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Disentangling Decarbonisation Ambidexterity: An Analysis of European Companies

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Abstract: Corporate strategies to tackle climate change have become a topic of much debate. Yet, limited attention has been paid to understanding how companies exploit and explore decarbonisation opportunities. We posit that the risks imposed by climate change and the opportunities that emerge under such a context require companies to develop a decarbonisation ambidexterity capability to reconcile the exploration of more radical, long-term eco-innovation opportunities, while also being eco-efficient in their current activities. Based on the ambidexterity literature, we ask: How do companies explore and exploit to reduce their carbon footprint? Through an inductive analysis of the climate change reports of 410 European companies from different sectors, we identify seven core exploitative and explorative initiatives adopted by companies in response to climate change. We argue that, to reach the established targets, companies must adopt multiple initiatives focused on both exploring new knowledge and technologies and exploiting improvements in existing routines and processes, and we show how companies have combined these efforts.

Keywords: corporate carbon management; climate change; innovation



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1. Introduction

Companies make a substantial contribution to global greenhouse gas (GHG) emissions, and their decarbonisation is vital in the fight against climate change [1–4]. Many studies have focused on identifying and classifying corporate carbon management strategies and practices [5–8], examining which strategies companies from different sectors employ [5,9] and the outcomes of such strategies [10,11].

Despite the recognition of different corporate strategies in response to climate change, less is known about the conditions under which organisations can pursue multiple strategic options simultaneously [12]. In this study, we posit that the risks imposed by climate change and the opportunities that emerge in such a context require companies to innovate along two perspectives: they must explore and exploit decarbonisation opportunities [13]. This means that companies must develop a decarbonisation ambidexterity capability to explore future-oriented innovation opportunities, while also being adaptive and efficient in their current activities and routines.

While both exploitation and exploration are indirectly acknowledged in corporate carbon management studies, the literature has not yet covered the adaptive and alignment efforts and the conditions supporting an ambidextrous endeavour towards decarbonisation [2,3,14]. Thus, through the lens of the ambidexterity literature, we ask: How do companies explore and exploit to reduce their carbon footprint? Drawing on an inductive and qualitative analysis of 410 carbon management reports of European companies from multiple sectors extracted from the Carbon Disclosure Project (CDP), we identify exploitation and exploration initiatives and discuss how these are reconciled as companies aim for carbon reduction targets.

Knowledge Gaps and Contributions

This study reveals ambidextrous initiatives for carbon emission reductions at the organisational level, bridging and contributing to different streams of the literature. First, we build on the literature that acknowledged that climate change solutions demand unprecedented levels of innovation [15,16]. This literature has primarily looked at the impact of green innovations on carbon emission reduction at a national level, e.g., [17,18]. We contribute to this literature by examining the dynamics happening at the level of the firm, i.e., the exploitative and explorative initiatives adopted by companies on the path towards decarbonisation. Second, we build on the literature on corporate sustainability, which has investigated ambidextrous behaviour in the context of green or sustainable innovations in organisations, e.g., [19,20]. We contribute to this literature by looking, more specifically, at the connection between ambidexterity and corporate decarbonisation efforts [4].

2. Background

2.1. Corporate Action for Climate Change

In response to pressures from governments, investors, and other stakeholders, many companies have been taking action to reduce their emissions and adopting a variety of carbon and energy management practices [21]. The literature on climate action from an organisational perspective has investigated issues such as the drivers of corporate climate action, e.g., [7,22], barriers from external, internal, and dimensional perspectives [4], and actions that organisations can take [4,7,8,11]. We turn our attention to the existing body of literature looking at the actions that can be employed by companies in response to climate risks, as this stream of research has been mostly descriptive of ‘what’ they do, lacking insights on ‘how’ organisations adopt the proposed strategies and practices.

2.2. Corporate Carbon Management Strategies

A very prominent stream of organisational studies looking at climate change has focused on identifying ‘strategies’ or ‘practices’ that companies can adopt to deal with climate risks [11,23]. There is limited consensus, however, on which ‘actions’ constitute a climate change strategy [11]. While some scholars adopt the broad view that a climate change strategy is a pattern of corporate climate action, irrespective of the effects of these strategies on actual GHG emissions, others propose a more restricted view that such a strategy must reduce actual GHG emissions [11]. Various terms have also been considered in the literature for corporate responses to climate change, such as corporate climate strategy, carbon management practices, carbon management strategy, climate change mitigation strategy, etc. Overall, these strategies can be understood as initiatives to reduce the impact of a company’s business activities on climate change and to gain competitive advantages over time [7].

Research on corporate responses to climate change usually falls under three main research streams. The first stream investigates the deployment of carbon management strategies and practices in organisations [5,8,12,24–26]. The second stream focuses on the drivers or antecedents of corporate carbon management strategies [7,9,23,27,28]. The third stream looks at the outcomes of corporate carbon management strategies, such as reducing GHG emissions [7–10].

We build more directly on the first stream. These studies have categorised carbon management strategies differently (see Table 1). Most existing research on organisational responses to climate change is descriptive and rarely grounded in management theories [2,4,14,29,30]. Exceptions include studies employing stakeholder theory, e.g., [31,32], and institutional theory [3,33,34]. The capabilities perspective, and more specifically, the concept of ambidexterity, have not been systematically applied to studying organisational responses to climate change. This represents a valuable lens for understanding similarities and differences in how companies manage climate-related issues [2,24].

Table 1. A summary of categorisations of corporate carbon management strategies.

Terms Used	Scope of Categorisation	References
Strategic options for climate change	Internal (organisation), vertical (supply chain), and horizontal (beyond the supply chain)	Kolk and Pinkse (2005) [24]
Corporate climate change strategies	Operational activities for energy efficiency and GHG reduction and management activities	Jeswani et al., (2008) [25]
CO ₂ strategies	CO ₂ compensation, CO ₂ reduction, and carbon independence	Weinhofer and Hoffmann (2010) [26]
Carbon management activities	Emission reduction commitment, process and supply improvement, new market and business development, organizational involvement, and external relationships development	Lee (2012) [5]
Low-carbon operational practices	Low-carbon products, low-carbon production, and low-carbon logistics	Böttcher and Müller (2015) [9]
Carbon management practices	Intra-organisational carbon management practices and inter-organisational carbon management practices	Lee and Klassen (2016) [12]
Carbon management strategies	Product innovation, innovative technologies, process innovation, energy efficiency initiative, emissions trading participation, and carbon offset initiative	Yunus et al., (2016) [28]
Climate change mitigation strategies	Internal carbon reduction, external carbon reduction, and carbon compensation	Cadez and Czerny (2016) [6]
Corporate carbon strategies	Carbon governance, carbon reduction, and carbon competitiveness	Damert et al., (2017) [7]
Carbon-constrained business strategies	Internal emissions abatement, collaborative emissions abatement, and carbon compensation	Zhou and Wen (2020) [8]

Source: elaborated based on a literature review.

2.3. Innovation Ambidexterity

The concept of organisational ambidexterity as an organisational capability has been applied to various phenomena, given the many types of dualities that organisations attempt to address, such as efficiency and flexibility, adaptability and alignment, integration and responsiveness, and exploration and exploitation [35]. Some scholars have conceptualised organisational ambidexterity originally as the ability of an organisation to simultaneously pursue both explorative (discontinuous) and exploitative (incremental) innovation [36]. Companies that focus only on exploitation may lack the competencies to adapt to an evolving environment, while companies that emphasise exploring new and uncertain solutions may fail to develop and refine the existing competencies required to succeed in a competitive market [37].

The three high-level ambidexterity approaches discussed in the existing literature include temporal, structural, and contextual ambidexterity. Structural ambidexterity entails assigning exploration and exploitation to separate business units, balancing the two and developing a shared vision to avoid intra-organisational tensions [36]. In contextual ambidexterity, organisational members allocate their time between exploitation and exploration without structural separation [38]. In a temporal strategy, exploitative and exploratory modes follow each other, i.e., they are not coexistent [39].

As exploration and exploitation are contradictory forces, companies must reconcile their paradoxical organisational demands to achieve long-term performance [40]. The

core challenge of organisational ambidexterity comes from the fact that exploration and exploitation stem from different learning capabilities [41]. Over the years, scholars have extensively explored how ambidexterity is achieved [39] and the mechanisms by which it can be enabled [42]. Studies have, for example, explored a wide range of antecedents of different ambidexterity approaches, including top management team composition, whether or not the company has a clear vision, the extent to which organisational attention is focused on investments in R&D, continuous improvement, the interplay of different knowledge assets, intellectual capital, the existence of dynamic capabilities, innovation orientation, etc. [37,41].

Using an ambidexterity lens, some scholars have identified the effects of an ambidextrous endeavour on corporate sustainability. Hahn et al., (2016) [43], for example, explored how companies achieve higher levels of corporate social performance through the ambidextrous ability to simultaneously pursue instrumentally and morally driven social initiatives. Rintala et al., (2022) [44] identified that ambidexterity in logistics operations affects the strength of the virtuous cycle between environmental and financial performance. Sánchez et al., (2021) [45] identified that network ambidexterity (the ability to balance exploration with new partners and exploitation with prior partners) is an adequate strategy to deal with problems derived from collaboration practices to achieve environmental outcomes. Minatogawa et al., (2020) [46] identified ambidexterity as a mechanism to support sustainable business model innovation and Chen et al., (2014) [19] found that organisational ambidexterity leads to improved green innovation performance.

Although the literature on ambidexterity is vast and has looked at ambidexterity in the context of corporate sustainability, there has been no empirical study on how an ambidextrous endeavour can support organisational innovation towards decarbonisation. This is the gap we address.

3. Materials and Methods

This study aimed at identifying how organisations explore and exploit climate risks and opportunities and how companies organise to achieve both endeavours. The first step in analysing how organisations develop such capability was identifying organisations responding to climate change risks and opportunities through exploitation and exploration. For this purpose, we searched for companies that are committing to science-based targets for carbon emission reduction and that have been publicly disclosing information on their climate management approaches to the Carbon Disclosure Project (CDP). Targets for carbon emission reduction are considered ‘science-based’ if they align with what the latest climate scientific analyses deem necessary to limit global warming to well below 2 °C above pre-industrial levels and pursue efforts to limit warming to 1.5 °C. Over 80% of the world’s largest 500 corporations now voluntarily provide information to the CDP, considered the most authoritative dataset providing information on carbon management practices [10]. Companies can disclose information to the CDP through climate change, forests, and water security reports, which are available for public consultation.

3.1. Data Collection

We searched the CDP public database for European companies that submitted climate change reports in 2020 and 2021. The CDP climate change reports cover numerous issues on corporate carbon management, such as governance of climate risks and opportunities, engagement to deal with climate risks, emissions methodology, carbon pricing, etc. The European Union (EU) context is particularly relevant, because the EU is one of the most advanced regulatory environments regarding climate policy [6]. In June 2021, the EU adopted a European Climate Law, aiming to reach net-zero greenhouse gas emissions in the EU by 2050. European companies have already started defining science-based targets, thereby constituting a representative sample for analysis.

We then selected the climate change reports of European companies from different sectors for 2020 and 2021 that answered ‘yes’ to question 3.3 of the CDP questionnaire

related to the influence of climate risks and opportunities on firms' strategies. This question was selected for analysis as it could provide information on companies' innovation efforts (both exploitative and explorative efforts) and reveal conditions supporting or enabling such endeavours. Companies' descriptions of how climate risks and opportunities have influenced their strategies related to products and services, operations, and supply chain management provide evidence of their initiatives in those directions, revealing exploitative and explorative efforts and indicating if those companies have been ambidextrous in their approaches. The initial sample resulted in 937 reports for 2020 and 2021 from 410 European companies.

3.2. Data Analysis

A qualitative inductive approach was adopted to analyse the reports and companies' answers to question 3.3 of the CDP's questionnaire related to how they have dealt with climate risks and opportunities. The descriptions of companies' initiatives to deal with climate risks and opportunities regarding their products/services, operations, and supply chain management were analysed through axial coding, following procedures suggested by [47] for inductive theory-building.

The first step of the coding process resulted in 855 raw data extracts of practices related to products and services, 1798 raw data extracts of new practices in operations and 2726 data extracts on practices for supply chain management, as companies can implement multiple initiatives simultaneously. We then coded the extracts into first-order codes of practices and grouped them into second-order themes (first column of Table 2). Table 2 exemplifies this, showing quotes used as first-order codes and how we clustered them into second-order themes. These were further clustered into exploitative and explorative initiatives. The result of our axial coding is depicted in Figures 1 and 2. The following section presents the identified exploitative and explorative practices, along with extracts from the reports illustrating them.

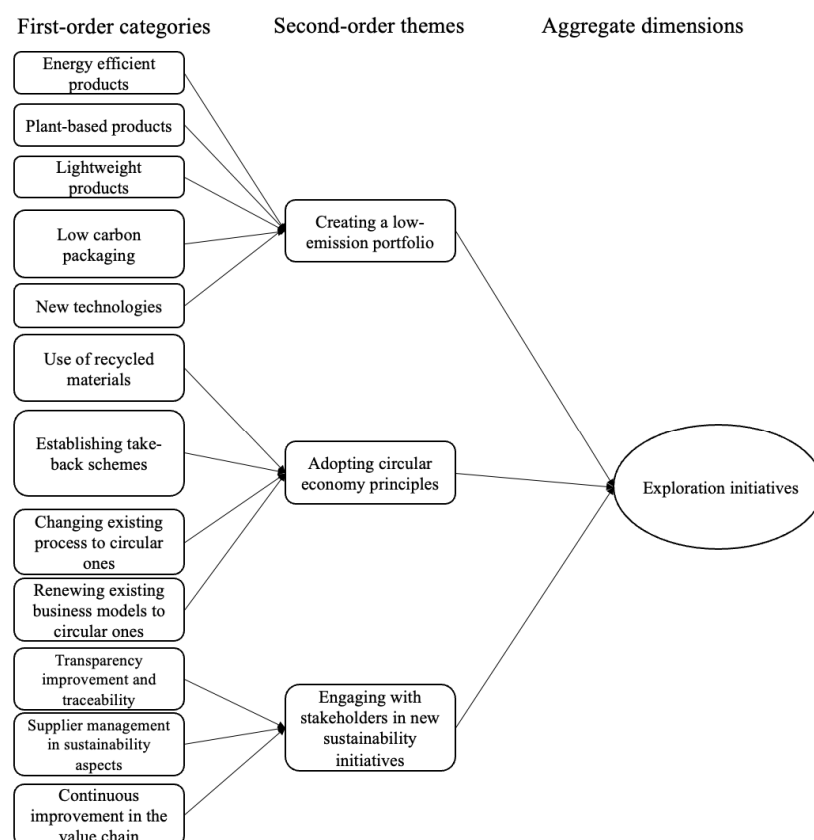


Figure 1. Data coding structure (exploration initiatives).

Table 2. Example of the coding process.

Second-Order Theme	First-Order Codes	Companies' Answers (Examples) Extracted from the Reports
Creating a low-emission portfolio	Energy-efficient products	"Risks and opportunities from policies to restrict emissions, government Net Zero commitments, costs of fossil fuel have influenced our strategic decision making to develop low carbon products and services. For example, in 2019 the company unveiled its next-generation full battery electric power and propulsion system for transit buses"
	Low-carbon packaging	"Climate-related risks and opportunities have influenced the company's product and services strategy, in particular our packaging strategy. The packaging that we use makes up approximately 43% of our total value chain carbon footprint. It is critical that we pioneer sustainable packaging design solutions and smart new ways to eliminate packaging waste, whilst lowering our carbon footprint"
	Plant-based products	"Due to potential risk of consumer behaviour change towards products and services that have a lower environmental footprint, along with the strategy of diversify our product range, the decision was made to invest in the vegetarian product manufacturer"
	Lightweight reduction initiatives	"Indeed the executive board of our Beauty & Care business division committed to develop lightweight reduction initiatives. In the glass industry, the weight of the bottles influences the emissions linked to transportation, but also to the production process. By developing products with reduced weight, or by reducing the mass of products from existing ranges by 5 or 8%, we were able to save 127 tonnes of CO ₂ "
Adopting circular economy principles	Using recycled materials	"One of the strategies of Pattern's plan "From Red to Green Carpet" is to reduce the environmental impact deriving from its products by applying the principles of the circular economy. All the products from its brand are realized with recycled materials, also recycling all fabric waste"
	Using waste materials to generate the energy required for operations	"This year, biogas accounted for 2% of the total renewable fuels generated on our sites. While this is a relatively small quantity compared with our overall energy needs, we have increased the amount of biogas generated and used by our sites by 5% compared with 2019. These sites are demonstrating a commitment to a circular economy by efficiently using their waste materials to generate energy required for their operations"
	Waste management	"Our aim is to produce stainless steel energy-efficient and with "0" WASTE. In order to achieve that, the company has implemented systems and set objectives and goals related to waste reduction, the promotion of good practices and the use of recycled materials""One example is the incorporation of the circular operations through circular waste management. The waste is managed in keeping with its nature and potential and the Group always promote its recovery. An exercise in homogenisation and sorting by type and method of disposal common to all the plants has been conducted in accordance with Spanish legislation, so as to perform better analysis and information reporting"
	Establishing take-back systems	"The biggest influence on strategy is on our aim on eco-designed products and on offering circular economy services (take back and reuse/recycle programs) in every country where we have industrial operations by 2025"
Redefining processes	Sustainability assessment in new product development	"The growing demand for low-carbon products has led the company to develop its internal capacity to quantify the environmental and social impacts of its products, with the aim to steer the Group product portfolio based on additional environmental and social criteria. For this purpose, an interdisciplinary team of experts worked to identify a consistent, high quality, scientifically robust and transparent methodology to assess product sustainability. The company has since launched the use of a methodology based on the World Business Council for Sustainable Development (WBCSD) framework for Portfolio Sustainability Assessments (PSA). This methodology is being applied to the Group existing portfolio as well as new product developments to ensure support the Group strategy and climate reduction ambitions for its product portfolio"
	Establishing risk assessment procedures	"Most importantly, to handle the uncertainty of physical risks the company continuously tests solutions for climate adaption and develops strong risk assessment procedures before procurement of new plots of land"
	Sourcing strategy	"Strive to source high volume components via a dual sourcing strategy where appropriate to mitigate the risk of supply chain disruption and constraints"

Source: elaborated based on the coding process and analysed CDP reports.



Figure 2. Data coding structure (exploitation initiatives).

4. Results

Companies managing climate risks and opportunities have been improving the efficiency of their current business activities while seeking innovations to reach net zero. The main initiatives within those two strategic directions were clustered into exploitative and explorative efforts, as presented in the remainder of this section.

4.1. Exploration Initiatives to Navigate Climate-Related Opportunities and Risks

4.1.1. Creating a Low-Emission Product and Service Portfolio

Risks and opportunities from policy to restrict emissions, net-zero government commitments, costs of fossil fuel, and changing customer behaviour towards products and services with a lower environmental footprint have led many companies to re-think their product/service portfolios and launch new products and services considered as ‘low-carbon’. They include lightweight products, energy-efficient products that, for example, support clients downstream in the supply chain, conserve energy, and reduce their GHG emissions, natural and plant-based products in the business-to-consumer market, etc. Many companies have invested in R&D to develop the next generation of products that have no climate impact. In the automotive sector, for example, regulatory and market demands have led manufacturers to renew their portfolio and produce electric vehicles, as stated by a car manufacturer in their CDP’s report:

“The Group is for instance developing an electric vehicle programme that aims to extend our range of electric vehicles and to achieve the objective of launching 8 battery electric vehicles and 5 plug in hybrid vehicle”.

Besides developing low-carbon products, companies have also been changing new product packaging and developing lighter packaging composed of recycled plastic and paper. Similarly, in the service industry, companies have also been diversifying their portfolio and expanding their business, for example, to include renewable energy services (by companies in the energy sector) and developing sustainable mobility services in the case of companies in the mobility industry, as noted by a car manufacturer:

“The products and services developed by the Group must be aligned with regulations and consumer expectations . . . These structural changes are taken into account in the group strategy and incorporated in the strategic midterm plan both as opportunities and competitiveness drivers. The Group’s plan is based on: the development of new electric and shared mobility services”.

Expanding and renewing the existing portfolio to the next generation of low-carbon products and services has been considered necessary to compete in the climate change context, as customer demand and emerging regulations have greatly boosted the growth of the market. By offering low-carbon products and services, firms also help to reduce the carbon footprint of the companies they supply.

Companies have also been taking the opportunity to align their decarbonisation agenda with their customer base, and many have been investing in new technologies to meet their customers’ emerging technological needs in the B2B market. Technologies that reduce the environmental footprint represent an opportunity in many industries. Examples include the emerging electric vehicle fleet and battery storage markets. In aerospace, suppliers of engines and fuel system equipment, for example, have been developing technologies to widen the field of drop-in sustainable fuels as much as possible and developing all-electric and hybrid propulsion systems, as highlighted by an aerospace company:

“The company has a major role to play in the arrival, by 2035 at the latest, of new low-carbon aircraft around 30% more energy efficient than the present-day fleet. Engine advancements are an instrumental factor here”.

4.1.2. Adopting Circular Economy Principles

Companies have also been adopting approaches to keep raw materials in use for as long as possible and at the highest possible level through extending products' lifetimes and closing resource loops through recycling, as the extraction and processing of resources are associated with approximately 50% of all global greenhouse gas emissions (World Economic Forum, 2022). Retail companies, for example, have been adapting/expanding their business and started initiatives to promote the benefits of a circular economy for fashion by encouraging customers to extend the life of their products through resale, as noted by a textile company:

"We aim to support and promote the benefits of a circular economy for fashion by encouraging customers to extend the life of their products through resale. Through the pilot, customers who consign our pieces at The RealReal are offered an exclusive personal shopping experience in select stores across the U.S."

Companies have been using recycled materials and establishing take-back schemes to close the loop of materials, as noted by a manufacturing company:

"Our USA business unit is already running at 100% close-loop recycled PMMA for all its PMMA consumption, which represent most of its plastics consumption. A close-loop contract was established with a PMMA chemical recycling company to enable this".

Investments in new recycling facilities, new technologies, and recycling approaches have also been made by some companies, as noted by a materials manufacturer:

"We have now established facilities to recycle waste refractories in every region. In addition, we are setting up recycling infrastructure at customer sites as well as trialling mobile treatment options. We are also pioneering technologies to maximise secondary raw material for recycling, e.g., automated sorting of brick quality, mineral processing to remove impurities and new ways to stabilise or remove contaminants".

The integration of circularity principles also concerns changes in processes, such as the design process, to include designing for circularity, including designing for disassembly and recycling, as stated by a manufacturer:

"Potential risks and opportunities related to product design, product use, and product end-of-life have influenced the Group to continually invest significantly in product development and design . . . In-house ecodesign methods are used to continuously reduce negative environmental impacts of products via material selection, durability, efficient use, chemical profile, and design for disassembly and recycling".

The transition to circular systems represents, overall, an innovation in the entire business model of the companies, as highlighted by a manufacturer:

"Our circular business model is aligned with climate risk mitigation as idle assets are brought back into circulation".

4.1.3. Engaging with Stakeholders in New Sustainability Initiatives

Companies have also been investing in new initiatives through engagement with a range of stakeholders, such as for the deployment of closed-loop systems, as highlighted by a manufacturer:

"We are engaging in the development of more closed-loop solutions (i.e., turn waste into resources) via different pilot projects to speed up the transition to a circular economy".

Some are pushing suppliers for joint work, transparency improvement, and traceability in the network while including sustainability and climate-related efforts in supplier evalua-

tion to strengthen links to the upstream supply chain. They are working collaboratively with suppliers to address emissions in the value chain, as highlighted by a manufacturer:

“We seek to strengthen our supplier management in sustainability aspects. For this reason, we held workshops with suppliers. We concentrated on especially CO₂-intensive suppliers and discussed with them the current state and goals of climate protection measures”.

Companies are running programmes to drive continuous improvement throughout the value chain. These partnerships also support capacity planning and management and the mitigation of risks of supply chain disruptions.

In order to manage emissions across the supply chain, companies are also introducing assessment approaches to evaluate the performance of their suppliers. They include regular audits on sustainability aspects among current and new suppliers. Codes of conduct have been developed by some manufacturers in order to ensure uniformity across their value chains, as highlighted by a chemical manufacturer:

“We expect our suppliers to share our principles and to act correctly in all respects, which means accepting responsibility towards their employees, business partners, society, and the environment. We have therefore issued a special code of conduct for suppliers, setting out binding requirements for these business partners”.

The results of sustainability assessments across the value chain have supported companies in determining and implementing appropriate measures to address sustainability risks and opportunities in the supply chain, including a review of the supplier selection process.

4.2. Exploitative Initiatives to Manage Climate-Related Opportunities and Risks

Companies have also been making efforts to improve the efficiency of current activities while they seek new opportunities.

4.2.1. Redefining Processes

Some key processes, such as new product development (NPD), have been redefined in the face of climate risks and opportunities. Many companies have been including eco-design principles in their NPD, in addition to conducting lifecycle assessments (LCA) to gain knowledge on the carbon footprint of their products. Design for Sustainability (DfS), including a range of tools to analyse the impact of products on areas such as materials, energy and emissions, waste, water, packaging, and usability, has also been adopted. Apart from the environmental dimension and carbon footprint assessment, companies in a range of sectors, such as mining, food, and cosmetics, have incorporated the assessment of the social impacts of their products and optimised their products based on the sustainability performance, as noted by a mining company:

“The growing demand for low-carbon products has led the company to develop its internal capacity to quantify the environmental and social impacts of its products, with the aim to steer the Group product portfolio based on additional environmental and social criteria”.

Some have also been changing their design process to develop product and service offerings that are tailored to their client’s needs and specific sustainability goals; Mondi, a manufacturer of packaging, for example, has adopted a customer-centric approach to product development to ensure that their packaging is fit for purpose and supports customers to achieve their sustainability goals. They have been developing packaging from low-carbon materials to meet their customers’ needs.

Other processes, such as procurement, have also been changing in multiple companies to include sustainability aspects in the procurement of materials and services, as highlighted by a manufacturer:

“Our sustainable business strategy applies to our value chain and thus also to the purchase of production materials and the procurement of services”.

Additionally, existing risk management processes have been updated to include an assessment of supply chain risks in the face of climate change and to support procurement and audit processes.

Companies have also redefined their strategies, such as those related to sourcing, given climate change risks. Many are diversifying their suppliers to mitigate any potential supply chain disruption risks, as highlighted by a manufacturer:

“We counter procurement risks relating to the delivery reliability and price of raw materials, commodities, and services by continuously monitoring our markets and suppliers and by appropriate contract management. This supplier diversification strategy has been implemented since many years and has helped us successfully in the past to mitigate any potential supply chain disruption risks”.

Changing to local suppliers has also been considered by many companies, as highlighted by a manufacturer:

“Having operations worldwide, in line with the key car manufacturers industrial footprint choices, the company has set up a local sourcing process, in order to reduce development and transportation impact, integrating a reduction of the carbon footprint of transportation”.

Manufacturers in the plastic industry have been developing partnerships with local and regional recycling companies for a locally available plastic waste feedstock supply, reducing the reliance on international crude oil supplies and mitigating political/security risks in the location of origin of feedstock or supply limitations. Many are seeking out alternative suppliers who prioritise sustainability and eco-friendly practices.

4.2.2. Assessing and Redesigning Existing Products and Supply Chains

Companies have also started to assess the sustainability performance of their current products, usually through LCAs, to find opportunities for carbon footprint reduction, as highlighted by a manufacturer:

“The application of Life Cycle Assessment techniques in the products manufacturing processes has enabled us to identify the main improvement opportunities throughout the supply chain and to define its environmental sustainability strategy”.

Existing products have been redesigned to reduce weight, as it directly relates to emission intensity, as noted by a pharmaceutical company:

“Indeed the executive board of our Beauty & Care business division committed to develop lightweight reduction initiatives. In the glass industry, the weight of the bottles influences the emissions linked to transportation, but also to the production process. By developing products with reduced weight, or by reducing the mass of products from existing ranges by 5 or 8%, we were able to save 127 tonnes of CO₂”.

The materials of packaging have changed from virgin plastics to recycled plastics and paper. Companies have also started to explore different material pathways for existing products, including higher recycled content and biodegradable materials, along with materials from sustainable sources and the use of by-products, as noted by a manufacturer:

“On raw materials, we work on lightweight drawings, with a −2% (in “Prestige BU”) to −20% (in “Mass BU”) target by 2030, on alternative low-emissions materials like honeycomb structure, wood instead of metal and recycled plastic instead of virgin”.

Besides redesigning existing products, companies have also been analysing existing supply chains to understand the end-of-life of products and redesigning the existing network.

4.2.3. Improving Energy Efficiency

Companies are also redefining their operations to improve energy efficiency and reduce emissions from operational activities. One of the main initiatives adopted in this direction across multiple sectors has been the change in sourcing to renewable energy or the self-generation of clean energy alternatives, as highlighted by an engineering company:

“In order to achieve the 1.5 °C goal we have analyzed our own direct and indirect emissions in detail. Based on this data we are going to source renewable electricity at selected Group locations, starting with German sites, which have the highest energy consumption in the Group. Alongside, we will install photovoltaics for the generation of own renewable energy at three German sites in the first step”.

Alongside switching to the use of clean energy, companies have been employing energy efficiency measures in their operations, setting up energy consumption reduction targets, monitoring systems in factories to reduce consumption, and establishing energy efficiency networks with other patterns to improve energy efficiency on an ongoing process by learning in the network, as highlighted by a steel producer:

“Within the “Energy Management Group Forum”, the most important Group companies of our Group in terms of energy consumption and by this CO₂ emissions are brought together in a group that was established in 2013. The aim is to improve energy efficiency in an ongoing process of learning from one another, with reduced greenhouse gases potentially resulting from these processes. A key tool used by this group is an energy efficiency knowledge platform in which all energy efficiency measures implemented or investigated in the companies are incorporated and available by all involved”.

The knowledge acquired, according to the steel manufacturer, has supported companies in the network in implementing more efficient processes throughout production plants. New programs and equipment are being installed by some companies and are utilising energy conservation technologies (such as efficient motors and auto shut offs). Plant energy monitoring systems have also been implemented.

Another initiative to improve energy efficiency is making changes to the products and their materials, for example, material technology transition in the glass industry, as highlighted by a glass producer:

“The higher the proportion of recycled glass (cullet), the lower the energy need for production, hence we work on increasing the share of cullet in line with applicable regulations which allows for substitution of primary raw materials. This is also one aspect in the overall decarbonisation strategy in our glass business”.

Efforts have been made to reduce energy demand in production, and companies have been identifying and replacing existing raw materials and substances:

“We have eliminated the use of hazardous substances to alkalize cocoa by using more environment friendly chemical. This in turn reduces energy demand in the processing of cocoa powder and reduced our GHG emissions”.

4.2.4. Streamlining Operations

Companies have also been implementing lean processes to reduce waste and increase efficiency in operations and supply chain management. Initiatives to optimise operations include the setup of environmental targets for production, such as for waste generation (focus on resource efficiency) and water consumption, the use of new (technology upgrades) and alternative technologies, and more efficient/optimised production processes that contribute to increasing energy savings, as highlighted by a manufacturer of optical systems:

“We implemented technical measures to lower the energy consumption, e.g., the own production of renewable energy by photovoltaics, and increased energy savings by optimizing processes (optimizing machinery and production footprint, LEAN management)”.

Companies are also investing in redesigning/optimising their processes (e.g., to reduce material consumption/improve efficiency) through operational excellence programmes, adopting new processes/modern production methods, retrofitting/replacing equipment to maximise efficiency, as well as increasing internal awareness, as highlighted by a machinery manufacturer:

“The action plan for reaching the challenging targets includes several short to medium-term initiatives involving the redesign of processes, equipment conversion and retrofitting, operational changes to new installations, and increased employee awareness”.

Indeed, streamlining operations requires new ways of working and cultural change. Many companies have been deploying employee engagement programmes to minimise energy and water consumption, as well as cut waste, as noted by an electronic components manufacturer:

“Our strategy is supported by specific improvement and employee engagement programmes as we work to minimise energy use, water use and packaging and to cut waste whilst increasing recycling”.

Moreover, besides streamlining internal operations, other initiatives related to external operations have been taken, such as those related to cutting down emissions on products’ distribution through the renewal of the fleet, as noted by a manufacturer of building products:

“Looking beyond our manufacturing operations, our distribution fleet of over 150 specialised vehicles is regularly being refreshed, with 60 new vehicles, all equipped with the latest Euro 6 engine technology to minimise emissions, joining the fleet in early 2021”.

Alternative transportation and green logistics initiatives have also been adopted:

“In the context of transporting products to customers, we applied for the “GoGreen” service provided by DHL, its major partner for transportation and logistic services. This ensures lower GHG emissions and we can monitor carbon footprint through specific reports that are issued annually”.

Companies have been taking different strategic approaches regarding their logistics systems, including using multimodal systems and more energy-efficient transport modes with low CO₂ intensity, such as ocean and rail, creating optimal distribution structures and optimising routes, as noted by a glass manufacturer:

“In order to mitigate the long term indirect impact of the company operations on Scope 3 CO₂ emissions, the company decided to organize multimodal transportation systems for raw materials”.

Logistics optimisation also supports cost reduction due to potential increases in logistics costs owing to climate-related risks, such as extreme weather events. Additionally, to improve efficiency in the supply chain, companies have been establishing a data-tracking system to monitor and analyse supply chain emissions, identify inefficiencies, and set targets for reducing carbon footprint.

Companies have also been replanning aspects of their production in the face of climate change risks and opportunities. They include the planning of new manufacturing facilities for the minimisation of distance to distribution centres, the relocation of manufacturing facilities to cut down on emissions related to transportation, and the replanning of internal production aspects, such as production rate, as highlighted by a manufacturer:

“The rate of production is planned in order to optimize the time of use of the machine. Scraps of plastic, cardboard, wood and metal are reused and integrated into the production process”.

Redefining factories' layouts and setting up new production lines devoted to the production of new products or improved products has also been considered by some manufacturers:

"We are investing in Europe and North America to set up 2 new production lines to build products with recycled material".

Companies have also been diversifying their supplier base to ensure that disruptions caused by climate-related risks and extreme weather events in one region do not substantively damage the supply chain.

5. Discussion and Final Remarks

The decarbonisation of companies is vital in the fight against climate change. Studies have identified and classified corporate carbon management strategies, including, for example, internal emission abatement strategies, collaborative emission abatement, and carbon compensation/offsetting [6,8,28]. Despite proposing different approaches that companies employ, research has yet to explore the context and conditions for adopting decarbonisation strategies simultaneously.

Reflecting on the literature and our findings, we conceptualise decarbonisation ambidexterity as the capability of combining the exploration of future-oriented innovation efforts with the exploitation of existing routines and processes to reduce a company's direct or indirect carbon emissions. From our analysis of 410 European companies, we identified that the exploitation efforts consist of four main initiatives, and exploration efforts consist of three main initiatives that are employed simultaneously by companies. They may not be exhaustive of all exploitation or exploration strategies, but they are the ones evidenced among a group of companies committed to carbon reduction, based in one of the most regulatorily stringent settings in the world, and that voluntarily reported on their decarbonisation efforts.

Our concept of decarbonisation ambidexterity and our empirical analysis of the exploitation and exploration strategies 410 companies report contribute to two streams of the literature. First, our findings on the exploitative and explorative initiatives adopted by organizations in the path towards decarbonisation extend the literature on green innovations for carbon emission reduction, which has primarily focused on innovations within or across countries, e.g., [17,18]. By conceptualising decarbonisation ambidexterity, we provide insights from an innovation capability perspective of companies, instead of the emphasis on innovation outcomes in or across countries.

Second, we contribute to the literature on corporate sustainability. This body of literature has investigated ambidextrous behaviour in the context of sustainable innovations, e.g., [19,20], but had not yet specifically investigated the connection between ambidexterity and corporate decarbonisation efforts [4]. Our study adds to this, as it shows that companies adopt multiple strategies, focused on both exploring new knowledge trajectories and the refinement of existing routines to reduce their carbon emissions. More specifically, our findings reveal what ambidexterity strategies consist of and unpack strategies, such as implementing circular economy principles and redefining issues related to their production, which had not been identified or extensively covered by studies on corporate GHG emission reduction.

6. Managerial Contributions

From a managerial perspective, our study provides insights into which exploitative and explorative initiatives practitioners can implement in practice to navigate climate risks and opportunities, and into how they are simultaneously adopted by companies committed to science-based GHG targets. They can be used as a benchmark, for example, for companies that have not yet structured a portfolio of decarbonisation activities so that they can identify and pursue a path towards decarbonisation. Companies that already have more structured decarbonisation strategies can also use our findings as a benchmark in ways that stimulate reflexivity on their priorities; for example, to identify if they are falling

short and how they are different (or should differentiate from others) in similar sectors or geographies.

7. Limitations and Directions for Future Research

Our work has some limitations that can be addressed by future studies. First, our sample was limited to some European companies that reported to the CDP in the last few years and looked at the practices that those companies adopted over two years. Further research can consider a wider sample, including worldwide companies under different institutional environments, to identify a broader set of exploitative and explorative initiatives, comparing companies across sectors and regions. Future studies could also look at the balance of different initiatives by companies from different sectors. We also encourage scholars to build on the findings of this study to develop a decarbonisation ambidexterity framework from a process perspective, to look at different decarbonisation ambidexterity approaches (e.g., structural, contextual) adopted by companies worldwide, and to investigate the mechanisms supporting different ambidexterity approaches.

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References

1. Wade, B.; Rekker, S. Research can (and should) support corporate decarbonisation. *Nat. Clim. Change* **2020**, *10*, 1064–1065. [\[CrossRef\]](#)
2. Daddi, T.; Todaro, N.M.; De Giacomo, M.R.; Frey, M. A Systematic Review of the Use of Organization and Management Theories in Climate Change Studies. *Bus. Strategy Environ.* **2018**, *27*, 456–474. [\[CrossRef\]](#)
3. Daddi, T.; Bleischwitz, R.; Todaro, N.M.; Gusmerotti, N.M.; De Giacomo, M.R. The influence of institutional pressures on climate mitigation and adaptation strategies. *J. Clean. Prod.* **2020**, *244*, 118879. [\[CrossRef\]](#)
4. Johnson, M.P.; Rötzel, T.S.; Frank, B. Beyond conventional corporate responses to climate change towards deep decarbonisation: A systematic literature review. *Manag. Rev. Q.* **2023**, *73*, 921–954.
5. Lee, S.-Y. Corporate Carbon Strategies in Responding to Climate Change. *Bus. Strategy Environ.* **2012**, *21*, 33–48. [\[CrossRef\]](#)
6. Cadez, S.; Czerny, A. Climate change mitigation strategies in carbon-intensive firms. *J. Clean. Prod.* **2017**, *112*, 4132–4143. [\[CrossRef\]](#)
7. Damert, M.; Paul, A.; Baumgartner, R.J. Exploring the determinants and long-term performance outcomes of corporate carbon strategies. *J. Clean. Prod.* **2017**, *160*, 123–138. [\[CrossRef\]](#)
8. Zhou, P.; Wen, W. Carbon-constrained firm decisions: From business strategies to operations modeling. *Eur. J. Oper. Res.* **2020**, *281*, 1–15. [\[CrossRef\]](#)
9. Böttcher, C.F.; Müller, M. Drivers, Practices and Outcomes of Low-carbon Operations: Approaches of German Automotive Suppliers to Cutting Carbon Emissions. *Bus. Strategy Environ.* **2015**, *24*, 477–498. [\[CrossRef\]](#)
10. Doda, B.; Gennaioli, C.; Gouldson, A.; Grover, D.; Sullivan, R. Are Corporate Carbon Management Practices Reducing Corporate Carbon Emissions? *Corp. Soc. Responsib. Environ. Manag.* **2016**, *23*, 257–270. [\[CrossRef\]](#)
11. Cadez, S.; Czerny, A.; Letmathe, P. Stakeholder pressures and corporate climate change mitigation strategies. *Bus. Strategy Environ.* **2019**, *28*, 1–14. [\[CrossRef\]](#)
12. Lee, S.-Y.; Klassen, R.D. Firms' Response to Climate Change: The Interplay of Business Uncertainty and Organizational Capabilities. *Bus. Strategy Environ.* **2016**, *25*, 577–592. [\[CrossRef\]](#)
13. Zeng, D.; Hu, J.; Ouyang, T. Managing Innovation Paradox in the Sustainable Innovation Ecosystem: A Case Study of Ambidextrous Capability in a Focal Firm. *Sustainability* **2017**, *9*, 2091. [\[CrossRef\]](#)

14. Wittneben BB, F.; Okereke, C.; Banerjee, S.B.; Levy, D.L. Climate Change and the Emergence of New Organizational Landscapes. *Organ. Stud.* **2012**, *33*, 1431–1450. [\[CrossRef\]](#)
15. Stern, N.; Valero, A. Innovation, growth and the transition to net-zero emissions. *Res. Policy* **2021**, *50*, 104293. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Hakovirta, M.; Kovanen, K.; Martikainen, S.; Manninen, J.; Harlin, A. Corporate net zero strategy—Opportunities in start-up driven climate innovation. *Bus. Strategy Environ.* **2022**; *in press*. [\[CrossRef\]](#)
17. Zhang, Y.-J.; Peng, Y.-L.; Ma, C.-Q.; Shen, B. Can environmental innovation facilitate carbon emissions reduction? Evidence from China. *Energy Policy* **2017**, *100*, 18–28. [\[CrossRef\]](#)
18. Zhao, Y.; Zhao, Z.; Qian, Z.; Zheng, L.; Fan, S.; Zuo, S. Is cooperative green innovation better for carbon reduction? Evidence from China. *J. Clean. Prod.* **2023**, *394*, 136400. [\[CrossRef\]](#)
19. Chen, Y.-S.; Chang, C.-H.; Lin, Y.-H. The Determinants of Green Radical and Incremental Innovation Performance: Green Shared Vision, Green Absorptive Capacity, and Green Organizational Ambidexterity. *Sustainability* **2014**, *6*, 7787–7806. [\[CrossRef\]](#)
20. Peters, K.; Buijs, P. Strategic ambidexterity in green product innovation: Obstacles and implications. *Bus. Strategy Environ.* **2022**, *31*, 173–193. [\[CrossRef\]](#)
21. Sullivan, R.; Gouldson, A. The Governance of Corporate Responses to Climate Change: An International Comparison. *Bus. Strategy Environ.* **2017**, *26*, 413–425. [\[CrossRef\]](#)
22. Slawinski, N.; Bansal, P. A Matter of Time: The Temporal Perspectives of Organizational Responses to Climate Change. *Organ. Stud.* **2012**, *33*, 1537–1563. [\[CrossRef\]](#)
23. Backman, C.A.; Verbeke, A.; Schulz, R.A. The Drivers of Corporate Climate Change Strategies and Public Policy: A New Resource-Based View Perspective. *Bus. Soc.* **2017**, *56*, 545–575. [\[CrossRef\]](#)
24. Kolk, A.; Pinkse, J. Business Responses to Climate Change: Identifying Emergent Strategies. *Calif. Manag. Rev.* **2005**, *47*, 6–20. [\[CrossRef\]](#)
25. Jeswani, H.K.; Wehrmeyer, W.; Mulugetta, Y. How warm is the corporate response to climate change? Evidence from Pakistan and the UK. *Bus. Strategy Environ.* **2008**, *17*, 46–60. [\[CrossRef\]](#)
26. Weinhofer, G.; Hoffmann, V.H. Mitigating climate change—How do corporate strategies differ? *Bus. Strategy Environ.* **2010**, *19*, 77–89. [\[CrossRef\]](#)
27. Reid, E.M.; Toffel, M.W. Responding to public and private politics: Corporate disclosure of climate change strategies. *Strateg. Manag. J.* **2009**, *30*, 1157–1178. [\[CrossRef\]](#)
28. Yunus, S.; Eljido-Ten, E.; Abhayawansa, S. Determinants of carbon management strategy adoption. *Manag. Audit. J.* **2016**, *31*, 156–179. [\[CrossRef\]](#)
29. Hahn, T.; Kolk, A.; Winn, M. A New Future for Business? Rethinking Management Theory and Business Strategy. *Bus. Soc.* **2010**, *49*, 385–401. [\[CrossRef\]](#)
30. Hahn, R.; Reimsbach, D.; Schiemann, F. Organizations, Climate Change, and Transparency: Reviewing the Literature on Carbon Disclosure. *Organ. Environ.* **2015**, *28*, 80–102. [\[CrossRef\]](#)
31. Comyns, B. Determinants of GHG Reporting: An Analysis of Global Oil and Gas Companies. *J. Bus. Ethics* **2016**, *136*, 349–369. [\[CrossRef\]](#)
32. Depoers, F.; Jeanjean, T.; Jérôme, T. Voluntary Disclosure of Greenhouse Gas Emissions: Contrasting the Carbon Disclosure Project and Corporate Reports. *Journal of Business Ethics* **2016**, *134*, 445–461. [\[CrossRef\]](#)
33. Delmas, M.A.; Montes-Sancho, M.J. Voluntary agreements to improve environmental quality: Symbolic and substantive cooperation. *Strateg. Manag. J.* **2010**, *31*, 575–601. [\[CrossRef\]](#)
34. Galbreath, J. Corporate governance practices that address climate change: An exploratory study. *Bus. Strategy Environ.* **2010**, *19*, 335–350. [\[CrossRef\]](#)
35. Birkinshaw, J.; Gupta, K. Clarifying the distinctive contribution of ambidexterity to the field of organization studies. *Acad. Manag. Perspect.* **2013**, *27*, 287–298. [\[CrossRef\]](#)
36. O'Reilly, C.A.; Tushman, M.L. The ambidextrous organization. *Harv. Bus. Rev.* **2004**, *82*, 74–83.
37. Farzaneh, M.; Wilden, R.; Afshari, L.; Mehralian, G. Dynamic capabilities and innovation ambidexterity: The roles of intellectual capital and innovation orientation. *J. Bus. Res.* **2022**, *148*, 47–59. [\[CrossRef\]](#)
38. Gibson, C.B.; Birkinshaw, J. The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity. *Acad. Manag. J.* **2004**, *47*, 209–226. [\[CrossRef\]](#)
39. O'Reilly, C.A.; Tushman, M.L. Organizational ambidexterity in action: How managers explore and exploit. *Calif. Manag. Rev.* **2011**, *53*, 5–22. [\[CrossRef\]](#)
40. Raisch, S.; Birkinshaw, J.; Probst, G.; Tushman, M.L. Organizational Ambidexterity: Balancing Exploitation and Exploration for Sustained Performance. *Organ. Sci.* **2009**, *20*, 685–695. [\[CrossRef\]](#)
41. Koryak, O.; Lockett, A.; Hayton, J.; Nicolaou, N.; Mole, K. Disentangling the antecedents of ambidexterity: Exploration and exploitation. *Res. Policy* **2018**, *47*, 413–427. [\[CrossRef\]](#)
42. Turner, N.; Swart, J.; Maylor, H. Mechanisms for Managing Ambidexterity: A Review and Research Agenda. *Int. J. Manag. Rev.* **2013**, *15*, 317–332. [\[CrossRef\]](#)
43. Hahn, T.; Pinkse, J.; Preuss, L.; Figge, F. Ambidexterity for Corporate Social Performance. *Organ. Stud.* **2016**, *37*, 213–235. [\[CrossRef\]](#)

44. Rintala, O.; Laari, S.; Solakivi, T.; Töyli, J.; Nikulainen, R.; Ojala, L. Revisiting the relationship between environmental and financial performance: The moderating role of ambidexterity in logistics. *Int. J. Prod. Econ.* **2022**, *248*, 108479. [[CrossRef](#)]
45. Sánchez, B.; Pérez-Valls, M.; Plaza-Úbeda, J.A.; Vázquez-Brust, D. Network ambidexterity and environmental performance: Code-sharing in the airline industry. *Bus. Strategy Environ.* **2022**, *31*, 1169–1183. [[CrossRef](#)]
46. Minatogawa, V.; Franco, M.; Durán, O.; Quadros, R.; Holgado, M.; Batocchio, A. Carving out New Business Models in a Small Company through Contextual Ambidexterity: The Case of a Sustainable Company. *Sustainability* **2020**, *12*, 2337. [[CrossRef](#)]
47. Gioia, D.A.; Corley, K.G.; Hamilton, A.L. Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organ. Res. Methods* **2013**, *16*, 15–31. [[CrossRef](#)]

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