprehensive and address social justice and climate aspects jointly to be bold and have wide societal relevance. Today the vision has a too narrow focus on net-zero technologies to reach carbon neutrality overlooking e.g. biodiversity and circular economy measures and lacks global justice consideration. Barriers to this kind of more holistic narrative according to N3 is that it is more complex and may be less catchy than the technology-narrative and that there is strong resistance from industry. The upcoming EU election is seen as a potential opportunity by N3 to raise discussions on visions and narratives and try to make the holistic approach more feasible.

Additionally, all inquired informants indicated that conditions to reach to target is missing e.g. related to the policy mix and public and private finance and that this lowered their assessment of the feature fulfilment. More private and public finance, market shaping policy, issues related to permits are measures mentioned by informants. Stakeholder involvement was also highlighted by N2 and N3 as a necessary condition that currently is lacking. The feasibility of these measures will be covered under C.1 Public finance mobilisation, C.3 Private finance mobilisation, B.1 Coherent and diverse policy mix, B.2 Market shaping and A.5 Stakeholder involvement.

5.1.3 A.2 Directionality

Feature definition: Green industrial policy has a clear and well-informed direction towards climate neutrality and specific, measurable and time-bound goals, with clear timeline and milestones.

The informants had quite different perceptions about the fulfilment of the feature ranging from 1 not fulfilled to 4 mostly fulfilled, see table 5-3. European Commission representatives indicated the highest fulfilment as a group and the NGO representatives the lowest fulfilment of the feature.

Table 5-3 Survey ratings of the feature Directionality. Rating 1-5 (not fulfilled – fully fulfilled)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
4	4	2	3	3	2	2	1	1	1	1	4	2	3	3

Factors mentioned in the interviews indicating some directionality towards climate neutrality were EU’s climate targets for 2030 and 2050 and related climate legislation such as EU ETS. The main gap identified was the lack of prescriptive plans and guidance from the EU on how the studied sectors should reach the climate neutrality target and when the different milestones should be met. In the 2020 Industrial Strategy and in the EU Climate law it was stated that there would be transition pathways for the sectors but currently there is only one sector specific transition pathway for the chemicals sector on EU level. To increase directionality multiple interviewees requested sectoral roadmaps to decarbonise the sectors (EP2, N2, N3). The feasibility of the measure is described as quite good by the informants across stakeholder groups.

Two different approaches to directionality were identified in the interviews. EC4 highlighted that directionality needs a bottom-up approach where it is the industry that needs to be clear about its plans and timelines. EP1 and N1 rather underlined the need for more direction from the EU on

what fundamental changes need to happen in the industries to reach climate neutrality and ensure that the policies are consistent with the target.

Additional measures to increase directionality mentioned by several of the interviewees were various policy measures including phase out plans or bans for the most polluting technologies e.g. blast furnaces in the steel industry (EP1, EP2, N3). The feasibility of the measure was assessed to be moderate and that it depends on the political equilibrium. TA1 and TA3 underlined the need for ensuring that there is a business case to improve the economic feasibility of green undertakings. Current finance for green solutions was also described as insufficient and in need of improvement by N3 and TT1. The feasibility of these measures will be covered under B.2 Market shaping, C.1 Public finance mobilisation and C.3 Private finance mobilisation.

5.1.4 A.3 Legitimacy

Feature definition: A consensus is found among a wide group of stakeholders regarding the need and relevance of action and mobilisation to reach industrial climate neutrality.

Most informants assessed the fulfilment of the legitimacy feature as moderately or mostly fulfilled, see table 5-4. The NGO stakeholder group stands out as the group were two out of three assessed the fulfilment to be only partially fulfilled.

Table 5-4 Survey ratings of the feature Legitimacy. Rating 1-5 (not fulfilled – fully fulfilled), number (informant indicted that they wanted to rate it differently in the interview and rating was adjusted.)*

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
3	-	4	4	4	3	3	2	4*	2	2	4	4	4	3

Several interviewees indicated that there is an agreement between a wide group of stakeholders on the need to decarbonise and reach climate neutrality by 2050 (N2, N3, TT1, TT2). On the other hand, there is not a consensus on *how* the targets should be met according to the interviewees. NGO representatives mention several differences between civil society and industry’s approach to the transition such as that industry often is conditioning the transition to having certain conditions in place e.g. access to public finance (N2, N3).

The importance of citizens in legitimacy considerations is highlighted by several informants. It is mentioned by trade association representatives that public acceptance for the transition requires a willingness to pay for CO₂ which they do not think necessarily is the case (TA1, TA2). TA2 highlights that it therefore is important to prove to citizens that increased CO₂ prices really contributes to overall emission reductions as this likely will increase willingness to accept such costs. It was pointed out by think tank representative that the complex policymaking processes in the EU and the intense lobbying of business and NGOs making it difficult for the average citizens to understand the EU processes and to have an influence which reduces legitimacy within this stakeholder group (TT2). EC1 however believes that there is a good social acceptability about e.g. that EU is investing much to decarbonise industry.

TT2: I think if you're talking technocratic elites and policy makers there's a fairly high amount of legitimacy if you include wider society um probably not. [...] I mean, a lot of the Brussels policymaking processes are very difficult to understand for the average citizen.

Measures suggested to increase the legitimacy are to create more spaces for stakeholders to discuss points of tensions and to have just transition policies to make the transition more acceptable to workers. The feasibility of more stakeholder dialogues is assessed as low due election times in the EU. The feasibility of just transition policies are covered under B.1 Diverse and coherent policy mix.

5.1.5 A.4 Realistic

Feature definition: The research and innovation actions needed to achieve industrial climate neutrality are ambitious and realistically feasible within the given time period.

In the survey the feature was rated as partially to mostly fulfilled by the informants, see table 5-5. The EU parliament and NGO stakeholder groups stands out for rating the feature somewhat lower than other groups.

Table 5-5 Survey ratings of the feature Relastic. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
2	-	4	4	3	2	2	2	2	3	2	4	-	4	3

From the interviews it became clear that most informants rated the feature fulfilment based on a broader definition of realistic than the given feature definition. The informants included not only R&I actions but also the economic and practical feasibility of needed net-zero technologies to be deployed and scaled at the speed needed to reach the industrial climate neutrality target. This led to a lower assessment in the survey for some informants compared to how the informant motivated and assessed the feature in the interview.

From a technology point of view, it is realistic to reach industrial climate neutrality in the EEIs by 2050 according to enquired informants from the Commission, NGOs and industry representatives. TA1 states that the current status of technology is sufficient to reach climate neutrality by 2050 but thinks a lot of research could be needed to improve it further. The main difficulties rather lie in the economic feasibility of the technologies and practical feasibility of actual transition on the ground.

Measures to increase the economic feasibility suggested are to enhance public and private investments into net-zero technologies (EC1). According to EC4 the economic feasibility will get better over time and view the speed of the practical transition on the ground as the greatest challenge. This concern is shared by TA1 who says that the number of plants that will have to be converted per year until 2050 will be impossible in terms of technical transition on the ground. Difference between feasibility to reach the industrial climate neutrality target between sectors was also highlighted. The steel industry is pointed out as the sector that may be the easiest to decarbonise and chemicals the sector that may be the trickiest given its diversity (N2).

A technology mentioned that would need more support is CCS (EC4, EP3, TA1, TA3). Measures suggested by EP3 to enhance the feasibility of CCS is more directionality on CCS from EU, channelling public funding to the technology and related infrastructure. An industry representative also raises public acceptance for CCS infrastructure as critical for the technology’s development. EP3 raises the high risk for CCS as a barrier for finance for the technology and that risk-sharing between the public and private sector is very important. Resistance from socialist and greens in

the EU Parliament is also mentioned by EP3 as a barrier for policy supporting scale-up of CCS since they want to limit the use of CCS to the heavy industry. Informants from the NGO and EU Parliament stakeholder group however disagreed that CCS is necessary for the decarbonisation of the EEIs and argued that there are other available technologies. N1 thought that public finance should not be directed to CCS but that private finance could invest in whatever technology they wish.

5.1.6 A.5 Stakeholder involvement

Feature definition: Stakeholders across scientific disciplines and sectors are involved in the policy processes, from the design to the revision of the green industrial policy and its climate neutrality target.

Most informants assessed that the feature Stakeholder involvement is moderately or mostly fulfilled, see table 5-6. Similarly, as for legitimacy it is the NGO stakeholder group that assess the fulfilment of the feature the lowest as a group.

Table 5-6 Survey ratings of the feature Stakeholder Involvement. Rating 1-5 (not fulfilled – fully fulfilled), number (informant indicated different rating in the interview and rating was adjusted)*

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
4	4	4	3	4	3*	4	3	2	2	2	4	3	3	4

EU's online public consultations where anyone interested can submit their feedback in the decision-making process is mentioned as a process that enable stakeholder involvement in the EU by three interviewees (N2, TA3, TT1). Multiple interviewees however highlight that the stakeholder involvement was limited in the Net Zero Industrial Act due to it being presented when it was not expected, that the public consultation was kept open at its minimum of four weeks and that it was negotiated very fast (EP3, N2, N3).

Industry is depicted in the interviews as a stakeholder group that that have many possibilities to provide their inputs to the policymaking. NGOs on the other hand does not have as much visibility and as many opportunities to provide their input according to several informants (EP2, N2, N3, TT1). Two NGO representatives (N2, N3) describe that many spaces where industrial policy is discussed are held behind closed doors where NGOs and citizens are excluded. Three informants (N2, N3, TT2) mentioned the recent meeting organised under the Belgian Council presidency where industry leaders presented 'The Antwerp Declaration for a European Industrial Deal' to Belgian Prime Minister, Alexander De Croo and Commission President, Ursula von der Leyen, was given as an such example where NGOs had not been invited.

TT1: [...] it's one thing to fill in a survey on like on the EU website and say what you think and another thing to like, you know, meet with von der Leyen and, you know, tell her what you want.

The main measure suggested by the interviewees is that the EU institution should create more opportunities for stakeholder involvement from NGOs, civil society, academia, trade unions to balance the industry perspective (EP2, N1, N2, N3, TT1). The feasibility of organising more stakeholder dialogues is assessed fairly high but dependent on the outcome of the upcoming election. TT1 however mention factors lowering non-industrial actors' ability to influence

compared to industry actors which are difficult to change such as non-industrial actor's generally lower economic resources and lower economic power in the sense that they cannot threaten to leave the EU as industry actors can.

5.1.7 A.6 Multiple bottom-up solutions and experimentation

Feature definition: The pathway to reach industrial climate neutrality targets is based on a bottom-up approach of multiple solutions encouraging cross-disciplinary and cross-sectoral collaboration and experimentation.

The assessment of the feature fulfilment ranged from no fulfilment to mostly fulfilled in the survey by the informants, see table 5-7. The feature also had the highest frequency of 'Not sure' responses. The Commission stakeholder group stands out as the group assessing the feature fulfilment the highest.

Table 5-7 Survey ratings of the feature Multiple Bottom-up Solutions and Experimentation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), number (informant indicated different rating in the interview and rating was adjusted)*

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
3	-	4	4	3	-	-	2	3*	-	1	2	3	-	3

Informants shared that the bottom-up approach is strong and central amongst those working with R&I, including working interdisciplinary and cross-sectorally. Industry representatives state that there is plenty of cross-sectoral collaboration between industries which is driving innovation. EC3 adds that industries become less cross-sectoral as the technology readiness level increases but that it is a natural consequence of technologies getting closer to the market. The main gap identified by the informants is that the bottom-up approach is not reflected in EU legislation. Their definition of what a bottom-up approach reflected in legislation entails differs, however. N2 thinks that EU legislation should promote a bottom-up approach by promoting newcomers using innovative breakthrough technologies rather than favouring the status quo and mentions the free allowances under EU ETS as an example. TA1 describes a bottom-up approach where there is a business case to carry out the green transition and where industry does not have to wait on policymakers for support. TA2 and TA3 highlight the need for technology neutrality in EU legislation. TA2 mentions that much policy only support the most optimal solutions which prevent a broader range of solutions.

TA3: So this is why in some cases, like with the net zero industry act, they have selected a few technologies, but it would be important to keep also technology neutrality approach to make sure that the innovation of tomorrow can have the right incentives.

N1 does not agree and think that that there is too much focus on technology neutrality and that the Commission should favour and pick the technologies that are mature and working.

N1: So, I think that we are at the stage where we have to pick the technologies and strategies that we know that are going to work and spark them boost them massively. It's not time for wait again for the next big thing that will solve everything.

Two NGO representatives (N1 and N2) also emphasise in relation to the feature that the Commission should take a more balanced stakeholder approach and include non-industrial actors

more. The feasibility of the Commission ‘picking technologies’ is assessed to be low by N1. For the feasibility of having a balanced stakeholder approach see section A.5 Stakeholder Involvement.

5.1.8 A.7 Flexibility

Feature definition: The industrial climate neutrality target and the means of intervention to meet said target both have mechanisms in place for revision to respond to changing circumstances if need be.

A majority of the informants rated the feature as partially or moderately fulfilled, see table 5-8. The European Parliament group and the Trade Association group stand out indicating the lowest feature fulfilment.

*Table 5-8 Survey ratings of the feature Flexibility. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), * (data point was removed due to informant indicating it was incorrect or could not motivate their ranking in the interview)*

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
-	4	2	3	2	2	-	4	2	3	2	2	2	3	*

When the interviewees elaborated on their assessment on the features it became clear that most of the informants assessed the feature based on a broader understanding of the feature than the definition given. This led to a lower assessment in the survey for some informants compared to how the informant motivated and assessed the feature in the interview.

Many informants across stakeholder groups indicated that there are mechanisms in place to revise legislation (EP1, TA2, TA3 and TT2). That the EU’s policy cycle is not always well aligned with what the EU is facing was pointed out as a reason for why legislation sometimes is slow to change to societal needs (EP2, TA3). Usually when a law has been decided the legislation is not reopened until the date stated in its revision clause. However, if there is political motivation to change the legislation earlier there are no legal barriers to do so (EC4, EP1).

On the other hand, several interviewees point out that too much flexibility can be problematic. EP1 states that there should not be too much flexibility regarding the climate neutrality target since a consistent debate on the targets would reduce directionality in the transition. TA2 and TT1 highlight that too recurrent changes in the policy also can hamper legal certainty and therefore also investments.

One measure that was mentioned by two EU Parliament representatives (EP1, EP2) to enhance flexibility was to use more delegated acts when suitable which can be changed much more quickly than legislation which has to go through a full policy cycle. This would however entail giving more power to the Commission from the European Parliament and the Council and the feasibility of this measure gaining support is therefore low (EP1).

5.1.9 B.1 Diverse and coherent policy mix

Feature definition: The green industrial policy mix encompasses a diverse and coherent set of policy interventions to support different disciplines, sectors and markets as needed to achieve industrial climate neutrality targets.

All informants rated the feature as moderately fulfilled or lower indicating a consensus on that there is room to enhance the feature fulfilment, see table 5-9. No great discrepancies are identified between the stakeholder groups, but is rated somewhat higher in the EU Commission stakeholder group and somewhat lower in the Trade association stakeholder group.

Table 5-9 Survey ratings of the feature Diverse and coherent policy mix. Rating 1-5 (not fulfilled – fully fulfilled)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
3	3	2	3	1	3	3	2	3	2	1	2	3	2	3

When it comes to diversity of the policy mix representatives from the Commission and think tanks states that the policy mix is pretty diverse. EC2 and EC4 are the most optimistic about both diversity and coherence stating that most policy elements are in place to reach climate neutrality.

EC4: So the directionality is there very very strongly I think and that has built also the consistency in EU policy. It has not been a stop-and-go policy like in other parts of the world.

Other informants strongly disagree e.g. N1 stating that they don't see a consistent direction in the policy mix. TT1 describes current policy mix as a patchwork of regulations and requests some type of package from the Commission to pull together all policies to a coherent policy framework for industrial decarbonisation. TT2 assess the feasibility of this measure to be fairly high stating that many actors including industry would want this. The climate ambition of this policy framework would however depend on the outcome of the upcoming election.

TA2 thinks that the policy mix is relatively clear and consistent where EU has full competence but less so where the competence is shared with Member States. To increase coherence changes will have to be made to the EU treaties (TA2). The feasibility of changing EU treaties is however very low according to TA2 since it would require even more powers to the EU which Member States would not accept.

Other informants think the certain policies are lacking for the policy mix to be diverse and coherent. With the current policy mix multiple informants lack market shaping policies (EC1, EP1, N1, TA1, TT1), fair and social transition policies such as reskilling programs and social conditionalities on public finance (EP1, EP2, N2, N3, TA3) and policy for circularity and resource use (N1, N2, N3). Policies enhancing facilitative conditions for industry such as access to renewable energy and infrastructure on e.g. hydrogen was expressed to be missing by EP1, TA1 and TA3. Additional conditions two trade association representatives (TA1, TA3) stated were lacking were access to alternative feedstocks and simplified permitting conditions.

The feasibility of market shaping measures will be covered under B.2, Market shaping. The feasibility of just and social transition policies EP1 assesses as low due to EU not being so strong on the social dimension and that most competencies lies with the Member States. The feasibility of social conditionality to public finance will be covered under C.1 Public finance mobilisation. The feasibility of more policy on circular economy is mixed, on the one hand circular economy measures could make the transition cheaper due to less feedstock being needed but on the other hand there is currently a much stronger narrative around technologies being the main solution to decarbonise rather than circular economy measures and it might therefore be more politically sensitive. Lastly the feasibility of the enabling conditions cheap access to renewable energy is low according to EC1 and says that it links more to Member States policy than to EU policies. TA1 is

sceptical about the EU being able to build out infrastructure for CO₂ at the pace they have announced and presents that laws will have to change of Member State level as a barrier.

5.1.10 B.2 Market shaping

Feature definition: The green industrial policy creates new markets and reshapes existing ones to tilt the playing field in favour of the development and deployment of net-zero technologies to the extent needed to achieve its industrial climate neutrality targets.

The perceived fulfilment of market shaping is more varied than diverse and coherent policy mix with rankings ranging from not fulfilled to mostly fulfilled, see table 5-10. It is also possible to note a larger discrepancy in rating within stakeholder groups than for other features. The largest discrepancy is seen within the EU Commission and EU parliament stakeholder groups ranging from 1-4 and the smallest within the Think tank stakeholder group ranging from 2-3.

Table 5-10 Survey ratings of the feature Market Shaping. Rating 1-5 (not fulfilled – fully fulfilled)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
1	4	3	3	1	3	4	1	3	2	1	2	3	3	2

Market shaping in the current policy mix mainly take shape through EU ETS and CBAM which will be introduced in 2026 and all informants gave examples of measures that could be needed to enhance feature fulfilment. Related to carbon pricing, stakeholders from various stakeholder groups expressed that a higher CO₂ price is needed to make more net-zero technologies economically feasible and that a fluctuating CO₂ price therefore can be problematic (EC4, N2, TA1). A Commission representative suggests that Carbon Contracts for Difference (CCfDs) could be used as an instrument to hedge the carbon market and compensate companies until a certain carbon price (EC4). The feasibility of using CCfD as a carbon price hedging instrument C4 assesses to be high as CCfD in principle already can be used in the innovation fund for competitive bidding.

Green public procurement was the most commonly mentioned measure to drive demand of low-carbon products and was mentioned by 10 of 11 informants who talked on the topic. To enable public procurement and create transparency about the climate impact of the products five informants highlighted that it is necessary to set definitions for green steel, cement and chemicals. Further, several informants suggested to introduce different eco-design requirements for the products e.g. on CO₂ intensity (EC4, EP1, N3)

Green public procurement was assessed to have relatively high feasibility by the informants. There is an ongoing discussion on the topic and more acknowledgement of that the measure is needed (EC3, TA2). Public procurement is included in the Net Zero Industry Act which could indicate movement on the area. However, first common definitions are needed for green steel, cement and chemicals. EC3 assesses this work as feasible even though setting a definition for chemicals will be challenging and shares that there is ongoing work on the issue with the International Energy Agency.

When it comes to eco-design requirements the feasibility increases by that the Eco-design for Sustainable Products Regulation is in place, but it is very much up to the Commission how strongly they will develop those (TT1). According to N1 it is very distant to happen.

Barriers identified by multiple informants across stakeholder groups which could apply to all suggested policy measures are that more environmental legislation is being rejected by Member States and conservatives in the European Parliament which could be linked with the upcoming election in June 2024.

5.1.11 C.1 Public finance mobilisation

Feature definition: Public finance is patient and is willing to take on higher risks and channel resources along the innovation chain of net-zero technologies as needed to achieve industrial climate neutrality targets. Further, public finance leverage other forms of finance, including private finance.

Most informants assessed the feature to be partially or moderately fulfilled with a few exceptions in the Commission and NGO stakeholder group rating it either higher or lower, see table 5-11.

Table 5-11 Survey ratings of the feature Public finance mobilisation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
3	-	4	-	2	2	-	1	3	4	2	2	3	3	2

In the interviews, the feature public finance mobilisation was extensively discussed covering multiple topics which will inform the structure of this section.

Existing public finance in the EU

The EU has different channels to finance the development and deployment of net-zero technologies. The main instruments on the EU level highlighted in the interviews were Horizon Europe, the Innovation Fund and finance from the European Investment Bank. Most finance is however provided through state aid from Member States which has been simplified by relaxation of EU state aid rules. Many of the informants highlight that there are great disparities in economic capacity between Member State resulting in that most state aid comes from a few rich countries such as Germany and France, whereas other Member States are at a disadvantage and risk creating an unlevelled playing field in the EU (EP1, EP2, N3, TT1).

Investment gap

Despite existing finance provided by the EU and its Member States there is a big investment gap for the development and deployment of net-zero technologies to reach the industrial climate neutrality target according to informants from all stakeholder groups. Multiple informants suggest increasing EU level funding to shrink the investment gap and/or limit the risk of fragmenting the EU single market. Measures to increase EU funding for net-zero technologies given include common EU borrowing (EP1, N1, N2, TA2, TT1, TT2), increasing available EU funding by upgrading the innovation fund by making changes in the EU ETS law e.g. using Member States EU ETS revenues to scale net-zero technologies (EP1, TA1) and stop subsidies for fossil fuels and redirect it to net-zero technologies (EP2 and N1). In addition, in order to increase common EU financing EU fiscal rules and treaties might need to be changed (N1, TA2, TT2). When it comes to increasing public finance in the EU using state aid, it could be relevant that such investments should be more explicitly encouraged (TT2).

The feasibility for EU common borrowing is assessed fairly low at the moment due to strong last divides between northern and Mediterranean Member States with northern Member States having low appetite for more common EU funding and giving more power to the EU level. The Commission indicated in the NZIA that there would be new common EU funding through a Sovereignty fund but that did not happen in the end. Factors indicating that it might become feasible is that the EU has had common borrowing before, that the Commission is aware that there is a big funding gap and that voices calling for EU-wide finance are growing.

Regarding changing the EU ETS regulation to increase available funding for the innovation fund e.g. using EU Member States' ETS revenues is assessed as low. Firstly, the EU ETS was recently negotiated and therefore currently not on the table to be updated. Secondly, Member States are unlikely not be willing to give up revenues they see as theirs. When it comes to redirecting EU finance from fossil sectors to net-zero technologies N1 believes it could be difficult to implement given the risk of a social backlash as seen within the agriculture sector. Lastly on EU level finance, changing EU fiscal policy and/or EU treaties to enable more common EU financing is assessed to be very difficult by N1, TA2 and TT2 giving the current political context where MS are very reluctant to give EU more power.

More finance using state aid is assessed to be more feasible but dependent of the willingness of Member States and their financial capacity. The risk of fragmenting the EU common market however constitutes a barrier for the EU to support state aid strongly.

Targeting and conditionality of finance

Moreover, several informants highlighted gaps in how existing finance is targeted. A recurring issue raised was that public finance for deployment is lacking. There are several funding opportunities for lower technology readiness (TRL) levels, whereas finance for later TRL is much more limited according to informants (EP1, TA3, TT2). Funding directed to deployment is mainly channelled by the innovation fund and the European Investment Bank. According to informants there is a large gap between available money in the Innovation fund and the demand from projects applying for funding. There is therefore a risk that innovative technologies will fail due to insufficient funding after the demonstration stage but before achieving commercial viability. If it manages to reach commercial viability there is no longer a high risk and investments will return. This situation is called 'the valley of death' and was described by EP1 and TA3 in the interviews.

In addition to more finance for early deployment industry representatives calls for more finance for scale-up which constitute a later stage of deployment. Currently only the first few projects of its kind will be able to receive funding from the innovation fund. "What about finance for the transition of the normal plants?" asks one of the industry representatives (TA1). EC1 disagrees and state that private investments should cover the deployment and scale up of technologies and argues that this opens market opportunities if they are successful.

Other informants also disagree and think that public finance, should prioritise some sectors over others e.g. targeting smaller companies and only those using breakthrough technologies (EP1, N1, N2). This measure is highlighted as extra important given the limited size of public finance and the growing focus on public finance for other areas such as defence. Informants from various stakeholder groups also suggests that public finance should come with social and environmental conditionalities (EP1, N2, N3).

The feasibility of upgrading the innovation fund as a measure to increase finance for deployment is described above under ‘Investment gap’ and increasing finance for deployment through the European Investment bank will be described under C.1 Public finance mobilisation. Regarding social and environmental conditionalities to public finance it is assessed to be practically quite feasible but politically less feasible given political resistance from conservative parties.

Coordination of public finance

Another measure suggested to enhance the efficiency of existing finance is to improve the coordination between EU and Member States funding (EC3, EC4 and EP1). EC4 brings up the Strategic Technologies for Europe Platform (STEP) as ongoing work to coordinate finance that currently are in different pots creating links between MS and EU funding to make financing easier and smarter. Coordinated auctions between EU and MS is given as a concrete measure to pool EU and MS finance which could reduce the administrative burden for companies seeking finance. EC4 is optimistic about Member States joining efforts to pool EU and MS finance. Currently Germany has joined the coordinated auction initiative.

Patience, risk-willingness and leverage of public finance

A final aspect of public finance mobilisation discussed was patience, risk-willingness and leverage of the finance. EU public finance is patient and has good leverage on private finance but is lacking risk-taking according to EC1. In the context of risk-taking public finance, the European Investment Bank is mentioned by multiple interviewees. The EIB is described as a traditionally risk-averse institution (EC1 and TT2).

Two Commission representatives (EC1, EC4) believes that the EIB should be prepared to take on more risk. “If not them, who?” asks EC1. It could be feasible for EIB to take increased risks given the guarantee from the EU budget the EIB can get as a public bank according to EC4 and TT2. EC4 underlines however that it can take time to evaluate existing level on risk taking and therefore also measures to increase it. An NGO representative on the other hand do not see the need for public finance taking on high risks anymore given that many net-zero technologies now are mature (N1).

5.1.12 C.2 Risks and Rewards

Feature definition: Public investments in the innovation chain of net-zero technologies aim at risk-sharing and public agencies reap some financial rewards of its investments to benefit citizens.

The feature is on average rated to have the lowest feature fulfilment by the informant, see table 5-12. Most informant assessing the feature to be not or only partially fulfilled with only two exceptions in the industry and think tank stakeholder groups.

*Table 5-12 Survey ratings of the feature Risks and rewards. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure), * (data point was removed due to informant indicating it was incorrect or could not motivate their ranking in the interview)*

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
1	-	1	-	1	2	*	1	2	1	1	4	-	*	3

When it comes to risk sharing EC4 and EP3 states that this is the terminology that is and should be used rather than derisking. On the other hand, two informants state that both public and private finance in the EU is a bit risk-averse if you compare globally (EC1, TT2). Regarding if public agencies should reap some financial rewards of its investments to benefit citizens the interviewees concluded that this is not currently the case in the sense of direct financial rewards. Three interviewees EP1, TT1 and TT2 also expressed hesitance or disagreement with that public agencies should reap direct financial rewards of their investments. Indirect financial rewards are currently captured by public agencies and citizens through tax revenues of successful companies (EP1, TA2). In addition, non-financial rewards are generated such as net-zero technologies contributing to a greener environment and that jobs are kept in the EU (EC1, TA2, TT1).

An NGO representative (N3) thinks that risks and rewards need to be better shared between the public and private sector.

N3: Industry has been asking the public to bear the risk it's like you know it's socializing the risk but like privatizing the profits.

EC1 thinks that more risk-sharing should be encouraged but believes the feasibility of increased risk-taking on the public side is low and therefore emphasizes the importance of risk taking on the private side. CCfD is mentioned by EC4 and TA2 as an instrument that could be relevant in regard both to risk- and reward sharing. When the CO₂ price is below a certain level the public compensates the companies. If the carbon price is above the decided level the companies instead pay back to the institutions. EC4 assesses the feasibility of using CCfD to be quite high. Additional measures suggested were to introduce some type of EU tax e.g. on windfall profits in the sectors if such were to arise (EP1). The feasibility of that kind of measure is assessed to be very low by both EP1 and TT2 since it is a competence of the Member States and that tax issues have a history of getting stuck in the EU legislative process.

5.1.13 C.3 Private finance mobilisation

The mobilisation of private finance is rated as partially or moderately fulfilled by all informants with the exception of two informants rating it lower in the Commission and NGO stakeholder group, see table 5-13.

Table 5-13 Survey ratings for the feature Private finance mobilisation. Rating 1-5 (not fulfilled – fully fulfilled), - (not sure)

EC1	EC2	EC3	EC4	EP1	EP2	EP3	N1	N2	N3	TA1	TA2	TA3	TT1	TT2
2	-	1	-	2	3	3	2	3	1	2	3	3	3	2

Among the inquired informants there seems to be a consensus that private finance mobilisation is key to financing the transition of the EEIs and close the current investment gap. N3 think that it is only right that the industry covers their own transition especially given the subsidies they have received over the years e.g. free allowances under the EU ETS. EC1 thinks private finance especially should cover finance for the deployment and scale-up of technologies. According to two EU Commission representatives (EC1 and EC4) private finance has been hesitant to invest due to the high costs of net-zero technologies, a too low CO₂ price and private finance being too risk-averse.

Key measures suggested to trigger private investments by non-industry informants are to ensure a sufficiently high CO₂ price to create a business case, introduce demand inducing policies and increase the risk willingness among private actors e.g. by increasing the depth of capital markets. EP1 also suggest forcing private investments by using standards for products requiring significant private investments.

Measures mentioned by TA3 to enhance private finance are to ensure that there is a business case both from an economic and practical point of view. Specific measure mentioned includes simplifying permitting conditions, keeping energy and feedstock prices low as well as sufficient public finance to de-risk private investments.

EC4 is optimistic that private finance will start to emerge in the coming five years thanks to the free allowances being phased out from EU ETS, maturity of technologies increases and public finance from the Innovation fund and Invest EU. N2 also thinks that the CO₂ price will increase due to ETS latest revision and that would give incentives to invest in breakthrough technologies.

When it comes to demand side measures TT2 assesses this as more feasible than to deepen capital markets. The feasibility of forcing private investments through standards for products EP1 assesses as feasible for some sectors. When it comes to the feasibility of advancing public investments see section C.1 Public finance mobilisation.

5.1.14 Features outside of the analytical framework

Findings identified which did not fit in the designed analytical framework but with relevance to mission-oriented green industrial policy were policy measures related the international dimension of green industrial policy and organisation for transformative green industrial policy.

A majority of the informants across stakeholder groups brought up the international dimension of green industrial policy in the EU and highlighted its importance for green industrial policy in the EU. Topics brought up related to the aim of strategic autonomy in the EU, international competition, the risk of green industrial protectionist policies creating diplomatic challenges and a trade-off between speed of deployment of net-zero technologies and buy-EU policies.

Lastly, three informants brought up the need for more collaboration across different departments working with different aspects of green industrial policy for more comprehensive and coherent green industrial policy (EC3, N2, N3).

5.2 Key barriers and enablers for transformative mission-oriented change

5.2.1 Key barriers for transformative mission-oriented change

Three key barriers are identified reducing the feasibility of increasing level of mission-orientation across several features. The first barrier deals with that the current design of EU and its treaties might not be compatible with producing the policy needed to achieve the industrial climate neutrality target. At the same time the feasibility of changing EU treaties is deemed to be low by

the informants. The EU usually moves slowly which is at odds with transformational change said TT2 in the interview. The only exception according to N2 and TA2 is during a crisis, when there is a huge sense of urgency, that more powers are given to the EU from Member States and more resources are mobilised e.g. common EU borrowing during the COVID-19 pandemic. TT2 therefore thinks that it is important to not expect too much from the EU institutions and also focus on Member State action and implementation. EC4 believes on the other hand that a strong EU pillar is crucial for transformative green industrial policy which is able to compete with China and the US.

A second barrier is the growing importance of other policy objectives both within industrial policy and in the broader policy landscape which may lead to climate neutrality objectives receiving lower priority. Within industrial policy objectives such as international competitiveness and strategic autonomy are on the rise. In relation to the broader policy mix there is e.g. a growing focus on public finance for other areas such as defence. Climate neutrality objectives risk losing priority especially if it is seen to be in conflict with competitiveness and strategic autonomy which was indicated by multiple informants.

EC1: So on the one hand we need to be ambitious with reaching the target, on the other hand the industry is very cautious with having too much pressure and too much norms, because then they really lose in terms of competitiveness.

EP2: And I will say here there is sometimes a tension between the deployment of clean techs and the production of clean techs. Because when you buy cheap clean techs from abroad, then you are accelerating the deployment. [...] If you wanted to only use made-in-EU solar panels today, we won't install much, but here there is two different aspects of clean tech production and deployment that needs to be reconciled. [...] We need to increase production in the EU and continue the deployment to reach our climate objectives.

Lastly, there is a growing resistance in the EU against new and ambitious climate legislation (EP3, TT1) with more voices advocating for a regulatory pause (N2). This lower the feasibility of many of the suggested measures related to diverse and coherent policy mix and market shaping, which many other features are dependent on for their fulfilment such as private finance mobilisation.

5.2.2 Key enablers for transformative mission-oriented change

In the interviews three enablers to transformative green industrial policy were identified. The first enabler relates to how green industrial policy is designed and organisation. According to EP1 and TA2, industrial policy needs to be discussed intertwined with other policy areas such as climate, energy, trade and competition policy to avoid that they conflict with each other. TA2 expresses that trade-offs between different policy objectives and traditional 'red lines' within various policy areas need to be challenged and addressed to extend the room of manoeuvre for industrial policy. An example of such as trade-off mentioned by TA2 relates to flexible state aid rules and a level playing field in the EU.

The second enabler is that the narrative stating that competitiveness suffers with strict environmental rules needs to change since it is not true and is used to hinder environmental policy according to EP1 and TT2.

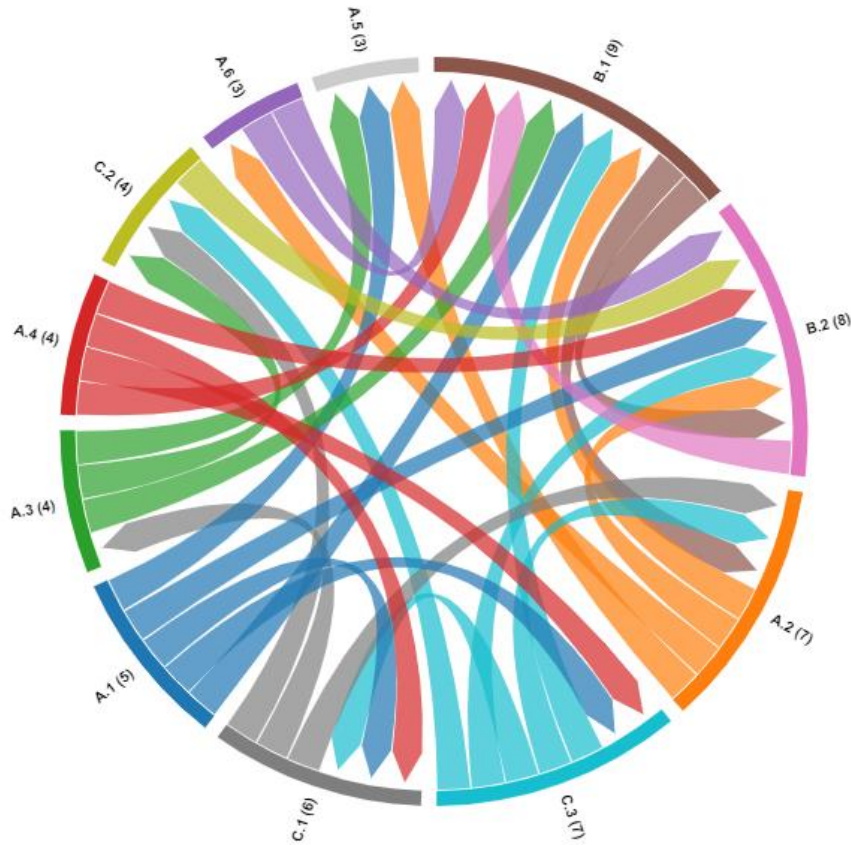
The last enabler is political will and courage and were highlighted by EP1, EP2 and N2 as an important enabler to overcome barriers for measures to advance feature fulfilment of various features. Many of the measures suggested by informants were described as practically feasible but unlikely due to the lack of political will.

5.3 Relationships between features

5.3.1 Dependencies between features

The interview data indicates various dependencies meaning that some features' fulfilment was dependent on the fulfilment of other features to some degree, indicating a positive reinforcing relationship between the features. These dependencies are illustrated in the chord diagram below (figure 5-1). Diverse and coherent policy mix and Market shaping were the features which the highest number of features were dependent on. These are followed by Directionality, Public finance mobilisation, Risks and rewards and Stakeholder involvement which all had three other features being dependent on them to some extent.

The features that on the other hand, were dependent on the highest number of other features were Private finance mobilisation and Ambition. Flexibility was the only feature that did not have a relationship with any other feature in terms of dependency. Some dependencies may be underrepresented due to the relationship being too evident to mention in the interview e.g. Market shaping on Ambition.



Legend	
A.1: Ambition	B.1: Diverse and coherent policy mix
A.2: Directionality	B.2: Market shaping
A.3: Legitimacy	C.1: Public finance mobilisation
A.4: Realistic	C.2: Risks and rewards
A.5: Stakeholder involvement	C.3: Private finance mobilisation
A.6: Multiple bottom-up solutions and experimentation	(Number): indicating number of relationships

Figure 5-1 Chord diagram of dependencies between features. The arrow from a feature indicates dependency on the feature the arrow is directed at.

5.3.2 Inherent tensions in the framework

Two pair of features displayed a negative relationship with one another. The first pair is Multiple bottom-up solutions and experimentation and Directionality. Due to e.g. limited public finance, a clear direction on what solutions should be prioritised is needed according to N2. In addition, N2 argued that net-zero technologies are already fairly market-ready and that there therefore is a lower need to encourage a broad range of solutions. This contrasts what e.g. TA3 said, who underlined the importance of not ‘picking technologies’. The second pair of features with a negative relationship is Flexibility and Directionality. If there is a high degree of flexibility where targets and interventions often change, Directionality risk to decrease which can have negative consequences for e.g. Private finance mobilisation (TA2, TT1).

5.4 Answers to the research questions

RQ1: What is the gap between the current EU industrial policy promoting the development and deployment of net-zero technologies to decarbonise the energy intensive sector and a mission-oriented policy approach to the same objective?

In the final assessment no feature is currently assessed as corresponding to a fully mission-oriented approach, ranging from a rating of (2) partially fulfilled to (4) mostly fulfilled – indicating a gap between current green industrial policy and a mission-oriented approach. In table 5-14, the survey assessment is based on the rounded off averages for the features in the survey. The final assessment is based on the survey assessments and the data collected during the interviews. In the final assessment Directionality, Diverse and coherent policy mix, Market shaping, Risks and rewards and Private finance mobilisation are rated to have the lowest fulfilment, only partially fulfilled, of the 12 features. The feature rated to have the highest fulfilment are Ambition, Realistic and Flexibility.

Table 5-14 Survey assessment and final assessment of feature fulfilment as well as key findings on feature fulfilment informing the final assessments.

Feature	Survey assessment	Final assessment	Key findings on feature fulfilment
Ambition (A.1)	3	4	+ Most stakeholders agreed target is ambitious - Target and its vision could be more holistic
Directionality (A.2)	2	2	+ EU climate targets provides a time-bound goal + Climate legislation such as EU ETS provides some direction - Sectoral decarbonisation roadmaps are missing leading to lack of specific goals and timelines
Legitimacy (A.3)	3	3	+ Most stakeholder groups in Brussels agree on the need for mobilisation to reach the target - Less consensus on how target should be reached - Legitimacy among citizens may be lower
Realistic (A.4)	3	4	+ High technological feasibility to reach target - Technological feasibility of CCS lower - Economic and logistic feasibility to deploy technologies to reach the target lower

Stakeholder involvement (A.5)	3	3	+ Public consultations + High involvement of industrial actors - Involvement of non-industrial actors lower
Multiple bottom-up solutions and experimentation (A.6)	3	3	+ Works well within R&I - Feature not reflected in regulation
Flexibility (A.7)	3	4	+ Mechanisms are in place for revision of targets and policies + No legal barriers hindering that policy can be updated before revision clause - The policy cycle for revision is not always well-aligned timewise with changing circumstances
Diverse and coherent policy mix (B.1)	2	2	+ Relevant policies from various policy fields are in place - Additional policies needed on e.g. just transition and access to inputs policies - Coherent policy framework missing
Market shaping (B.2)	2	2	+ Law on EU ETS and CBAM in place - Higher CO ₂ price needed and measures to deal with its fluctuations. - Policies on e.g. public procurement and eco-design requirements missing
Public finance mobilisation (C.1)	3	3	+ Several channels exists on EU level e.g. Horizon Europe and Innovation Fund + EU public finance leverages private finance - Huge investments gap remains - Gap of investments for deployment - Existing finance could be used smarter through e.g. coordination
Risks and rewards (C.2)	2	2	+ Indirect financial and non-financial rewards to citizens - No direct financial rewards to citizens - Risk-taking and sharing too low of both private and public actors
Private finance mobilisation (C.3)	2	2	- Private actors hesitant to invest given high costs of technologies and risk-averseness

The final assessment of most features is the same as the survey assessment. Three features are however rated higher in the final assessment: Ambition, Realistic and Flexibility. The assessments of these features differ due to informants taking other factors into consideration than the feature definition when rating the feature in the survey. The rating of Ambition was rated lower by many informants due to the lack of a coherent policy mix and sufficient finance which relate to other features. Realistic was rated lower due to informants incorporating not only the technical feasibility

in term of R&I actions as stated in the definition but also economic and logistic feasibility and CCS which was not included in the scope. Lastly, Flexibility was rated lower by informants also due to the policy cycle for revision not always aligned timewise with changing circumstances. Since there is no legal barrier to revise the legislation earlier however the feature is rated to be mostly fulfilled.

Furthermore, how large the gap between current EU green industrial policy and a mission-oriented approach in general is assessed to be differ between the stakeholder groups. The EU Commission and the think tank stakeholder group in general indicated the smallest gap with an average rating of 3.0 based on all feature ratings. This was followed by the EU Parliament with an average rating of 2.7, Trade Association with an average of 2.4 and lastly the NGOs indicating the largest gap with an average of 2.2.

RQ2: What measures are needed to close the gap between current policy and a mission-oriented policy approach?

Measures were suggested by EU stakeholders to enhance the fulfilment of all twelve features, covering a wide range of policy instruments. Key measures suggested in relation to the mission-oriented dimension *Strategic orientation* were 1) a more holistic broader common vision of the industry of tomorrow, 2) sectoral roadmaps to decarbonise the sectors, 3) more opportunities for stakeholder involvement from non-industrial actors to ensure a balance stakeholder approach and 4) bottom-up approach reflected in legislation.

Central measures suggested in regard to the mission-oriented dimension *Mission-oriented policy* were 1) just transition policies, 2) policies for circularity and resource use, 3) access to renewable energy and infrastructure, 4) green public procurement and 5) eco-design requirements for steel, cement and chemicals.

Lastly, key measures in relation to mission-oriented dimension *Mission-oriented finance* were 1) common EU borrowing including changing EU fiscal rules and treaties, 2) more finance towards early deployment, 3) more targeted public finance towards smaller companies using breakthrough technologies, 4) encourage risk-and reward sharing e.g. through CCfDs, 5) ensure that there is a business case e.g. through sufficiently high CO₂ price. For a full list of the measures suggested by informants, see appendix E.

Moreover, differences and similarities could be seen in regard to what measures the different stakeholders suggested. The most coherent stakeholder groups in regards of suggested measures were the trade association and NGO which on many occasions suggested similar measures. The trade association stakeholder group put a heavy emphasis on ensuring a business case in which they included inter alia simplified permitting conditions and access to energy and infrastructure. The NGO stakeholder group underlined to a higher degree than other groups stakeholder participation and circular economy measures. Many measures were also suggested by representatives from the EU Parliament, NGO and/or think tanks such as the need for a common vision for industry of tomorrow, sectoral decarbonisation roadmaps and social and environmental conditionalities to public finance. Measures suggested from EU Commission representatives tended to focus on market shaping measures and measures related to public and private investments and risks and rewards. When it comes to measures to promote CCS these were often mentioned by representatives from the EU Commission, EU Parliament and Trade associations. Four measures were suggested by representatives from all or almost all stakeholder groups: just

transition policies, green public procurement, definitions for green steel, cement and chemicals and common EU borrowing.

RQ3: What is the feasibility of the measures needed to close the gap?

The four measures that were mentioned by all or almost all stakeholder group, just transition policies, green public procurement, definitions for green steel, cement and chemicals and common EU borrowing, could indicate that these might be more likely to take shape in the future or at least be central in upcoming policy discussions. For a detailed answer of the feasibility in relation to all the respective measures see Appendix E. Instead, here, a summarised assessment of the measures in relation to their feature will be described.

Market shaping, Private finance mobilisation, Directionality and Stakeholder involvement are features which suggested measures had high feasibility, indicating good potential for enhanced feature fulfilment. When it comes to Diverse and coherent policy mix and Risks and Rewards the feasibility was mixed, where some suggested measures were indicated to have high feasibility whereas other measures have low or moderate feasibility. This indicates potential to enhance the feature fulfilment but barriers to fully complete it. The feasibility of enhancing the feature fulfilment of Multiple Bottom-up solutions and experimentation, Public finance mobilisation, Ambition and Realistic were assessed to be low/moderate where some measures had low feasibility and other moderate feasibility. Lastly the feasibility to enhance the fulfilment of Legitimacy and Flexibility was assessed to be low, indicating the greatest difficulties to enhance the fulfilment.

In addition to the individual feasibility to enhance the feature fulfilments the three identified key barriers to enhance transformative mission-oriented change needs to be overcome to enhance the feasibility of transformative green industrial policy. These barriers are 1) structure of EU hampering transformative action, 2) competing objectives and 3) resistance against new climate legislation. To overcome these barriers and the ones identified in relation to the individual measures the identified key enablers may play an important role 1) industrial policy must be intertwined with other policy areas and points of conflict need to be addressed, 2) change of environmental vs. competitiveness narrative and 3) political will and courage.

6 Discussion

6.1 Towards a mission-oriented green industrial policy in the EU?

This section will discuss the main question of the thesis regarding the current conditions to advance a mission-oriented approach to green industrial policy in the EU. This will be done by firstly discussing rationales and caveats for adopting a mission-oriented approach to green industrial policy in the EU, secondly, opportunities and challenges when it comes to advancing mission-oriented features and lastly, enablers and barriers which could address the opportunities and challenges, in light of the research results and literature.

6.1.1 Rationale and caveats

The rationale for a mission-oriented green industrial policy in the EU finds support both from the study results and literature. The thesis takes its starting point that industrial decarbonisation by 2050 could be seen as a mission objective tackling a grand societal challenge and that a mission-oriented green industrial policy could be an appropriate approach. The result of the study provides support to this initial assumption by various EU stakeholders indicating high importance of most of the twelve features to achieve the industrial climate neutrality. Features pointed out as particularly important in relation to enhancing multiple features were Diverse and coherent policy mix, Market shaping, Public finance mobilisation, Risks and rewards, Stakeholder involvement and Directionality, see figure 5-1. These six features cover key aspects of mission-orientation across the three mission-oriented dimensions indicating value of enhanced mission-orientation to achieve the mission objective.

Moreover, the study results also provide indications that green industrial policy is motivated using a market fixing rationale, as described in 2.1.1. The large investment gap of both public and private finance and lack of risk-taking described by informants is fully in line with the description of the existence of various markets failures such as reluctance of risk-taking and insufficient carbon pricing leading to underinvestments in net-zero technologies described in literature (see e.g. (Criscuolo et al., 2023; Rodrik, 2014; Tagliapietra et al., 2023).

A potential caveat to mission-oriented green industrial policy on an EU level is its legitimacy, despite the feature being rated high in the survey. Legitimacy, understood as the consensus among a wide group of stakeholders about the need and relevance of action and mobilisation to reach industrial climate neutrality, was assessed to be fairly high within stakeholder groups in the EU but potentially lower when it comes to citizens (IT2). The fairly high assessment of the feature in the survey by EU stakeholders confirms the assessment regarding consensus among EU Stakeholders. When it comes to legitimacy among citizens it is likely lower due to the complex policymaking processes in the EU and the intense lobbying of business and NGOs making it difficult for the average citizens to understand the EU processes and to have an influence (IT2). Since missions are based around the idea of mobilisation and active participation of a wide range of stakeholders including citizens (Larrue, 2021; Mazzucato, 2018a) this might be more difficult to achieve at an EU level than on national or regional level.

6.1.2 Opportunities and challenges

When it comes to the opportunities to advance a mission-oriented approach, measures were suggested for all the features by informants on how the feature fulfilment could be enhanced. The measures suggested were a diverse mix of demand- and supply side measures including market-based instruments, product regulation which is supported by previous literature as key for effective green industrial policy (see e.g. Altenburg & Rodrik, 2017; Criscuolo et al., 2023; Ekdahl, 2023; Ekdahl et al., 2024). Many of the suggested measures received explicit support in literature e.g. the need for detailed plans in addition to climate targets for directionality and just transition policies (see e.g. Nilsson et al., 2021). The feasibility of the measures however varied, and some features were therefore shown to be more feasible to advance than others.

Several informants identified the risk of state aid from Member States causing fragmentation of the single market and further enhancing disparities and inequalities in the EU which also was highlighted in literature (see e.g. Bourgery-Gonse, 2023) and therefore called for EU level financing such as common EU borrowing to avoid this issue. The feasibility for EU level financing is currently however low given a strong divide between EU countries on the topic and also seen by the EU Commission downgrading the suggested Sovereignty Fund in the GDIP to the STEP. Only a think tank representative (IT2) mentioned increased use of state aid as a measure that might need to be explicitly more encouraged to enhance public finance for net-zero technologies, given the low feasibility of more common EU level funding. Given the controversy of the use of state aid and that state aid rules lately have temporarily been relaxed to encourage state aid use for industrial decarbonisation projects, see section 2.14 it can be understood why few informants mentioned this measure. How the EU in a scenario of explicitly encouraging state aid could deal with and potentially mitigate the consequences of continued intensified use of state aid rule are questions that would have to be looked into.

Another challenge regarding finance is that stakeholders did not agree on at which TRL private finance should cover investments rather than public finance. Multiple informants suggested more public finance towards deployment and representatives from the trade associations also called for more finance for scale-up. In contrast, a Commission representative stated that these activities should be covered by private investments. Traditional industrial policy withdraw support as soon as the technologies start to compete in the market, which is in line with the statement by the Commission representative. In green industrial policy there is however a case to support the deployment of net-zero technologies even beyond the point at which they break (see e.g. Altenburg & Rodrik, 2017) which should encourage more public finance for deployment to bridge the valley of death and ensure investments along the full innovation value chain of net-zero technologies.

Another likely challenge a mission for industrial climate neutrality in the EU would face is to exit the 'STI-only trap', meaning that missions mainly are kept in the realm of research and innovation, both in terms of what authorities are leading the mission and in terms of focus leading to a too narrow focus on technological innovation (section 2.2). In the interviews, stakeholders in Brussels working with innovation policy seemed to be the ones that were the most open to and already have adopted certain mission-oriented aspects in their work. This is in line with literature stating that the mission-oriented approach adheres to the 'common wisdom' of innovation policy (see e.g. Larrue, 2021). Some informants did however not agree with all mission-oriented features. Too much flexibility was mentioned as negative by a couple of informants, multiple bottom-up solutions was seen as negative in contrast to picking already successful technologies, high risk-taking was not seen as needed in public finance mobilisation and many informants were hesitant

towards the idea of direct financial rewards to public agencies related to Risks and rewards. This indicates that there will be resistance from stakeholder groups in Brussels in relation to certain aspects of different mission-oriented features. An industrial mission for the decarbonisation of the energy-intensive industries under the Horizon Europe therefore seems more likely than such an EU mission at the centre of the next EU industrial strategy. To pursue green industrial missions within broader industrial policy some convincing of stakeholders outside of R&I policy about the need of certain mission-oriented aspects would therefore likely be needed.

6.1.3 Key enablers and barriers

There are some key enablers and barriers identified to address the opportunities and challenges previously outlined. Key barriers and enablers differ from opportunities and challenges in the discussion in that the former were identified to have potential to enable or disable a wider set of mission-oriented features or mission-oriented policy as a whole.

In the study results three key barriers and enablers were identified. The barriers deserve to be discussed in further detail and in relation to existing literature since they need to be dealt with or overcome to advance a mission-oriented approach. Possibilities to overcome these barriers will be discussed based on the three enablers identified from the interviews and in literature.

The first barrier deals with that the functioning and governance of the EU, set in its treaties, might not be compatible with producing the policy needed to achieve industrial decarbonisation by 2050 and that the EU only moves fast when in a crisis. Inherent challenges related to the complex structure of EU policymaking is also raised by Veugelers et al., (2024) as a barrier to coordinated green industrial policy. The EU has issues with both coordination between the various level of governance and their respective competencies related to green industrial policy. To overcome these challenges strong leadership that is competent and accountable to clear goals and milestones is needed to coordinate the various level of governance responsible for different parts of EU green industrial policy (Veugelers et al., 2024). The issue whether the EU's policy-making system inherently is non-transformative and only can move fast in times of crises however remain. If this is the case the EU level might not be the appropriate level for mission-oriented industrial policy. Alternatively, treaties of the EU might have to be reconsidered to ensure a structure of EU policymaking which enables transformative change.

The second barrier deals with the growing focus of other industrial policy objectives than climate neutrality such as international competitiveness and strategic autonomy, which is seen in the EU's latest two industrial strategies and confirmed by literature (De Ville, 2023; European Commission, 2021, 2023b; Veugelers et al., 2024). This risk leading to climate objectives receiving lower priority and especially if its seen to be in conflict with other industrial policy objectives, which increasingly is the case in industrial policy (Aiginger & Rodrik, 2020)

The first enabler can be key to overcome this barrier and deals with changing the narrative about that there is a conflict between competitiveness and climate neutrality objectives, since this is not true and hinder environmental policy according to EP1 and TT1. The informants receive support from Lechtenböhmer & Fishedick (2020) and Altenburg & Rorik (2017) stating that the transition to climate neutrality holds great opportunities as the central driver of innovation for European industrial as well as for early movers to develop new markets.

TT1: Once the global demand for these products goes up, we need to be able to produce those. And if we can produce those and if we can be like the leaders, then we will have the competitive industries and the industries that have done all of these changes [---] they will be the competitive ones”.

In the long-term there is no trade-off between social, economic and environmental objectives as there is no economic success on an inhabitable planet. In the short-term there are however trade-offs such as increased price burden on producers which may risk their competitiveness (Altenburg & Rodrik, 2017).

The second enabler could help tackle both the first and second barrier, and deals with how green industrial policy is designed. In addition, to enhanced coordination between different EU level of governance and their respective competencies, coordination between various policy areas is needed so they do not conflict. That industrial policy should be intertwined with other policy areas is underlined by Aiginger & Rodrik (2020) as key to ensure successful industrial policy. Tightly connected to this enabler the point is the finding that more collaboration across the departments working with different aspects of green industrial policy is needed for coherent green industrial policy (see section 5.1.14). This aspects relates strongly to Mazzucato’s description of organisation for governing missions and related needed public capabilities (Kattel & Mazzucato, 2018; Mazzucato, 2016; Mazzucato & Kattel, 2023)

The last barrier deals with a growing political resistance in the EU against new environmental legislation which may fully jeopardize the short-term feasibility of enhancing mission-oriented green industrial policy. To overcome this barrier its antithesis political will is needed which constitute the third enabler identified in the interviews. This enabler connects to the public capability of leadership which Kattel & Mazzucato (2018) underlined as key to manage a mission and the type of strong leadership Veugelers et al. (2024) called for to overcome the first barrier. To overcome the second barrier related to managing to prioritize climate objectives in the presence of other industrial policy objectives political will and leadership is also likely pivotal.

To summarise the section there are rationales for mission-oriented green industrial policy in the EU and opportunities to enhance a mission-oriented approach. There are however substantial caveats, challenges and barriers to the use of the approach at EU level. A point that is repeatedly mentioned in the interviews is the complex structure of EU policymaking hampering coordinated green industrial policy and wide stakeholder involvement decreasing legitimacy. A potential enabler to mission-oriented transformative change identified in the study as specifically key to address various barriers is political will, strong leadership and courage.

6.2 Significance of the analytical framework

A secondary outcome of the study is that it to some extent tests how well a mission-oriented approach works as a lens to discuss transformative green industrial policy. All features in the analytical framework could be discussed with the informants in relation to EU green industrial policy indicating relevance of the framework for green industrial policy. It proved however to be difficult in the interviews to only address the development and deployment of net-zero technologies. The decarbonisation strategies circular economy and CCS were brought up in a majority of the interviews despite not being covered by the analytical framework and interview

questions. Due to the scope of the study, it was suitable to mainly focus on one of the decarbonisation strategies. However, informants' input regarding circular economy and CCS showed however that the mission-oriented features in the framework were relevant to also discuss these decarbonisation strategies. Adapted versions of the framework would likely work well to analyse potential industrial missions for circular economy and/or CCS. However, since CCS technologies have the potential to enable status quo technologies to continue to operate (Bataille et al., 2018) it entails the risk to be used in a non-transformative way. Before including CCS in a mission therefore, it would be integral to carefully discuss how it should be used to ensure that the mission remains transformative.

6.3 Critical reflections on research limitations

The methods applied in the study were sufficient and appropriate to reply the RQs. Limitations were however identified which will be covered below, in relation to the use of theory in the research design as well as key limitations in regard to the data collection approaches.

The research design was heavily influenced by the use of mission-oriented innovation policy as existing knowledge to inform the analytical framework. The analytical framework informed both survey and interview questions as well as the data analysis given the use of the features as pre-determined codes. The main focus of mission-oriented innovation policy is on innovation policy whereas this only constitute one aspect of industrial policy. The framework may therefore better cover features important to innovation such as Bottom-up solutions and experimentation policy than other industrial policy areas such as deployment. The relevance of chosen mission-oriented features was however confirmed to be important to green industrial policy by an extensive literature review of green industrial policy literature.

Furthermore, the use of the analytical framework to inform the interview guide was suitable to analyse these specific features but risk leading to important aspects of green industrial policy outside of the framework to not be captured. To counterbalance this risk a semi-structured approach in the interview was important to be able to follow up on elements outside of the analytical framework. The final open question in the interview guide was also important to let the interviewees complement the interviews with other aspects they believed to be important that had not been covered where e.g. the international dimension to green industrial policy was mentioned by some informants (see section 5.1.14). Similarly, in the data analysis it was important to allow for data-driven inductive codes to emerge and to allow some flexibility to the pre-determined codes to analyse data falling outside a narrow interpretation of the definitions provided in the analytical framework.

Additional limitations connected to the interviews relate to interview design and the representativeness of the study participants. A key limitation related to interview design was that not all questions could be asked to all informants due to time constraints. Decision rules for feature selection was therefore developed which prioritised asking about the features rated low, in the survey prior to the interview, by the informants in line with the RQs focusing of identifying the gap between current policy and a mission-oriented approach and measures to close the gap. This may however have led to the final assessment of feature fulfilment to have a tendency towards reflecting the assessments of informants indicating lower feature fulfilment to a higher degree. To counterbalance this risk informants who rated the feature fulfilments to be substantially higher

were also asked to motivate their rating which provided data indicating higher feature fulfilment. The decision rules also led to features that were rated low to be more extensively discussed than features rated high. Some features such as public finance mobilisation was often brought up by the informant themselves leading the feature to be covered to a greater extent than other features. This led to a that a more comprehensive analysis was possible regarding e.g. policy mix and finance issues in comparison to e.g. realistic and legitimacy.

Moreover, due to the multiple stakeholder groups covered in the study, only a limited number of informants could be interviewed for each group meaning limited representativeness of the informants for the stakeholder group as whole. This holds especially true for very diverse stakeholder groups such as the EU Parliament which have seven party groups. For the narrower stakeholder groups such as Trade associations and environmental NGOs, the representativeness of the informants are likely higher which also could be seen in the similar measures they suggested. However, the careful targeting of informants within the stakeholder groups and the very high acceptance rate of approached informants ensured that the recruited informants were highly relevant to the study. The 100 % response rate to the survey by the informants also allows for better comparison and analysis of the groups.

Lastly, when it comes to the survey a key limitation is that feature definitions could be interpreted differently by informants than intended when they assessed their fulfilment, which may have influenced their rating and reduced validity. In the interviews the informants had the possibility to motivate some of their ratings which provided information about how they had interpreted the features which allowed for a more correct analysis of their assessments. In particular, the features Ambition, Realistic and Flexibility were repeatedly interpreted wider than the feature definitions. However, since not all informants were asked about all features there is a risk that important information on how the feature was interpreted was lost and that the rating therefore does not perfectly correspond to the intended feature definition. This risk was mitigated to the extent possible by adjusting ratings when new assessments were indicated by interviewees and by excluding data points where the informant could not motivate their rating or indicated that they wanted to change it but did not indicate a new rating. Despite that not all informants could motivate all of their rating in the interview, trends were identified in how certain features were interpreted by the informants which was taken into consideration when analysing all informants' ratings for those features. The use of multiple informants' assessments across different stakeholder groups both in the survey and in the interview lowers the risk of this limitation having an impact on the validity of the final assessment.

The generalisability of results is however limited and should be understood as a contemporary snapshot view of specifically EU stakeholders' assessment of the feasibility of enhancing mission-oriented features a certain moment in time. The current fast developments in green industrial policy and the upcoming EU elections are two factors why the results need to be understood in a context-specific manner. Some findings may be transferable to other contexts, but that analysis does not fall within the scope of this study.

7 Conclusions and recommendations

7.1 Conclusions on mission-oriented EU green industrial policy

The aim of the thesis was to contribute with knowledge on advancing transformative change within green industrial policy to support the fulfilment of EU climate targets by answering the main research question about that the current conditions is to advance a mission-oriented approach to green industrial policy in the EU. This was achieved by answering the three RQs regarding existing gap between current EU green industrial policy and a mission-oriented policy approach, what measures could be needed to close the gap and what are their feasibility.

Based on the study results a gap between current green industrial policy and a mission-oriented approach was identified in relation to all twelve mission-oriented studied features. The fulfilment of the mission-oriented features ranged from partially to mostly fulfilled, with five features assessed as partially fulfilled, four features assessed as moderately fulfilled and three features assessed as mostly fulfilled. The average assessment of the twelve features fulfilments varied between the stakeholder groups from 2.2-3.0. Measures were suggested by EU stakeholders to enhance the fulfilment of all twelve features, covering a diverse mix of both demand- and supply measures, market-based instruments, product regulation and subsidies. Four measures were suggested by representatives from all or almost all stakeholder groups which could indicate a higher political feasibility for these measures: just transition policies, green public procurement, definitions for green steel, cement and chemicals and common EU borrowing. The feasibility of the suggested measures in general varied from very low to high feasibility.

Several key conclusions emerge from the analysed data regarding the main research question about current conditions to advance a mission-oriented green industrial policy in the EU. Firstly, it is shown that there are rationales for mission-oriented green industrial policy but that the challenges for citizens to influence and engage with the EU is a caveat when it comes to governing an industrial mission on an EU level.

Secondly, when it comes to opportunities to advance a mission-oriented approach the study results show that there are measures that can be taken to narrow the identified gap. The opportunities to advance the features however vary due to their different degree of current fulfilment and feasibility of their related suggested measures. The results show that certain of the studied features, such as Market shaping, Private finance mobilisation, Directionality and Stakeholder engagement, exhibit low fulfilment levels but demonstrate high feasibility of improvement. These features represent significant opportunities for enhancement to advance a mission-oriented green industrial policy in the EU.

On the other hand, there are measures such as Diverse and coherent policy mix, Risks and rewards, Legitimacy, Public finance mobilisation and Bottom-up solutions and experimentation which display low or moderate fulfilment and lower feasibility of the suggested measures. These measures might be particularly challenging to advance and may therefore require particular attention and effort to overcome existing barriers. Lastly, the features Ambition, Realistic and Flexibility exhibit lower feasibility of improvement yet are already largely fulfilled indicating that these features are already being largely addressed within the current framework. This group of measures require effort to maintain current level of fulfilment as well action to further enhance fulfilment to advance a mission-oriented approach.

To allow for these opportunities, however, substantial challenges and barriers need to be overcome. Challenges identified are the low feasibility of EU level finance and the negative consequences associated with the use of state aid as two ways to enhance public finance in the EU. Additional challenges are bridging the valley of death, as well as escaping the ‘STI-only trap’ and convincing actors outside of the R&I field of the benefits of a mission-oriented approach. A key barrier identified is the complex structure of EU policymaking hampering coordinated green industrial policy and wide stakeholder involvement which risk decreasing the legitimacy of mission-oriented green industrial policy at an EU level. Other barriers include the growing focus of other industrial policy objectives than climate neutrality and political resistance against new environmental legislation. Two important enablers identified to overcome barriers to mission-oriented transformative change are that green industrial policy must be designed intertwined with other policy areas which might require more cross-departmental governance as well as a shift in narrative that competitiveness and climate neutrality objectives would be at odds with one another. The enabler identified as particular key to enable mission-oriented transformative change is political will, strong leadership and courage.

In summary, the analysis has identified a gap between current green industrial policy and a mission-oriented approach to green industrial policy. To close the gap and increase level of mission-orientation targeted measures to enhance feature fulfilment are needed. The feasibility of the measures varies and are impacted by various barriers. However, by strategically addressing these barriers, focusing on facilitating needed enablers, the EU and its stakeholders could unlock the transformative potential of a mission-oriented approach and achieve industrial decarbonisation of the energy-intensive industries in the EU by 2050.

7.2 Practical Contributions and Recommendations

The outcomes of the research can contribute with various valuable insights to practitioners. Firstly, the results provide assessments of the current fulfilment of the mission-oriented features from five different stakeholder groups. This allows for comparison and can give an indication about the degree of shared understanding of current EU green industrial policy between stakeholder groups. Secondly, the study provides a list of concrete policy measures and their associated feasibility suggested by interviewed EU stakeholders to advance mission-oriented features which could be used by practitioners, see appendix E. Practitioners can also identify which stakeholder group(s) mentioned various measures which could give an additional indication about their perceived feasibility among various stakeholder groups.

Lastly, the results of the study generate a set of valuable recommendations on actions and features to prioritise to advance a mission-oriented green industrial policy in the EU:

- Directionality, Stakeholder engagement, Market shaping and Private finance mobilisation show particularly good opportunities to be enhanced and constitute a good starting point to advance a mission-oriented approach.
- Significant effort is needed towards producing more feasible measures and overcoming challenges and barriers to the suggested measures related to Legitimacy, Bottom-up solutions and experimentation, Diverse and coherent policy mix, Public finance mobilisation and Risks and rewards.

- In regard to the features Ambition, Realistic and Flexibility, the main priority should be to ensure that the current level of fulfilment is maintained.
- Overall, promoting the identified key enablers and taking actions aimed at overcoming the identified barriers and challenges should be prioritised. Actions include:
 - Convincing stakeholders outside of R&I policy about the need of certain mission-oriented aspects.
 - Ensuring sufficient finance for deployment.
 - Considering reviewing EU treaties to ensure a structure of EU policymaking which enables transformative change.

7.3 Recommendations for future research

The study makes a valuable theoretical contribution in developing a mission-oriented framework for industrial policy based on mission-oriented innovation and industrial policy literature. An additional theoretical contribution made is an analysis on the dependencies and points of tensions between the features in the framework. Lastly, the study makes an additional novel academic contribution by applying the analytical framework to analyse green industrial policy which has not adopted a mission-oriented approach. Overall, the study makes a valuable contribution to bridge the field of mission-oriented innovation and green industrial policy.

Regarding future research there is great potential to advance knowledge on transformative green industrial policy and there are many angles which could be explored. As this study focuses specifically on green industrial policy in EU and is the first of its kind, similar studies could be conducted in the EU and other contexts which could enable interesting comparisons, and with time potentially allow for findings that could be generalised and transferable. This type of studies could consider adopting a broader scope in regard to decarbonisation strategies and also including circular economy measures and/or CCS and adapt the analytical framework accordingly.

To deepen and complement the study made, a deeper document analysis of EU industrial strategies could be interesting to understand how the EU Commissions' language and position of mission-oriented aspects in green industrial policy has developed over time. More extensive research on legitimacy for an industrial mission in relation to citizens would be important to answer if the EU level is less suitable to govern an industrial mission compared to other governance levels. It would also be interesting to explore mission-oriented organisation and governance further as these seems to be an important enabler for transformative change and was excluded from the scope of this study.

Lastly, this study makes the assumption that mission-oriented policy and its features as a package have transformative capacity. In future research it would be interesting to explore if some of the mission-oriented features are especially important when it comes to driving transformative change and thereby provide more detailed recommendations on how to advance transformative change.

Bibliography

- Aiginger, K., & Rodrik, D. (2020). Rebirth of Industrial Policy and an Agenda for the Twenty-First Century. *Journal of Industry, Competition and Trade*, 20(2), 189–207. <https://doi.org/10.1007/s10842-019-00322-3>
- Altenburg, T., & Rodrik, D. (2017). Green Industrial Policy: Accelerating Structural Change Towards Wealthy Green Economies. In *Green Industrial Policy. Concept, Policies, Country Experiences*. UN Environment; German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).
- Bataille, C., Åhman, M., Neuhoff, K., Nilsson, L. J., Fishedick, M., Lechtenböhmer, S., Solano-Rodriguez, B., Denis-Ryan, A., Stiebert, S., Waisman, H., Sartor, O., & Rahbar, S. (2018). A review of technology and policy deep decarbonization pathway options for making energy-intensive industry production consistent with the Paris Agreement. *Journal of Cleaner Production*, 187, 960–973. <https://doi.org/10.1016/j.jclepro.2018.03.107>
- Berestycki, C., Carattini, S., Dechezleprêtre, A., & Kruse, T. (2022). *Measuring and assessing the effects of climate policy uncertainty* (OECD Economics Department Working Papers 1724; OECD Economics Department Working Papers, Vol. 1724). <https://doi.org/10.1787/34483d83-en>
- Bingham, A. J. (2023). From Data Management to Actionable Findings: A Five-Phase Process of Qualitative Data Analysis. *International Journal of Qualitative Methods*, 22, 16094069231183620. <https://doi.org/10.1177/16094069231183620>
- Bourgery-Gonse, T. (2023, September 12). Analysis: EU subsidy race is on – and Germany is winning it. *Euractiv*. <https://www.euractiv.com/section/economy-jobs/news/analysis-eu-subsidy-race-is-on-and-germany-is-winning-it/>
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic Analysis. In P. Liamputtong (Ed.), *Handbook of Research Methods in Health Social Sciences* (pp. 843–860). Springer Singapore. https://doi.org/10.1007/978-981-10-5251-4_103

- Chua, W. P., & Garvey, T. (2021). *2019 Greenhouse Gas Inventory for ETS*.
https://www.ets.org/content/dam/ets-org/pdfs/news/GHG-Inventory-Report_ETS_Final_090821_s.pdf
- Clark, T., Foster, L., Sloan, L., & Bryman, A. (with Vacchelli, E.). (2021). *Bryman's social research methods* (Sixth edition). Oxford University Press.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (Fifth edition). SAGE.
- Crisuolo, C., Dechezleprêtre, A., & Lalanne, G. (2023). Industrial strategies for the green transition. In S. Tagliapietra & R. Veugelers (Eds.), *Sparkling Europe's new industrial revolution: A policy for net zero, growth and resilience* (pp. 122–151). Bruegel.
- Crisuolo, C., Gonne, N., Kitazawa, K., & Lalanne, G. (2022). *An industrial policy framework for OECD countries: Old debates, new perspectives* (OECD Science, Technology and Industry Policy Papers 127; OECD Science, Technology and Industry Policy Papers, Vol. 127).
<https://doi.org/10.1787/0002217c-en>
- Danish Technological Institute, Joint Institute for Innovation Policy (JIIP), Joanneum Research, Joint Institute for Innovation Policy, TecNALIA, TNO, & VTT. (2018). *Mission-oriented research and innovation—Inventory and characterisation of initiatives: Final report*. European Commission. <https://op.europa.eu/en/publication-detail/-/publication/3b46ce3f-5338-11e8-be1d-01aa75ed71a1/language-en>
- De Ville, F. (2023). *The Return of Industrial Policy in the European Union* [Page]. Universiteit Gent. https://www.ugent.be/ps/politiekewetenschappen/gies/en/research/publications/gies_papers/2023-global-energy-crisis/the-return-of-industrial-policy-in-the-european-union
- Denzin, N. K. (2015). Triangulation. In G. Ritzer (Ed.), *The Blackwell Encyclopedia of Sociology* (1st ed.). Wiley. <https://doi.org/10.1002/9781405165518.wbeost050.pub2>
- Ekdahl, M. (2023). *Circular Industrial Transition: Can the green industrial policy revival support circular industrial transition in Sweden?* Lund University. <https://lup.lub.lu.se/student-papers/search/publication/9150815>

- Ekdahl, M., Milios, L., & Dalhammar, C. (2024). Industrial policy for a circular industrial transition in Sweden: An exploratory analysis. *Sustainable Production and Consumption*, 47, 190–207. <https://doi.org/10.1016/j.spc.2024.03.031>
- European Commission. (n.d.-a). *2030 climate & energy framework—European Commission*. Retrieved 9 January 2024, from https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2030-climate-energy-framework_en
- European Commission. (n.d.-b). *Carbon Border Adjustment Mechanism—European Commission*. Retrieved 7 May 2024, from https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en
- European Commission. (n.d.-c). *Fit for 55: Delivering on the proposals - European Commission*. Retrieved 9 January 2024, from https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals_en
- European Commission. (n.d.-d). *NextGenerationEU - European Commission*. Retrieved 7 May 2024, from https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu_en
- European Commission. (n.d.-e). *State Aid Overview*. Retrieved 14 December 2023, from https://competition-policy.ec.europa.eu/state-aid/overview_en
- European Commission. (n.d.-f). *Temporary Crisis and Transition Framework*. Retrieved 14 December 2023, from https://competition-policy.ec.europa.eu/state-aid/temporary-crisis-and-transition-framework_en
- European Commission. (2019). *Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions The European Green Deal*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>
- European Commission. (2020). *Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions A New Industrial*

Strategy for Europe. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0102&from=EN>

European Commission. (2021). *Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery.* <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0350&from=EN>

European Commission. (2022). *€3 billion call under the EU Innovation Fund* [Text]. European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6489

European Commission. (2023a). *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act).* <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0161>

European Commission. (2023b, February 1). *Communication from the Commission to the European parliament, the Council, the European economic and social committee and the Committee of the regions: Green Deal Industrial Plan for the Net-Zero Age: A Green Deal Industrial Plan for the Net-Zero Age.* <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:62:FIN>

European Commission. (2024, April 16). *EU Missions in Horizon Europe—European Commission.* https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en

European Commission & Joint Research Centre. (2021). *Shaping and securing the EU's open strategic autonomy by 2040 and beyond.* Publications Office. <https://data.europa.eu/doi/10.2760/414963>

European Commission, & Mazzucato, M. (2018). *Mission-oriented research & innovation in the European Union: a problem solving approach to fuel innovation led growth.* Publications Office. <https://data.europa.eu/doi/10.2777/36546>

- European Commission, & Mazzucato, M. (2019). *Governing missions in the European Union*. Publications Office. <https://data.europa.eu/doi/10.2777/618697>
- European Council. (2024a). *EU industrial policy*. <https://www.consilium.europa.eu/en/policies/eu-industrial-policy/>
- European Council. (2024b). *Strategic Technologies for Europe Platform: Provisional agreement to boost investments in critical technologies*. <https://www.consilium.europa.eu/en/press/press-releases/2024/02/07/strategic-technologies-for-europe-platform-provisional-agreement-to-boost-investments-in-critical-technologies/>
- GoodTape. (n.d.). *Security—Good Tape*. Retrieved 9 May 2024, from <https://goodtape.io/security>
- Hallegatte, S., Fay, M., & Vogt-Schilb, A. (2013). *Green Industrial Policies: When and How*. The World Bank. <https://doi.org/10.1596/1813-9450-6677>
- IPCC. (2022). *Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* (1st ed.). Cambridge University Press. <https://doi.org/10.1017/9781009157940>
- Janssen, M. J., Torrens, J., Wesseling, J. H., & Wanzenböck, I. (2021). The promises and premises of mission-oriented innovation policy—A reflection and ways forward. *Science and Public Policy*, scaa072. <https://doi.org/10.1093/scipol/scaa072>
- Kattel, R., & Mazzucato, M. (2018). Mission-oriented innovation policy and dynamic capabilities in the public sector. *Industrial and Corporate Change*, 27(5), 787–801. <https://doi.org/10.1093/icc/dty032>
- Larrue, P. (2021). *The design and implementation of mission-oriented innovation policies: A new systemic policy approach to address societal challenges* (OECD Science, Technology and Industry Policy Papers 100; OECD Science, Technology and Industry Policy Papers, Vol. 100). <https://doi.org/10.1787/3f6c76a4-en>
- Lechtenböhmer, S., & Fishedick, M. (2020). *An Integrated Climate-Industrial Policy as the Core of the European Green Deal*.

- https://epub.wupperinst.org/frontdoor/deliver/index/docId/7483/file/7483_Climate-Industrial-Policy.pdf
- Material Economics. (2019). *Industrial Transformation 2050 Pathways to Net-Zero Emissions from EU Heavy Industry*. <https://materialeconomics.com/publications/publication/industrial-transformation-2050>
- Mazzucato, M. (2016). From market fixing to market-creating: A new framework for innovation policy. *Industry and Innovation*, 23(2), 140–156. <https://doi.org/10.1080/13662716.2016.1146124>
- Mazzucato, M. (2018a). Mission-oriented innovation policies: Challenges and opportunities. *Industrial and Corporate Change*, 27(5), 803–815. <https://doi.org/10.1093/icc/dty034>
- Mazzucato, M. (2018b). *The entrepreneurial state: Debunking public vs. private sector myths*. Penguin Books.
- Mazzucato, M. (2021). *Mission economy: A moonshot guide to changing capitalism*. Allen Lane, an imprint of Penguin Books.
- Mazzucato, M., & Kattel, R. (2023). *Mission-oriented industrial strategy*. UNIDO. <https://www.unido.org/sites/default/files/unido-publications/2023-11/Mission-Oriented%20Industrial%20Strategy.pdf>
- Mazzucato, M., Kattel, R., & Ryan-Collins, J. (2020). Challenge-Driven Innovation Policy: Towards a New Policy Toolkit. *Journal of Industry, Competition and Trade*, 20(2), 421–437. <https://doi.org/10.1007/s10842-019-00329-w>
- Mazzucato, M., & Mikheeva, O. (2020). *The EIB and the new EU missions framework—Opportunities and lessons from the EIB’s advisory support to the circular economy* [IIPP Policy Report (IIPP 2020-17)]. UCL Institute for Innovation and Public Purpose. <https://www.ucl.ac.uk/bartlett/public-purpose/wp2020-17>
- Meckling, J. (2021). Making Industrial Policy Work for Decarbonization. *Global Environmental Politics*, 21(4), 134–147. https://doi.org/10.1162/glep_a_00624
- Nilsson, L. J., Åhman, M., Bauer, F., Ericsson, K., Johansson, B., Van Sluisveld, M., Valentin, V., Andersson, F. N. G., Chris, B., de la Rue du can, S., Hansen, T., Lechtenböhmer, S., &

- Schiro, D. (2020). A European industrial development policy for prosperity and zero emission. *ECEEE 2020 Industrial Summer Study Proceedings*.
https://www.researchgate.net/publication/342977476_A_European_industrial_development_policy_for_prosperity_and_zero_emissions
- Nilsson, L. J., Bauer, F., Åhman, M., Andersson, F. N. G., Bataille, C., De La Rue Du Can, S., Ericsson, K., Hansen, T., Johansson, B., Lechtenböhmer, S., Van Sluisveld, M., & Vogl, V. (2021). An industrial policy framework for transforming energy and emissions intensive industries towards zero emissions. *Climate Policy*, 21(8), 1053–1065.
<https://doi.org/10.1080/14693062.2021.1957665>
- OECD. (2020, June 25). *What is mission-oriented policy?* Mission Action Lab. <https://oecd-missions.org/key-topics/what-is-mission-oriented-policy/>
- OECD. (2023). *OECD Science, Technology and Innovation Outlook 2023: Enabling Transitions in Times of Disruption*. OECD. <https://doi.org/10.1787/0b55736e-en>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., De Wit, C. A., Hughes, T., Van Der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., ... Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461(7263), 472–475.
<https://doi.org/10.1038/461472a>
- Rodrik, D. (2014). Green industrial policy. *Oxford Review of Economic Policy*, 30(3), 469–491.
<https://doi.org/10.1093/oxrep/gru025>
- Schreier, M. (2012). *Qualitative content analysis in practice*. SAGE.
- Stöllinger, R. (2023). *Advancing the European Green Deal with industrial policy*.
- Tagliapietra, S., Trasi, C., & Veugelers, R. (2023). Europe's Green Industrial Policy. *ICE, Revista de Economía*, 932. <https://doi.org/10.32796/ice.2023.932.7657>
- Veugelers, R., Tagliapietra, S., & Trasi, C. (2024). Green Industrial Policy in Europe: Past, Present, and Prospects. *Journal of Industry, Competition and Trade*, 24(1), 4.
<https://doi.org/10.1007/s10842-024-00418-5>

- von der Leyen, U. (2023, February 1). *Statement by the President on the Green Deal Industrial Plan* [Text]. European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/statement_23_521
- Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy*, 41(6), 1037–1047. <https://doi.org/10.1016/j.respol.2011.10.015>
- Wyns, T., & Khandekar, G. (2019). Industrial Climate Neutrality in the EU: Outline of an Integrated Industrial Green Deal. *Intereconomics*, 54(6), 325–332. <https://doi.org/10.1007/s10272-019-0848-6>
- Yarmuth, J. A. (2022, August 16). *Text - H.R.5376 - 117th Congress (2021-2022): Inflation Reduction Act of 2022* (2021-09-27) [Legislation]. <https://www.congress.gov/bill/117th-congress/house-bill/5376/text>

Appendix A – Consent form for interview

Informed Consent Form Interview

This form is to ensure that you have been given information about the EU Green industrial policy MSc thesis project (see Information Sheet, page 2) and to give you an opportunity to confirm that you are willing to participate in the research as an interviewee. A signed form indicates consent and understanding of below points:

I have been familiarised with the EU Green Industrial Policy MSc thesis project, I have had the possibility to ask questions and I have received satisfactory answers to my questions before being interviewed
As a research participant, I am aware of my right to withdraw participation at any time
I give my consent that the interview can be audio- and/or video- recorded, recorded in writing, transcribed, translated and analysed
I give my consent to be identified by my position and stakeholder group
I understand that the results of the research will be presented so that no information can be traced to me personally / I have been informed that pseudonymity of participants will be ensured
I give my consent that an anonymous record of my interview will be safely stored for 10 years for future reference to thereafter be deleted

Note: Your participation is voluntary. As an interviewee, you do not have to answer all the questions that are asked; you reserve the right to refuse or cease participation in the interview process without stating your reason and may request to keep certain materials confidential. In addition, you have the right to review any summary or synthesis of the interview at any time up until the data is actually published.

There will be no monetary payment for participating in the research, but you will have contributed to a research project that generally aims at adhering to EU climate targets.

Please, sign below to confirm your consent – digital signatures are possible:

	Participant	Researcher
Name		Emma Wikström
Signature		
Date		15 March 2024

Information sheet

Thank you for indicating your interest in contributing to the EU Green Industrial Policy MSc thesis project conducted as the final part of the MSc degree program Environmental Management and Policy at the International Institute for Industrial Environmental Economics, at Lund University, Sweden.

Description of the Research Project

The MSc thesis seeks to explore the topic of EU green industrial policy promoting the development and deployment of new net-zero technologies in the steel, cement, and chemical industries in the EU. The main aim of the thesis is to contribute with knowledge on the feasibility of enhancing 'transformative features' of green industrial policy to decarbonise the energy-intensive industry in the EU. Twelve 'transformative features' have been identified and will be analysed in the study. The twelve features make up a framework for 'mission-oriented green industrial policy' which is inspired by literature on mission-oriented innovation policy and green industrial policy. To assess the feasibility of enhancing the 'transformative features' of EU green industrial policy, representatives from different EU stakeholder groups are interviewed including from the EU Commission, EU Parliament, trade associations, NGOs and think tanks.

Purpose of the Interview

Therefore, as part of this research project, I invite you to an interview. I would like to learn more about:

- *Your assessment of current EU green industrial policy's fulfilment of the above stated features.*
- *Your suggestions of measures that could be needed to enhance the fulfilment of the above stated features.*
- *Your assessment of the feasibility of the suggested measures.*

The collected information will be used to produce a MSc thesis which will be publicly available. The research might also result in the publication of an academic article. The research results benefit the society as a whole; they are not used to satisfy special interests of individuals.

Data Management

Collected data will only be used within the Green Industrial Policy thesis project. When the thesis project and potential publications are finalised, transcriptions of the interviews will be securely stored behind password for 10 years on Lund University servers as anonymous data. After that time period, the data will be deleted. In addition, data will be deleted at any time on request of the participant.

Throughout the research process, pseudonymisation of personal data is applied to ensure that no information can be traced back to the interviewee. Interviewees will be pseudonymised according to position and stakeholder group e.g. Policy Advisor, NGO. Special attention is paid to possible direct quotes so that they cannot inadvertently identify respondents.

The audio/video-recordings, if authorised by the interviewee, will be permanently deleted after they have been transcribed and analysed, hence they will not be stored for 10 years. At any stage of the Green Industrial Policy MSc thesis project, the research participants have a right to gain access to their own personal data, request data correction or limitations to how their data is processed.

For any enquiries regarding this research, please contact:

Emma Wikström
IIIEE / Lund University
Email: em2743wi-s@student.lu

Appendix B - Consent form for survey

Informed Consent Form Survey

Thank you for expressing your interest in contributing to the EU Green Industrial Policy MSc thesis project conducted as the final part of the MSc degree program Environmental Management and Policy at the International Institute for Industrial Environmental Economics, at Lund University, Sweden.

Description of the Research Project

The MSc thesis seeks to explore the topic of EU green industrial policy promoting the development and deployment of new net-zero technologies in the steel, cement, and chemical industries in the EU. The main aim of the thesis is to contribute with knowledge on the feasibility of enhancing 'transformative features' of green industrial policy to decarbonise the energy-intensive industry in the EU. Twelve 'transformative features' have been identified and will be analysed in the study. The twelve features make up a framework for 'mission-oriented green industrial policy' which is inspired by literature on mission-oriented innovation policy and green industrial policy. To assess the feasibility of enhancing the 'transformative features' of EU green industrial policy, representatives from different EU stakeholder groups are interviewed including from the EU Commission, EU Parliament, trade associations, NGOs and think tanks.

Purpose of the Survey

Therefore, as part of this research project, I invite you to fill in a survey as a preparation for and/or supplement to the interview. I would like to learn more about:

- *Your assessment of current EU green industrial policy's fulfilment of the above stated features.*

The collected information will be used to produce a MSc thesis which will be publicly available. The research might also result in the publication of an academic article. The research results benefit the society as a whole; they are not used to satisfy special interests of individuals.

Data Management

Collected data will only be used within the Green Industrial Policy thesis project. When the thesis project and potential publications are finalised, the collected data will be securely stored behind password for 10 years on Lund University servers as anonymous data. After that time period, the data will be deleted. In addition, data will be deleted at any time on request of the participant.

Throughout the research process, pseudonymisation of personal data is applied to ensure that no information can be traced back to the informant. Informants will be pseudonymised according to position and stakeholder group e.g. Policy Advisor, NGO. Special attention is paid to possible direct quotes so that they cannot inadvertently identify respondents. At any stage of the Green Industrial Policy MSc thesis project, the research participants have a right to gain access to their own personal data, request data correction or limitations to how their data is processed.

Agreeing to the consent form indicates consent and understanding of below points:

- I have been familiarised with the EU Green Industrial Policy MSc thesis project, I have had the possibility to ask questions and I have received satisfactory answers to my questions before answering the survey
- As a research participant, I am aware of my right to withdraw participation at any time
- I give my consent that the data collected from the survey can be analysed
- I give my consent to be identified by my position and stakeholder group
- I understand that the results of the research will be presented so that no information can be traced to me personally / I have been informed that pseudonymity of participants will be ensured
- I give my consent that data collected in the survey will be anonymously safely stored for 10 years for future reference to thereafter be deleted

Note: Your participation is voluntary. As an informant, you reserve the right to refuse or cease participation in the information collection process without stating your reason and may request to keep certain materials confidential. In addition, you have the right to review your own survey response at any time up until the data is actually published.

There will be no monetary payment for participating in the research, but you will have contributed to a research project that generally aims at adhering to EU climate targets.

For any enquiries regarding this research, please contact:

Emma Wikström
IIIEE / Lund University
Email: em2743wi-s@student.lu.se

Appendix C – Complete interview guide

A) Introduction to interview

Briefly introducing myself, revising research aim, reminder of scope and interview purpose.

B) Background of interviewee

- What is your current role in your organisation and how is your work related to green industrial policy?

C) ‘Transformative features’

1. Ambition

- You assessed the feature Ambition as X number, could you briefly motivate why?
- What measures could be needed to enhance the ambition of the climate neutrality target and the narrative around it?
- What is the feasibility of these measures?

2. Directionality

- You assessed the Directionality as X number, could you briefly motivate why?
- What measures could be needed to enhance the directionality towards climate-neutrality with a clear timeline with milestones?
- What is the feasibility of these measures?

3. Legitimacy

- You assessed the feature Legitimacy as X number, could you briefly motivate why?
- What measures could be needed to enhance the consensus about the need and relevance of mobilisation to reach the climate neutrality target?
- What is the feasibility of these measures?

4. Realistic

- You assessed the feature Realistic as X number, could you briefly motivate why?
- What measures could be needed to enhance how realistically feasible the research and innovation actions are?
- What is the feasibility of these measures?

5. Stakeholder involvement

- You assessed the feature Stakeholder involvement as X number, could you briefly motivate why?
- What measures could be needed to enhance stakeholder involvement across scientific disciplines and sectors in the policy process of green industrial policy?
- What is the feasibility of these measures?

6. Bottom-up solutions and experimentation

- You assessed the feature Bottom-up solutions and experimentation as X number, could you briefly motivate why?
- What measures could be needed to enhance a bottom-up approach which encourages cross-disciplinary and cross-sectoral collaboration and experimentation?
- What is the feasibility of these measures?

7. Flexibility

- You assessed the feature Flexibility as X number, could you briefly motivate why?
- What measures could be needed to enhance flexibility, with built-in mechanisms for revision of policy to respond to changing circumstances if needed?
- What is the feasibility of these measures?

8. Diverse and coherent policy mix

- You assessed the feature Diverse and coherent policy mix as X number, could you briefly motivate why?
- What measures could be needed to enhance the diversity and coherence of the green industrial policy mix?
- What is the feasibility of these measures?

9. Market shaping

- You assessed the feature Market shaping as X number, could you briefly motivate why?
- What measures could be needed to enhance market-shaping which tilts the playing field in favour of net-zero technologies?
- What is the feasibility of these measures?

10. Public finance mobilisation

- You assessed the feature Public finance mobilisation as X number, could you briefly motivate why?
- What measures could be needed to enhance the mobilisation of patient and risk-willing public finance?
- What is the feasibility of these measures?

11. Risks and rewards

- You assessed the feature Risks and rewards as X number, could you briefly motivate why?
- What measures could be needed to enhance reward-sharing of public investments so that public agencies reap some financial rewards of its investments?
- What is the feasibility of these measures?

12. Private finance mobilisation

- You assessed the feature Private finance mobilisation as X number, could you briefly motivate why?
- What measures could be needed to enhance the mobilisation of private investments?
- What is the feasibility of these measures?

D) Feasibility of transformative green industrial policy

- What could be needed to overcome the barriers currently hindering a transformative green industrial policy that could enable the EU to reach the goal of net-zero emission in the energy intensive industries by 2050?

E) Final remarks interview

- Do you have anything that you would like to add connecting to what we have been speaking about or any other dimension of EU green industrial policy that we did not cover?
- Any questions about the research?

Reminder on how data will be treated and ask if informant is interested in receiving the final report

Appendix D – Survey

Survey: Assessment of EU Green Industrial Policy Features

Thank you for filling out the survey as a preparation and complement to our upcoming interview!

Q19

Survey description

In the survey you will be asked to assess how well current green industrial policy fulfils 12 different 'transformative features'. Before each question you will be provided with a statement describing each 'transformative feature' applied to EU green industrial policy promoting the development and deployment of net-zero technologies for the energy intensive industries steel, cement, and chemicals. Your task is to assess how well current EU green industrial policy fulfils the feature described in the statement on a scale of 1-5, from not fulfilled to fully fulfilled.

Your assessment of the features will serve as a basis for our upcoming interview where we will discuss measures to enhance some of the features' fulfilment as well as the feasibility of these measures.

In the survey green industrial policy consistently refers to:

Green industrial policy aiming at climate neutrality by 2050 in the energy intensive industries **steel, cement, and chemicals** by promoting the development and deployment of **net-zero technologies** in the sector.

If you have any questions about the survey, please do not hesitate to reach out.

Email: em2743wi-s@student.lu.se

Phone: +46 738 773 622

Q2

1. Feature 1: Ambition

The target to reach climate neutrality in the energy-intensive industries in the EU by 2050 is bold, inspirational and has wide societal relevance.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q3

2. Feature 2: Directionality

EU green industrial policy has a clear and well-informed direction towards climate neutrality in the energy-intensive industries and specific, measurable, and time-bound goals, with clear timeline and milestones.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q4

3. Feature 3: Legitimacy

A consensus is found among a wide group of stakeholders regarding the need and relevance of action and mobilisation to reach climate neutrality in the energy-intensive industries in the EU by 2050.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q5

4. Feature 4: Realistic

The research and innovation actions needed to achieve climate neutrality in the energy-intensive industries in the EU by 2050 are ambitious and realistically feasible within the given time period.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q6

5. Feature 5: Stakeholder involvement

Stakeholders across scientific disciplines and sectors are actively and consistently involved in the policy processes, from the design to the revision of green industrial policy and its climate neutrality target.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q7

6. Feature 6: Bottom-up solutions and experimentation

The pathway to reach climate neutrality in the energy-intensive industries by 2050 is based on a bottom-up approach of multiple solutions encouraging cross-disciplinary and cross-sectoral collaboration and experimentation.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q8

7. Feature 7: Flexibility

The climate neutrality target for the energy-intensive industries and the means of intervention to meet said target both have mechanisms in place for revision to respond to changing circumstances if need be.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q10

8. Feature 8: Diverse and coherent policy mix

The green industrial policy mix encompasses a diverse and coherent set of policy interventions to support different scientific disciplines, sectors, and markets as needed to achieve climate neutrality in the energy-intensive industries by 2050.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q11

9. Feature 9: Market shaping

The green industrial policy creates new markets and reshapes existing ones to tilt the playing field in favour of the development and deployment of net-zero technologies for the energy-intensive industries to the extent needed to achieve climate neutrality in the sector by 2050.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q12

10. Feature 10: Public finance mobilisation

Public finance is patient and willing to take on higher risks and channel resources along the innovation chain of net-zero technologies for the energy-intensive industries to the extent needed to achieve climate neutrality in the sector by 2050. Further, public finance leverages other forms of finance, including private finance.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q13

11. Feature 11: Risks and rewards

Public investments in the innovation chain of net-zero technologies result in public agencies taking on risks of investments but also enable them to reap some of its financial rewards to benefit citizens.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q14

12. Feature 12: Private finance mobilisation

Private stakeholders are mobilised to channel resources along the innovation chain of net-zero technologies for the energy-intensive industries to the extent needed to achieve climate neutrality in the sector by 2050.

How well is the 'transformative feature' described in the statement fulfilled by current EU green industrial policy?

- 1: Not Fulfilled
- 2: Partially Fulfilled
- 3: Moderately Fulfilled
- 4: Mostly Fulfilled
- 5: Fully Fulfilled
- Not sure

Q17

13. Please feel free to share any comments you may have

----- -- SIDBRYTNING -- -----

Q15

14. Full name

Q16

15. Position and Organisation

Q20

Thank you for filling out the survey and contributing to the research!

Kind regards,

Emma Wikström

MSc Environmental Management and Policy
International Institute for Industrial Environmental Economics, Lund University

Appendix E – Tables of suggested measures and their feasibility

In the interviews measures to enhance feature fulfilment were suggested for all twelve features and their feasibility were assessed by the informants. Below table 0-2 presents the suggested measures by EU stakeholders and their assessed feasibility in relation to the twelve mission-oriented features. The feasibility of measures is missing for some measures where no answer was provided to the question or when the researcher missed to follow up a measure with a question on feasibility.

Table 0-2 Suggested measures by EU stakeholders and their assessed feasibility as well as their sources, in relation to the twelve mission-oriented features A.1-C.3.

Feature	Measures	Assessed feasibility	Sources
Ambition (A.1)	Broader common vision of industry and jobs of tomorrow		EP1, EP2, N2, TT1
	Holistic vision addressing social justice, circular economy and environment	Low/Moderate	N3, N1, N2
	Enhance public and private finance	See C.1 and C.3	EC1, EP2, TA1
	Market shaping measures e.g. regulations, norms, public procurement	See B.2	EC1
	Simplified permitting conditions	See B.1	TA1
	More stakeholder involvement	Moderate/High (see A.5)	N2, N3
Directionality (A.2)	Sectoral roadmaps to decarbonise the sectors	High	EP2, N2, N3
	Phase-out plans/bans for the most polluting technologies	Moderate	EP1, N3
	Governments should pick technologies	Low	N1
Legitimacy (A.3)	More spaces for stakeholders to discuss points of tensions	Low	N3
	Just transition policies	Low (See B.1)	EP1

Realistic (A.4)	Enhance public and private finance	See C.1 and C.3	EC1
	Enhance directionality and finance to CCS and related infrastructure aimed at risk-sharing	Moderate	EC4, EP3, TA1, TA3
Stakeholder involvement (A.5)	More opportunities for stakeholder involvement from non-industrial stakeholders to ensure balance between stakeholders	Moderate/High	EP2, N1, N2, N3, TT1
Multiple bottom-up solutions and experimentation (A.6)	Reflect bottom-up approach in legislation: ensure newcomers using breakthrough technologies are favoured over incumbents		N2
	Reflect bottom-up approach in legislation: Ensure that there is a business case		TA1
	Reflect bottom-up approach in legislation: Ensure technology neutrality		TA2, TA3
	Need for balanced stakeholder approach	Moderate/High (see A.5)	N1, N2
Flexibility (A.7)	More use of delegated acts	Low	EP1, EP2
Diverse and coherent policy mix (B.1)	Package for coherent policy framework for industrial decarbonisation	High	TT1
	Change EU treaties	Low	TA2
	Market shaping policies	See B.2	EC1, EP1, N1, TA1, TT1
	Just transition policies	Low	EP1, EP2, N2, N3, TA3
	Policies for circularity and resource use	Low/moderate	N1, N2, N3
	Access to renewable energy and infrastructure		EP1, TA1, TA3
	Access to alternative feedstocks		TA1, TA3

	Simplified permitting conditions		TA1, TA3
Market shaping (B.2)	Green public procurement	High	11 informants
	Set definitions for green steel, cement and chemicals	High	EC4, EP1, N1, N3, TT2
	Eco-design requirements for steel, cement and chemicals	Low/Moderate	EC4, EP1, N3
	Higher CO ₂ price		EC4, N2, TA1
	Use CCfD as CO ₂ price hedging	High	EC4
Public finance mobilization (C.1)	Common EU borrowing	Low/Moderate	EP1, N1, N2, TA2, TT1, TT2
	Redirect MS EU ETS revenues to the innovation fund	Low	EP1, TA1
	Stop subsidies to fossil fuels and redirect finance to net-zero technologies	Low	EP2, N1
	Change EU fiscal rules and EU treaties to enable common EU financing	Low	N1, TA2, TT2
	Encourage state aid for net-zero technologies	Low/Moderate	TT2
	More finance towards early-deployment		EC4, TT2
	More finance towards scale-up		TA1, TA3
	Targeted finance towards smaller companies using breakthrough technologies		EP1, N1, N2
	Social and environmental conditionalities to public finance	Moderate	EP1, N2, N3
	Increase risk-taking in the EIB	Moderate	EC1, EC4
Risks and rewards (C.2)	Encourage risk-sharing		EC1, N3
	Encourage reward-sharing		N3

	CCfD as instrument for risk and reward sharing	High	EC4, TA2
	Tax on windfall profits	Low	EP1
Private finance mobilisation (C.3)	Ensure sufficiently high CO ₂ price		EC4, N2
	Increase risk-willingness by increasing the depth of capital markets	Low/Moderate	TT2
	Adopt product standards requiring significant private investments		EP1
	Ensure a business case from business and practical point of view: including simplified permitting procedures, access to cheap energy and feedstock		TA3
	Sufficient public finance de-risking investments		TA3