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Exploring European SMEs in the cleantech sector

a survey-based analysis through European Green Deal pillars

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Executive summary

The European Green Deal stands as a pivotal driver for the experimental research conducted within this thesis. The project entails a comprehensive study of the Green Deal and its pillars through official documentation, integrated with interviews extracted from conferences and literature articles.

As part of a broader three-year project falling under the EIBURS initiative, I directly engaged in the development and implementation of a questionnaire targeting small and medium-sized enterprises (SMEs) across Europe. We meticulously implemented the questionnaire, from its architectural design to administration and subsequent analysis of responses. The study of these responses not only provides valuable insights but also serves as a guiding indicator for the project's sponsors, the European Investment Fund (EIF) and the European Investment Bank (EIB). In this historical period, characterized by substantial efforts to achieve the primary goal of net-zero emissions by 2050, our research contributes to the ongoing discourse on sustainable development and environmental policy implementation.

Following all the good practices of good questionnaire design, aware of the limitations and practical solutions, we developed an in-depth qualitative analysis of the responses obtained. The questionnaire proves to be a useful tool to suggest the principal actions to be taken in order to facilitate European SME's operating in the cleantech sector. All analyzed responses obtained from a sample of 23868 companies proved the hypotheses developed during formulation. A detailed analysis of each question is described in the following sections. We sometimes identified different behaviors based on the clustering of companies between innovators and ecosystem.

One interesting insight, which leaves room for future research, was the attempt to aggregate other socioeconomic data from firms to group responses. A higher response rate would allow much more interesting insights and analysis. In general, we can say that 50% of European small and medium-sized companies feel ready to individually meet the EGD targets within the next 25 years. 50% of companies are also convinced that their nation is capable of achieving the goals proposed by the EGD. Interesting variances by geographic region are noted: Nordic countries and Central Europe are more confident than the Mediterranean and Eastern regions. It is noteworthy that as many as 83% of companies are confident that the entire European Union will meet the EGD goals. In this case, it is the "trailed" countries that are the most confident in the undertaking.

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Lastly, I owe an immense debt of gratitude to my mother and father, whose unwavering support and encouragement provided me with the opportunity to stand here today defending this thesis. They have also played a pivotal role in fostering skills beyond the realms of academia.

Glossary

BCG Boston Consulting Group.

BEP Break-even Point.

CCMT Clean and Climate-friendly Mobile Technologies.

CEO Chief Executive Officer.

CINEA Climate, Environment and Infrastructure Executive Agency.

DG CLIMA Directorate-General for Climate Action.

DG COMP Directorate-General for Competition.

DG FISMA Directorate-General for Financial Stability, Financial Services and Capital Markets Union.

ECB European Central Bank.

EGD European Green Deal.

EIB European Investment Bank.

EIBURS EIB University Research Sponsorship.

EIF European Investment Fund.

EPO European Patent Office.

ETS Emissions Trading System.

EU European Union.

FFF Family, Friends and Fools.

GDP Gross Domestic Product.

GHG Greenhouse Gas.

ICT Information and Communication Technology.

IPCEI Important Projects of Common European Interest.

IPO Initial Public Offering.

IRA Inflation Reduction Act.

NACE Nomenclature of Economic Activities in the European Community.

OECD Organisation for Economic Co-operation and Development .

OPS Operations.

P2P Peer-to-Peer.

PE Private Equity.

PF Project Finance.

R&D Research and Development.

SDG Sustainable Development Goal.

SME Small Medium Entreprise.

TRL Technology Readiness Level.

TTO Technology Transfer Office.

UN United Nations.

US United States.

USA United States of America.

VC Venture Capital.

WP Work Package.

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Chapter 1

Introduction

1.1 Framework

During academic life, it is important to persistently explore a domain in which one can make a difference in life. Research is not easy and is based on an iterative and repetitive process. This thesis represents the culmination of my study process and encompasses a portion of the best skills I have been able to develop throughout my academic journey. It is a fusion of the key competencies acquired, not only from a technical standpoint but also, and above all, from a human perspective. Combining a research project with the thesis is an ambitious challenge that raises the ambition level even higher.

The topic chosen for my thesis aligns with the research focus of the EIBURS project "The cleantech industry in the European Green Deal," a project coordinated by Politecnico di Torino in collaboration with Politecnico di Milano and the University of Bologna. This initiative is sponsored by the European Investment Bank (EIB) and carried out in partnership with the European Investment Fund (EIF).

The project encompasses a broad scope and involves various departments, spanning across diverse themes, including financing, policies, regulations, and all the related implications.

The European Green Deal (EGD) is a pivotal initiative aimed at propelling the European Union (EU) towards a sustainable and low-carbon future, addressing climate change and fostering economic growth through innovative environmental policies and investments. The political and economic strategic importance of the EGD makes it a topic of enormous interest for the entire academic and industrial community, and it will have significant effects on the entire European population. Therefore, it is undoubtedly a subject of long-term interest for a thesis project that can be of practical and forward-looking utility.

The novelty of the topic makes it captivating, although it complicates a systematic literature review. The project itself aims to be a first step for the subsequent literature. The opportunity to collaborate with the excellence of European-level research by administering a questionnaire to small and medium-sized enterprises (SMEs) operating in the cleantech sector is a stimulating activity that provides an exceptional perspective and demonstrates the synergy between academia and the industrial world.

SMEs and entrepreneurs are of critical importance for reaching climate objectives. They have a significant environmental footprint on aggregate, but also make important contributions to reaching net zero through their innovations and greening efforts (1). For a long time, small businesses and entrepreneurs haven't gotten much attention when it comes to climate change, even though they are a big part of the solution. Nowadays different governments are working on plans to help SMEs going green.

On one side, SMEs collectively have a big impact on the environment. On the other side, they can come up with new ideas and technologies to solve environmental problems. And

as we move toward a more sustainable economy, there will be new chances for SMEs and entrepreneurs to innovate.

We don't have a comprehensive information about how much SMEs impact the environment, but we know that SMEs are trying to reduce their impact. They're doing it because it saves money in the long term (even if it's not always easy for SMEs) due to customer's pressure. Other factors that push them in this direction are employees, investors, and bigger companies trying to be greener.

Including SMEs to reach EGD goals is fundamental. Specific goals are set for reducing climate effects by 2030 and 2050 and many countries are still coming up with plans for SMEs and the environment. The COVID-19 pandemic showed how much SMEs matter and are vulnerable to shocks.

The EGD aims to create a 2050 neutral economy through multiple channels of intervention. Technological innovation is crucial to reach the targets of decarbonisation of the energy sector and to increase energy efficiency, enhance the role of the circular economy in many sectors and develop cheaper and healthier forms of private and public transport. In this context, a 'green' or 'clean' economy emphasizes the search for innovative opportunities in cleantech, able to address the resource scarcities and environmental risks.(2)

The EU is dedicated to achieving sustainable economic growth. A vital part of Europe's plan to reach net-zero emissions is through Greentech innovation. Advancements in Green technology are crucial for the EU to meet its environmental goals in a way that's affordable, by reducing the costs of cutting CO2 and pollution. Additionally, innovation can aid EU businesses in adjusting to the changing climate. As the demand for environmentally friendly products and services rises, there are remarkable opportunities for growth in the European Greentech industry.

1.2 Stakeholders

1.2.1 The European Investment Bank

The EIB being the biggest multilateral financial institution in the world is the lending arm of the European Union. The EIB Group has a strong focus on impact and is one of the main actors in climate finance offering to its customers loans, guarantees, equity investments and advisory services.

The EIB is financially autonomous and raises funds by issuing bonds on the capital markets. The credit rating guarantees optimal financial conditions and low interest rates. This solid position is given also by the shareholders: the 27 Member States of the European Union. Italy is the main contributor in order of total subscribed capital (46 billion€) having the same Share of Germany and France, around 19%.

EIB investments are actively supporting the green transition committing to Paris Agreement's goals (the international treaty on climate change) and the United Nations' Sustainable Development Goals. Over the next decade €1 trillion in investment has been pledged for the climate and environmental sustainability.

EIB is a gamechanger in the execution of European Green Deal principles: €36.5 billion have been devoted to green investments. €14.11 billion have been addressed in financing for smaller business. The EIB's climate and energy goals are important not only per-se but also for the fact that are setting new standards in Europe and beyond. Fossil fuel projects are no more backed and by 2025 50% of EIB's investments will be devoted to climate action and sustainability.

The EIB has invested more than €70 billion all over the globe in the last decade (2012-2022), mobilising billions in investment each year from the private sector: EIB involvement encourages private sector involvement, attracting new investment. Developing countries need more than €2 trillion in extra annual investment to meet the UN Sustainable Development Goals and the ambitions of the Paris Agreement for addressing climate change, the amount can be reached only with the private contribution.

As the EU climate bank, the EIB is working to support the European Green Deal, the European Union's blueprint to make sure its policies reduce greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels). The European Union, however, accounts for only 10% of global emissions, so EIB Global will help extend Europe's decarbonisation efforts beyond the borders, trying to develop an efficient European system that is able to compete with the external actors.

1.2.2 The European Investment Fund

The EIB Group consists of the European Investment Bank and the European Investment Fund. EIF designs and develops venture and growth capital, guaranteeing microfinance instruments to promote innovation and employment.

EIF statutory goal is to address SME's risk. Fostering EU objectives, notably in the field of entrepreneurship, growth, innovation, research and development, employment and regional development; EIF is still capable of generating an appropriate return for its shareholders, through a commercial pricing policy and a balance of fee and risk-based income. EIF poses itself as an agile facilitator between policy and markets and acts as an active developer of the European VC and PE ecosystem. The main goal is to make Europe competitive and 'future-proof'.

InvestEU is the main financing initiative (represented around 45% of 2022 activities) implemented by the EIF on behalf of the EU. The thematic focus is to strengthen European competitiveness and strategic autonomy in key sectors, mobilising funding for the key public policy goals at EU level.

EIF also targets the debt requirements, as many SMEs seek debt financing. Therefore EIF provides guarantees and credit enhancement through securitisation to improve the lending capacity of the financial intermediaries and thus the availability and terms of debt for beneficiary SMEs.

1.2.3 The Organization for Economic Co-operation and Development

The OECD is an international organisation that works to build better policies for better lives. OECD goal since 60 years is to shape policies that foster prosperity, equality, opportunity and well-being for all. OECD cooperates with governments, policy makers and citizens, on finding solutions to a range of social, economic and environmental challenges such as improving economic performance, creating jobs and fostering education.

Through its Committee on Financing SMEs and Entrepreneurship, the OECD is playing an important role in developing the evidence and policies that enable SMEs and entrepreneurs to ride the green transition. In November 2021, the OECD established a Platform on Financing Es for Sustainability. The platform aims at creating a network of key stakeholders, including public and private financial institutions, policy makers and SME's representatives, with the aim to foster knowledge sharing on sustainable finance for SMEs and identify practical financial solutions to accompany SMEs on their journey to net zero.

Mitigating climate change is among the most central issues on the global policy agenda. Many countries have committed to reach 'net zero' greenhouse gas (GHG) emissions by 2050. Net zero emissions refers to the situation where GHG going into the atmosphere are balanced by removal of others out of the atmosphere.

Although the business-climate nexus has been an integral part of climate change discussions, for a long time, SMEs have often been absent from this debate. The key focus has historically been, with few exceptions on large emitters, in part due to data scarcity on the environmental footprint of SMEs. In short, SMEs and entrepreneurs were seen mainly as part of the solution, and less as part of the problem, given the various examples of successful green innovation by SMEs and entrepreneurs.(1)

1.3 Comprehensive undertaking

The Knowledge Programme of the EIB Institute channels its research grants through different schemes, one of which is EIB University Research Sponsorship Programme. Politecnico di Torino has been selected by the EIB Institute for the EIBURS sponsorship to carry out research on the theme "The European Cleantech industry, the EU Green Deal and SME equity demand", in cooperation with the EIF. The project is devoted to the improvement of the understanding of the European cleantech sector and seeks to provide an answer to the question of how cleantech firms contribute to the achievement of EU policy goals, and what policymakers can do to promote a healthy ecosystem.

The overall goal of the project is to:

1. Analyse the actions that are undertaken by European cleantech firms to engage in transformative climate and innovation actions to align with the European Green Deal inspired policies;
2. Examine the association of the environmental innovation and the number of new investments made by VC investors in cleantech companies on environmental indicators;
3. Analyse the enabling factors for the development of European cleantech firms, with a focus on EU-level and country-level targeted policies and regulations and the different sources of financing;
4. Analyse the extent to which the implementation of policies and regulations affect both the propensity of cleantech firms to seek external equity financing and the equity offer by VC funds.

The results stemming from such research activities will lead to the definition of a set of policy recommendations.

The proposal is composed of 8 work packages. WPs from 1 to 5 are devoted to research activities, WP6 is inherent to training activities, WP7 is related to dissemination activities and WP8 is related to the management of the project. All WPs are organised in Tasks to facilitate the development of work, its monitoring and evaluation. My contribution to this project is part of WP2, which is also the subject of my master's thesis and involves the investigation, preparation, administration, analysis, and quantitative visualization of data from a questionnaire directed at small and medium-sized cleantech enterprises identified in a previous phase of the broader project.

WP2 "European Green Deal and the transformative climate and innovation actions of cleantech firms" aims at exploring to what extent the cleantech firms identified in WP1 take actions to drive their business towards the incorporation of the elements that are central to the European Green Deal in their technological development and investment activity. More specifically, this work package aims at:

1. Collecting data through a survey addressed to a selected sample of European cleantech firms identified in WP1 on the elements that are central to the European Green Deal they adhere to;
2. Providing a taxonomy of the transformative climate and innovation actions that are implemented by cleantech firms to adhere to the elements identified in the European Green Deal;
3. Identifying the environmental impact of the entrepreneurial activity of European cleantech firms.

The work package is dedicated to the collection of data through a survey addressed to the European cleantech firms identified in WP1 on their propensity to implement actions in the light of the pillars of the EGD. Following the list of main tasks I held as a research fellow:

- Supporting the development of the questions for the questionnaire after the analysis of similar statistical surveys;
- Assisting in the selection of relevant questions according to their strategical relevance after an in depth study of actual literature;
- Preparing the questions on Qualtrics (the tool used for the distribution);
- Distributing to cleantech companies;
- Monitoring the distribution process;
- Manipulating the collected data joining relevant information from other databases;
- Analysing and visually representing the collected answers.

1.4 Research problem and objectives

A brief reasoned analysis of the title is an excellent starting point to effectively explain the structure of the thesis. The goal is a broad and inclusive exploration of the cleantech landscape in Europe. Cleantech refers to all companies that develop *"(new) sustainable technologies and solutions able to offer the market a diverse range of products, processes and services to provide higher environmental performances. Cleantech is based on challenges such as reducing the use of natural resources, lowering the energy consumption, improving energy generation cycles and cutting or eliminating emissions, pollutants, and wastes"*.

The research focuses on small and medium-sized enterprises that permeate the European territory and despite not being uniquely defined at the European level are essential and vital engine of the socioeconomic fabric.

The analysis is based on a pragmatic approach that starts with the administration of a questionnaire to a large number of companies already selected at an earlier point in the research. The structure of the questionnaire traces the pillars highlighted by "The Green Deal Industrial Plan: putting Europe's net-zero industry in the lead" published in February 2023.

The research scope of this project does not offer an established and robust literature due to the novelty of the topic, the very nature of the project which does not consist of a study with clear and defined boundaries, rather broad and multifaceted aspects of research. For this reason, the research problem and objectives may seem unstructured. One of the main goals of the whole project is to be able to serve as a pilot project for subsequent more in-depth studies about small and medium-sized cleantech companies operating in Europe according to the principles of the European Green Deal.

The European Green Deal is an initiative in its early stages, with many of its key points still being defined. As a result, the literature surrounding it is continually evolving, and only a limited amount of scientific material is currently available. The goals and facets of EGD include a strong human component given the multitude of actors involved that are heterogeneous and with different points of view: EU, EIB, EIF, other supranational bodies, companies, academia and all European states, legislative bodies of individual states, and finally every single European citizen subjected to all directives and policy choices are the main (and not exclusive) stakeholders involved.

Some articles occur in the literature, but no research has proven to be complete and exhaustive; case studies referring to a specific location and a specific technology are quite common but can only give partial insights.

The thesis, like the project itself aims at an exhaustive survey to investigate main difficulties and gaps on the four EGD pillars. An interesting starting point is from the study of conferences and summits, roundtables and comparisons among the main stakeholders involved in this complex process of innovation and renovation called European Green Deal.

The project aims to discover the European cleantech sector and understand whether firms contribute to the achievement of EU policy goals. In the end it is important to assess which actions policymakers can implement to boost the ecosystem. By developing a survey addressed to a defined sample of Cleantech European SMEs it is possible to investigate the above discussed issues and map the activities and the attitudes of the firm enacted to align with European Green Deal policies.

The survey allows a multi-country perspective, based on the analysis of cleantech firms in the main European Member States, it is interesting to evaluate correlations within and between countries and sectors by combining different research methods (i.e., quantitative analyses, interviews with relevant actors, extensive reviews, survey, visualization techniques).

1.5 Context-specific qualitative assessment

Among the initiatives, roundtable discussions and talks have been organized, providing insightful perspectives for evaluating perceptions and outlooks experienced by the very stakeholders who will be involved in the transition.

Below are the most interesting views that emerged from the "Financing Innovative Clean Tech Conference" and the "Cleantech for Europe Summit 2023". The European Green Deal has defined a strategy for the development of a globally competitive, resilient and carbon neutral industry by 2050. The European industry is keen to become a front runner of decarbonisation through clean tech solutions with breakthrough technologies and innovative business models. This requires an enabling regulatory framework and investment from both the public and private sectors. The European Commission has launched the EU Innovation Fund programme, one of the world's largest grant funding programmes for the demonstration of first-of-a-kind low-carbon technologies to support European industries.

The Innovation Fund is 100% funded by the EU Emissions Trading System (ETS) and is expected to provide around EUR 38 billion of support during the period from 2020 to 2030 (depending on carbon price), for the commercial demonstration of innovative low-carbon technologies, aiming to bring to the market industrial solutions that help decarbonise Europe and support its transition to climate neutrality.

Cleantech has transcended its niche status and become an economic imperative for the EU. Essential to competitiveness and long-term survival, it's a driving force in the global shift to clean energy. The European Green Deal is establishing a regulatory framework for predictable investments. Despite Europe's 8% share in global CO2 emissions, efforts focus on swift financing, addressing skill shortages, and shaping trade policies. The Innovation Fund is central to this agenda, propelling clean tech, green competitiveness, and innovation. (Director General, DG CLIMA)

CINEA is set to deliberate on the pivotal framework conditions necessary to expedite clean tech investments, exploring how innovation integrated into industry business models can drive carbon neutrality. With a budget of approximately 60 billion euros until 2027, CINEA plays a crucial role in championing the EGD. The Innovation Fund, integral to this initiative, backs projects with significant ripple effects across the entire value chain. Regulatory support from government or local authorities is identified as a vital component, expediting project maturity by accelerating permit approval timelines. (Acting Director, CINEA)

EU competition policy has been vital for economic prosperity, ensuring vigorous competition benefits consumers. Massive long-term investments are needed for the green and digital transition, enhancing global competitiveness. Ramp-up of renewables is essential for climate action and reducing reliance on fossil fuels. Public funding and competition policy

incentivize necessary investments, while state control complements environmental policies, mobilizing funds cost-effectively. (Director,DG COMP)

Taxonomy serves as a classification system, providing clarity on economic activities aligned with climate targets. It functions as a criteria dictionary with six defined objectives, aiming to encompass sectors facing significant challenges in transitioning and reducing emissions. Key areas, such as renewable energies, hydrogen, energy storage, renovations, energy efficiency, and low carbon transport, are particularly relevant for clean tech. Taxonomy is a valuable tool for transitioning, applicable regardless of the starting point. (Head of Unit Sustainable Finance, DG FISMA)

About 60% of projects are in a technology development stage between piloting and early performance. These projects require sustained support due to high execution risk, with products often featuring risk-absorbing characteristics. Cleantech investments, particularly in projects with a three to five-year period of zero cash flows, are considered patient, resembling debt instruments without immediate cash repayment. (OPS Director for Equity, Growth and PF, EIB)

The EIB supports companies from early technological development to mainstreaming. The venture debt product, structured flexibly with a five to seven-year duration, signals commitment to supporting innovative technologies. While it includes more covenants, it offers lower pricing and addresses risk through a warrant feature. Project financing varies with mature technologies due to differing risks. (Head of Division for Climate Equity and Capital Growth, EIB)

The EIB offers extensive advisory services for investment projects globally, spanning all project stages. Operating in upstream support, project implementation, and knowledge-sharing studies, the EIB emphasizes ecosystem development in emerging technologies, disseminating best practices. Recognizing the conservative nature of the financial industry, the EIB underscores the importance of well-presented financial viewpoints for timely and adequate financing, crucial for successful technological advancements. (Director of the Advisory Services Department EIB)

Cleantech investments hold significant potential for enhancing the competitiveness of European industries, fostering collaboration, knowledge exchange, and inspiration. A symbiotic learning process occurs among businesses, innovators, entrepreneurs, and policymakers through ongoing dialogue, ensuring project success. These initiatives play a substantial role in reducing EU greenhouse gas emissions. Close collaboration with the Commission and partners is integral to the success of the European Green Deal.

The projects not only contribute to environmental benefits but also align with strategies for hydrogen sector integration, circular economy, and the transition away from fossil fuels. The EGD promises social and economic advantages, including the growth of new sectors, creation of quality jobs in the green transition, support for local economies, and collaboration

across industries. Additionally, it is anticipated to yield specific economic benefits by lowering prices of new technologies and products, ultimately creating new markets.

The International Energy Agency estimates that the mass-manufactured clean technology market will reach 650 billion euros by 2030. The European Union is positioned favourably to capture a substantial share of this market. The European Green Deal provides regulatory signals, enabling the private sector to plan medium and long-term investments. This facilitates European businesses in leveraging a first-mover advantage in the green economy. Moreover, the Next Generation EU plan allocates significant funds, with 100 billion euros already earmarked for green and digital transition, reinforcing the commitment to substantial investments. (Executive Vice President of the European Commission)

The EU must ensure fair competition, firstly within the EU and then between large and small companies undergoing scaling. Small businesses face challenges competing with larger counterparts, particularly in terms of state aid, markets, funding, and regulations. Despite doubling its investment value from 2020 to 2021, cleantech faced a setback in 2022, with total VC investment exceeding 10 billion euros in the EU. To foster competition, Europe needs to secure private funding and attract investment, as this stage is critical in preventing technology migration to the US due to capital limitations in the EU. (Executive Director at Cleantech for Europe)

1.6 Cleantech sector views and top priorities

Below is a list of points we have taken into consideration to investigate the priority of questions to be submitted to cleantech companies in order to develop a targeted questionnaire of strategic interest to the respondent. These points have emerged from interviews with CEOs of companies that participated in the Cleantech for Europe Summit 2023:

- Increase speed and simplicity in the framework. It takes too long from the decision to do something, the communication, and the execution of the business plan;
- Reduce the blame game between the different institutions and the overall regulation complexity;
- Increase the Innovation fund help for smaller companies. There is a strong tendency that money still ends up with incumbents;
- Strengthen the Single European Market with a good framework of harmonized rules;
- Reduce complexity in support/funding schemes. Increase Europe pragmatism to reduce the company effort (full time workers) to navigate the initiatives from EIB,EIF, etc;
- Standardize the funding requirements and the application procedures to make easier the access;
- Set global standards for renewable hydrogen and other technologies at the higher EU level;
- Ease capital raising procedures following the USA simplified model much easier than European;
- Reduce the risks through governments responsibility and co-investment in technological projects;
- Set clear definitions of technologies and standards and a proper taxonomy;
- Compensate the need for skilled people through relocation from other sectors or through reskilling;
- Guarantee the sourcing of critical materials at a competitive cost;
- Privilege a short supply chain for reasons related to energy security and sustainability;
- Increase predictability of demands and margins in order to safely develop and scale up the business;
- Coordinate innovation initiatives creating a network with universities, research organizations, industry, and SMEs;

1.7 Limitations

Sending out a questionnaire on a specific subject to a number of companies spread across a vast territory where direct contact is not feasible is certainly a limitation that results in a reduced response rate. We have sought a tradeoff in the length and duration of the questionnaire; however, we are aware that due to the technicality of the responses and the fact that respondents cannot be just anyone within the company but only individuals of strategic importance with very busy schedules, we cannot expect a high response rate. Certainly, the sponsorship of the Polytechnic University of Turin and other universities in the Italian territory leads to recognition from companies located in Italy, which we expect could be more numerous.

In order to collect the most accurate data from respondents, investigators must understand and be able to prevent or at least minimize bias in the design of their questionnaires. Bias may arise from the way individual questions are designed, the way the questionnaire as a whole is designed, and how the questionnaire is administered or completed.(3)

Another limitation is inherent in the subjectivity of some responses and the risk of desirability bias. Social desirability is the extent to which individuals tend to project favorable images of themselves during social interactions. That is, participants who are asked sensitive questions may respond in a manner that aligns with socially desirable responses.(4)

Cultural aspects should also not be overlooked. The culture of the respondents can affect their perception of questions and therefore their answers. At the end of the discussion, we will see a brief paragraph dedicated to this possible cultural correlation.

1.8 Structure

Reading up to this chapter, one has already encountered a few helpful introductory paragraphs to get into perspective. The main European players have been briefly discussed so as not to sound like mere acronyms without real meaning. As anticipated, my thesis research is a sub-package of a large research project with a total duration of 3 years. We have already reported the cornerstones of the research, the executive summary and the structure of the project with some insights on the part of my direct interest. Problems and objectives have been touched upon from the issues addressed in thematic conferences.

The second chapter is a review of the literature about European Green Deal that was organized according to four basic pillars: financing, regulations, skills, and supply chain. The clean sector is the main actor referred to by the European Green Deal, which is also among the first initiatives to attach considerable importance to SMEs and their role in the ecological transition.

A description of the questionnaire is necessary to introduce the analytical part of the research. We intend to investigate clusters and patterns of cleantech companies in Europe representing the same peculiarities. We expect these to be dependent on the sector in which it operates and the geographical location of the company.

The methodology consists of defining a questionnaire structured according to all good principles. The questions have been designed to make the compilation simple and quick, so the sample has been identified and tracked on the best financial datasets available that have been integrated. Response collection was managed using Qualtrics software. A good attitude is the statistical description of the responses collected before any qualitative or quantitative analysis. A second step of the project could be in-depth interviews addressed to the managers of the companies contacted.

It is then hoped to draw interesting interpretations of the results obtained, perhaps capable of dispelling some myths. Is Northern Europe for all intents and purposes a step ahead in innovation? What are the perceptions of companies that will directly take part in the green revolution?

One of the goals of the thesis and of the entire project is to be able to suggest to the principal (EIB and EIF) an articulate discussion of the benefits of adhering to the goals of the European green deal. Certainly, the working paper that will be produced by the EIBURS project is an excellent starting point for future studies in the cleantech field. It is appropriate to briefly highlight the contribution made to the literature and the gaps and limitations identified while suggesting possible topics for future investigation. Finally, reported in the appendix is reported and EGD vademecum and the much-discussed questionnaire in its full version.

Enjoy your reading!

Chapter 2

Literature Review

The environmental question was not born yesterday, one of the very first discussions recently celebrated its 50th birthday and not coincidentally was held in Stockholm in 1972: "Conference on the Human Environment." it has been a succession of treaties and summits, but only since 2015 with the Paris Agreement there have been concrete efforts to ensure that carbon emissions do not lead to an increase of more than 2°C. Are we still on time? Every day, we are seeing the growing impact of climate change. Fighting it is imperative for the future of Europe and of the world.

The urgency to scale up action has never been greater. Society has a narrowing window of just over a decade (by 2030) to implement radical reductions (45%–50%) in global greenhouse gas emissions. Realizing this target will require a speed of global decarbonization six times faster than has been achieved thus far and entail an industrial transition to net zero emissions in Europe by 2050 the very latest.

To meet the needs of current generations without compromising future generations' ability to satisfy their needs a global agenda for change is required; then main ingredients have to be long-term strategies for sustainable development encouraging cooperation and achievement of joint objectives on an international scale.

In December 2019, the European Commission announced the European Green Deal as the strategy through which to achieve EU climate neutrality by 2050. EU leaders welcomed this Commission initiative, endorsing the 2050 objective of a climate-neutral EU. The goal is that while tackling the existential threat of climate change, the EU will pursue economic growth in ways which create better jobs and enhance people's well-being.

The Green Deal includes measures such as investing in environmentally-friendly technologies, supporting innovation, helping the development of cleaner forms of transport, decarbonising the energy sector, ensuring buildings become more energy efficient, working internationally to improve standards around the world.

Clean technology (or "cleantech") can be described as new technology and related business models able to offer the market a diverse range of products, services and processes

based on the use of renewable materials and energy sources, thus reducing the use of natural resources and cutting or eliminating emissions and wastes.(5)(6)

Many interventions have sprung into action across the globe. From the ambitious policies of the IRA in the United States to countless other initiatives worldwide, there is a growing recognition that a radical change is required to definitely solve this pressing crisis. Climate change knows no borders, and the global community is working to address its far-reaching consequences. While these interventions vary in scope and approach, they share a common goal: to mitigate and adapt to the impacts of climate change. Climate change demands a radical transformation in the way we live, work, and consume resources. It calls for innovative solutions, responsible consumption, and global cooperation. The fight against climate change is not just an option; it's an imperative for our survival.

There is widespread consensus among policy makers, businesses, the scientific community and wider society that the transition towards a low-carbon economy by decoupling economic activity from the use of finite resources is imperative for sustainability.(7)

This is why the EU Green Deal includes a European Climate Pact. The pact aims to foster engagement and co-operation between individuals, communities, and organisations, which will encourage people to commit to concrete actions to reduce their own greenhouse gas emissions.

A fundamental change of businesses and business models is required. Business models, through the value proposition (product/service offering), creation and delivery (e.g. partners and activities), and value capture (cost and revenue streams), will need to include a wide range of stakeholder concerns, and the environment and society need to be regarded as important stakeholders to tackle key global issues. Cleantech companies that seek to protect and enhance their supply of natural (and social) capital will gain a competitive advantage in the coming decades. Hence, 'sustainability' can also be viewed as a business opportunity.(8)

Early-stage ventures play a fundamental role in advancing the goals set out in the EGD. Within the EGD, funding for SMEs forms a pivotal pillar. New companies in the sustainability sector face significant challenges when compared to well-established incumbents. However, they are a necessary engine for driving the transformation towards a more sustainable future.

Venture capital and private equity are undeniably among the preferred financial tools for supporting early-stage green ventures. These investment instruments provide the necessary capital and expertise to nurture innovative green technologies and business models. Yet, the scale of the challenge posed by the EGD necessitates additional support from private investments.

The EGD represents not only a challenge but also an opportunity. It has the potential to catalyse a wave of green investments, both within and beyond the EU. The pursuit of a more sustainable future aligns with the global trend towards environmental responsibility. As a result, the EGD can attract investments with positive externalities that extend well beyond the EU's borders.

Policy makers dispose of a range of alternatives to encourage the redirection of private finance from ‘dirty’ to clean innovation and so to achieve the low-carbon transition. We are going to go in depth into those aspects in the next chapters.

The literature review was an iterative process closely conjoined with the preparation of the questionnaire. The questions were methodically developed and documented in their first version to propose questions with an appropriate balance between scientific interest and ease of response: of course, the initial proposals required considerable modification to make the question more interpretable by a respondent who does not always have the technical skills for a scientifically interesting answer. The cues taken however made for good quality questions that achieved a reasonable response rate and a balanced structure proving the methodology used. The organization by pillar is a pattern that is therefore repeated for the review and questionnaire design, which are two activities carried out iteratively and hand in hand.

2.1 European Green Deal

The European Green Deal is a multifaceted and comprehensive initiative introduced by the European Commission. It goes well beyond ecological considerations and represents an ambitious and integrated strategy. Its primary goal is to transform the EU into a sustainable, climate-neutral, and fair society. It encompasses not only environmental aspects but also economic, social, and technological dimensions. The Green Deal aims to tackle urgent challenges such as climate change, the depletion of resources, and social inequality.

Through a range of policies that include promoting renewable energy adoption, advancing the circular economy, protecting biodiversity, and fostering sustainable transportation, the European Green Deal aims to stimulate innovation, create jobs, and promote resilient economic growth. This forward-looking effort underscores the EU's commitment to becoming a global leader in sustainability.

The massive reorganization of the top levels of the European Commission and the European central Bank sparked the launch of the European Green Deal initiative. The project is wide ranging and involves not only environmental aspects, but also socioeconomic ones: not only emissions must be controlled, but also the unemployment rate is a key performance indicator. Resources must be used in such a way as to trigger a renewal of the European innovation system; while being a challenge, the EGD is the only opportunity to reach a carbon neutral European economy by 2050. In May 2019, European elections yielded a remarkable success for the European Green Party. Later that year, Christine Lagarde became president of the European Central Bank (ECB) and Ursula von der Leyen President of the European Commission. Both pointed out climate change in the priorities for their mandates.(9)

The European Green Deal, presented by the Commission on 11 December 2019, sets the goal of making Europe the first climate-neutral continent by 2050. The European Climate Law enshrines in binding legislation the EU's commitment to climate neutrality. Reported below are some of the main ingredients in the agenda:

- Reduce emissions (55% at least compared to 1990 levels) by 2030, and make Europe the first net-zero continent by 2050;
- Design transformative policies in the fields of energy, industry, building and renovation, mobility, the food system, ecosystems and biodiversity;
- Boost investments in the order of EUR 260 billion annually up to 2030, with different systems: a sustainable investment plan, climate mainstreaming in the EU budget, and resources such as the emissions trading system. Involve directly the private sector with a sustainable finance strategy;
- Apply a Just Transition Mechanism for mostly affected regions and sectors;
- Mobilise research and innovation, activate education and training;

- Deliver a European Climate Pact to enable involvement and facilitate commitment of the public and of all stakeholders

Von der Leyen framed carbon neutrality as "the greatest challenge and opportunity of our times" (von der Leyen, 2019). Some scepticisms emerged as to the capability of the Commission to meet this challenge and turn it into an opportunity. However, the commitment is a credible signal for two reasons. ECB under Mario Draghi has already demonstrated a capability to act in historical proportions. Secondly, one should not underestimate the importance of having a German and a French, both with serious European credentials, pursuing complementary strategies at the helm of the Commission and the ECB. Further, another European, Kristalina Georgieva is now managing director of the IMF, and has similarly put climate change on the agenda of her institution.(9)

2.2 The Green Deal Industrial Plan: putting Europe's net-zero industry in the lead

The European Council warmly invited to make proposals by the end of January 2023 to mobilise actively resources and improve framework conditions for investment in cleantech initiatives that guarantees EU's resilience and competitiveness.

In February 2023, the European Commission presented a Green Deal Industrial Plan to enhance the competitiveness of Europe's net-zero industry and support the transition to climate neutrality. The Plan aims to provide a more supportive environment for the scaling up of the EU's manufacturing capacity for the net-zero technologies and products required to meet Europe's ambitious climate targets.

The Plan builds on previous initiatives and relies on the strengths of the EU Single Market, complementing ongoing efforts under the EGD and REPowerEU. It is based on four pillars: a predictable and simplified regulatory environment, speeding up access to finance, enhancing skills, and open trade for resilient supply chains.(10)

The Plan was announced by President von der Leyen in her speech at to the World Economic Forum in Davos in January 2023 as opportunity for the EU to sharpen its competitive edge through clean-tech investment and being a leading promoter on the path to climate neutrality.

A predictable and simplified regulatory environment

The Commission is planning to introduce a Net-Zero Industry Act, which will establish objectives for achieving net-zero industrial capacity. Europe's competitiveness will strongly rely on its capacity to develop and manufacture the clean technologies. This act will create a regulatory framework designed for rapid implementation. It aims to streamline and expedite permitting processes, develop important European projects, and establish standards to facilitate the widespread adoption of technologies within the Single Market and reduce the level of technological uncertainty.

This framework will be accompanied by the Critical Raw Materials Act, intended to guarantee adequate access to essential materials (e.g. rare earths, crucial for producing key technologies). Based on the recent experience of the energetic crisis post Ukrainian conflict there will be a reform of the electricity market in order that consumers can take advantage of the reduced costs associated with renewable energy sources that are in recent years by far more competitive than in the past.

Faster access to funding

Public funding has the potential to unlock substantial private investment needed for the transition towards environmentally friendly initiatives. Within the realm of competition policy, the Commission's objective is to ensure fair competition within the Single Market

while facilitating each Member State in providing necessary assistance to expedite the green transition.

To achieve this goal, the Commission plans to collaborate with Member States on amending the Temporary State Aid Crisis and Transition Framework and revising the General Block Exemption Regulation to streamline and simplify the approval process for projects related to Important Projects of Common European Interest (IPCEI).

The Commission will also facilitate the use of existing EU funds for financing clean tech innovation, manufacturing and deployment ... The Commission will work with Member States in the short term, with a focus on REPowerEU, InvestEU and the Innovation Fund, on a bridging solution to provide fast and targeted support. For the mid-term, the Commission intends to give a structural answer to the investment needs, by proposing a European Sovereignty Fund in the context of the review of the Multi-annual financial framework before summer 2023.(10)

Enhancing skills

A huge share of all jobs could be affected by the green transition (35-40%), developing the skills needed for new jobs will be a priority that can't be overlooked. New green centred roles will develop in the next years. EU plan is to establish Net-Zero Industry Academies to provide up-skilling and re-skilling programmes in strategic sectors. The main challenges are:

- Combining a 'Skills-first' approach, recognising actual skills based on qualifications;
- Facilitating access of third country nationals to EU labour markets in priority sectors;
- Aligning public and private funding for skills development.

Open trade for resilient supply chains

The current level of globalization is both an opportunity for growth when referred to virtuous realities as well as a threat of unfair competition from realities less sensitive to the joint effort to achieve sustainability goals.

Under the principles of fair competition and open trade, the World Trade Organization is the main stakeholder and will have a central role in order to build on the engagements with the EU's partners. The EU Commission will continue to develop its network of Free Trade Agreements and other forms of cooperation with partners to support the green transition. It will also explore the creation of a Critical Raw Materials Club, to bring together raw material 'consumers' and resource-rich producer countries to ensure global security of supply.

The Commission will also protect the Single Market from unfair trade in the clean tech sector and will use its instruments to ensure that foreign subsidies do not distort competition in the Single Market, also in the clean-tech sector.

2.2.1 Regulations

Cleantech SME financing is a milestone to anchor to manage climate change. Despite this felt need, this is a decidedly neglected "grey area" of public policy that has only sometimes directed efforts toward large-scale energy projects. The literature review agrees on this judgment.

Whilst there is growing consensus that there is a need for policy intervention, there is also a confusing and complex array of policy responses and instruments which currently lack coherency. There is, therefore, a need for further research to generate bridges between innovation, finance, and policy studies and inform policy development of the boundary spanning and more co-ordinated response required to encourage environmental impact investing and a clearer pathway to global low carbon and circular economy solutions. Existing green finance has been growing with the greater focus for national policies and international collaborations (World Bank and European Union) on leveraging private sector finance.(11)

Policies and regulations are considered to be one of the most influential external factor in order to stimulate the competitiveness of cleantech firms. Many studies devoted to this topic. Policies seem to be a two-edged blade; on the one hand they are essential for making clean technologies economically viable, on the other hand there is a risk of diverting firms' focus from the radical innovations necessary to aid our battle against the climate changes.(12)

Countries have put in place a vast number of policies to reach climate objectives, the direct effect is not a boost for SMEs and entrepreneurs that are not always able to deal with those regulations. Such policies typically target the broader business population. Better insight on the policies suited to support green entrepreneurship and the greening of SMEs is essential to ensure a coherent and integrated policy approach that recognises differences across types of firms. Here comes another difficulty that deals with the classification and taxonomy of the distinct activities.

In addition, there is a multitude of strategies countries adopt in environmental and climate policies. The positive externality is the opportunity for mutual learning between countries and sharing of experiences on what works properly and what should be refined. "Given the large heterogeneity of SMEs and entrepreneurs, and the different environmental challenges they face, it is clear that one-size fits all policies is not the solution."(1)

Policies can profoundly influence cleantech opportunities but many public initiatives are misguided. Programs to boost new ventures might seem like an esoteric corner of public policy, far less important than the big issues of war and peace and health benefits, not to mention the rescue of giant firms that are on the ropes, but this perception can be misleading because of the magnitude of changes that can occur when venture programs are done well.(13)

There have been many trials from government in order to develop entrepreneurial sector, the green case is just an in-depth, a specialization of other past efforts that are useful to

learn from. When scouting literature we can find arguments for and against government intervention. Lerner in its article points out a set of points that are critical to the success of the government intervention. Following in a shortlist the vademecum:

- Leverage the local academic research base (through the TTO role)
- Conform to global standards
- Recognize the long term nature of this kind of initiatives
- Seize appropriately the initiatives (not too large or too small)
- Recognize the importance of global network
- Stimulate creativity and flexibility
- Spend resources on the "education" of the different stakeholders

Definitely policy makers need to take a systemic approach to enable the redirection of diverse private financial sources. Instruments range from cutting 'dirty' R&D subsidies and support for clean technology innovation and diffusion, levelling the institutional playing field and making risks of high-carbon and low-carbon technologies transparent to providing a consistent but adaptive long-term transition strategy. This would allow financiers to gradually shift their investments away from high-carbon mainstream markets and scale low-carbon technology niche-markets. However financiers also need to sharpen their competencies with regard to new clean technologies and markets.(7)

2.2.2 Financing

Innovative small firms often find it the hardest to obtain finance due to their risky business models and the need to create new markets that are difficult to be evaluated for banks. In addition the output of the first innovation steps are often intangible goods (patents for example) that are hard to use as a collateral. Historically small firms' failure rates are high and their portfolio is not structured around a wide range of products (in this case technologies), so the risk is high and also concentrated. The low level of symmetry in information clearly increases the price for financing and the high context specificity discourages investors. Supply for finance presents a literature widely recognized issue for this kind of companies. The survey indagates this aspect with a few questions to better understand the need for external financing (and the size of this need) and to disclose the effectiveness of past funding programmes and the interest of firms in more innovative finance instruments.

European cleantech companies still struggle to finance their scale-ups. EU is studying the best financial tools that can facilitate a faster deployment across the continent both in the short and long term. The need for a clear research and policy agenda to assist early stage Cleantech financing has never been greater.(11)

One of the most commonly identified barriers to low-carbon innovation is the financing environment, it results that currently there is a financial gap to be addressed, market failures exist in the above-mentioned market and are driven by a miscellanea of asymmetries and the wrong expectations about social and environmental externalities. In addiction SMEs have often been overlooked misunderstanding their key role in addressing climate change in a wide range of sectors. On the other hand, impact investing mainstreamed in more mature markets. New instruments have been selected by innovative investors yielding good performances: we are talking about crowdfunding, P2P lending, green bonds, accelerators, seed venture capital and sort of blockchain strategies.

When deciding to invest in any kind of project (also applies to life) it is important to find the meaning of this activity. This is one of the efforts required to impact investors: the type of financing required by innovative SMEs is long-term, capital intensive (meaning it requires large sums of money) and is exposed to three main risks simultaneously: technological risk, market risk and regulatory risk. It comes to mind as an investment suitable only for FFF: family, friends and fools.

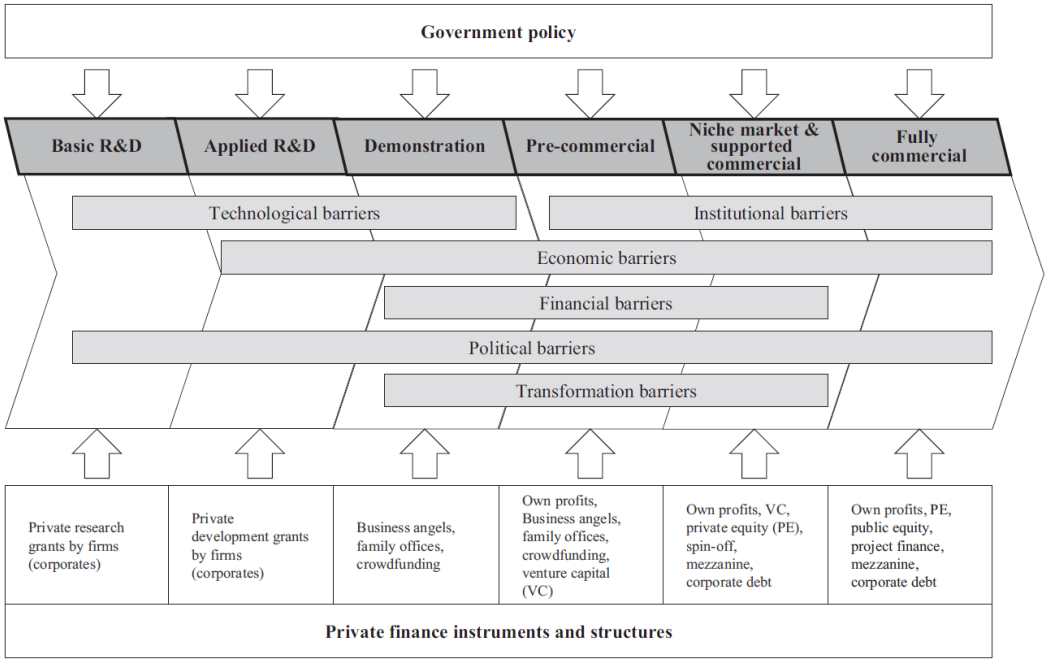

Fig. 2.1 Policies and Financial Instruments

The picture highlights in the central part the barriers along the innovation cycle (a part of the survey is devoted to indagate the TRL level to identify the positioning in the innovation cycle). The categories are not strictly delimited. Along the evolution of the technology the ideal financial instrument and the related risk changes continuously. During the basic and applied research stages technologies are often developed by public research institutes and universities (more rarely from private firms), both of which supply the necessary finance through grants and subsidies. In the demonstration and early commercialization phase

('valley of death'), private financiers such as business angels, family offices and Venture Capitalists invest in start-ups and small innovative firms, whereas large or mature firms deploy internal funds for ongoing R&D and commercialization activities. Only when the technology is sufficiently mature and allows for scale-up towards production it can be financed by VC or family offices with a long-term investment strategy. Founders also draw from informal capital sources of such as family and friends. Recently, crowdfunding has emerged as an alternative way to raise seed finance. Beginning with the niche-market stage, ideally the private sector actors take the lead to foster diffusion of the technology. Firms concentrate on market development while banks, private equity investors and internal funds provide financing for production and marketing. Additionally institutional investors finance complementary assets such as projects and infrastructure.(7)

Europe has the leadership in early-stage R&D: in EU a third of the world's best-rank research institutions are located, a third of the world's patents, and more startups in the climate space than the US and China combined (Craig Douglas - Founding Partner at World Fund). Unfortunately, the situation is not the same in all the 27 member states.

On the other hand, the US is better than Europe in fundings availability. The same funds are much more developed that the one available in Europe both in quantity and dimension. The IRA is a policy framework that allows to see clear incentives for investors and companies, this boosted investment decisions. There is not enough capital willing to pay for risky investments, but that's a longer-term problem. For the shorter term, no banks and financial institutions are willing to take the early-stage risk. A lot of big insurance and finance companies are interested in sustainability, however, "all of these big funds typically won't get out of bed for less than 100 million deployed, but they don't want to hold more than 10-15% of a fund. That means you have to be a minimum of 750 million to a billion" (Craig Douglas). A solution EIF could promote is the creation of a cooperative joint fund with bigger financing capabilities.

In clean tech industry Capital expenditures tend to be large. There is the need to mobilize more capital than in other sector but also the risk to deal with is higher, those two effects combined depress the market offer.

On clean tech, certainly the biggest issue is to attract investors from the private sector, like Pension funds and insurance companies. In the second step it is not easy to find the creative people who have enough courage to go for the bigger solution, so bigger Venture Capital funds, much more common in US, a reason behind the situation is that actors do not have the skills to assess the investment. (Marjut Falkstedt - Chief Executive at EIF)

In Europe the lower levels of the TRL works properly, the bringing to market phase is much more complex. EU is funded with 530 million allowances over 10 years until 2030, so it is possible to develop big projects, but the environmental targets are very ambitious and need a huge slice of the pie.

The Innovation Fund grant a maximum amount for an individual project up to €40 million to support highly innovative, disruptive or breakthrough technologies in deep decarbonisation, any case it is fundamental to increase the accessibility: national contact points are available in each member state to assist high quality projects in the development.

Venture Capital financing can be considered the main source of external funding for Cleantech companies due to the fact that Cleantech innovations need heavy upfront investments from the first steps of R&D. Other traditional financing sources are less suitable also for the longer time span to reach the BEP and then profitability, on the other hand VC patient capital is the preferred source available in order to finance the growth of those companies. It is not only matter of money but expertise and network externalities are an incredible boost especially in the boot-strapping steps.

Next to financial support, venture capitalists provide triple bottom line business advice and network support. Key success factors include business model innovation, collaborations, and a strong business case, whereas failure factors include a lack of suitable investors, a strong incumbent industry and a short-term investor mind-set.(8)

The EIBURS project in the publication of the first working paper for EIF devoted a section to the study of the financing of cleantech sections. This is derived from the merging of the Orbis database with data on VC investment from VICO 4.0 (a pan-European dataset on VC investment activity comprising more than 54,910 European VC investment deals). A total of 170 companies received at least one investment from VC investors that is substantially larger for Cleantech innovators category compared to the ecosystem companies. The class of companies with the highest share of VC-backed companies is "Sustainable energy production" followed by “Energy-efficient industrial technologies”. VC investors also recognise the importance of solutions addressing environmental pollution and waste management challenges. Notably, 63.7% of the patenting companies that received VC investments have obtained at least one EPO patent specifically in the CCMT (Clean and Climate-friendly Mobile Technologies) fields.(14)

In 2022, the European Union and its 27 member states contributed €28.5 billion in climate finance from public sources and mobilised an additional amount of €11.9 billion of private finance to support developing countries to reduce their greenhouse gas emissions and adapt to the impacts of climate change; classifying as the biggest providers of climate finance in the world.

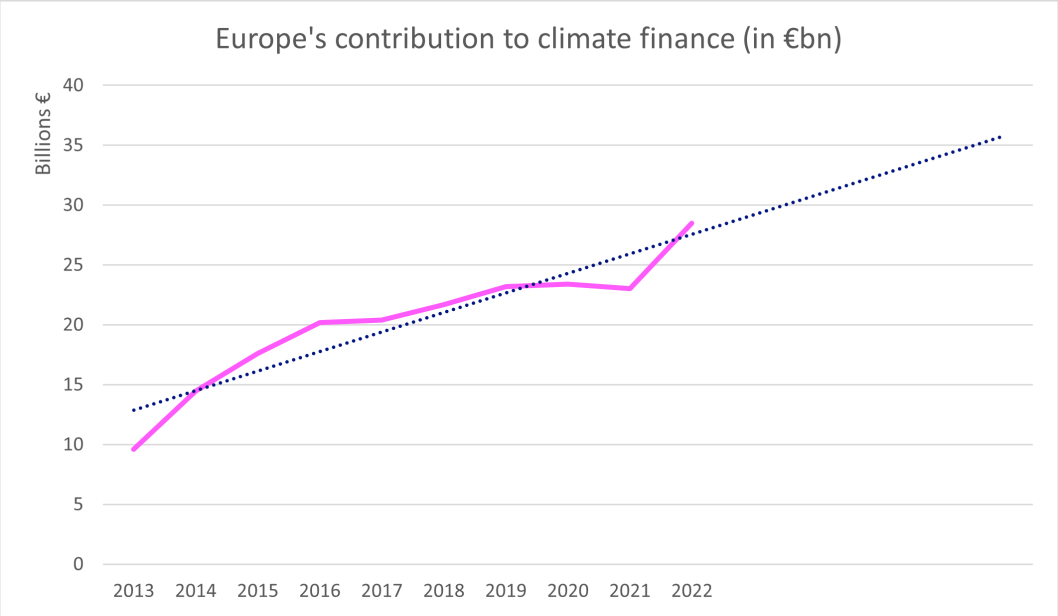

Fig. 2.2 Europe's contribution to climate finance

The overall public figure is calculated by using a new methodology, based on commitments for bilateral and disbursements of multilateral finance made in 2022. If the previous year's methodology were used, the overall public finance contribution for 2022 would have been €30.5 billion.(15)

The Council approved the figures, in preparation for the United Nations Climate Change Conference of the Parties (COP28), which took place from 30 November to 12 December in Dubai, United Arab Emirates. The figures are based on the EU climate finance reporting rules laid down in the governance regulation.

In 2022, over 54% of the €28.5 billion public funding for developing countries was dedicated to either climate adaptation or cross-cutting action (involving both climate change mitigation and adaptation initiatives), with close to half of the total funding (almost 49%) coming in the form of grants. The EU and its member states are determined to continue delivering on their international climate finance commitments towards the developed countries' collective goal of mobilising $100 billion per year, which is applicable through to 2025. This resolve is demonstrated by the new level of EU climate finance reached in 2022, which represents a significant progression compared to previous years. This economical effort will be a great bet in the next years.

2.2.3 Skills

Green transition will create new jobs, but also close obsolete positions, unfortunately the "obsolete worker" won't be the same person gaining the new position: it is possible that the resource does not have the qualifications to reskill, but a more basic difficulty arises. A Polish coal miner can't get the new job in a Danish wind factory for a geographical issue.

Here comes the importance of good social insurance and social security policies. A social difficulty arise in educating people and building the trust that new sustainable companies are more profitable, competitive and future-oriented.

At the moment an integrated skill strategy is missing at the EU level. It is important to understand how to engage with the wealth of human capital and how to ensure that skills will be available all throughout the union. Companies pointed out the fact that it's not that easy to acquire skilled technicians. A practicable solution for bigger companies has been to develop own academies to provide both practical and theoretical trainings to re-qualify previous skills (for example a gas boiler installer could learn how to install heat pump).

Digital skills can't be overlooked in the learning process, the difficulty stands in the fact that the company should have the resources to introduce the learning activity in its business model, and in some regions is still difficult to find the people interested in those programmes in energy related careers. There is very low awareness still from High School of those career opportunities. Just raising awareness in the education system could be a first step. "The biggest challenge is getting students interested, motivating them and inspiring to work in clean tech". (Policy Officer, DG CLIMA)

Shortage of skilled figures is a non-negligible challenge, this requires outsourcing the business to non-European competitors and sometimes the company is unable to internalize the expertise, this triggers a vicious cycle to be broken even if apparently expensive.

BCG Henderson Institute recently published an article(16) decreeing that the skills shortage in the green energy sector is a global challenge. The shortage of suitable skills to work in the "clean" energy sector is slowing the path to decarbonization. The demand trend is worsening and a gap of 7 million workers is projected by 2030. These side effects are not negligible and are themselves a cause and contributor to the energy crisis. The impact solely due to this gap is estimated to be a temperature increase of 0.1°C, further delaying progress in clean energy production.

Closing the gap is not impossible, however, it is imperative that institutions, governments and businesses work together by creating synergies to ensure adequate training on a large scale, fostering an integrated migration and permitting strategy to attract talent globally and encourage a process of management change.

This green skills gap is especially acute in solar, wind, and biofuels technologies—key pillars of the energy transition. Global migration can create opportunities for individuals, companies, and societies. Closing the skills gap by 2030 is possible. What makes it challenging is a mismatch between geography, skills, and timing (16). Large-scale upskilling is a key part of the solution, this is going to be a "skills-based legal migration". In countries where unemployment is relatively low, broadening the talent pool will be fundamental.

Solar panel installers, wind farm operators, welding and metal technicians in solar energy plants, technicians in fire protection and occupational safety, R&D engineers for solar and battery technologies are just few examples of the most required workers. The people

dimension tends to be overlooked in big conferences and events, fixing this is a key to find the solution. Governments and organization's role is required in order to fund and scale training programs to upskill and retrain workers in green skills. BCG estimates that less than half (40%) of the resources need only a partial education. The issue is that training programs can be very expensive and difficult to scale up. Even if many activities are effective they do not have the energy to deliver impact elsewhere.

On the organization playground a change management effort is required by top management. The human resources teams need more resources to attract talent and develop the core capabilities of the firm. This often requires an upgrade in human resources capabilities to identify talent across the world, evaluate their skills and then integrate these workers into local teams. Today is not still developed an effective global job market. Companies can pursue the goal either internally or via partners by creating digital cross-country talent and upskilling platforms for green jobs. Competitive compensation, flexible working hours, and upward career mobility are the primary instruments held by the companies.

In 2020 OECD predicted that automation would lead to 14% of the world's jobs to vanish within 20 years while one third will be radically transformed. This process involves 1 billion people around the world and at that moment AI potentiality was not still disclosed as it is today, so we can assume a further effect. To cope with technology evolution, many organizations are investing heavily in upskilling (up to 1.5% of revenue are invested in learning and development of skills).

BCG partnered with Harvard University's Digital Reskilling Lab and interviewed big companies' top management to indagate large-scale reskilling strategies:

- Reskilling is a core strategic move especially when dealing with new fields that can deliver a huge competitive advantage;
- Reskilling is not only a HR initiative. Senior directors need to manage effective and promote reskilling initiatives, clearly communicating the connection between reskilling and strategy;
- Reskilling goes beyond training. A structured reskilling program requires a shift in mindset and behaviours. It's a complex process that begins with supply and demand, recruiting, training, learning, and only at the end matching resources with positions;
- Reskilling calls for partnership and Governments can provide strong incentives. Cross collaboration between industries and universities is beneficial.

2.2.4 Supply Chain

Nowadays, SMEs are characterized by an integration into global value chains, where they have to face the social and environmental requirements of their multinational customers. As large companies make efforts to improve their environmental performance and governments

pass increasingly demanding environmental regulations responding to the expectations of different social groups, SMEs must also reduce the environmental impact of their operations. The growing concern regarding the state of the natural environment has prompted manufacturing companies to adopt and apply green procurement practices in their business processes, the importance of which is underlined by the fact that supply chain management is more and more often one of the key elements of a company's competitive edge. The role of SMEs in global supply chains is important not only from an economic, but also from an environmental point of view. Global supply chains can also ensure that SMEs comply with environmental regulations. If large customers define environmental criteria during their purchasing activities, then SMEs also need to meet these requirements to succeed on the market.(17)

The supply chain is a group of companies involved in the flow of raw materials and final products generating value for the final consumer. A good management and a mutual risk and profit sharing is the key to generate e solid competitive advantage. A famous case study of strategy in this regard is taught to highlight the virtuous attitude of Japanese car manufacturers compared to American manufacturers in supply chain management and value chain profits appropriation.

European SMEs are at the forefront of opportunities within the European Green Deal, particularly in the context of supply chains. For sure the EGD creates a massive market for green and sustainable products and services. SMEs can tap into the increasing consumer demand that for sure reflects on the previous levels of the supply chain. This is contemporarily an opportunity and a menace to be managed. Innovation and Research is required in all levels of the chain to generate a resilient ecosystem that is effectively able to reduce the environmental impact.

Collaboration in innovation clusters and networks allows SMEs to share resources, knowledge, and research, facilitating the development of green solutions, however, SMEs also face risks and competition especially from incumbents and from companies in other geographical domains where environmental requirements are less stringent for example.

Disruptions in global supply chains, exacerbated by climate change impacts and the transition to green technologies, can affect SMEs' operations and complicate the transition.

Policy makers are studying those aspects and recognize at least on the paper the risks involved and are moving in order to create clear and stable regulatory frameworks that facilitate compliance and innovation, promoting a level playing field for all market players and encourage the formation of industry clusters to foster collaboration, knowledge-sharing, and economies of scale.

In conclusion, the EGD presents both opportunities and risks for SMEs in the context of supply chains and external competition. Policymakers must play a pivotal role in supporting SMEs through tailored financial assistance, regulatory clarity, and protection from external unfair competition.

2.3 Cleantech sector overview

Many recent events are undoubtedly propelling cleantech into the mainstream, just think of the energy crisis we are facing and all the natural events (that probably are no more so natural) and are increasing their impacts more and more apocalyptically. A first point to be made clear about this is that what has for years been considered cleantech i.e., clean energy production, is but one of many facets, we have already learned from the previous chapters, and the taxonomy we will discuss shortly is but proof of this assertion.

Cleantech investments also impact emerging markets positively, create safe jobs, and expand sustainable energy access. The time to embrace the future is now.(18) For several years now, the most forward-looking companies have been proactively gearing up to take on this challenge. For sure the challenge of the millennium (let's say the century). We are potentially ready to meet today's and tomorrow's demand for coping with the climate crisis, still several steps short of putting it on the agenda.

The global economy is undergoing a dramatical change. External pressure push companies to produce and consume more efficiently. This is the trigger for innovation and then new opportunities. In recent years, the cutting edge of cleantech has received outsized investment and headlines and weathered the challenges of outsized expectations. It will continue to provide solid returns in the medium and long-term.(18)

The biggest companies are now buying their call option into cleantech. Large cap firms are building their portfolio of clean products to keep the pace of other competitive firms and investors have been able to anticipate this attitude. Cleantech is not only an opportunity to stick a SDG rainbow-colored label on a report, it has also pragmatic facets and is an undeniable opportunity for savings and efficiencies that are driving cleantech's to mass market adoption. Also at the macroeconomic level cleantech can't be disregarded, it is a large slice of employment and GDP pie attracting the interest of states and investors, in fact it is extremely promising and exciting the opportunity we face today.

The definition of the term cleantech has been much debated in the literature, as there are no unambiguous definitions although they are very similar and complementary, it is not worth wasting pages of this project reporting on so many different definitions. We refer to the one given on the introduction of the questionnaire. Economically speaking, however, a definition turns out to be interesting; this could in fact determine whether a multimillion-dollar project is worthy of funding rather than not. Europe is still spending resources on this, just outside Europe on the other hand, Institutional investor consultancy Cambridge Associates defines cleantech as "an umbrella term for a wide range of technologies and services," and related "companies and projects in cleantech if they develop non-fossil fuel energy sources, promote industrial efficiency by conserving resources and replacing existing processes with less polluting alternatives, recycle waste effectively and efficiently, or provide a product or service that creates an environmental improvement."

The incubation period of a technology lifecycle is quite critical and interesting. At this time, technology is still immature and diffusion limited. However, it is likely that awareness of the new technology will be quite widespread, and that the promises associated to it may be expressed in exaggerated terms. Practitioners often say that new technology easily suffers from hyperinflated expectations, or simply hype. A well-known representation of this phenomenon is routinely proposed by the Gartner consultancy for technology related to ICT, in the form of hype cycles.(19) This is a baseline for any cleantech technology, and I think it is appropriate to expand this consideration to investments in the entire clean sector since it is but the sum of the clean technologies developed by each company. It has not always been an easy period for clean technologies due to underwhelming returns caused by uncertainty in national regulatory frameworks and to over expectations about technologies. Many companies simply survived while much less have been able to surf the wave in the past decades. In recent years the trend is evolving: there have been cleantech IPOs, market-watchers are ready to invest, the market is pulling those technologies definitely.

The example from cleantech is not far from the dot com era. Some vertical industries or other narrowly-defined markets even flourish, and that is where cleantech is today—with survivors gaining more traction and the right companies in certain spaces finding critical capital and strategic relationships to build their businesses.(18)

Cleantech today is moving to the mass market. The chasm has been crossed for many technologies, let's think to a Tesla owner, to a solar panel system installed on a roof and to many other technologies that are today mainstream. For most recent technologies, a market gap still exists between early adopters of new technologies and the majority of consumers, but crossing is partly guaranteed by the public incentives and a population that is much more sensible to climate issues. Many disrupting technologies are now establishing dealing with the next issue: what about the establishment of the paradigm and the definition of standards? It is still work in progress.

It is expectable that a significant segment of the cleantech transition will happen softly, "... with cost and efficiency driving marginal, but resource-significant product changes. Investment decisions mirror this phenomenon. A minority of venture investors support the earliest innovators. Others are more comfortable investing in second generation technologies or following the lead of other investors. Still others wait for the market to develop. There are now investment opportunities available to investors interested in both early ventures and established organizations. This is an exciting time to invest in cleantech because investors can position themselves to reap upside without having to suffer losses in the development stages of many technologies."(18)

Cleantech sector development is threatened by different barriers. Technologically innovation is crowded out by lock-in and path dependency and policy makers are the main player in order to address this issue coordinating demand-side policies (in the survey we will indagate the most appreciated solutions by companies). Lock in effect has also a deeper facet: let's take the example of fossil fuelled vehicles. On one side it is necessary to develop the

new infrastructure (complementary assets) and than the old structure have to be dismissed requiring a huge economical effort. Information asymmetry in the first stages of development and also in the initial stages of adoption explained by Moore's curve are another salient phenomenon that can be effectively faced by the policy makers.

Survey is developed also to investigate which are perceived as the most critical risks, for sure regulatory risk is proved to be a real menace in the decision for the financing of a new project. The reputational risk and the public acceptance of the new technology can't be overlooked and this effect reflects on the long timescales for return that make the investment unattractive (we have already dialled with the concept of patient investment).

Demand-pull policies can support consumption and can take the form of tax breaks and incentives for entrepreneurs to gain a competitive advantage vis-à-vis(7). On the other hand, to push the demand subsidies such as refund schemes can incentivize the diffusion in the short run of the new technology.

It is widespread the idea of a certain limited appropriability in the R&D phases and this is another drawback leading to private underinvestment.

2.4 The role of SMEs in green transition

So far, the academic literature has mainly investigated the role of established firms as valuable actors able to conduct research and development activities in the cleantech field. However, also small early-stage ventures and SMEs may play a significant role in cleantech innovation.(20)(21)

For many years SMEs have not been a central focus of the policy debate about climate change. The main focus was about cost reduction and not about to opportunity to be a transition driver. That perspective is now changing. The aggregate footprint of SMEs is huge but in addiction small early born companies are the "fuel" (no worry, it's non-fossil-based) to the transition for their ability to develop and bring to the market innovative technologies. This is the reason why many governments enacted plans to develop the Cleantech SME ecosystem. COVID-19 further demonstrated the importance and vulnerability of SMEs boosting the assignment of recovery plans to make SMEs more resilient and greener. Available data on the SME environmental footprint is scarce, on the other hand, it is clear that on aggregate SME's impact can't be neglected.

The first driver for companies "greening" seems to be the opportunity to save on costs. Shifting consumer demand and pressures from society is a pull, including investors, supply chains and sometime the employees itself. On the other hand some barriers slow down the process: awareness and knowledge are not always mature enough. Also inputs are much more scarce: let's think as inputs to skilled workforce and to financing. This generates an uncertainty loop that starting from regulations and policies reflects to investments.

A second challenge insists on the simple fact that 27 views decline in Europe with different facets. Diversity can be an opportunity for unparalleled mutual enrichment that accelerates the process from sharing successes and failures, as if we were in a large network of programmers developing open-source code. It would be naive to overlook that this opportunity arises from a primary lack of guidelines that leave member countries and companies bewildered and in need of guidelines (and concrete initiatives) to continue the greening process.

An integrated approach however challenging to seek is the best way to give this situation a boost, and this is where the European union and all the actors we described in the first chapter are actively working to get to a finish line. The funding of this very project seems to me to be a prime example of the institutional commitment to reach the goal.

The OECD Platform on Financing SMEs for Sustainability has an important role to play in creating the conditions for SMEs to finance their green investments and innovations by tackling demand and supply-side obstacles. Other ongoing analytical work focuses on better understanding the drivers and barriers to green entrepreneurship and the greening of SMEs, and the implications for policy. The OECD SME and Entrepreneurship Strategy will deliver Guiding Principles for SME and entrepreneurship policies, including on greening.

Strengthening the evidence base on the greening of SMEs and entrepreneurship will be a key challenge in the years to come. (1) In brief the key steps to be followed:

- Improvement of the evidence base on the greening of SMEs through quality data analysis, collection and dissemination;
- Granular business case analysis to improve government support for different types of greening activities;
- Analysis on the development of the regulatory framework for the green transition;
- Identification of happy ending cases to suggest functional approaches for integrated policies;
- Deep understanding of the financial tools and the needs of SMEs and entrepreneurs to evaluate the best investment products;
- Direct inclusion of SMEs and entrepreneurs in policy design (for example with a survey, it could be a good idea) through assessments and consultations.

2.5 The EU greentech ecosystem

By endorsing the Paris Agreement on climate change, the European Union has committed itself to follow a path of sustainable economic growth. Innovations in the field of environmental sustainability, commonly referred to as Greentech, are a key element of Europe's environmental and net-zero strategy. Innovative breakthroughs in the sphere of Green technology lower the marginal cost of pollution reduction and can ensure the EU reaches its environmental targets in a cost-efficient manner. Moreover, they can help EU firms to respond and adapt to the reality of an altered climate.(22)

As already discussed small firms have a central role but are more vulnerable, especially when seeking for external equity financing. According to the ECB's SME Access to Finance (SAFE) survey, 11% of SMEs in Europe considered equity a viable financing option, while only 1% have actually used it (23). This could potentially be a significant hurdle for the growth of the Venture Capital and Private Equity ecosystem. In Europe 70% to 80% of PE and VC funds already incorporate environmental and climate considerations into their investment decisions, but this is not a practical commitment, in fact standing on Cleantech Group analysis, EU Greentech ventures attract only 6.9% of global Greentech growth and scale-up capital (compared to 54% for North America), possibly indicating a lack of key support mechanisms required for SMEs to successfully complete their product development cycle, from investments in R&D expenditures to product commercialisation.(24) It seems that the higher levels of the TRL are not easy to be developed in EU probably due to too stringent regulations that discourage the latter states of the production, on the other hand research is flourish.

The role of the financial market environment has been underexplored both with respect to the equity and the debt sides. Pitchbook database is a good source to evaluate Greentech investment activity. It stores the annual, country-level early-stage (e.g., accelerators, venture capital) and growth private equity deals, aggregated from deal-level microdata. Deal count is a proxy for volumes because the amount of the deal is quite often a missing data. The actual EU sample from (22) consists of 5,391 early-stage financing deals (PE+VC) in companies that were headquartered in one of the 27 EU member states. A rough-cut analysis evidence the significant increase of deals in recent years, particularly with a positive steep increase from 2013. Also the total amount of deals increased but the increase in Greentech has been faster, so it is not simply a global scale effect.

The deals are mostly concentrated in France, Germany, Netherlands, Sweden and Spain. The distribution of Greentech investment activity concentrates around important capital hubs is in accordance with the findings of earlier EIF papers(25). Eastern Europe and Italy Greentech appear to lag the rest of Europe, both in absolute and relative terms.

The concentration of Greentech deal activity around major urban hubs is likely to be rooted in the presence of knowledge spillovers and labour market scale effects, which lead to agglomeration externalities that cause industries to concentrate in specific regions.(26)(27)

This is especially important for greentech companies which processes differentiates from the traditional industry by the high degree of knowledge intensity and the need for highly educated labour force.

Patterns of technological specialisation differently developed across the EU because of different cultural and technological backgrounds. Innovations in the fields of energy are often based in large metropolitan hubs such as Paris, Berlin, Stockholm, and Amsterdam. About clean energy generation (solar and wind) apparently are less developed in Eastern Europe. Mobility initiatives and electric vehicles grid development are still developed around big metropolis. It's obvious that a big European capital is going to be the green leader in term of the total number of Greentech mobility deals.

The trend about big hubs reverts in the field of agricultural innovation and environment for the nature of the deals itself. The Netherlands, Ireland and Italy are at the forefront of global innovation in food and agriculture.

2.6 Gap identification and research contribution

There has been a limited amount of research in the area of early stage Cleantech SME impact investment. To get an overview of the subject area, I have reviewed the literature using Scopus engine.

To learn the approach, several queries were launched, this given below a generic one, different queries were processed in order to investigate each pillar.

TITLE-ABS-KEY (clean OR cleantech OR green AND smes OR start-up) AND (LIMIT-TO (SUBJAREA , "BUSI"))

The various investigations found some common flaws: The aforementioned search reported a rich outcome of 3408 articles, however, the scope is very broad and general; analysis of the titles and abstracts quickly reveals the weakness of the articles for the purposes of this project, which is broader. A systematic and comprehensive analysis does not appear to have been developed perhaps because it is too onerous or multifaceted.

Many of the articles identified refer to a specific case study that is limited to one technology, one state, or the combination of the two. While interesting, it is not useful if not misleading to obtain useful information: the manufacturing sector of Bangladesh, for example, is not interesting for the purposes of my project.

It should also be specified that from the first review to now, the time when I write the thesis and finish the articles, the landscape is constantly changing. Thousands of researchers worldwide, hundreds of universities and experts are working intensively on the field: a quarter of the articles refer to the last year (2023). Finally, many of the articles refer to specific technologies, also interesting, but too specific and very vertical. It follows from this consideration that articles of actually good quality for this project are few and extremely valuable, the research itself has been complicated and tricky.

Let us give an example of a slightly more articulate query to substantiate these considerations:

TITLE-ABS-KEY (clean OR cleantech OR green) AND (smes OR start-up) AND (finance OR financing) AND (europe OR european) AND (LIMIT-TO (SUBJAREA , "BUSI"))

The number of articles restict to 985. Definitely the following can be an exhasustive query:

TITLE-ABS-KEY (clean OR cleantech OR green) AND (smes OR start-up) AND (finance OR financing) AND (europe OR european) AND (egd OR european AND green AND deal) AND (LIMIT-TO (SUBJAREA , "BUSI"))

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79 articles is the outcome of this request.

The process just described wants to underline the breadth of the topic addressed and as the first major gap the fact that today there is no defined standard structure for the classification and study of the phenomenon, only many interesting but poorly organized strands.

The sample includes articles from a wide range of journals, further highlighting the dispersed and emergent nature of this discourse.

Another research(12) spots out the fact that individual factors, in other terms the individual capabilities of entrepreneurs are not accounted for, in the last part of the survey this is partly addressed taking into account the perceptions of the responder about the EGD goals and feasibility in the long term.

While external factors deserved a good attention in the literature, firm-specific factors are partly to be addressed, the survey address this topic in a few questions for example indagating the geographical dimension of the supply chain. In addition we have the opportunity to relate the data from our taxonomy in order to know much more about location, scope of the technology and patenting activities, this is for sure a great value added.

Chapter 3

Methodology

3.1 Approach

Questionnaires are used in sample surveys to elicit reports of facts, attitudes, and other subjective states. Respondents may be asked to report about themselves or another entity, such as a businesses in this specific case. The utility of asking the same questions across a broad group of people in order to obtain comparable information from them has been appreciated at least since 1086, when William the Conqueror surveyed the wealth and landholdings of England using a standard set of inquiries and compiled the results in the "Domesday Book." Sophistication about survey techniques has increased vastly. For the most part, questionnaire construction has remained more an art than a science. In recent decades there have been infusions of theory from relevant disciplines (such as cognitive psychology and linguistic pragmatics), testing and evaluation techniques have grown more comprehensive and informative, and knowledge about questionnaire design effects and their causes has cumulated. These developments are beginning to transform survey questionnaire construction from an art to a science.(28)

A questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis. Questionnaires should always have a definite purpose that is related to the objectives of the research, and it needs to be clear from the outset how the findings will be used.(29)

A questionnaire is used in case resources are limited as a questionnaire can be quite inexpensive to design and administer and time is an important resource which a questionnaire consumes to its maximum extent, protection of the privacy of the participants as participants will respond honestly only if their identity is hidden and confidentiality is maintained, and corroborating with other findings as questionnaires can be useful confirmation tools when corroborated with other studies that have resources to pursue other data collection strategies.(29)

To develop the questionnaire effectively and professionally, we began with an in-depth study of introductory materials on EGD to delve into the framework and better understand the cleantech ecosystem to which the interviewees belong. In addition to official OECD materials and academic articles, we complemented our research by examining recent conferences on the subject. This comprehensive approach allowed us to gain a thorough understanding of the phenomenon we aim to study in this thesis.

Use of existing instruments may provide the advantage of cost-effectiveness and knowledge accumulation; however, instruments should be used in the same way that they were designed, to fit the situation in terms of place, time, and population. Appropriate questionnaire design is essential to ensure valid responses to questions. The main purposes in designing questionnaires are commonly to obtain accurate relevant information and to maximize the response rate for the survey.(4)

Given that the design of a questionnaire is more of an art than a precisely defined science, we leveraged the study of a series of successfully consolidated questionnaires endorsed by virtuous institutions. This approach allowed us to grasp the structure, types of questions, and effort required. It served as an initial inspiration for organizing the entire framework and assessing a comprehensive set of questions suitable for a global study of the phenomenon.

The heterogeneous composition of the research team played a crucial role in shaping valuable questions for each subdomain. The research project itself is structured around a series of themes that reflect the core principles of EGD. This approach allowed us to develop a framework and an organized structure for the questionnaire, aligning with the key directives of EGD.

The questionnaire was initially designed in sections. For each section, a brief literature analysis was conducted to identify gaps and develop questions that would be applicable for future research developments. The process was documented in Excel, systematically listing the candidate question, potential research questions, and the preferred alternative for presenting the question. This structured approach ensured that the questionnaire not only addressed current research needs but also laid the groundwork for potential future investigations. To streamline the response process, the preferred choice was to use closed-ended questions.

Thus, open ended questions can be used as a preliminary method with a small sample to determine common themes in advance. Closed-ended items are easy to administer and analyse. Closed formats include choice of categories, Likert-style scale (e.g., strongly agree, agree, cannot decide, disagree, strongly disagree), differential scales (e.g., extremely interesting to extremely dull, rated on a 10 point scale), checklists, and rankings.(4)

An iterative series of brainstorming sessions was scheduled at various points to scrutinize the proposed questions and establish priorities, given the unfortunately limited time available for respondents. The diverse composition of the group proved to be highly beneficial in this context as well.

We presented the initial draft of questions to the group, and before incorporating a more refined version into Qualtrics, we worked in a rapid turnaround to enhance the questionnaire's quality.

The revision process also involved a step with the project's client. Two members of the European Investment Fund provided their input during the refinement and organization phase of the questions, contributing to the overall clarity and coherence of the questionnaire.

It has always been considered good survey practice to pretest survey questions to ensure they can be administered by interviewers and understood and answered by respondents. Historically, such pretests involved interviewers completing a small number of interviews and being debriefed. Problems were identified based on interview results, such as a large number of "don't know" responses, or on interviewers' reports of their own or respondents' difficulties with the questions.(28)

The final version was achieved after testing with an initial sample of three companies. This process ensured the removal of any biases related to the clarity of the questions with certainty. A useful method for checking a questionnaire and making sure it is accurately capturing the intended information is to pretest among a smaller subset of target respondents.(29)

Constructing a questionnaire involves many decisions about the wording and ordering of questions, selection and wording of response categories, formatting and mode of administration of the questionnaire, and introducing and explaining the survey. Although designing a questionnaire remains an art, there is increasing knowledge available to inform these decisions.(28)

3.2 Development

Self-administration is the most popular method of administering questionnaires in survey studies. Self-administered questionnaires can be collected via post, email, or electronically. Self administered questionnaires are easy to implement, cost-effective, and protect confidentiality. Moreover, they can be completed at the respondent's convenience and administered in a standard manner.(4)

Mail questions are written surveys that are sent through the mail to selected members of the population to be surveyed. Merits of the chosen alternative are good response rate with rigorous follow-up procedures, it is relatively easy to obtain listed population and locate respondents, it's easy to administer at relatively low cost, can cover a wider geographical area and is more manageable for handling larger samples. On the other hand the demerits are that the questionnaire may be given to someone else to fill out or may not reach the desired respondent, it is the most difficult type of questionnaire to design, it could be hard to interpret open-ended questions and time-consuming.

The goal is to present a uniform stimulus to respondents so that their responses are comparable. Research showing that small changes in question wording or order can substantially affect responses has reinforced the assumption that questions must be asked exactly as worded, and in the same order, to produce comparable data.

In the development of the questionnaire, we paid utmost attention to adhering to all best practices for the structuring and formulation of questions, including the following, explained briefly. A questionnaire should:

1. Be composed of a simple and a specific language;
2. Demand one answer on one dimension;
3. Yield a truthful and accurate answer;
4. Accommodate all possible contingencies of a response;
5. Have mutually exclusive response options;
6. Produce variability in response;
7. Minimize social desirability;

The questions included in the survey should meet the following standards being:

1. Easily understandable;
2. Simplified;
3. Conveying only one thought at a time;

4. Aligning as closely as possible with the respondent's thought process;
5. Avoiding words with ambiguous meanings;
6. Steering clear of danger words, catchphrases, and words with emotional connotations.

Both cognitive and linguistic factors may impede respondents' ability to understand a question at all, as well as give rise to variable or erroneous interpretations. Administering the questionnaire to a culturally diverse and geographically dispersed sample required heightened attention to avoid any potential sources of ambiguity. "Avoid ambiguity" is a truism of questionnaire design. However, language is inherently ambiguous, and seemingly simple words may have multiple meanings. Ambiguity also can arise from contradictory grammatical and semantic elements.(28)

Given the globalized target audience and additional associated risks, it was decided to present a single version of the questionnaire in English. (A largely unmet need concerns pretesting of translated questionnaires. For cross-national surveys, and increasingly for intra-national ones, it is critical to establish that a questionnaire works and produces comparable responses in multiple languages.)(28)

Accurate translation not only strengthens equivalence, but also helps to avoid bias. However, when linguistic differences such as the literal meaning of words between the source and target language exist, the process of translation is more difficult.(4)

Short and simple questions are generally recommended, because participants tend to have higher response rates and a higher proportion of completed answers for shorter items than for more complex items.(4) Cognitive overload due to complexity or ambiguity may result in portions of a question being lost, leading to partial or variable interpretations and misinterpretations.(28) Consideration should be given to the wording of questions, that is, technical jargon, slang, and abbreviations should be avoided. The reading level of items should correspond to the level of education of respondents.(4) In crafting survey questions, it is crucial to navigate potential pitfalls and maintain uniformity to ensure accurate and meaningful responses. Here are key considerations:

- Clarity and Ambiguity: Questions should be crystal clear to prevent misunderstandings and ensure respondents interpret them as intended;
- Simplicity over Complexity: Favor straightforward and concise questions, avoiding unnecessary complexity that may hinder respondent comprehension;
- Avoiding Double-Barreled Questions: Construct questions with a singular focus to prevent confusion for both respondents and investigators;
- Balancing Question Length: Strive for a balance between brevity and detail. Short questions may seem abrupt, while longer ones with transitions enhance accuracy;

- Accessible Language: Steer clear of technical jargon and uncommon words to ensure broad understanding, particularly among the general public;
- Precision in Wording: Eliminate vague words that might lead to ambiguous answers, maintaining precision in question formulation;
- Preventing Data Degradation: Collect accurate, continuous data at the source;
- Providing Adequate Choices: Offer a sufficient range to allow respondents to express their views accurately;
- Consistent Scale Format: The format of response scales, whether even or odd, can impact results;
- Standardization in Surveys: Maintain consistency in measurement scales and wording across surveys for meaningful comparability;
- Mindful Response Formats: In self-administered questionnaires, be aware of how the horizontal or vertical format may influence respondent answers;
- Mitigating Consistency Bias: Incorporate both positive and negative statements on an issue to minimize consistent bias in responses;
- Guarding Against Response Fatigue: Long questionnaires may induce fatigue, leading to uniform and potentially inaccurate responses;
- Minimizing Skipped Questions: Logical flow errors leading to skipped questions can result in the loss of valuable information;
- Understanding End Aversion: Respondents may prefer middle-of-the-road answers;

To encourage reader participation in the research, we have clearly outlined the virtuous purpose of the project: contributing to the shaping of new European directives. Additionally, we have pledged to send participants the project's final report, making their involvement not only impactful for the advancement of European guidelines but also an opportunity to stay informed about valuable insights revealed during the survey.

3.3 Structure

The questionnaire consists of a set of 28 questions, of which only 4 are open-ended questions used to gather personal information from the respondent. An advantage of open questions is their ability to capture answers unanticipated by questionnaire designers. They can provide detailed responses in respondents' own words, which may be a rich source of data. They avoid tipping off respondents as to what response is normative, so they may obtain more complete reports of socially undesirable behaviors. On the other hand, responses to open questions are often too vague or general to meet question objectives. Closed questions are easier to code and analyze and compare across surveys.(28)

Structured questions are those questions in which there are definite, concrete and predetermined questions. The questions are presented with exactly the same wordings and in the same order to all respondents. A highly structured questionnaire is one in which all questions and answers are specified and comments in respondents own words are minimized.(29)

The closed-ended responses fall into two possible categories:

- Single choice (response alternatives must be meaningful and capture the intended range of responses. When respondents are asked to select only one response, response alternatives must also be mutually exclusive;(28)
- From 1 to 3 choices (Careful grouping and labeling of categories is required to ensure they discriminate).(28)

An alternative considered but not implemented for the second category was to introduce an ordinal ranking for the three alternatives to gather more detailed information. However, this approach would have demanded additional time and effort, risking potential compromise to the quality of subsequent responses.

The use of multiple-choice questions, one of the more traditional methods, is highly suitable because respondents find them easy to answer and they allow researchers to easily identify the main concerns of the respondents. This method has two types of formats: one is Simple-multiple-choice; the other is Modified-multiple-choice. In the Simple-multiple-choice format, respondents must choose one from among the given alternatives. Simple-multiple-choice identifies only the most important alternative for each respondent, thus preventing the respondent from expressing his or her preference concerning a selected alternative over the others. Furthermore, no information regarding the relationship among the non-selected alternatives is derived. In the Modified-multiple-choice format, respondents are given the option of indicating their top-two (or more) alternatives. Since respondents are allowed to express their preferred alternatives, Modified-multiple-choice can be expected to be an effective way to make up for the lack of information incurred by Simple-multiple-choice. However, the difference in the degree of importance among the selected alternatives

is not clarified, nor is the information concerning non-selected alternatives reflected in the results.

Some questions (denoted with (1 choice for each row)) have been presented in a Matrix form. Identical response categories are assigned to multiple questions. The questions are placed one under the other, forming a matrix with response categories along the top and a list of questions down the side. This is an efficient use of page space and respondents' time.(29)

When generating the questionnaire, consider that the order of the items may play a considerable role in responses, demographic data may be presented at the end to keep respondents engaged.(4) These questions hence are placed at the end of the questionnaire.

Question order changes the context in which a particular question is asked. Prior questions can influence answers to subsequent questions through several mechanisms. First, the semantic content of a question can influence interpretations of subsequent questions, especially when the subsequent questions are ambiguous.(28)

The question sequence must be clear and smoothly moving. A proper sequence of questions reduces considerably the chances of individual question being misunderstood. The first few questions are particularly important because they are likely to influence the attitude of respondents and in seeking his desired cooperation.(29)

Answering a question implies accepting its presuppositions, and a respondent may be led to provide an answer even if its presuppositions are false. Filter questions [e.g., "Do you work?" and (if yes) "Do you work regular hours?"] can be used to test and thereby avoid unwarranted presuppositions.(28)

Should "don't know" be offered as an explicit response option? On the one hand, this has been advocated as a way of filtering out respondents who do not have an opinion and whose responses might therefore be meaningless. On the other hand, it increases the number of respondents who say "don't know," resulting in loss of data.(28)

3.3.1 Introduction

The introduction outlines the scope, research stakeholders, and sponsors, encouraging respondents to participate while ensuring the confidentiality of their data. The estimated time for completion is some minutes, and a dedicated email address is provided for any feedback or concerns related to the questionnaire.

3.3.2 The company

A brief introduction defines the concept of cleantech before posing the initial question (Q1) that inquires about the company's actual involvement in the cleantech sector. The first question serves as a filter to identify and exclude companies not operating in this field. Subsequently, we delve into the drivers that prompted the company's engagement (Q2). A

parallel question explores the primary obstacles encountered in the cleantech realm (Q3). Moving forward, Q4 investigates how uncertainty impacts the company's activities across three facets: technological, market and regulatory. Q5 aims to explore the actions undertaken by the company to align with and meet the goals of EGD.

3.3.3 Innovation

The innovation section is dedicated to companies developing clean technology. The first question, Q6, investigates the level of technology development according to the Technology Readiness Level (TRL) scale. This is ideal for delving into the maturity of the technology, as several fundamental aspects depend on it (such as the type of investment or the main stakeholders strongly connected to it). The following questions in section Q7 and Q8 are reserved for companies actively developing technology and respectively inquire about the source of innovation within the company (external, internal, or hybrid) and the preferred tools for intellectual property defence. We expect that the vast majority of the companies in question are developing at least one technology. In the case of companies with multiple technologies, the Technology Readiness Level of the primary clean technology is requested.

3.3.4 Regulatory environment

We are ready to delve into the heart of the research with questions specifically aimed at investigating the pillars of the European Green Deal. Q9 requires, for each regulatory area, an influence on a Likert scale with three levels to define the most impactful regulatory aspects for each company. We expect these influences to vary significantly depending on the country of origin or the jurisdiction to which the company is subject and the industry sector according to the identified taxonomy.

Q10 intentionally, with a negative connotation, seeks to pinpoint the drawbacks of recent regulations that have emerged from the interviews described in the previous points. This allows us to identify the main challenges faced by European cleantech companies to understand how to address them with future policies.

With the same objective, Q11 asks about the possible support preferred by companies to have an effective boost to innovation. Q12 is a Likert scale aimed at gathering an assessment of the current state of affairs. All alternatives are presented unidirectionally (with a positive connotation), and the Likert scale has even values. Although this poses a risk of indifferent responses (neither agree nor disagree), the reader benefits from clarity and quick completion, given the complexity of the questions and topics covered. This is certainly an advantage.

3.3.5 Access to funding

Q13 consists of a series of interconnected sub-questions. Only for companies that have decided to raise funds from external investors for ongoing activities, the following information is requested:

- The amount the company aims to raise in the next five years, with an order of magnitude estimate;
- How much of this amount will be entirely dedicated to supporting cleantech activities.

Respondents have the option to refrain from answering these financial questions if they deem it appropriate not to disclose this information. Given the well-known challenges in accessing public grants, Q14 inquires about the primary difficulty encountered in accessing public funds. The question is directly aimed at identifying ways to simplify the processes for allocating European funds that will be earmarked in the coming years.

Q15 presents a comprehensive and mutually exclusive list of financing instruments, ranging from traditional options like simple debt and equity to recent hybrid solutions and fintech. For each instrument, respondents are asked to indicate whether the instrument has been used in the past, if the company would seriously consider using the instrument or the case in which the instrument is automatically ruled out as an option among possible alternatives.

This set of three alternatives allows respondents to provide insights into their company's historical use, current openness to considering specific instruments, and any pre-existing exclusions among the listed financing options.

3.3.6 Skills

Q16 presents a list of 10 skills from different domains (plus soft skills as the eleventh alternative). For each skill, respondents are provided with four alternatives to indicate:

- Necessary or Not Required: Whether the skill is considered necessary for the company's operations or not required;
- Already Available or Not Available: Whether the skill is already present within the company or not currently available;
- Internal Development or External Acquisition: If the skill is currently unavailable internally, respondents are asked to specify whether they plan to develop this competence internally or acquire it externally through outsourcing.

This structure allows respondents to provide insights into the perceived importance of various skills, their current availability within the company, and the strategies planned for skill development or acquisition, both internally and externally.

3.3.7 Supply chain

Q17 simply asks for the length of the supply chain. Clearly, we expect that, depending on the developed technology, similarities can be identified (for example, in the importation of a specific raw material from abroad). The question also opens the broader issue of the current supplier selection to understand the actual drivers behind the choices made and the sensitivity developed in streamlining the supplier pool (Q18). Q19 then inquires about possible actions that could be implemented by the government (or Europe) to increase the resilience capabilities of a supply chain. Q20 shifts the perspective, changing the point of view by asking the company itself about actions taken with the same purpose of enhancing supply chain resilience.

3.3.8 View on EU Green Deal

Questions 21 and 22 are Likert scale questions that ask the respondent to express their opinion about the consequences of regulations introduced by the EGD. Specifically, Question 22 seeks the respondent's perception of the goal to achieve net-zero emissions by 2050 at three different levels of detail: at the entire European level, with reference to the individual country, and finally, speaking for their own company. In this case, a strong correlation with the company's home country is expected. A larger number of responses would allow for a nuanced study on this intriguing topic.

3.3.9 The responder

The last four questions are the only open-ended and non-mandatory ones. They request personal information that the respondent can choose to provide, indicating their willingness for a potential follow-up interview or further discussion about the given responses. The requested information includes role and business unit affiliation, full name, email address, and telephone contact.

3.4 Population

Below are reported the figures from the first step of the EIBURS project that provides a thorough understanding of the ecosystem in which the research takes place.

The mapping was divided into several areas: an initial categorization was by segment, thus by category of technology developed. The geographic study of company dispersion, categorization according to NACE classification, and other details regarding year of incorporation and patents filed are certainly an interesting point of discussion to try to justify patterns.

The final sample consisted of 23,868 European companies broadly identified as Cleantech and active (failed or no more active firms have been excluded from the sample):

1. **Cleantech innovators** are companies that create (and eventually use) the clean technology as their core business. They are at the centre of the supply chain;
2. **Cleantech ecosystem** are companies that adopt clean technologies, sell services based on clean technologies, or provide inputs for the development of clean technologies. In the category are included “experimenters”, “manufacturers”, “distributors”, “integrators”, and “operators”.

2,990 companies are individuated as “innovators” (12.5%) while the others are to be considered part of the ecosystem. The more granular distinction of the ecosystem is not relevant for the purpose of the survey and for this thesis. In fact the aim is to prepare the survey collecting answers that can have a different weight and interpretation according to this classification, definitely the ecosystem labels can be aggregated in the macrofamily.

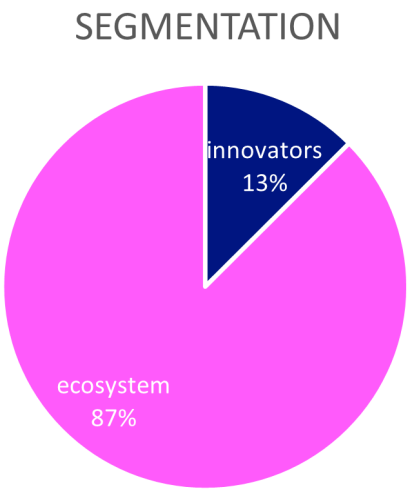

Fig. 3.1 Segmentation

It is not easy to manage such a big database and unfortunately some values are missing for some companies for different reasons, any case the analysis can be statistically valid due to the size of the sample. Following an insight of the STATA DB records available.

I was pleased to clean up the original database and re-extract the values to create the following quantitative visualizations, some other possible inferences not reported in the research project can emerge.

Regarding the classification of technologies, it is methodologically correct to specify that the company-technology assignment is not unique; indeed, some companies are recognized as operating in more than one technology area, probably because of the varied portfolio of technologies.

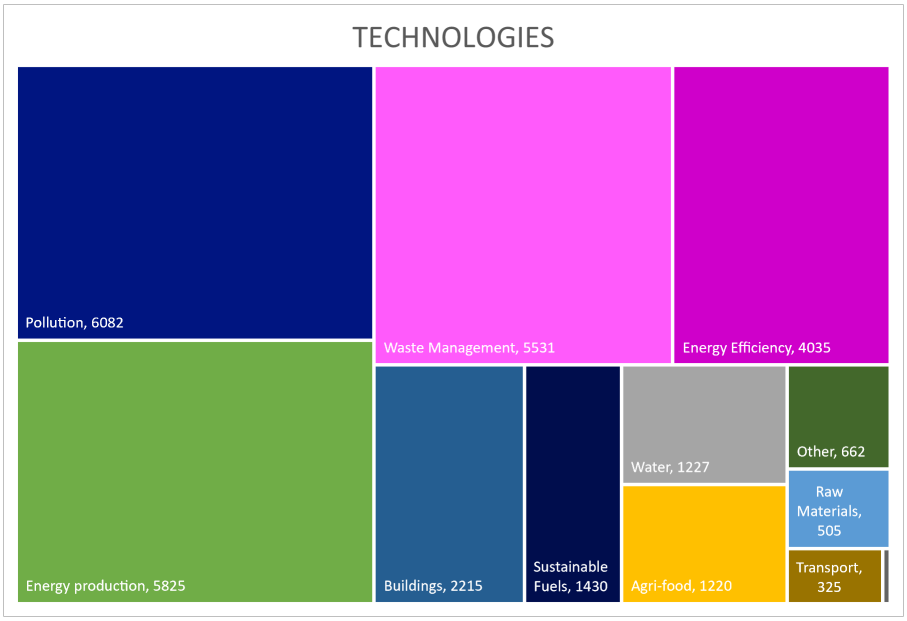

Fig. 3.2 Technologies

A tree map is an appropriate tool to represent the technologies share, the graph is self explanatory. This share does not account for the weight of different projects but we can proxy all the projects with the same weight. A Pareto chart is a good graphic tool to evidence the most developed areas, remember that the total values do not sum up to the total number of companies because a company can be associated with more than one technology.

Examining the spatial distribution of Cleantech companies provides valuable insights for policymakers, investors, and Cleantech firms themselves. It helps in identifying clusters, understanding regional advantages, evaluating policy effectiveness, identifying market gaps, and informing strategic planning and resource allocation decisions.(14)

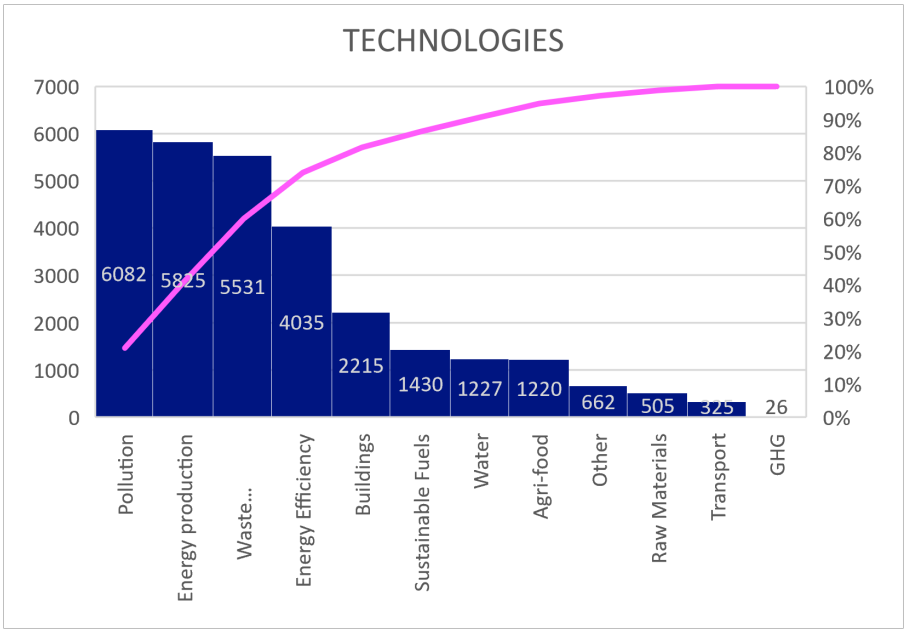

Fig. 3.3 Technologies

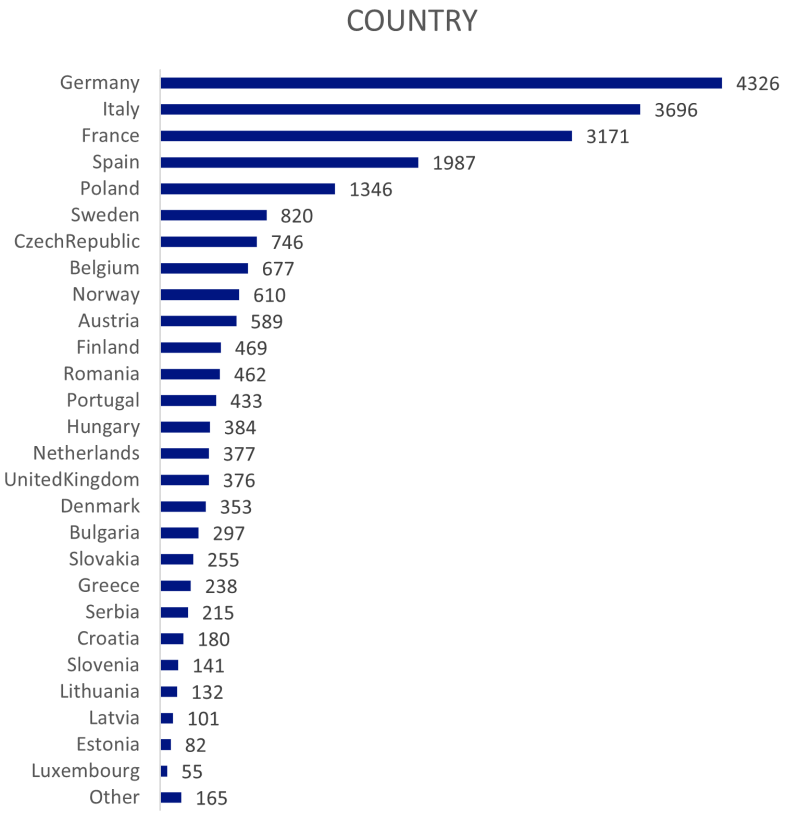

Fig. 3.4 Country

More than half of Cleantech companies (51.18%) are located in just three countries: Germany (18.65%), Italy (17.85%), and France (14.33%). Cleantech companies are active

across a wide range of NACE sectors. When considering both innovators and ecosystem, the majority of Cleantech companies operate in the manufacturing, wholesale and retail trade, water supply, waste management, and construction sectors. Focusing only on Cleantech innovators, there is a significantly stronger concentration in manufacturing (42.91%), which indicates that Cleantech innovation occurs predominantly in hardware-intensive sectors.

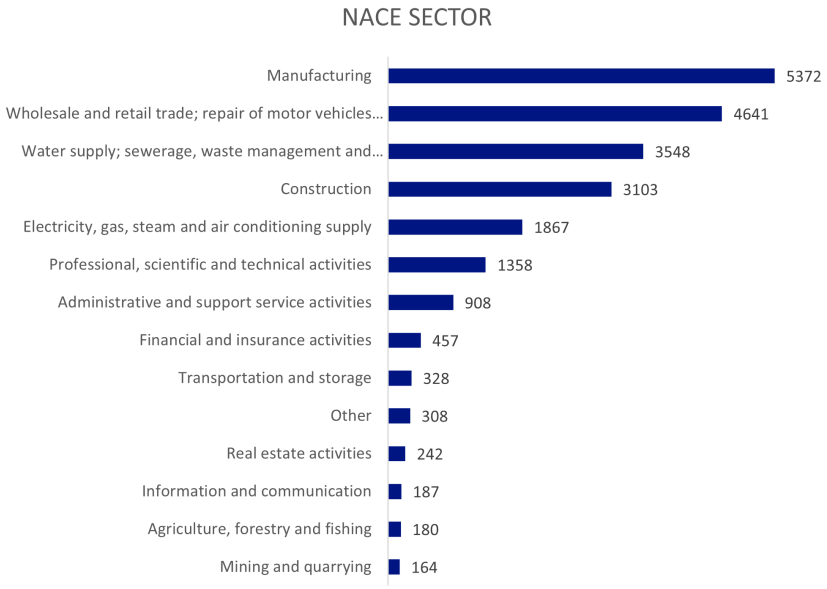

Fig. 3.5 Nace sector

While interest in Cleantech has experienced a strong surge in recent years, driven, among other things, by evolutions on the regulatory front, environmental technology is not a new phenomenon and predates the current green regulatory wave. This is confirmed by the data, which illustrates the distribution of Cleantech companies by year of incorporation and shows that over half (63.77%) of the companies were founded in the previous decennium, prior to the first Cleantech investment wave.

Noteworthy is the gradual decline in the number of Cleantech companies after 2010. One potential explanation for initial downward trend is the global economic downturn that occurred during this period, commonly referred to as the "cleantech crash" when the aftermath of the Great Financial Crisis led to reduced investment and funding opportunities for innovative companies. These challenges were further aggravated by the sovereign debt crisis, as public budgetary constraints led to reduced incentives and subsidies for green technology, creating a less favourable environment for Cleantech to flourish. Similarly, the table shows a drop from 2016 onwards explained by the methodological approach adopted for constructing the initial sampling based on censoring of the most recent companies. This choice was driven by the need to track the evolution of these companies over time for a significant number of years.

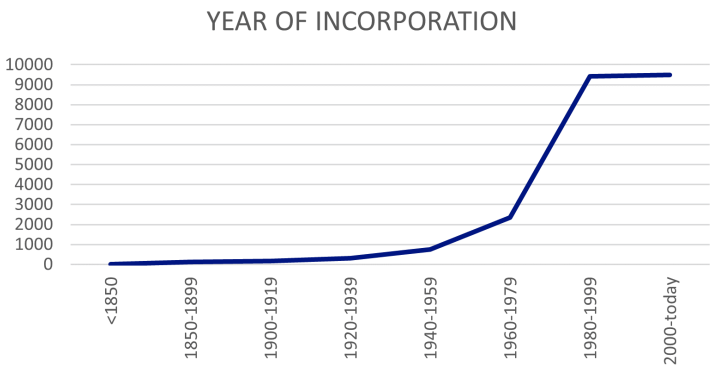

Fig. 3.6 Year of incorporation

Whatever the relationship between a firm's size and its innovations, one of the relatively few things that researchers can agree on is the critical role played by new firms, or entrants, in many industries. (Lerner, 2010) The graphical display of company size well describes the structure of European companies that are characterised by being small and medium-sized enterprises (less than 50 employees). 53% of the sample are enterprises with less than 50 employees, cumulatively 82% have fewer than 200 employees.

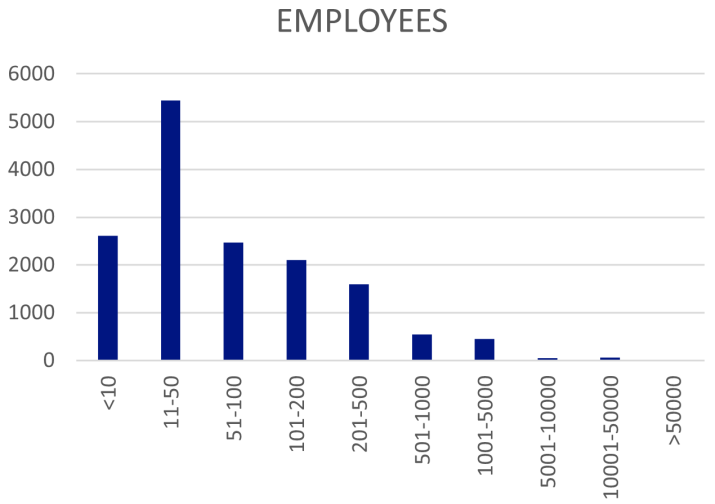

Fig. 3.7 Employees

The data presented in our study reaffirms the vibrant nature of the Cleantech industry in Europe. With a flourishing startup ecosystem, the sector is well-positioned to contribute significantly to the shift towards a low-carbon economy and tackle the urgent global challenge of climate change. The findings also highlight notable variations among European countries, reflecting the diverse landscape in terms of investment levels, innovation and regulatory support across Member States. These differences underscore the need for targeted strategies tailored to each country's specific context to foster sustainable growth and maximize the potential of the Cleantech industry in Europe.

3.5 Distribution

We decided to use Qualtrics as online survey platform for designing, creating and distributing our survey. Qualtrics provides an intuitive interface, allowing us to easily design and distribute customized surveys. Its advanced survey logic and dynamic question branching feature enable us to tailor the survey experience for our respondents, ensuring relevant and accurate data collection. Additionally, Qualtrics offers comprehensive data collection capabilities, including multiple distribution channels such as email, which align perfectly with our outreach strategy especially for submitting reminders for the compilation.

The survey distribution commenced on July 18, 2023, and concluded on October 15, 2023. Throughout this extended period, we monitored the distribution process by actively managing a dedicated email inbox to address any respondent queries. Emails were systematically dispatched approximately twice a week, primarily on Mondays and Fridays, to maximize respondent engagement. Companies that had already responded or declared their lack of interest in the project were consistently excluded from subsequent sampling. As anticipated, following each wave of distributions (depicted by pink vertical lines), there was a surge in the number of surveys initiated (represented by blue bars), which gradually declined over time. The blue dotted line illustrates the trend of surveys initiated per day. Consequently, we anticipated that further extending the distribution window would not significantly augment the number of respondents. With each wave, the percentage of companies within the sample decreases, and consequently, so does the number of companies interested in providing their response.

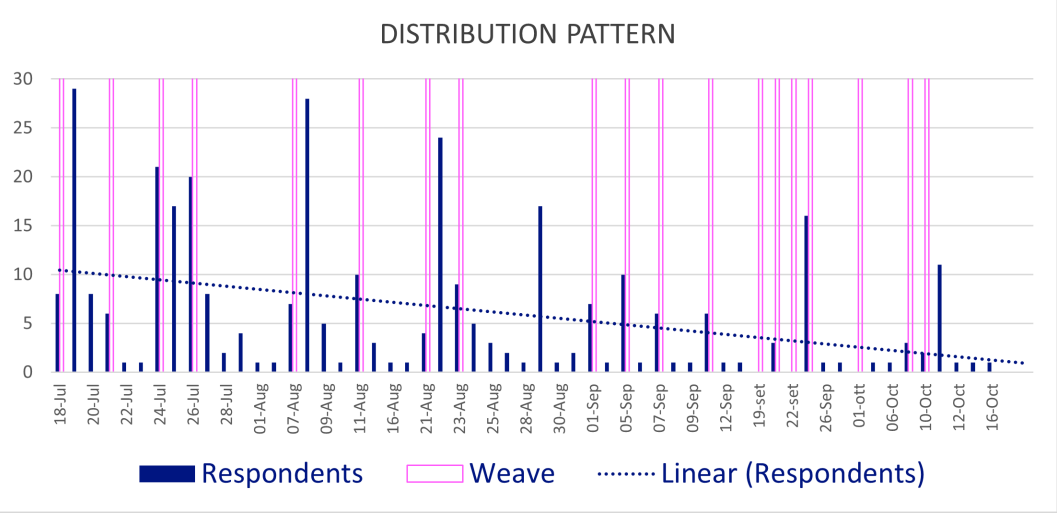

Fig. 3.8 Distribution Pattern

3.6 Process

From the output of Project WP1, we identified 23,868 companies (divided between pre and post-2018, a statistically and logically insignificant distinction). Out of these, we obtained contacts for only 15,034 companies. To increase the response rate, we sought multiple email addresses per company by cross-referencing data from Orbis and Pitchbook. We acquired a total of 22,169 contacts; approximately 5,000 emails bounced for various reasons (soft or hard bounce). Due to some duplicate emails, we reached a total of 13,456 different companies. 323 questionnaires were completed, of which only 169 were 100% complete and thus considered. We achieved a modest response rate, but one that still allows for interesting insights in the next steps of the research. The response rate is approximately 2.40%, halved when considering only complete responses.

Therefore, we gathered opinions from 159 different companies (with 10 of these being emails from the same company or belonging to the initial pilot).

We considered segmenting the sample to increase the response rate by potentially eliminating certain categories in favor of others (for example Eastern Europe response rate have been significantly lower). This could target statistically more interested hypotheses (e.g., aiming for a 10% response rate).

However, to avoid sampling bias (where the sample is not representative of the whole European population) and selection bias (where certain factors influence participant selection), we opted to retain the entire sample. We delegate to future studies the opportunity to pursue this initiative, suggesting this potential approach for further investigation.

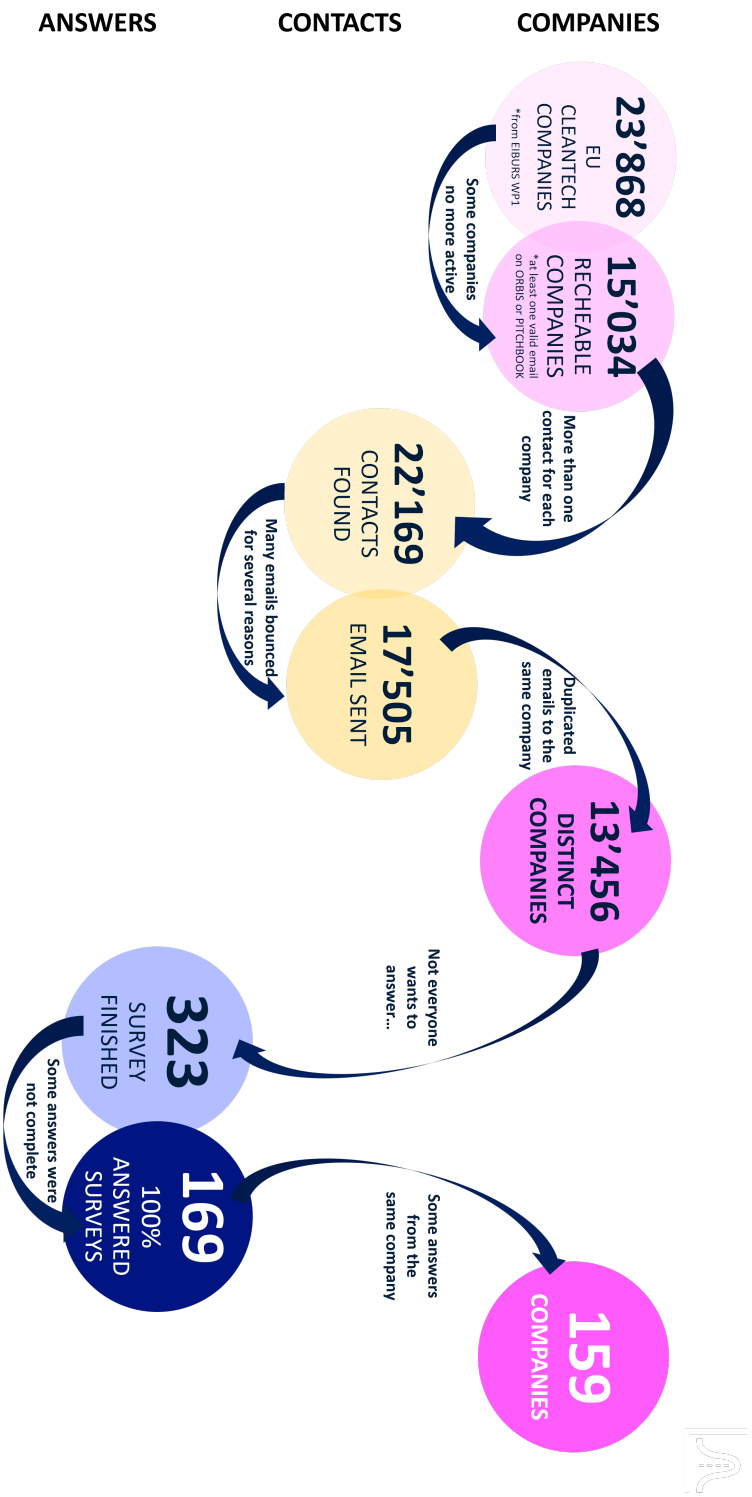

Fig. 3.9 Distribution Process

Chapter 4

Results and analysis

4.1 Description of respondents

The questionnaire was filled out by 329 companies; some responses were not provided in full and were excluded from the analysis as they were deemed not significant. A total of 169 participants completed the questionnaire comprehensively. One-fourth of the respondents were classified as "innovators" according to our categorization, while the remaining 125 are part of the ecosystem. Since the distinction between these two categories is sometimes blurred, and we do not expect significant differences in responses between the two entities, it makes sense to treat them in an aggregated manner. In some cases, we highlight any notable discrepancies in responses between the two groups.

Further analyses based on the granularity of the sample would be interesting to develop a kind of cluster analysis, perhaps based on the country of origin or the cleantech sector in which the company operates. Unfortunately, the current numbers do not allow for a robust and structured investigation, which could be a future development of research in the case of a higher response rate. Nevertheless, we will seek insights and correlations in the analysis of different questions in cases where specific expectations or situations allow for the identification of a pattern to either confirm or challenge the hypothesis.

4.2 Descriptive statistics of responses

4.2.1 Concerning the decision to operate in the cleantech sector, which of the following statement is mostly appropriated? (1 choice)

The first question serves as a significant filter for the entire questionnaire. Thirty companies were excluded from subsequent steps as they stated they do not operate in the cleantech sector. Recording their responses would not have made sense (column left blank with highlighted borders). Excluding two special cases that did not identify with any category, about half of the companies declared having had cleantech as their core business from the beginning, while another quarter had a partial shift towards green activities over the years. Only seven respondents underwent a radical change in their business plan towards cleantech. The vast majority of respondents, therefore, have a clear commitment to cleantech technology development, making them the ideal sample to answer all subsequent questions.

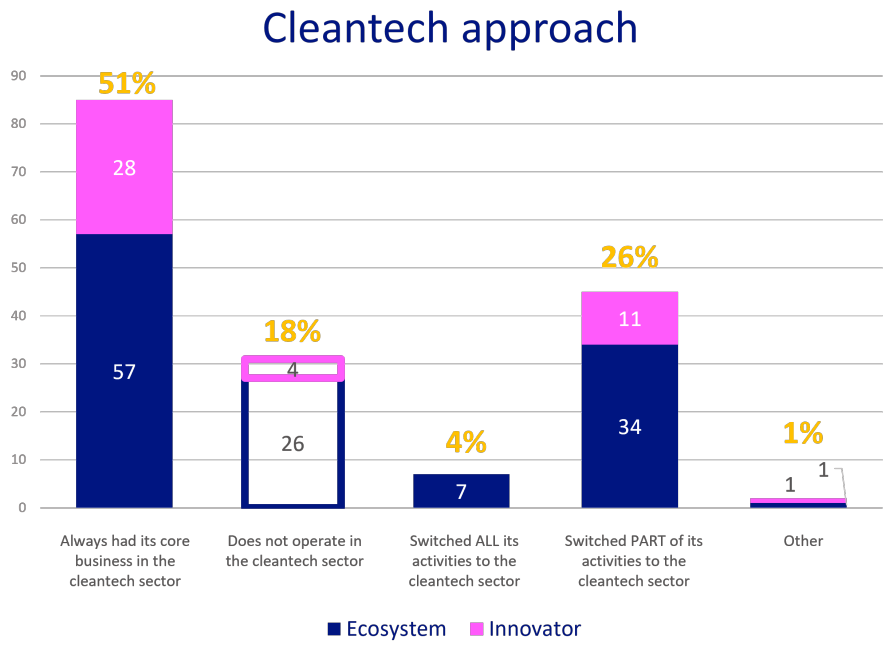

Fig. 4.1 Q1 Cleantech approach

4.2.2 What are the main drivers for your company to operate in the cleantech sector? (from 1 to 3 choices)

The choice of graphs is not purely stylistic; it imparts certain meanings that might be otherwise challenging to grasp. When bars are juxtaposed (as in this case), it indicates a clear mixability of the innovator and ecosystem groups: the responses exhibit the same share. In stacked bar charts, a significant deviation is observed, suggesting a need for a more in-depth analysis.

The first question allows respondents to choose up to three alternatives to define the main drivers that prompted the company to operate in the cleantech sector.

Two responses far surpass all others: adhering to the company's mission and vision, and the possibility of better business opportunities are the preferred answers. Stakeholders' pressure and incentives from the public sector are currently not decisive factors in the transition. We anticipate that strategic maneuvers in the coming years could reverse this trend, compelling more companies to enter the cleantech realm. The need to comply with regulations and standards, brand reputation, and financial considerations are other selected motivations within the sample.

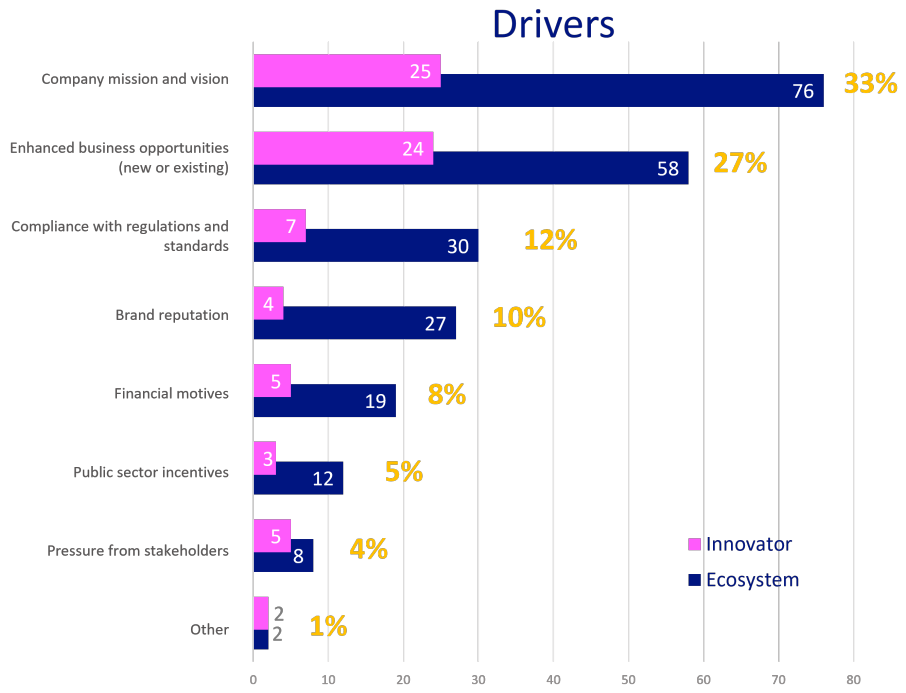

Fig. 4.2 Q2 Drivers

4.2.3 What are the main difficulties your company faced after you entered the cleantech sector? (from 1 to 3 choices)

The question is somewhat symmetric to the previous one, asking about the main challenges encountered. The less pronounced difference in the choice of categories indicates a split sample and a general importance attributed to almost all identified causes. This suggests a challenging and still-developing environment. The uncertainty of standards and regulations is among the primary issues for at least one in five companies, with greater weight for those in the ecosystem (for pure innovators in lower TRL stages, regulatory aspects are less prominent).

In contrast, innovators perceive greater challenges in accessing funding due to high risk. Other significant issues identified include the complexity of the technological development process, an immature demand that needs to be created, a widespread shortage of workers with the required skills, and a weak sustainability orientation in the supply chain.

From the perspective of intellectual property protection, there is a minimal response (1%). This suggests that in Europe, we can rely on a robust and well-structured IPR system, allowing us to direct more effort towards addressing the other identified challenges.

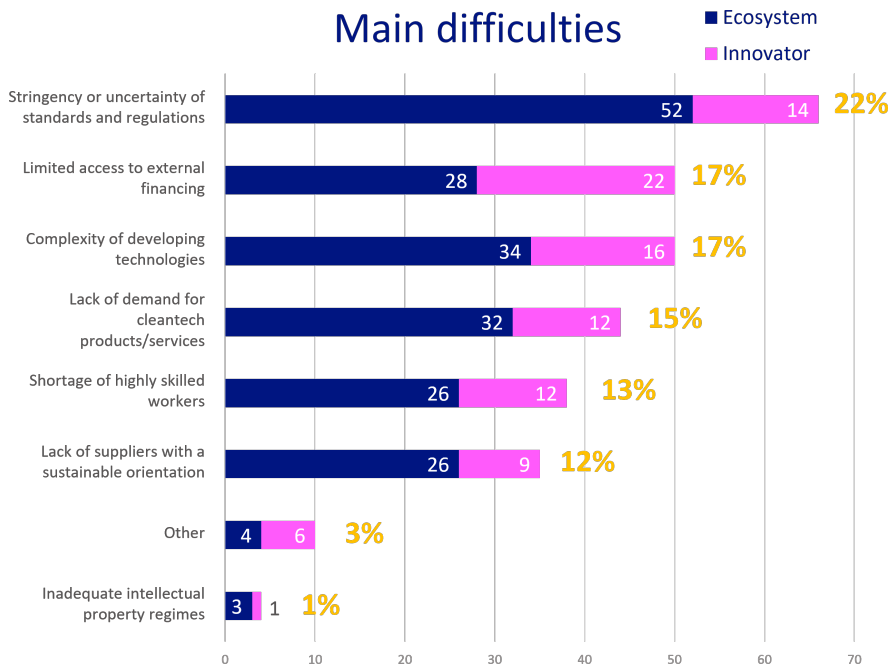

Fig. 4.3 Q3 Main difficulties

4.2.4 How much the following types of uncertainty are affecting your activities? (1 choice for each row)

Matrix questions lend themselves to a modal analysis as the best indicator of central tendency; for this reason, non-modal bars are represented in a opaque blurred color. A proper structuring of the question entails a single mode among the responses, which effectively represent an ordinal, non-interval scale.

The three types of uncertainty are mutually exclusive and recognized in the literature. We can assert that technological uncertainty is inherent in the same type of activity and only marginally affects the outcome. Conversely, market uncertainty, arising from an immature and developing market (with some technologies still in the prototypical phase and others in the early stages of Moore's segmentation, yet to cross the "chasm"), was foreseeable. A strong regulatory influence was also anticipated and is a phenomenon described in various interviews, to be further explored in the dedicated section of the questionnaire.

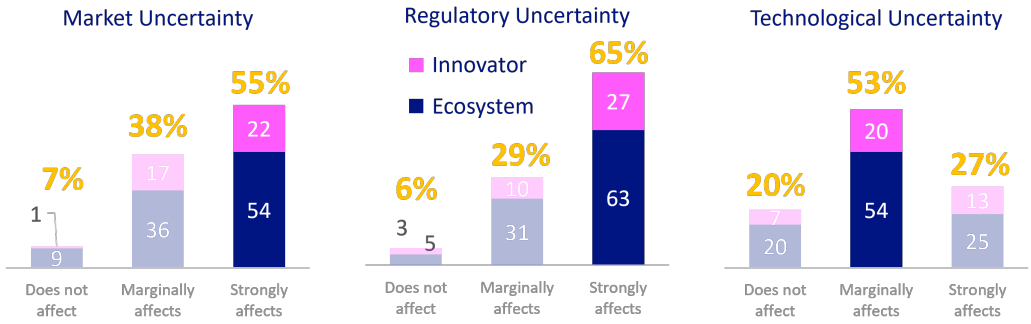

Fig. 4.4 Q4 Uncertainty

4.2.5 What is your company doing to meet the goals set by the European Green Deal? (from 1 to 3 choices)

All companies are currently taking steps to achieve the goals of the European Green Deal, aiming for greater sustainability. This question may be susceptible to desirability bias; however, since the bias is randomly distributed among the alternatives, we can identify the preferred initiatives: 1/3 are expanding their product or service range to include green options, while 1/4 are adopting green impact technologies. Additionally, 1/5 are opting to engage a pool of green suppliers and paying attention to procurement policies.

Two alternatives are perceived as less preferred, perhaps due to their perceived immaturity or high costs with delayed returns in the short term: offsetting carbon emissions and upskilling the workforce. It's worth noting that encouragement for smart working is not universally adopted, as some companies prefer an office-based work model.

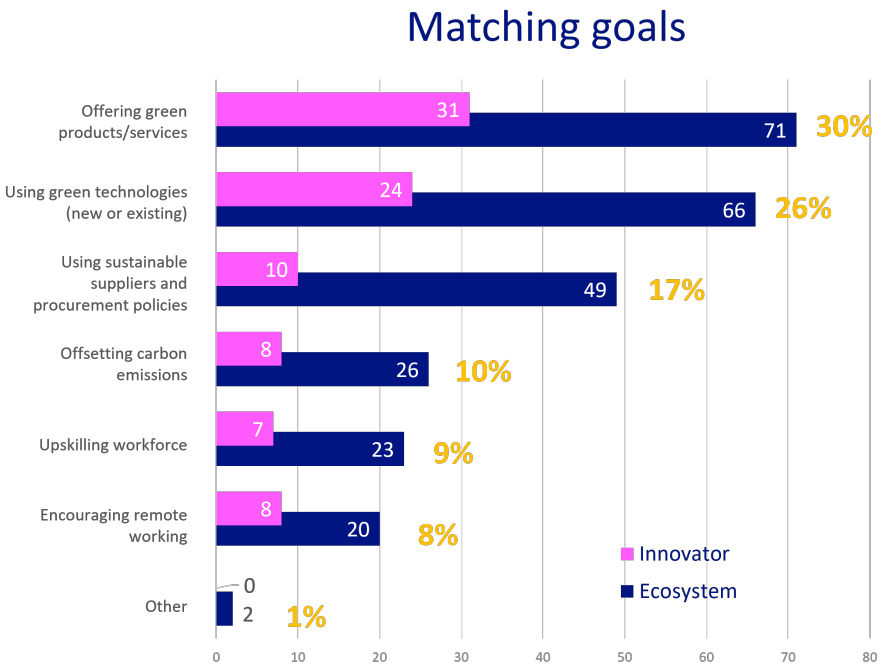

Fig. 4.5 Q5 Matching goals

4.2.6 How would you define the readiness level of the CORE CLEAN TECHNOLOGY embedded in the company's main project (TRL)? (1 choice)

The question about Technology Readiness Level (TRL) once again serves as a filter, excluding another 23 companies that claim not to be developers of clean technologies. This scenario is more common in the ecosystem, while innovators, in the vast majority of cases, identify as developers of technology. We can expect higher TRL values for the ecosystem and lower TRL values for the innovators cause the ecosystem are usually located in a higher point in the supply chain. They usually are not involved in the direct development of the technology rather than in the commercialization or application of it.

The question requires an understanding of the meaning of TRL, which is explained to the respondent before the question to guide them in their response. Even in this case, the different thresholds are not sharply defined. We can infer that a modest number of companies are still in the very early stages of research, a typical attitude for European innovations that find fertile ground in the research world. However, referring to actual companies, most technologies are at relatively high levels, close to industrialization (the majority of technologies at TRL 9 can be considered effectively commercialized).

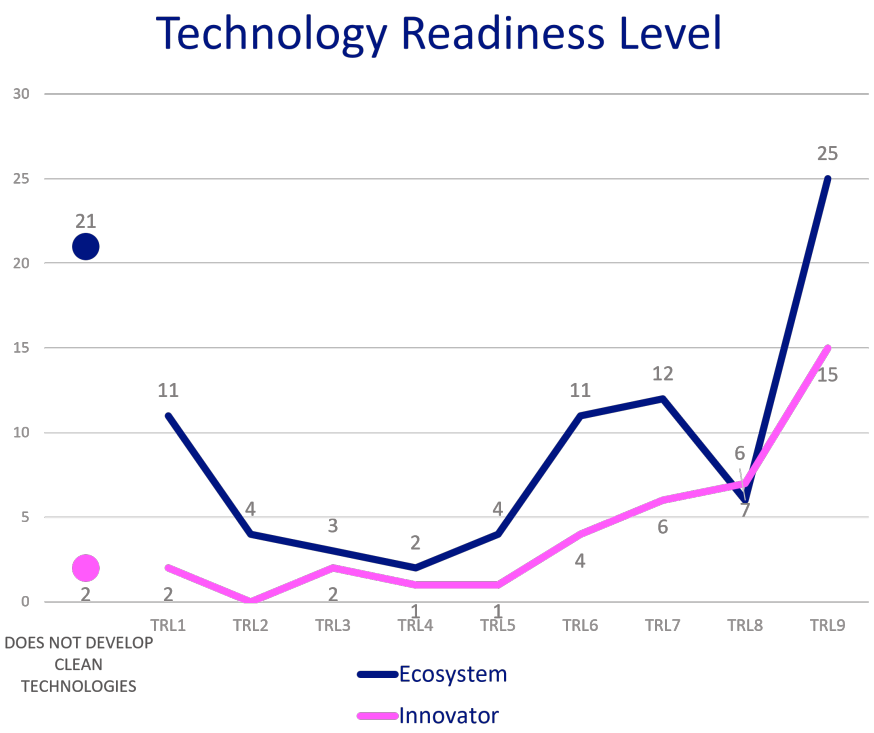

Fig. 4.6 Q6 Technology readiness level

4.2.7 Referring to your cleantech products or services recent innovations, has your company recently engaged in the following innovation activities? (1 choice for each row)

As anticipated for innovation-related questions, different behaviours are expected for the two subgroups. Innovators are decidedly more active in engaging in innovative activities, and all alternatives have been chosen. In-house solutions are preferred, likely due to the confidentiality and value of the technology. Nonetheless, collaborations with universities and research centres are also widespread, and in about 70% of cases, external consulting has been utilized.

Mergers and acquisitions (M&A) and partnerships are the least common solutions, logically so given the size of the considered companies (small and medium-sized enterprises often lack the resources for elaborate M&A or partnerships, making these alternatives less preferred). However, they are still employed by 60%, likely mostly in the form of industrial partnerships.

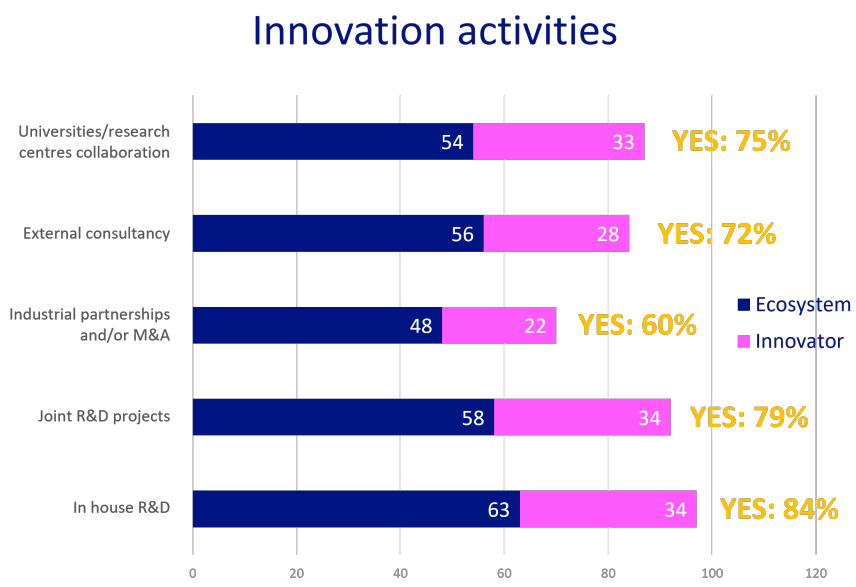

Fig. 4.7 Q7 Innovation activities

4.2.8 What has your company done to protect its cleantech intellectual property? (1 choice for each row)

Percentages are significantly reduced, and greater variability is observed in responses regarding the protection of intellectual property. Patents and trademarks are the preferred solutions for the vast majority of companies, reflecting a strong technological fervour that requires intellectual property protection for introducing "new to the world" innovations.

Half of the companies have resorted to trade secrets to protect their competitive advantage. Copyright, industrial design, and the application of a utility model are decidedly less adopted alternatives (less than one-third for each of these options).

We do not have total certainty that the sample has grasped with complete awareness the nuances between the proposed alternatives. Certainly, more than half of the companies, precisely 59%, have resorted to patent registration, which is also the most well-known solution.

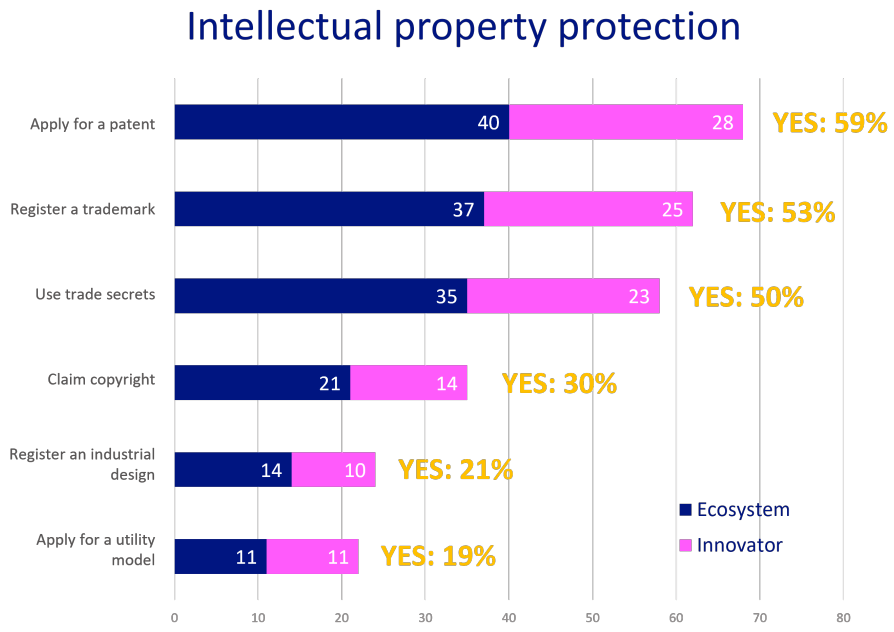

Fig. 4.8 Q8 Intellectual property protection

4.2.9 How much are regulations/policies on the below area affecting your cleantech activities? (1 choice for each row)

Q9 is the first of four questions dedicated to the first pillar of the European Green Deal. The matrix-structured question aims to define the impact of various identified regulatory areas. The scale used is Likert-like and includes three levels: does not affect, marginally affects, and strongly affects. As these three alternatives are arranged on an ordinal scale, modal analysis is possible. At a glance, it can be seen that no area has a negligible effect. In a way, a right-skewed distribution indicates a greater impact of regulation. Product safety, Environmental, and New technologies introduction are the areas with the greatest regulatory impact. Respondents' mode suggests that Consumer Protection, Operational and Worker safety, Intellectual Property, Tax, and Employment are areas with only marginal impact. 67% of respondents identify environmental regulation as strongly impactful. No significant differences in responses are observed between the two groups.

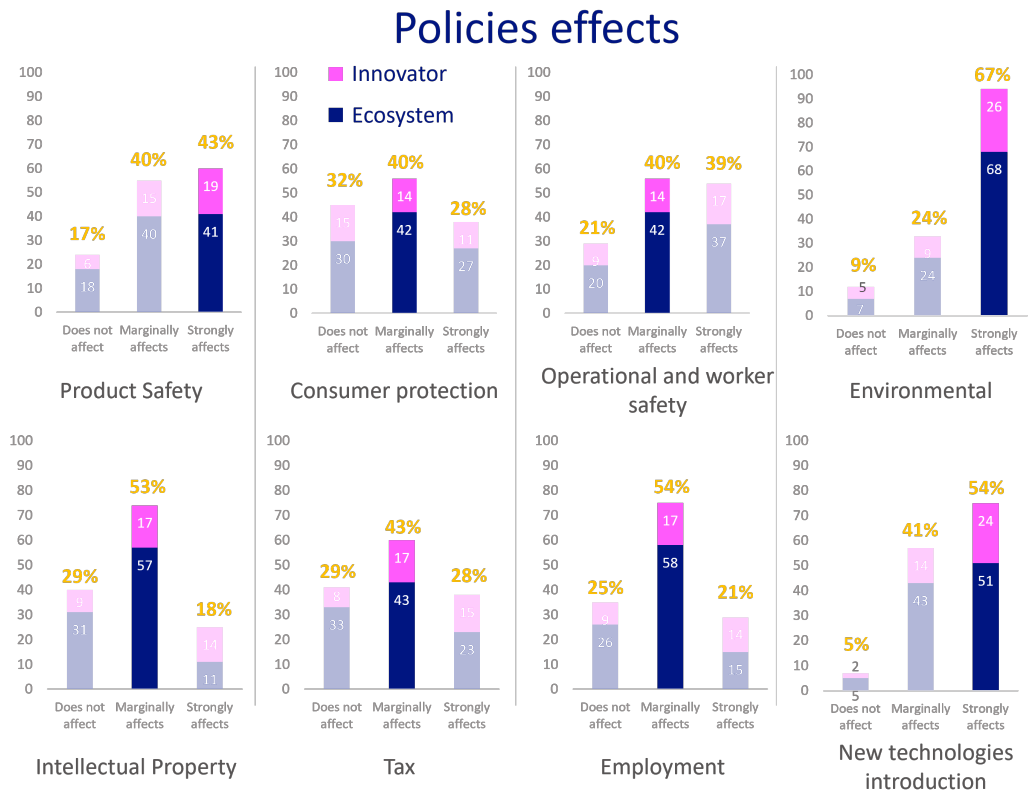

Fig. 4.9 Q9 Policies effects

4.2.10 What are the undesirable effects of recent regulations/policies on your cleantech activities? (from 1 to 3 choices)

Q10 stems from a hypothesis formulated during interviews, indicating that regulations pose a threat to the European innovative ecosystem. However, the specific pain points suffered by companies are not precisely outlined. Only 8% of companies claim not to be subject to "side effects." It would be interesting and desirable to assess the same results after a few years and observe an increased percentage, using it as an indicator of the virtue of the regulatory system. Fortunately, only a small but non-negligible portion states that innovation is hindered by an unsupportive regulatory system. The three main negative effects, in order, are: generating an excessive administrative burden (33%), creating operational uncertainty (26%), and generating unbalanced competition with extra-EU companies (28%). While the first two effects are easily understandable and predictable, the third has garnered significant attention, as already highlighted during the interview phase. It is crucial that unnecessarily stringent regulations risk not to boost innovation negatively affecting the environment, forcing companies to shift activities or supply chains to countries that pay less attention to certain sustainability issues and are still in the process of development.

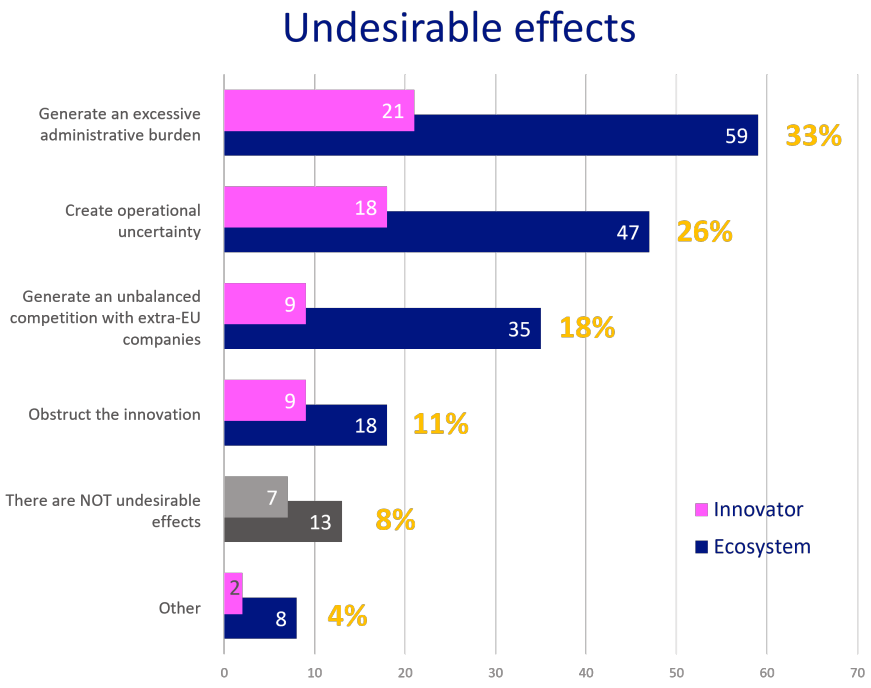

Fig. 4.10 Q10 Undesirable effects

4.2.11 Which of these regulations/policies can mostly support technological development in the cleantech sector? (from 1 to 3 choices)

The tools for the development of new technologies are diverse, offering a range of flexible alternatives in terms of technology, maturity, and stakeholders. We clearly expect that the two groups may somehow diverge in their responses to these questions: the most suitable tools for innovators are not necessarily the favorites for the ecosystem. A first glance at the graph strongly supports this hypothesis. While the ratio between magenta bars and blue bars remains constant in almost all previous responses, in this case, we observe a nonlinear relationship. As the responses are ordered based on the innovator category, we see that the profile outlined by the blue bars deviates from the innovators' profile.

The conclusion is interesting and would be statistically significant with higher numbers. In any case, this reinforces the previous point of the research project: the clustering of the two groups seems to have effectively identified two groups with different needs. The variance between the responses is not as pronounced as in other answers. We see that Direct Policies, Tax Incentives, and Regulation/Standardization alone cover about 50% of the preferred solutions. The remaining slice, however, is divided among only 5 categories. Therefore, Boosting outcomes and Development of complementary assets are preferred by the ecosystem rather than by innovators (as practical solutions to already developed innovation to increase its diffusion). Conversely, the solution Dialogue and networking is preferred by the innovator category to facilitate the development of early TRL steps, as well as Public Procurement. It indeed proves true that each tool available is ideal at a specific stage of development.

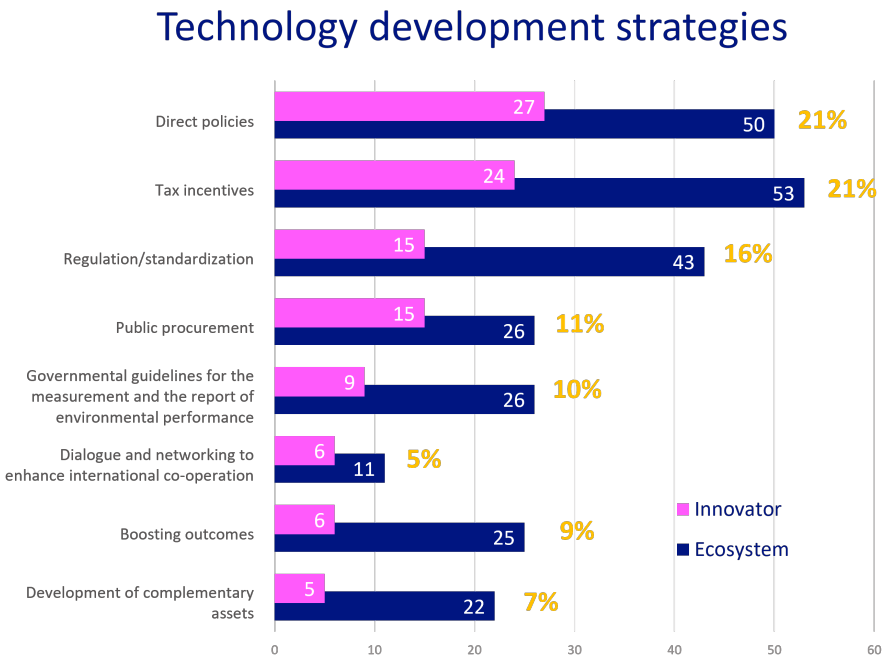

Fig. 4.11 Q11 technology development strategies

4.2.12 Referring to the main regulations/policies relevant to your core clean-tech activities, how much do you agree on the following statements? (1 choice for each row)

The aim of the question is to generally understand the sentiments and opinions of the population to assess the quality of the current legislative framework from various perspectives. The questions are designed with a preferential direction on the right side of the scale (all questions have a positive connotation). The objectives are set in a transparent and clear way. However, the second question suffers from a bias due to a double mode, highlighting a weakness in the question that assumes a single mode as an indicator of correctness in formulation. This means that the question should be broken down into at least two sub-questions with different modes.

The last three questions reveal a split sample with a mode on the neutral response, indicating a poor opinion and some confusion. Regarding this, it would be an excellent point for analysis to stratify the sample according to the country of origin (the available information allows for it, although the respondent numbers may not provide adequate robustness). We expect that responses on the Likert scale may vary significantly from nation to nation. Therefore, "Neither agree nor disagree" results for "The prioritization of goals and measures is well defined," "They are practically enforceable," and "The monitoring activities are clearly disclosed." As with the previous question, it is hoped that a rightward skewness over time will occur if well-structured policies and regulations are formulated to address current shortcomings.

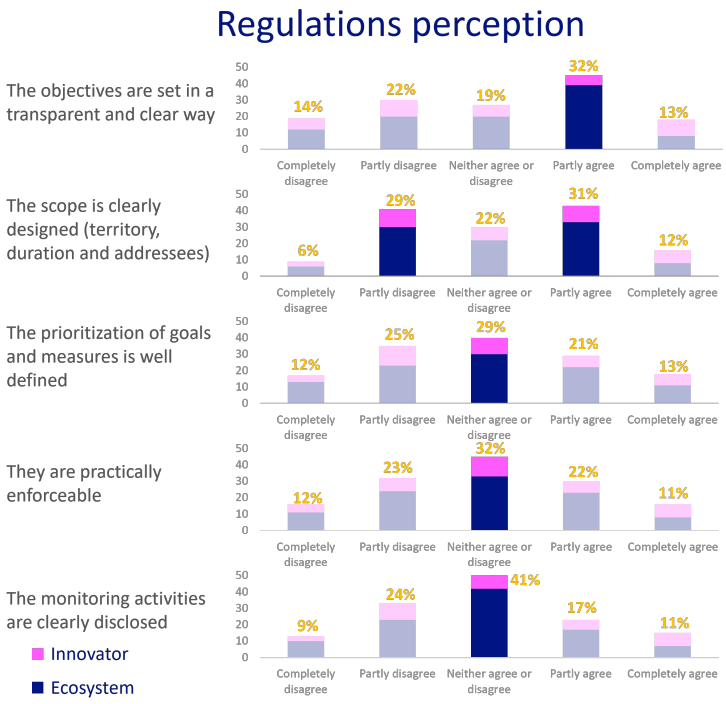

Fig. 4.12 Q12 Regulation Perception

4.2.13 Funding

Does your company have any plans to raise funds from EXTERNAL investors for its ongoing activities? (1 choice)

How much do you want to raise for your activities in the next five years? (1 choice)

How much of the funding you intend to raise will be dedicated to support cleantech activities? (1 choice)

The question 13 is substructured into 3 questions aimed at categorizing companies based on their need for external funding, the estimated amount for the next 5 years, and the purpose of the funds. The collected information is purely indicative to allow for ambitious hypotheses. Approximately 65% of the companies anticipate needing to request financing, as their cash flows or other forms of self-financing are not sufficient. This percentage is divided between Ecosystem and Innovators (respectively 43 and 23 firms). The distribution is not equal to that of the sample; innovators explicitly state a greater need for financing. The following questions are contingent on a non-negative response to the previously described question. This question reinforces the previous point of the research. Regarding the expected rounds for the next five years, the response is delicate and should be further investigated in detail and complemented with other financial data. We can say that all companies expect typical startup phase growth; further comments would be speculative. Innovators proportionally request amounts ranging from 2 to 50 million euros. A significant portion of ecosystem companies requires a modest round (less than 2 million euros or more than 50 million euros). We are pleased to observe that for almost all respondents, the majority of the funding is intended for the development of cleantech activities.

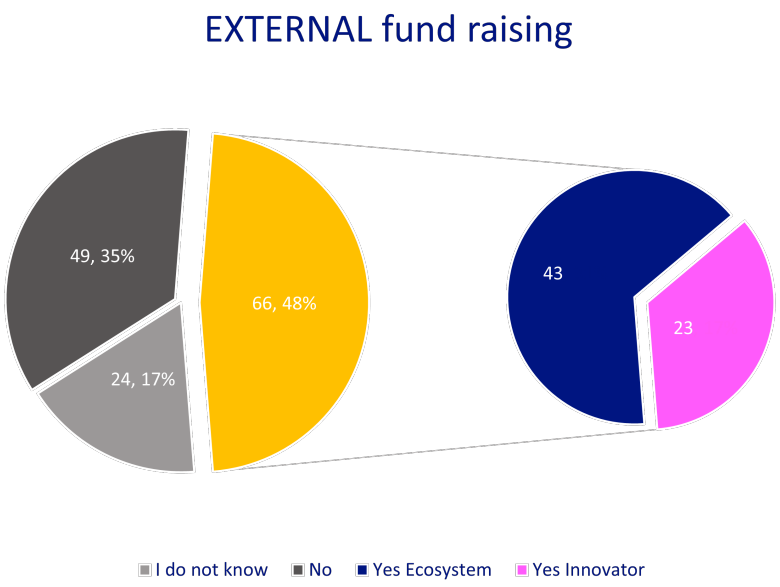

Fig. 4.13 Q13a External fund rising

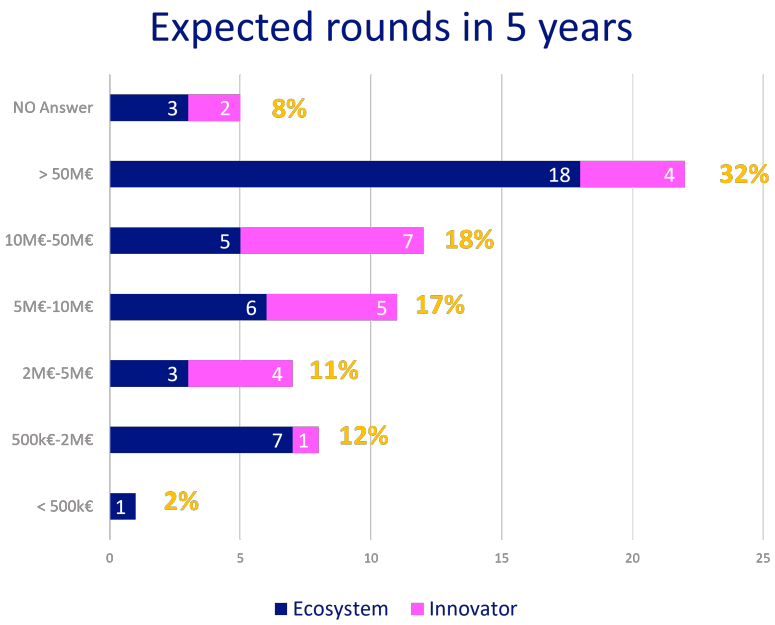

Fig. 4.14 Q13b Expected rounds in 5 years

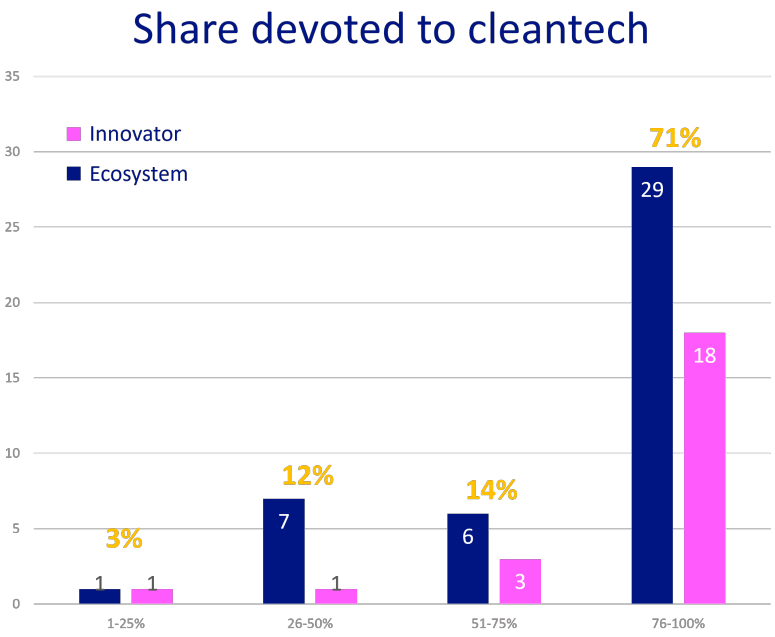

Fig. 4.15 Q13c Share devoted to cleantech

4.2.14 What is the main challenge in participating in public funding programmes? (1 choice)

Question 14 arises from the insights gained during conferences and confirms the hypothesis of public financing being perceived as challenging by 63% of the companies. High competition in tenders and lack of information are considered less decisive factors (less than 15%). Only 7 companies have stated that they have not encountered difficulties.

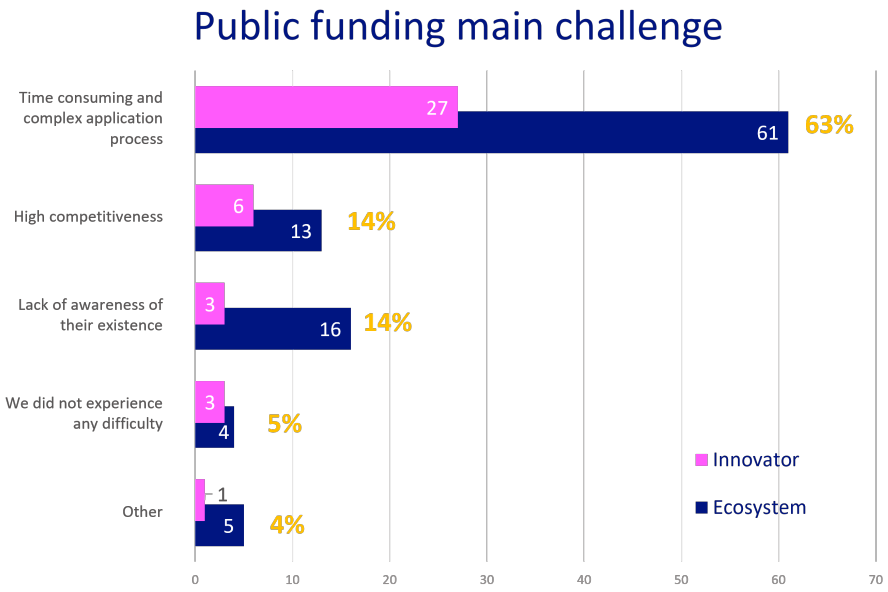

Fig. 4.16 Q14 Public funding main challenge

4.2.15 Has your company used or would consider using the following financing instruments? (1 choice for each row)

Small multiples graphs plotted represent the preferred financing methods for companies. We expect a more pronounced inclination towards less traditional financing methods from innovators. The scale is not a true Likert scale, but the x-axis has an ordinal connotation among the alternatives: it expresses the propensity to use the instrument by dividing the group into those who have used it, those who would consider it, and those who would rule it out a priori. The only method ruled out a priori is online finance, still immature. Regarding traditional methods, they have already been used by companies, with clear preferences for Internal Financing (80%), Bank Debt (58%), Equity (50%), and Grants (53%). In line with expectations, less traditional methods are among those not yet chosen, although promising according to the collected statistics: 70% of companies would consider using green bonds, 40% venture debt (riskier than bank debt but still reputable among alternatives), asset-based finance garners 47% (although not the ideal financing method for more abstract research steps), and Hybrid Financing counts 58% of companies that would consider using it.

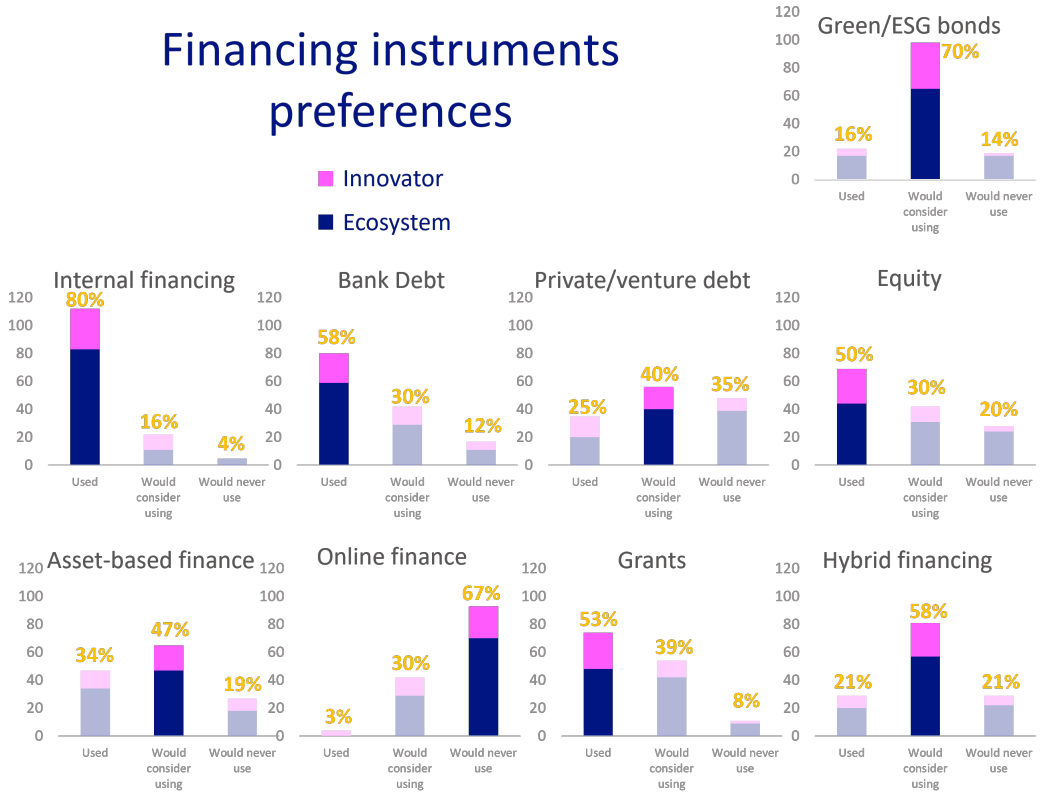

Fig. 4.17 Q15 Financing instruments preferences

4.2.16 State if the skills listed are needed in your company and if you are going to outsource them (1 choice for each row)

Q16 is a structured matrix question designed to gather as much information as possible. On the first axis, we have a list of skills required by the market, both hard and soft skills. On the second axis, there are four pseudo-ordinal alternatives that help identify the company's position regarding each skill: the skill may first be deemed unnecessary (not needed), or, if necessary, we inquire whether it is already available in the market (needed available). If not available but required, we then assess whether in-house development or outsourcing is preferred. This approach provides a comprehensive description of the situation. The results are interesting and align with expectations.

"Data Science and Business Intelligence" are necessary skills already present in the company, with about a third of companies willing to develop them in-house and a fifth leaning towards outsourcing. "Technology and Engineering" skills are closer to the core business, and the demand trend from the previous question is emphasized (approximately 65% of companies are satisfied with their resources and prefer internal development over outsourcing). Regarding "Design," 15% of companies consider it unnecessary, 45% are already satisfied, and the remaining portion is evenly split between in-house development and outsourcing.

"Finance and Accounting" skills are already well-established, with three-quarters of companies equipped with this function. Legal skills show a strong inclination towards outsourcing, given their sporadic and occasional nature. Only 10% intend to develop this type of expertise in-house due to its limited reusability. "Marketing and PR" falls within consolidated skills, evenly distributed between in-house and outsourced for the remaining portion.

For "Research and Science," a unique pattern is expected. In this case, approximately one-third of companies claim not to have the resource and plan to seek it through outsourcing. "Business and Strategic Planning" is already available and developed for almost all companies, with in-house development planned for the remaining few. The same trend applies to "Soft Skills."

"Sustainability" is a current and much-discussed topic, with less than half of the companies reporting having an adequate workforce. One-third of companies need to develop this competence in-house, and only a small part considers outsourcing. "Intellectual Property Management" exhibits a similar pattern to "Legal" due to its nature, with limited internal development and outsourcing in the majority of cases.

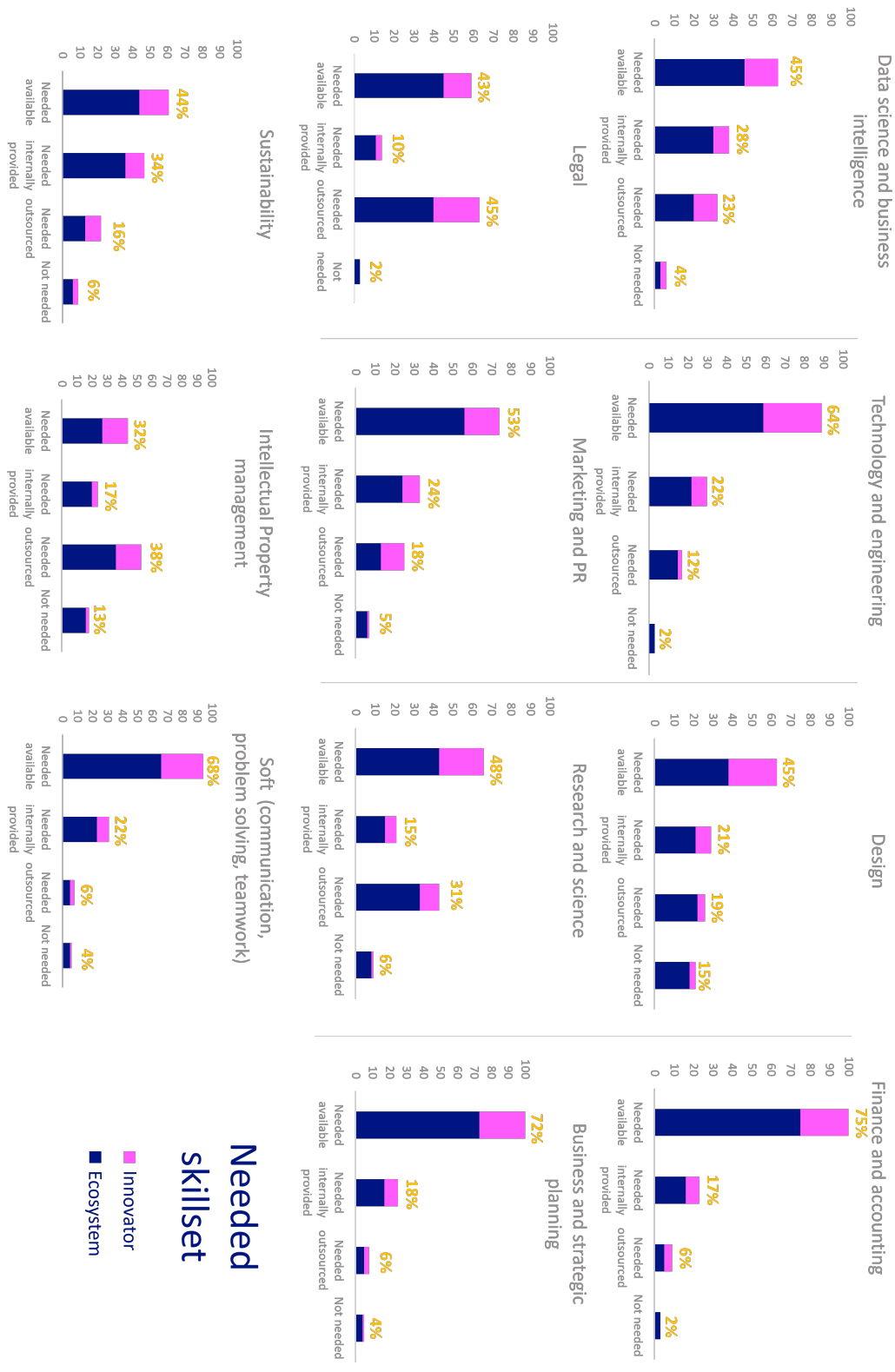

Fig. 4.18 Q16 Needed skillset

4.2.17 Where are your suppliers mainly localized? (1 choice)

Q17 examines the placement of suppliers with the aim of assessing the length of the supply chain. Ideally, a shorter chain is considered more virtuous. The behavior of ecosystems and innovators is nearly similar, with the only difference being a practically negligible number of innovators with chains within the same region. This can be explained by the fact that, being new technologies, they do not yet have a dense concentration in the territory. Less than 20% of companies have chains that extend beyond European borders. Approximately 25% of companies manage to contain their supply chain within national borders. The numbers are promising, and we hope that effective regulations can reduce the need to resort to non-European suppliers, which may have less stringent regulations and thus slow down the global process towards net zero.

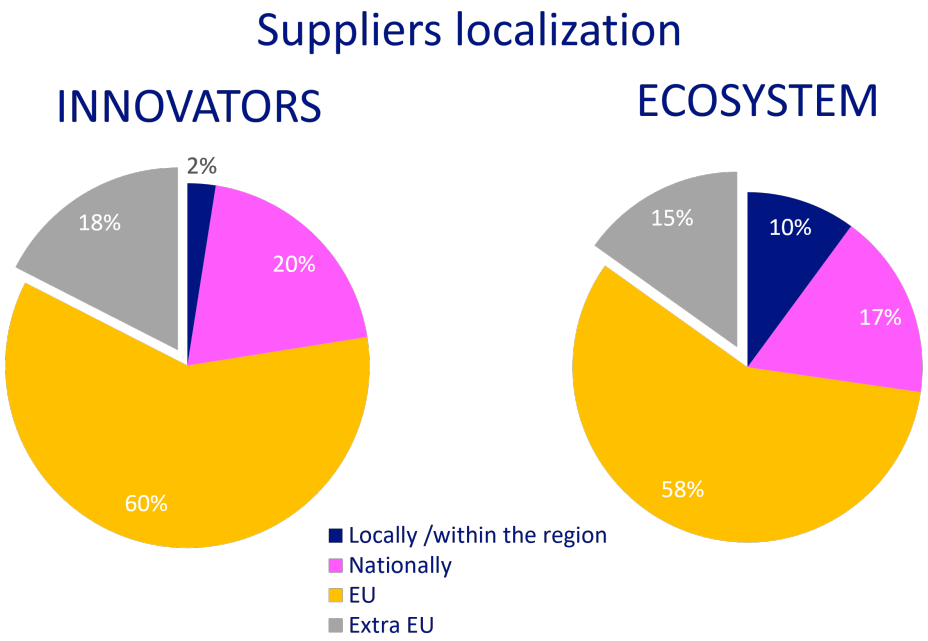

Fig. 4.19 Q17 Suppliers localization

4.2.18 Which are the main reasons for the selection of the current pool of suppliers? (from 1 to 3 choices)

Question 18 also stems from an interesting insight from the interviews, including the previously discussed risk of unbalanced competition resulting from the choice of an unsustainable supply chain. Therefore, we asked respondents to list one to three main reasons for choosing the current pool of suppliers. We identified six main dimensions to choose from. Respondents also added other dimensions of interest, including technical skills and unavailability of raw materials in the EU (it is recommended to add these two dimensions in a future version of this questionnaire). Quality and price (certainly interrelated aspects) are the two main drivers. However, three other aspects carry a significant weight of more than 10%: ease of doing business, physical proximity, and sustainability. It is interesting to observe how these categories are of greater interest to the ecosystem rather than to innovators: the response is in line with expectations, as the ecosystem organizes itself at the time of product commercialization. Therefore, these aspects are less relevant to innovators. Cultural affinity is decisive for only 4% of companies, half of which are innovators.

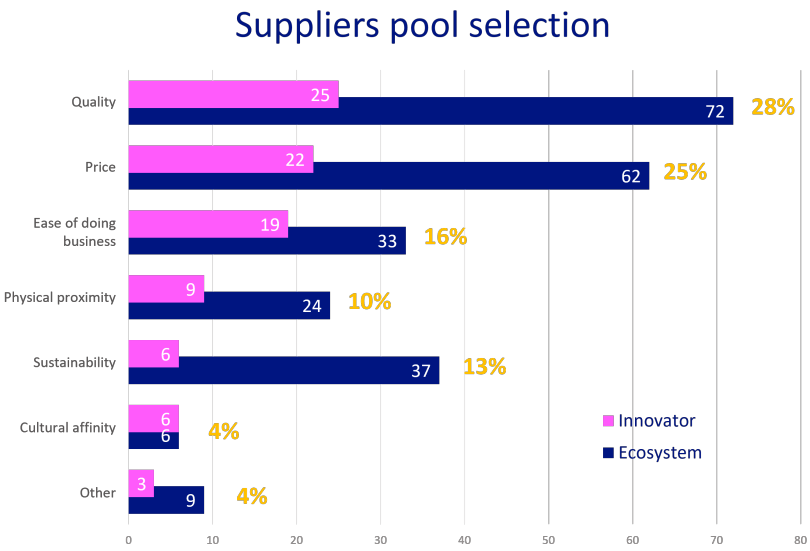

Fig. 4.20 Q18 Suppliers pool selection

4.2.19 Which of the following policy goals should the government pursue to improve the resilience of supply chains in your country? (from 1 to 3 choices)

For Q19, it is also interesting to evaluate the "others" category. Suggestions gathered from open-ended questions identify the ability to develop relevant skills (already discussed in the previous pillar) as crucial. It is also stated as fundamental to address inequalities with non-European actors (especially felt in the PV sector). Some propose a deeper study of carbon tax among the solutions to make the supply chain more resilient through government interventions. Two responses stand out, gathering more than 50% of respondents: "Ensure stable and predictable trade and investment policies" and "Work on critical infrastructures." Three other responses shared about 10% of the weight: "Ensure the supply of essential goods," "Implement trade facilitation measures," and "Lower the costs and increase access to digital trade." Only 3% declare that none of the aforementioned solutions are good strategies to improve the resilience of current supply chains. Another 3% propose alternative solutions not listed earlier in this commentary. Once again, there is a distinct trend for the ecosystem regarding the goal of "Lower the costs and increase access to digital trade." This point is significantly more emphasized for the ecosystem than for innovators.

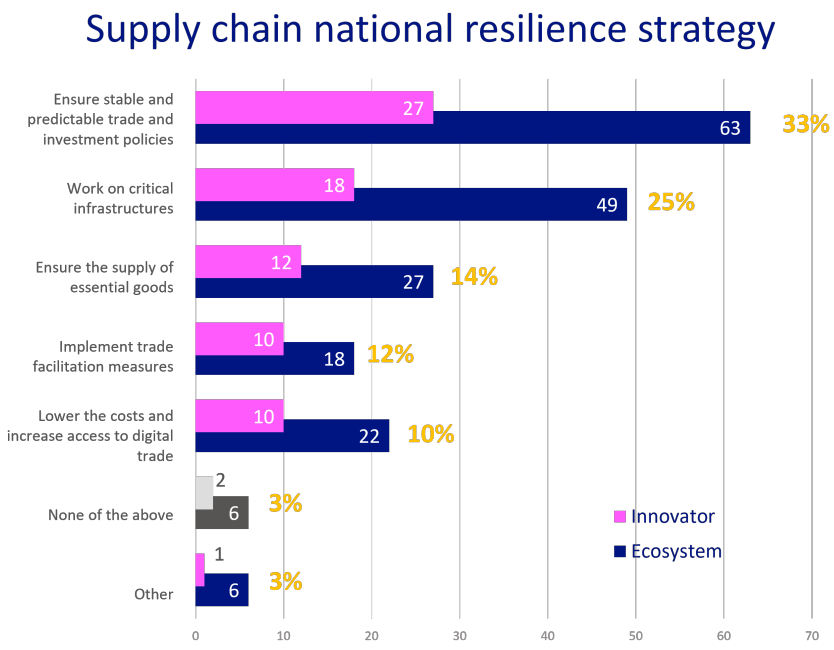

Fig. 4.21 Q19 Supply chain national resilience strategy

4.2.20 Which of the following actions is YOUR COMPANY considering to make its supply chain more resilient? (from 1 to 3 choices)

Question 20 is another variation aimed at studying the same aspect and investigating the active commitment demonstrated by the company to make the supply chain more resilient. Two responses cover exactly half of the respondents: "Selective risk-taking" and "Hedging," which stand out for having a similar connotation. Selective risk-taking refers to consciously assuming risks in certain areas of the supply chain where it is believed they can be better managed or mitigated. Hedging indicates the practice of protecting against potential financial losses by purchasing financial instruments such as futures or options, which allow locking in prices or exchange rates at a specific level. Among the other less prominent alternatives, selected by at least 10%, we have "Postponement," which involves delaying certain activities or decisions until more information is available or until a more favourable time, and "Control," which refers to implementing measures to monitor and manage risks within the supply chain effectively. "Transferring or sharing risks" involves shifting or distributing risks to other parties. "Security" refers to ensuring the safety and protection of supply chain operations. 6% of companies declare not to have undertaken any of the previous initiatives to increase the resilience of their supply chain.

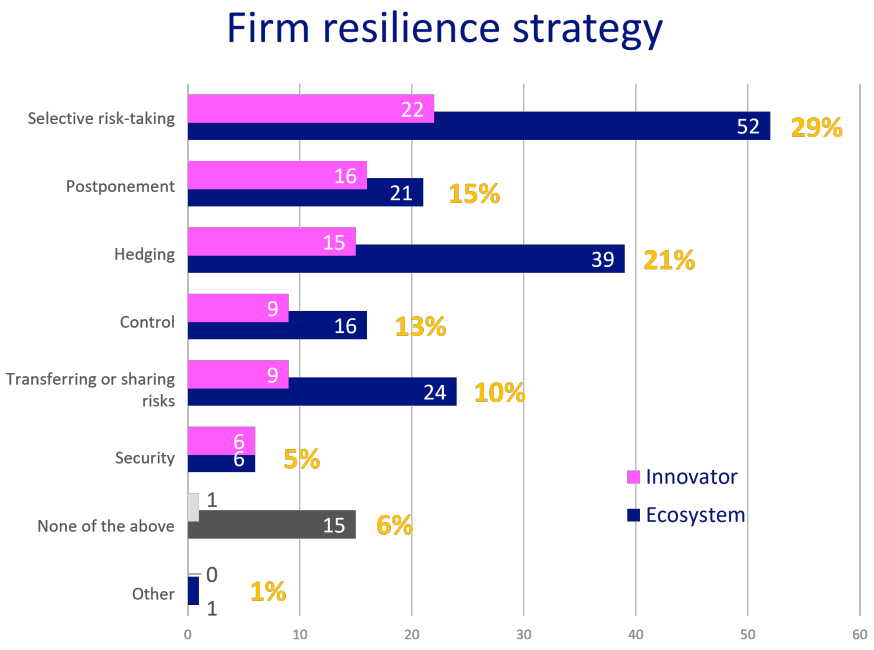

Fig. 4.22 Q20 Firm resilience strategy

4.2.21 How much would you agree with the following statements about the EU Green Deal (EGD)? (1 choice for each row)

The last two non-personal questions of the questionnaire fall under the respondent category and were designed to obtain perspectives regarding the European Green Deal (EGD). Question 21 consists of a Likert scale structured around 5 sub-questions. From a modal analysis, it is evident that the risk of poor enforceability of the EGD at the European level is high: individual implementations by states may bridge this gap. The goals and target objectives of the EGD appear too ambitious for 37% of respondents. However, 50% of respondents confirm that "The EGD will create a more predictable and clearer regulatory environment." Most respondents express neutrality regarding whether the EGD promotes common incentives across the EU. Only 23% of respondents are partially satisfied with the EU's financial support to implement the EGD, and 41% fear the creation of greater disparities (not equality) among different European regions and countries, exacerbating differences between countries more and less oriented towards sustainability. Almost all respondents agree on the difficult coordinating role of various member countries in achieving common objectives. All responses are consistent with the insights gathered from the interviews.

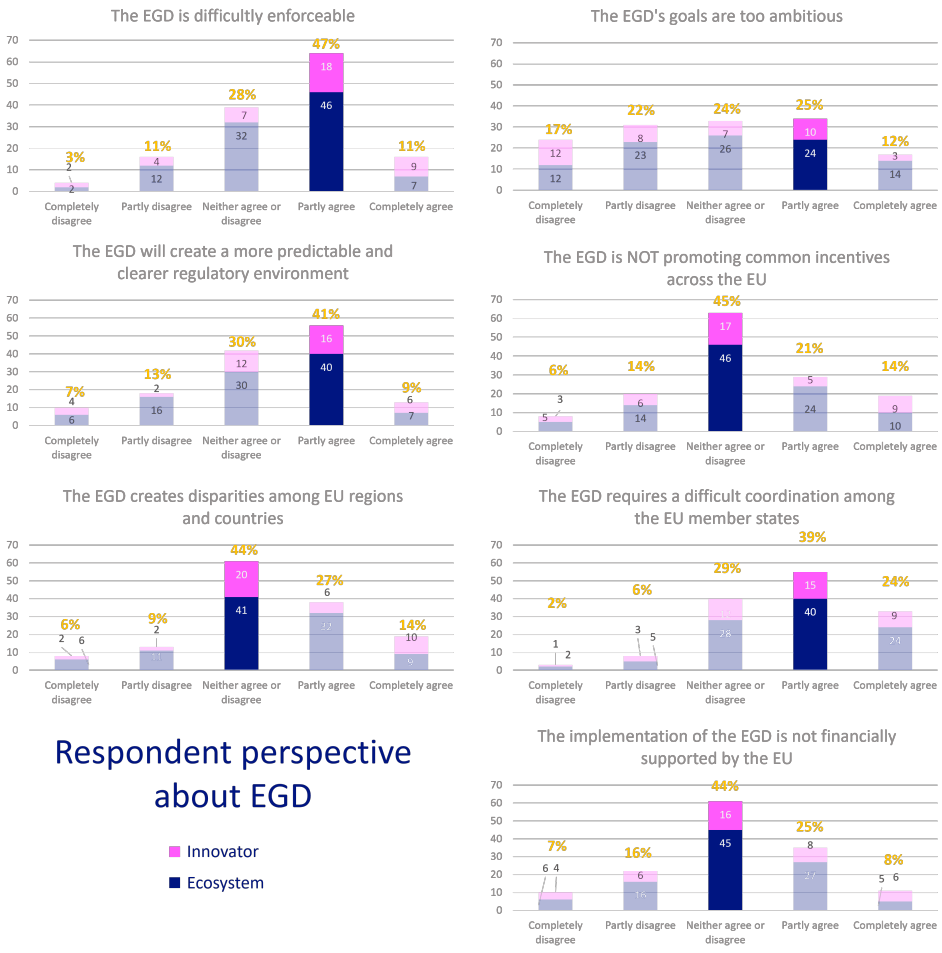

Fig. 4.23 Q21 Respondent perspective about EGD

4.2.22 How achievable do you think are the following scenarios? (1 choice for each row)

For Q22 (and also for Q21), a strong cultural component is expected, which is why the discussion is expanded in the next chapter to evaluate this hypothesis. The question is again a Likert scale, asking for opinions regarding the achievement of the net zero goal by 2050. The three sub-questions are organized in a logically increasing geographical order: respondents are asked their opinion first regarding their own company, then their country of origin, and finally extended to the entire European Union. A quick glance yields a positive message to conclude the questionnaire: all three scenarios are skewed towards the positive side, either "Partly agree" or "Completely agree". Not coincidentally, the skewness increases with geographical scope: 49% are confident in their company's abilities, 50% trust in their nation's capabilities, and 67% trust in the capabilities of the entire EU.

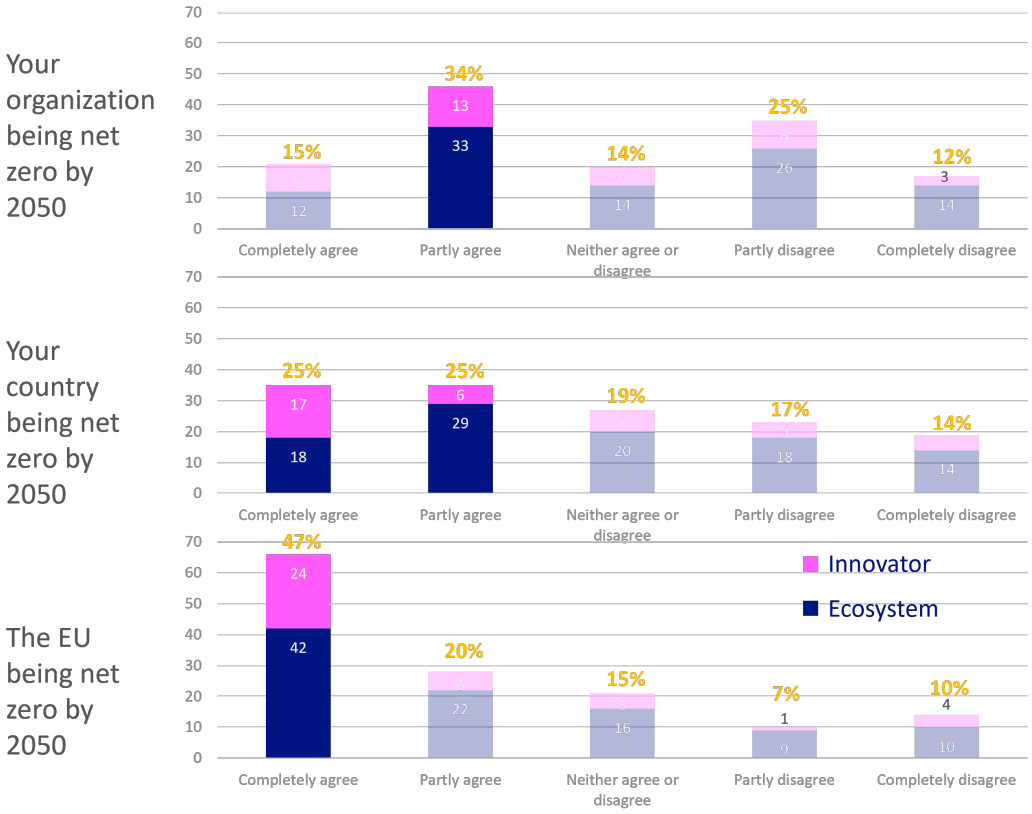

Fig. 4.24 Q22 Possible scenarios

4.2.23 What is your position in the company? (please specify both the role and the business unit)

4.2.24 What is your name and surname?

4.2.25 What is your email address?

4.2.26 What is your phone contact?

The last four responses are personal questions that we do not report for privacy reasons. No inference, qualitative or otherwise, can be extrapolated from these questions. However, a positive observation arises from the fact that even these non-obligatory responses had a high response rate. We thank all respondents, and despite a limited number of total respondents, we are excited about the excellent quality of the responses collected. The final questions specify a desire to recontact the company for any developments; therefore, we collect the direct contacts of 150 prominent individuals from cleantech companies, including CEOs, directors, founders, associates, advisors, chairmen, CFOs, presidents, and partners, and the list goes on.

4.3 Correlation

Given the constraints of the limited response rate, it's crucial to develop an analysis strategy that can still yield valuable insights. Understanding public perceptions and attitudes towards the European Green Deal is vital for informing future policy decisions. One potential avenue is to explore correlations between participants' country of origin and their alignment with the Green Deal's principles and objectives.

Furthermore, examining the relationship between participants' comprehension of the Green Deal's taxonomy and their support for its initiatives could provide valuable insights. This analysis may reveal whether a deeper understanding of the taxonomy correlates with stronger endorsement of specific aspects of the Green Deal, guiding educational efforts and policy implementation.

Considering the diversity of European countries, conducting a multi-factor analysis based on participants' country of residence can provide tailored insights. By examining how demographic, socio-economic, and cultural factors intersect with support for Green Deal policies, we can offer nuanced observations specific to each country's context.

Adjusting the granularity of our analysis, such as the Green Deal taxonomy categories or geographical regions, may uncover more nuanced trends and correlations. This approach allows for a deeper exploration of the data, leading to more meaningful insights.

Additionally, employing cluster analysis to group participants based on their survey responses can provide further insights. By identifying patterns and trends within the data, we can gain a deeper understanding of the diverse perspectives on the Green Deal across Europe.

In summary, despite the challenges posed by the limited response rate, an analysis approach focused on exploring correlations and conducting multi-factor analyses holds promise for understanding public perceptions of the European Green Deal. By embracing these methods, we aim to contribute to discussions on sustainable development and environmental policy in Europe.

4.3.1 Specific questions analysis

We can consider omitting these hypothetical scenarios. Let's explore a couple of possible analyses together to better understand the potential impact. Providing a complete analysis of all questions doesn't make sense because, logically, some won't show divergent behaviors based on group membership, and the sample size isn't sufficient for thorough analysis. However, it's crucial to outline the intended approach to offer a starting point for potential future research.

4.3.2 Clusterization by taxonomy

Let's go back to question 4, as previously discussed, and instead of classifying respondents into the innovators and ecosystem clusters, let's group them based on the cleantech taxonomy identified in WP1 of the project: the sample is not evenly distributed, but we can observe, by highlighting two categories out of the seven: 1-environmental management and 3-industrial energy management, that the behaviors of these categories differ from the aggregated ones: technological uncertainty is more decisive for industrial energy management, while market uncertainty has a greater weight for the environmental management category. This type of reasoning can be applied to other questions as well and suggests a more granular approach depending on the cleantech domain in which the company operates.

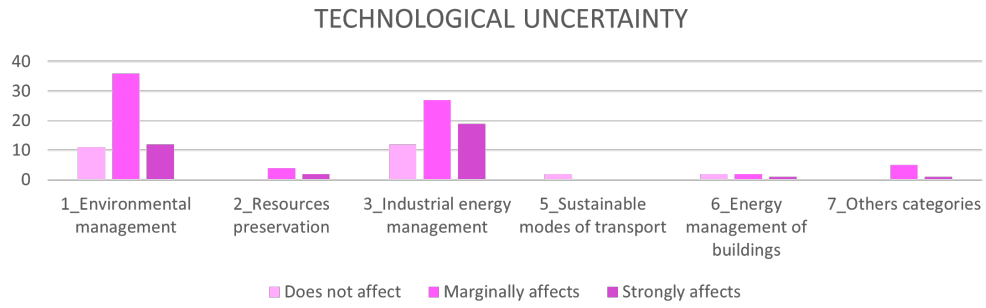

Fig. 4.25 Technological uncertainty

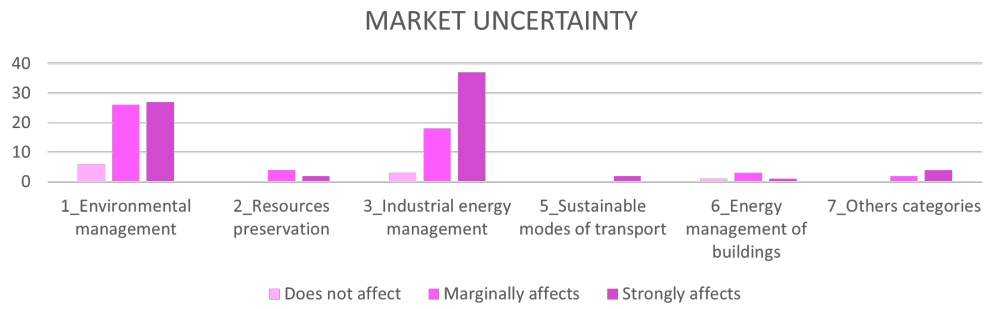

Fig. 4.26 Market uncertainty

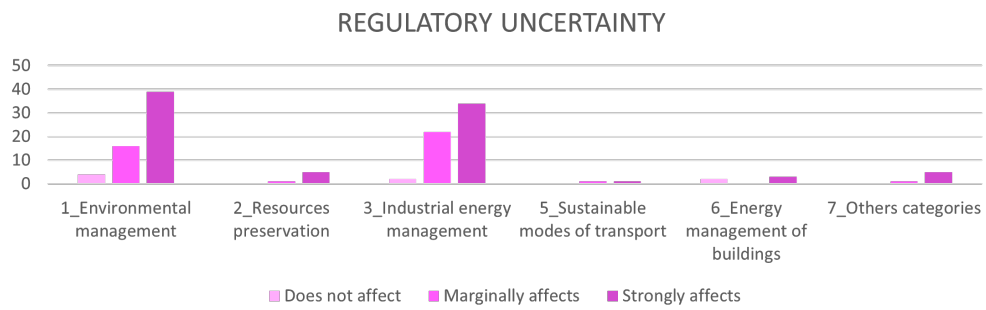

Fig. 4.27 Regulatory uncertainty

4.3.3 Clusterization by geographical area

The last question concerns the assumptions about achieving net zero goals by 2050. We stratify the responses by countries; however, to avoid too low granularity, we apply regional grouping using Excel. We obtain the responses grouped into the 7 major European regions: Balkan, Baltic, Central, Eastern, Mediterranean, Nordic, and United Kingdom.

Note that the country data has been normalized and represented as percentages to simplify visualization. This view provides an incredible overview of the respondents. Below are some observations:

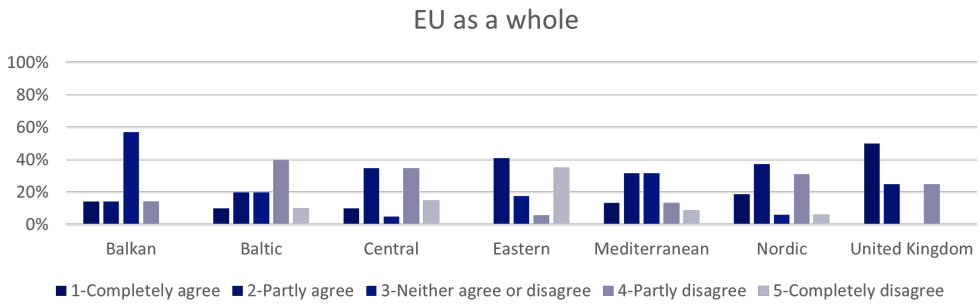

Fig. 4.28 EU as a whole

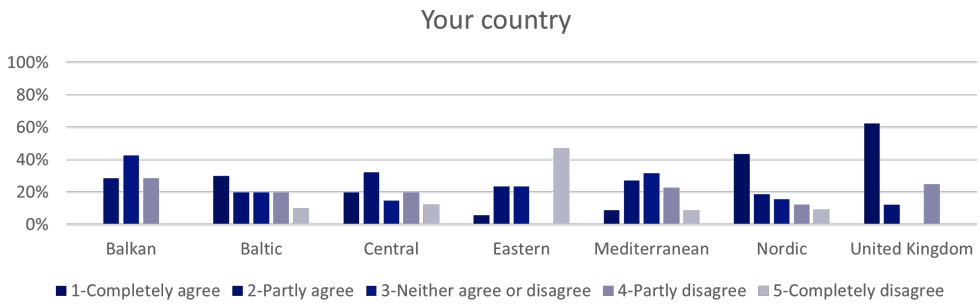

Fig. 4.29 Your country

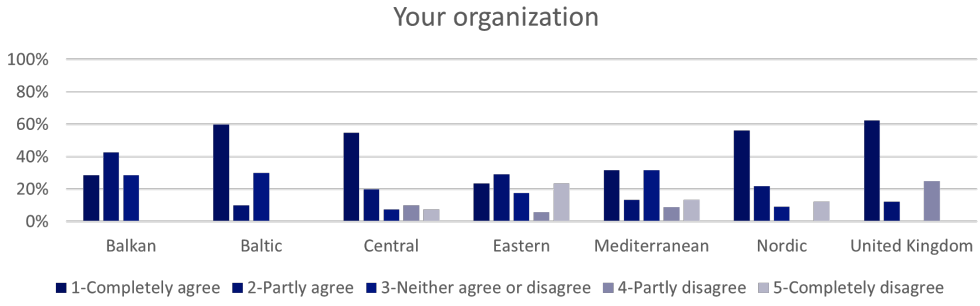

Fig. 4.30 Your organization

Let's analyze the three questions in the previous logical order:

Regarding the capacity at the European level, we see that Baltic, Central, and Nordic regions are the most skeptical. The UK, Eastern, Mediterranean, and Balkan regions are slightly skewed towards positive responses. Changing perspective and posing the question only for one's own country, the scenario completely reverses. Baltic, Central, Nordic, and UK are decidedly confident in their abilities, whereas regions like Eastern recognize weaknesses. The final layer, at the organizational level, suffers from a strong bias: we are talking about cleantech companies that have emissions neutralization among their objectives. However, we can observe a gap in the "height" of the blue columns, which are more developed for the first group, Central-Northern Europe.

Indeed, in this case, the breakdown by region emphasizes the point even further. It offers a granular insight into the nuanced perspectives across different geographical areas, shedding light on regional differences that might otherwise be obscured in aggregated data. This detailed analysis allows for a more comprehensive understanding of the varying attitudes and opinions regarding the feasibility of achieving net zero goals by 2050 within the European context.

Chapter 5

Discussion

After this extensive review of all the questions for which we have already provided interpretation and a brief qualitative discussion in the previous chapter, what are our key takeaways?

We have obtained responses of excellent quality, even if few in absolute number. However, it was already within expectations that we would not achieve an excessively high response rate due to the nature of the questionnaire itself.

We conducted our analysis by clustering the sample into two categories: innovators and ecosystem. With larger numbers, we could have clustered based on any other information collected from Orbis and VICO, creating intriguing insights and stratifying based on additional dimensions. This approach enables qualitative responses to myriad questions from the dataset. While further depth may not be feasible or practical, the ability to relate additional information about each company's response is a powerful tool that provides legislators with insightful considerations. For instance, we could assess whether a regulation among those discussed is more or less invasive based on factors such as the number of employees, incorporation status, or expected growth opportunities for a company.

Aware of the limitations discussed in a separate paragraph, we delve deeper with a brief paragraph into potential solutions for enhancing the questionnaire's response rate.

5.1 Improving survey response rate

‘Differences with respect to response trends, levels and types of nonresponse seem to be affected to a great extent by sample and survey characteristics, fieldwork strategy and aspects of the survey organization. To this extent, response and nonresponse levels are also partly under the control of the survey organization’.(30)

Such data could then be used to develop and improve best practice systems for national and international surveys, and would serve as an incentive for other organizations to monitor fieldwork continuously and record fieldwork outcomes, resulting in a rich dataset to analyse trends and investigate potential determinants of nonresponse. (31)

Ensuring a high response rate for a questionnaire is essential for maintaining the validity and reliability of collected data. Stimulating participant interest and securing their cooperation can pose challenges. We initiated our efforts by addressing clear and engaging communication, emphasizing personalization, such as including the recipient’s name, for example. Additionally, adopting a more concise approach by further limiting the questionnaire’s length and focusing solely on essential questions presents another opportunity to enhance the response rate. While we aim to minimize the completion time to a few minutes, it’s crucial to strike a balance to gather all necessary information for each pillar effectively.

Incentives and recognition were provided, with a commitment to deliver reports to respondents, aiming to significantly boost the response rate and encourage participants to complete the questionnaire. To ensure engagement, we implemented a rigorous reminders strategy, sending follow-up emails to participants who had not yet completed the questionnaire.

Lastly, expressing sincere gratitude to participants for their time and effort, coupled with providing feedback on the research results, serves not only to acknowledge their contribution but also to foster future participation.

Chapter 6

Conclusion

6.0.1 Summary of key findings

We are pleased with the outcome achieved. The value of this small research project should not be confined solely to this qualitative analysis, considering all the limitations already discussed. The true value lies in the fact that this is a pilot project within a broader initiative. We have also discussed potential improvements for the questionnaire developed in light of the responses obtained. We are excited to envision this questionnaire as the basis for future projects, providing guidance on the main directions for investigating the health and condition of small and medium-sized cleantech enterprises in Europe.

Furthermore, we are satisfied with the quality of the responses collected, although they may not be numerous numerically, they are of excellent quality. This suggests to us that administering such a questionnaire is not merely a monitoring activity but can also serve as a dissemination activity, prompting companies to engage in a sort of self-analysis of their own cleantech situation and perhaps suggesting a direction.

6.0.2 Areas for future research

Lastly, it would be beneficial to contemplate repeating this experiment after a few years, perhaps with a periodic frequency of several months, to assess the impacts of new European decision-making, evaluate its quality, and obtain even more interesting data by significantly increasing the response rate. Additionally, gathering a history of information about the same company would allow us to observe and study an evolutionary process, which we expect to be a growing trend of green initiatives in the years to come.

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Appendix A

Appendix A: Survey

A.0.1 INTRODUCTION

Welcome to the Survey on the **"Cleantech industry in the European Green Deal"** a project coordinated by **Politecnico di Torino** in partnership with **Politecnico di Milano** and University of Bologna sponsored by the European Investment Bank (**EIB** https://www.eib.org) and run in collaboration with the European Investment Fund (**EIF** https://www.eif.org).

You have been selected to participate in this Europe-wide survey the purpose of which is to assess the drivers obstacles and policy landscape for the cleantech industry.

Why should you take part?

- The responses to the survey will help the EIF and the EIB to further develop their support for the cleantech field and contribute to the European cleantech ecosystem!
- You will receive a report of the survey results.

Your answers to this voluntary survey will be treated in strict confidence, only used for research purposes and published in aggregated form only. Your contribution and time are very valuable for the richness of the survey's findings. If you have any questions or troubles, please feel free to contact us.

The survey is designed to take approximately 5 minutes to complete. There are no right or wrong answers to the survey questions. We are simply seeking your opinion.

If you are not the relevant contact point, we would be pleased if you could direct us to a relevant representative within your organization for this inquiry. For any kind of clarification, or if you do not wish to be contacted for this research project, you can notify directly to eiburs@polito.it

A.0.2 THE COMPANY

Your business has been identified as cleantech based on the business description in company accounts.

In our classification of cleantech we refer to: *"(new) sustainable technologies and solutions able to offer the market a diverse range of products, processes and services to provide higher environmental performances. Cleantech is based on challenges such as reducing the use of natural resources, lowering the energy consumption, improving energy generation cycles and cutting or eliminating emissions, pollutants, and wastes"*.

Since the survey grounds on this definition, please refer to (the part of) your business that is more related with this.

1. Concerning the decision to operate in the cleantech sector, which of the following statement is mostly appropriated? (1 choice)

- ○ **My company does not operate in the cleantech sector (SKIP TO END)**
- ○ My company always had its core business in the cleantech sector
- ○ My company switched ALL of its activities to the cleantech sector at some point in time
- ○ Other (please specify)

2. What are the main drivers for your company to operate in the cleantech sector? (from 1 to 3 choices)

- ☐ Enhanced business opportunities (new or existing)
- ☐ Pressure from stakeholders
- ☐ Compliance with regulations and standards
- ☐ Public sector incentives
- ☐ Brand reputation
- ☐ Company mission and vision
- ☐ Financial motives
- ☐ Other (please specify)

3. What are the main difficulties your company faced after you entered the cleantech sector? (from 1 to 3 choices)

☐ Lack of demand for cleantech products/services

☐ Lack of suppliers with a sustainable orientation

☐ Shortage of highly skilled workers

☐ Limited access to external financing

☐ Stringency or uncertainty of standards and regulations

☐ Complexity of developing technologies

☐ Inadequate intellectual property regimes

☐ Other (please specify)

4. How much the following types of uncertainty are affecting your activities? (1 choice for each row)

	Does not affect	Marginally affects	Strongly affects
TECHNOLOGICAL uncertainty (due to technological constraints and limitations)	○	○	○
MARKET uncertainty (due to volatility in the market)	○	○	○
REGULATORY uncertainty (due to unpredictability of policy-maker decisions)	○	○	○

5. The European Green Deal is a package of policy initiatives, which aims to set the EU on the path to a green transition, with the ultimate goal of reaching climate neutrality by 2050. What is your company doing to meet the goals set by the European Green Deal? (from 1 to 3 choices)

☐ Using green technologies (new or existing)

☐ Using sustainable suppliers and procurement policies

☐ Offering green products/services

☐ Offsetting carbon emissions

☐ Encouraging remote working

☐ Upskilling workforce

☐ Other (please specify)

A.0.3 INNOVATION

The following questions are dedicated to the clean technologies your company is developing

6. N.B. The Technology Readiness Level (TRL) is a measure from 1 to 9 assessing technology maturity. Each level represents a specific stage of development and testing of a technology, with higher levels indicating more advanced and closer-to-market technologies. How would you define the readiness level of the CORE CLEAN TECHNOLOGY embedded in the company's main project (TRL) ? (1 choice)

○ **MY COMPANY DOES NOT DEVELOP CLEAN TECHNOLOGIES (SKIP TO REGULATORY ENVIRONMENT)**

○ TRL1 basic principles observed

○ TRL2 technology concept formulated

○ TRL3 experimental proof of concept

○ TRL4 technology validated in lab

○ TRL5 technology validated in relevant environment

○ TRL6 technology demonstrated in relevant environment

○ TRL7 system prototype demonstration in operational environment

○ TRL8 system complete and qualified

○ TRL9 actual system proven in operational environment

7. Referring to your cleantech products or services recent innovations, has your company recently engaged in the following innovation activities? (1 choice for each row)

	Yes	No
In house R&D	○	○
Joint R&D projects	○	○
Industrial partnerships (joint ventures, alliances) and/or M&A	○	○
External consultancy	○	○
Universities/research centers collaboration	○	○

8. What has your company done to protect its cleantech intellectual property? (1 choice for each row)

	Yes	No
Apply for a patent	○	○
Apply for a utility model	○	○
Register an industrial design	○	○
Register a trademark	○	○
Use trade secret	○	○
Claim copyright	○	○

A.0.4 REGULATORY ENVIRONMENT

9. How much are regulations/policies on the below area affecting your cleantech activities? (1 choice for each row)

	Does not affect	Marginally affects	Strongly affects
Product safety	○	○	○
Consumer protection	○	○	○
Operational and worker safety	○	○	○
Environmental	○	○	○
Intellectual property	○	○	○
Tax	○	○	○
Employment	○	○	○
New technologies introduction and development	○	○	○

10. What are the undesirable effects of recent regulations/policies on your cleantech activities? (from 1 to 3 choices)

☐ Obstruct the innovation

☐ Create operational uncertainty

☐ Generate an excessive administrative burden

☐ Generate an unbalanced competition with extra-EU companies

☐ There are NOT undesirable effects **[EXCLUSIVE]**

☐ Other (please specify)

11. Which of these regulations/policies can mostly support technological development in the cleantech sector? (from 1 to 3 choices)

☐ Direct policies (e.g. grants)

☐ Tax incentives (e.g. tax breaks)

☐ Boosting outcomes (e.g. no income tax, hyper amortization)

☐ Public procurement (e.g. the State creates an early market)

☐ Regulation/standardization (e.g. the State issues product-specific regulation)

☐ Development of complementary assets (e.g. Infrastructure for recharging electric vehicles)

☐ Governmental guidelines for the measurement and the report of environmental performance

☐ Dialogue and networking to enhance international co-operation

12. Referring to the main regulations/policies relevant to your core cleantech activities, how much do you agree on the following statements? (1 choice for each row)

	Completely disagree	Partly disagree	Neither agree or disagree	Partly agree	Completely agree
Definitional details are clearly stated (e.g. Definitions, main entities involved, exceptions, taxonomy)	○	○	○	○	○
The objectives are set in a transparent and clear way	○	○	○	○	○
The scope is clearly designed (territory, duration and addressees)	○	○	○	○	○
The prioritization of goals and measures is well defined	○	○	○	○	○
They are practically enforceable	○	○	○	○	○
The monitoring activities are clearly disclosed	○	○	○	○	○

A.0.5 ACCESS TO FUNDING

13a. Does your company have any plans to raise funds from EXTERNAL investors for its ongoing activities? (1 choice)

- ○ **Yes (SHOW 13b&13c)**
- ○ No
- ○ I do not know

13b How much do you want to raise for your activities in the next five years? (1 choice)

- ○ < 500k€
- ○ 500k€-2M€
- ○ 2M€-5M€
- ○ 5M€-10M€
- ○ 10M€-50M€
- ○ > 50M€
- ○ I prefer not to answer

13c How much of the funding you intend to raise will be dedicated to support cleantech activities? (1 choice)

- ○ 0%
- ○ 1-25%
- ○ 26-50%
- ○ 51-75%
- ○ 76-100%

14. What is the main challenge in participating in public funding programmes? (1 choice)

- ○ Lack of awareness of their existence
- ○ Time consuming and complex application process
- ○ High competitiveness
- ○ We did not experience any difficulty
- ○ Other (please specify)

15 Has your company used or would consider using the following financing instruments? (1 choice for each row)

	Used	Would consider using	Would never use
Internal financing	○	○	○
Bank debt	○	○	○
Private/venture debt	○	○	○
Equity	○	○	○
Asset-based finance (e.g. leasing and hire purchases, factoring and invoice discounting)	○	○	○
Online alternative finance (e.g. crowdfunding)	○	○	○
Grants	○	○	○
Hybrid financing instruments (e.g. tax deductibility, convertible loans)	○	○	○
Green/ESG bonds (e.g. tax deductibility, convertible loans)	○	○	○

A.0.6 SKILLS

16. State if the skills listed are needed in your company and if you are going to outsource them (1 choice for each row)

	Needed and already available	Needed and will be internally provided	Needed and will be outsourced	Not needed
Data science and business intelligence skills	○	○	○	○
Technology and engineering skills	○	○	○	○
Design skills	○	○	○	○
Finance and accounting skills	○	○	○	○
Legal skills	○	○	○	○
Marketing and PR skills	○	○	○	○
Research and science skills	○	○	○	○
Business and strategic planning skills	○	○	○	○
Intellectual Property management skills	○	○	○	○
Sustainability skills	○	○	○	○
Soft skills (communication, problem solving, teamwork)	○	○	○	○

A.0.7 SUPPLY CHAIN

17. Where are your suppliers mainly localized? (1 choice)

- ○ Locally /within the region
- ○ Nationally
- ○ EU
- ○ Extra EU

18. Which are the main reasons for the selection of the current pool of suppliers? (from 1 to 3 choices)

- ☐ Price
- ☐ Physical proximity
- ☐ Ease of doing business
- ☐ Cultural affinity
- ☐ Quality
- ☐ Sustainability
- ☐ Other (please specify)

19. Which of the following policy goals should the government pursue to improve the resilience of supply chains in your country? (from 1 to 3 choices)

- ☐ Lower the costs and increase access to digital trade
- ☐ Implement trade facilitation measures: streamline and automate border processes
- ☐ Ensure stable, transparent, and predictable trade and investment policies
- ☐ Work on critical infrastructures: prescriptive regulatory tools, compensation mechanisms, and voluntary frameworks
- ☐ Ensure the supply of essential goods
- ☐ None of the above **[EXCLUSIVE]**
- ☐ Other (please specify)

20. Which of the following actions is YOUR COMPANY considering to make its supply chain more resilient? (from 1 to 3 choices)

- ☐ Postponement (producing or shipping goods once customer orders are received)
- ☐ Selective risk-taking (producing or shipping goods based on anticipated customer demand)
- ☐ Hedging (diversifying suppliers and location of production)
- ☐ Control (through vertical integration of main suppliers)
- ☐ Transferring or sharing risks (via outsourcing and offshoring)
- ☐ Security (identifying shipments at risk, facilitated by information technology)
- ☐ None of the above **[EXCLUSIVE]**
- ☐ Other (please specify)

A.0.8 VIEW ON EU GREEN DEAL

What are the perceptions regarding the feasibility of the European Green Deal (referred to hereafter as EGD)?

21. How much would you agree with the following statements about the EU Green Deal (EGD)? (1 choice for each row)

	Completely disagree	Partly disagree	Neither agree or disagree	Partly agree	Completely agree
The EGD is difficultly enforceable	○	○	○	○	○
The EGD's goals are too ambitious	○	○	○	○	○
The EGD will create a more predictable and clearer regulatory environment	○	○	○	○	○
The EGD is NOT promoting common incentives across the EU	○	○	○	○	○
The implementation of the EGD is not financially supported by the EU	○	○	○	○	○
The EGD creates disparities among EU regions and countries	○	○	○	○	○
The EGD requires a difficult coordination among the EU member states	○	○	○	○	○

22. How achievable do you think are the following scenarios? (1 choice for each row)

	Completely disagree	Partly disagree	Neither agree or disagree	Partly agree	Completely agree
The EU as a whole being net zero by 2050	○	○	○	○	○
Your country being net zero by 2050	○	○	○	○	○
Your organization being net zero by 2050	○	○	○	○	○

A.0.9 THE RESPONDER

At the bottom some optional questions so that we can get back in touch for further information and a possible interview

23. What is your position in the company? (please specify both the role and the business unit)

24. What is your name and surname?

25. What is your email address?

26. What is your phone contact? (Please, remember to specify the national prefix e.g. +39 3331234567)